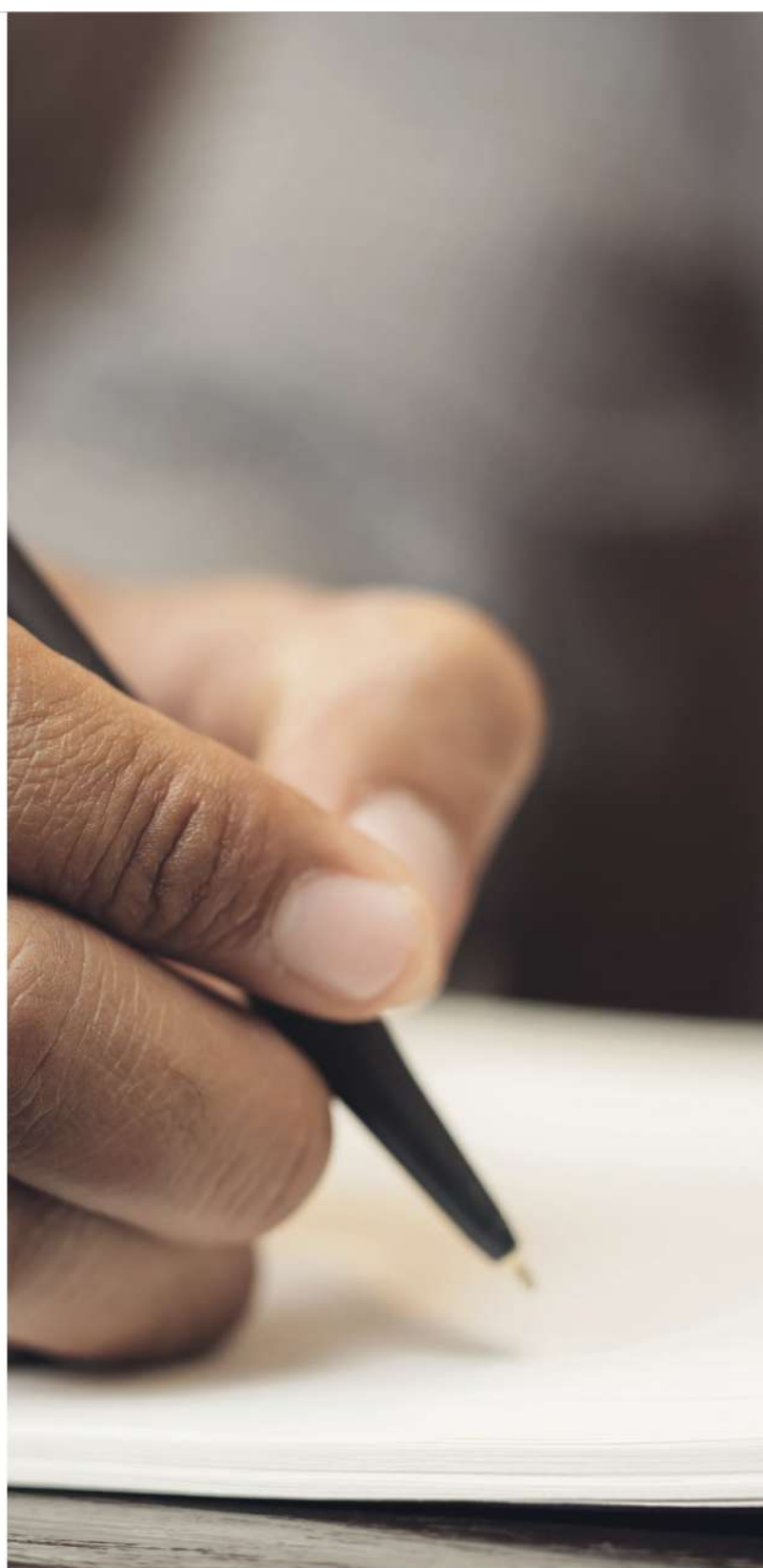


CUET 2022

GUIDE SAMPLE PAPERS



**Specially curated Sample papers for
Subjects Physics, Chemistry, Maths,
Biology and General Test on updated
pattern of CUET 2022**

A note to students

Dear Students,

Common University Entrance Test (CUET (UG) - 2022) has become one of the most crucial exams of your career as it will be the gateway for many prestigious universities of India. If you are not opting Engineering or Medical as an Undergraduate course then in order to take admission into courses such as BSc, BA, BCom etc. you have to qualify the CUET. As per the notification from National Testing Agency (NTA), [CUET \(UG\) – 2022](#) will be testing your knowledge in primarily 3 areas:

[A] Languages Test

[B] Domain Specific Subject Test

[C] General Test

Now let's have a look at each area one by one.

[A] Language Test:

This area of CUET will consist of two sections. The first section consists of 13 language options, namely, Tamil, Telugu, Kannada, Malayalam, Marathi, Gujarati, Odiya, Bengali, Assamese, Punjabi, English, Hindi and Urdu. The second section consists of 20 language options, namely, French, Spanish, German, Nepali, Persian, Italian, Arabic, Sindhi, Sanskrit, Kashmiri, Konkani, Bodo, Dogri, Maithili, Manipuri, Santhali, Tibetan, Japanese, Russian, Chinese.

You can choose a maximum of any 3 languages from Section IA and Section IB taken Together. In this section, 40 out of 50 questions have to be attempted. The choice of language should be done while considering the applicable University or desired course guidelines. For example, if you want to take admission in University of Delhi, Candidates must appear in at least one language.

[B] Domain Specific Subject Test:

In this section, a total of 27 subjects are mentioned, out of which you can choose a maximum of Six (06) Subjects. In each subject, 50 questions will be asked and out of which 40 have to be answered. Following is the exhaustive list of subjects which can be considered.

- 1.Accountancy/ Book Keeping
- 2.Biology/ Biological Studies/Biotechnology/Biochemistry
- 3.Business Studies
- 4.Chemistry
- 5.Computer Science/ Informatics Practices
- 6.Economics/ Business Economics
- 7.Engineering Graphics
- 8.Entrepreneurship

9. Geography/Geology
10. History
11. Home Science
12. Knowledge Tradition and Practices of India
13. Legal Studies
14. Environmental Science
15. Mathematics
16. Physical Education/ NCC /Yoga
17. Physics
18. Political Science
19. Psychology
20. Sociology
21. Teaching Aptitude
22. Agriculture
23. Mass Media/ Mass Communication
24. Anthropology
25. Fine Arts/Visual Arts (Sculpture/ Painting)/Commercial Arts,
26. Performing Arts –
 - (i) Dance (Kathak/ Bharatnatyam/Odissi/ Kathakali/Kuchipudi/ Manipuri)
 - (ii) Drama- Theatre
 - (iii) Music General (Hindustani/ Carnatic/ Rabindra Sangeet/Percussion/Non-Percussion)
27. Sanskrit

The choice of these subjects should be done very carefully and they should be matching with the prerequisites of the desired course given by the applicable University. For example, if you want to take admission in University of Delhi and your desired course is BA(H) in Economics, then the merit shall be determined on the basis of one language and three best Domain specific subjects as specified in the List of 27 Subjects. Out of three Domain specific subjects chosen above, the concerned subject in which the admission is sought has to be one of the subjects selected (which is Economics in this case), failing which a deduction of 2.5% will be imposed on the aggregate “Best Four” percentage.

[C] General test:

This test will consist of questions from General Mental Ability, General Knowledge, Current Affairs, Numerical Ability, Quantitative reasoning, Logical and Analytical reasoning. A total of 60 questions have to be attempted out of 75 questions. The requirement of this test will also depend on the university and the desired course. For example, For BA, BVoc and BCom courses (aka "pass" courses) of University of Delhi, candidates have the choice of a language test along with one domain specific subject and a general examination or a three-subject test.

Summarising the CUET 2022, you have to focus on the subjects that you have taken in your boards. For example, if you have taken Hindi, English, Maths, Physics, Chemistry then in CUET - 2022, you can opt for English or Hindi in Language test and Maths, Physics and Chemistry in Subject test. Obviously the final selection of subjects will be based upon the Program-specific

Eligibility criteria given by the applicable University. The merit will be calculated based on the scores you have obtained in CUET 2022.

In this Ebook we have provided the Sample papers for the subjects Maths, Physics, Chemistry, Biology and General Test. You can solve them to get the idea of the real examination.

For more information regarding the exam, please visit <https://www.careers360.com/exams/cuet>

All the best !!!

Team Careers360

CAREERS360

CUET 2022 : Physics Sample Papers

Q. 1 If 10^{10} electrons are acquired by a neutral body then the charge on the body is:

Option 1:

$-1.6 \times 10^{-19} \text{C}$

Option 2:

$-1.6 \times 10^{-29} \text{C}$

Option 3:

$1.6 \times 10^{-9} \text{C}$

Option 4:

$-1.6 \times 10^{-9} \text{C}$

Correct Answer:

$-1.6 \times 10^{-9} \text{C}$

Solution:

As we learn

Properties of Charge -

Transferable

- wherein

It can be transferred from one body to another.

$$q = ne = -10^{10} \times 1.6 \times 10^{-19} = -1.6 \times 10^{-9} \text{ C}$$

Q. 2 The value of electrostatic potential due to a circular ring of charge 'Q' and radius 'R' at a distance ' $\sqrt{3}R$ ' on its axis from the center of the ring is -

Option 1:

$\frac{kq}{r}$

Option 2:

$\frac{2KQ}{R}$

Option 3:

$$\frac{kQ}{\sqrt{2}R}$$

Option 4:

$$\frac{kQ}{2R}$$

Correct Answer:

$$\frac{kQ}{2R}$$

Solution:

As we learn

E and V at a point P that lies on the axis of ring -

$$E_x = \frac{kQx}{(x^2 + R^2)^{\frac{3}{2}}}, \quad V = \frac{kQ}{(x^2 + R^2)^{\frac{1}{2}}}$$

-

$$V = \frac{kQ}{\sqrt{x^2 + R^2}} \Rightarrow \frac{kQ}{\sqrt{(3R)^2 + R^2}}$$

$$V \Rightarrow \frac{kQ}{2R}$$

Q. 3 A 100 V, the 40watt bulb is connected across a 220V 0c supply. The power consumed by the bulb is

Option 1:

400 W

Option 2:

193.6 W

Option 3:

250 W

Option 4:

133.3 W

Correct Answer:

193.6 W

Solution:

As we learned

if $R=r$ -

$$P_{max} = \frac{E^2}{4r}$$

- wherein

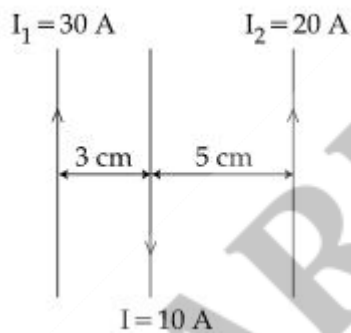
Power delivered will be maximum

$$R = \frac{V^2}{P} = \frac{100^2}{40}$$

$$\begin{aligned} \text{power consumed} &= \frac{V^2}{R} = \frac{220^2}{100^2} \times 40 \\ &= \frac{22 \times 22}{10} \times 4 \end{aligned}$$

193.6

- Q. 4** Three straight parallel current carrying conductors are shown in the figure. The force experienced by the middle conductor of length 25 cm is :



Option 1:

$3 \times 10^{-4} \text{ N}$ toward right

Option 2:

$6 \times 10^{-4} \text{ N}$ toward left

Option 3:

$9 \times 10^{-4} \text{ N}$ toward left

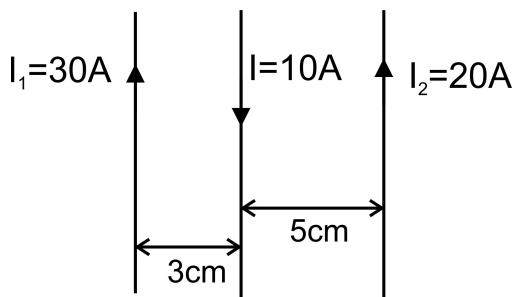
Option 4:

Zero

Correct Answer:

$3 \times 10^{-4} \text{ N}$ toward right

Solution:



Force due to wire one

$$F_1 = \frac{\mu_0 I_1 I_2}{2\pi r_1} l = \frac{2 \times 10^{-7} \times 30 \times 10}{3 \times 10^{-2}} \times 25 \times 10^{-2} = 5 \times 10^{-4} \text{ towards right}$$

Force due to wire two

$$F_2 = \frac{\mu_0 I I_2}{2\pi r_2} l = \frac{2 \times 10^{-7} \times 20 \times 10}{5 \times 10^{-2}} \times 25 \times 10^{-2} = 2 \times 10^{-4} \text{ towards left}$$

Net force = 3×10^{-4} towards right

- Q. 5** A short bar magnet of magnetic moment 0.4 J T^{-1} is placed in a uniform magnetic field of 0.24 T . The magnet is in stable equilibrium when the potential energy is -

Option 1:

-0.082

Option 2:

0.082

Option 3:

-0.096J

Option 4:

Zero

Correct Answer:

-0.096J

Solution:

As we learn

Potential energy of current carrying coil -

$$U = -MB \cos \theta$$

$$U = - \vec{M} \cdot \vec{B}$$

For stable equilibrium

$$P_{min} = -MB$$

$$= -0.4 \times 0.24$$

$$= -0.096J$$

Q. 6 The flux linked with a coil at any instant t is $5t^3 - 2t + 12$. The induced emf at $t = 2$ sec is:

Option 1:

34 volt

Option 2:

-34 volt

Option 3:

58 volt

Option 4:

-58 volt

Correct Answer:

-58 volt

Solution:

As we learn

Rate of change of magnetic Flux -

$$\varepsilon = \frac{-d\phi}{dt}$$

- wherein

$$d\phi \rightarrow \phi_2 - \phi_1$$

$\phi_2 - \phi_1$ — change in flux

$$e = \frac{-d\phi}{dt} = -[15t^2 - 2] = -[(15 \times 4) - 2] = -58 \text{ volt}$$

Q. 7 The primary winding of the transformer has 100 turns whereas the secondary has 1000 turns. The primary is connected to an ac supply of 20V. The secondary will have an output of-

Option 1:
200V

Option 2:
100V

Option 3:
20V

Option 4:
2V

Correct Answer:
200V

Solution:

As we have learnt,

Step up transformer If increase voltage and decrease current -

$$N_s > N_p$$

- wherein

$N_s \rightarrow$ Number of turns in secondary

$N_p \rightarrow$ Number of turns in primary

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

$$\Rightarrow V_s = \frac{N_s}{N_p} V_p = 200V$$

Q. 8 When light passes from one medium to another then which of the following quantity remains unchanged.

Option 1:
Wave length

Option 2:
Speed

Option 3:
Frequency

Option 4:
None of these

Correct Answer:
Frequency

Solution:

As we learned

Frequency of EM wave -

When light passes from one medium to another, the frequency remains constant but the wavelength changes.

Frequency remains constant.

Q. 9 an object is placed at a distance of 0.25 M in front of plane mirror the distance between object and image is

Option 1:
0.75 M

Option 2:
0.50 M

Option 3:
0.25 M

Option 4:
1.0 M

Correct Answer:
0.50 M

Solution:

as we learn

Image formation from plane mirror -

- 1) Distance of object from mirror = Distance of image from the mirror.
- 2) Line joining a point object and its image is normal to the reflecting surface
- 3) Size of image is same as that of the object.
- 4) For real object the image is virtual and for a virtual object the image is real.

Distance of object from mirror = distance of image from mirror

distance between object and image = $0.25 + 0.25 = 0.50$

Q. 10 Two slits in young's experiment have width in the ratio 1:25. The ratio of intensity at maxima and minima in the interference pattern $\frac{I_{max}}{I_{min}}$ is:

Option 1:

$$\frac{9}{4}$$

Option 2:

$$\frac{3}{2}$$

Option 3:

$$\frac{121}{49}$$

Option 4:

$$\frac{5}{1}$$

Correct Answer:

$$\frac{9}{4}$$

Solution:

As we learn

Maximum amplitude & Intensity -

When $\theta = 0, 2\pi, \dots, 2n\pi$

$$A_{max} = A_1 + A_2$$

$$I_{max} = (\sqrt{I_1} + \sqrt{I_2})^2$$

$$\frac{I_1}{I_2} = \frac{1}{25} \quad \text{OR} \quad \frac{I_2}{I_1} = \frac{25}{1}$$

$$\frac{I_{max}}{I_{min}} = \left(\frac{\sqrt{I_2} + \sqrt{I_1}}{\sqrt{I_2} - \sqrt{I_1}} \right)^2 \quad \frac{I_{max}}{I_{min}} = \left(\frac{\sqrt{I_2} + \sqrt{I_1}}{\sqrt{I_2} - \sqrt{I_1}} \right)^2 = \left(\frac{\sqrt{\frac{I_2}{I_1}} + 1}{\sqrt{\frac{I_2}{I_1}} - 1} \right)^2$$

$$\frac{I_{max}}{I_{min}} = \left(\frac{5 + 1}{5 - 1} \right)^2 = \frac{9}{4}$$

Q. 11 The kinetic energy of a free electron is increased by 50%. Then the ratio of initial to final de Broglie wavelength is

Option 1:

$$\sqrt{0.5}$$

Option 2:

$$\sqrt{1.5}$$

Option 3:

$$1.5$$

Option 4:

$$0.5$$

Correct Answer:

$$\sqrt{1.5}$$

Solution:

As we learn

De - Broglie wavelength -

$$\lambda = \frac{h}{p} = \frac{h}{mv} = \frac{h}{\sqrt{2mE}}$$

- wherein

h = plank's constant

m = mass of particle

v = speed of the particle

E = Kinetic energy of particle

$$\lambda = \frac{h}{\sqrt{2mE}}$$

$$\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{E_2}{E_1}} = \sqrt{\frac{1.5E_1}{E_1}} = \sqrt{1.5}$$

Q. 12 If the binding energy of the electron in a hydrogen atom is 13.6 eV, the energy required to remove the electron from the first excited state of Li^{++} is :

Option 1:

$$122.4 \text{ eV}$$

Option 2:

30.6 eV

Option 3:

13.6 eV

Option 4:

3.4 eV

Correct Answer:

30.6 eV

Solution:

Energy required to remove an electron according to Bohr model is

$$\Delta E = E_o.Z \left(\frac{1}{n^2} - \frac{1}{\infty^2} \right)$$

Here electron is in first excited state $\therefore n = 2$

$z=3, E_o = 13.6\text{ev}$

$$\therefore \Delta E = 13.6 \times 9 \times \frac{1}{4} = 30.6\text{ev}$$

Q. 13 Half-lives of two radioactive elements A and B are 20 minutes and 40 minutes, respectively. Initially, the samples have equal number of nuclei. After 80 minutes, the ratio of decayed numbers of A and B nuclei will be :

Option 1:

1 : 16

Option 2:

4 : 1

Option 3:

1 : 4

Option 4:

5 : 4

Correct Answer:

5 : 4

Solution:

As we learnt in

Number of nuclei in terms of half life -

$$N = \frac{N_0}{2^{t/t_{1/2}}}$$

A ($T_{1/2} = 20$ minutes)

B ($T_{1/2} = 40$ minutes)

$$N_A = \frac{N_0}{2^{t/T_{1/2}}}$$

$$N_B = \frac{N_0}{2^{t/t_{1/2}}}$$

at $t = 80$ min.

$$N_A = \frac{N_0}{2^4} = \frac{N_0}{16}$$

at $t = 80$ min.

$$N_B = \frac{N_0}{2^2} = \frac{N_0}{4}$$

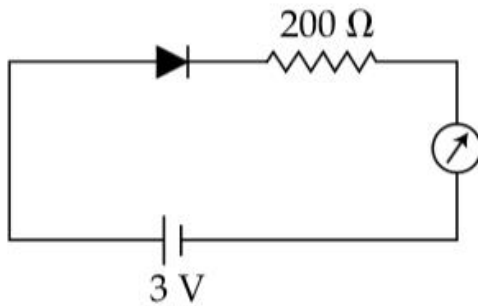
$$\text{Decayed number of } A = \frac{16N_0 - N_0}{16} = \frac{15}{16}N_0$$

$$\text{Decayed number of } B = \frac{3N_0}{4}$$

$$\text{Ratio} = \frac{\frac{15}{16}N_0}{\frac{3}{4}N_0} = \frac{5}{4}$$

Correct option is 4

Q. 14 The reading of the ammeter (in mA) for a silicon diode in the given circuit is :



Correct Answer:

11.5

Solution:

As we learnt in

Knee voltage of P-N junction -

It is defined as that forward voltage at which the current through the junction starts rising rapidly with increase in voltage .

- wherein

Knee voltage for Ge is 0.3 V

Knee voltage for Si is 0.7 V

For silicon diode barrier potential is 0.7V

 therefore $I = \frac{3-0.7}{200} \text{A} = 0.0115 \text{A} = 11.5 \text{mA}$

Q. 15 Transducer is used to convert

Option 1:

analog to digital signal

Option 2:

digital to analog signal

Option 3:

one form of energy into another

Option 4:

all of the above

Correct Answer:

one form of energy into another

Solution:

as we learn

Transducer -

A device that convert one form of energy into another.

An electrical transducer convert some physical variable (e.g. pressure) into electrical form.

Q. 16 Two charge of magnitude 1C each are placed at the two vertices of an equilateral triangle triangle of side d. The magnitude of electric field at the third vertices is equal to

$P \times \frac{1}{4\pi\epsilon_0 d^2}$. Then the value of P is:

Option 1:

$$\sqrt{2}$$

Option 2:

$$2$$

Option 3:

$$\sqrt{3}$$

Option 4:

$$\frac{1}{\sqrt{3}}$$

Correct Answer:

$$\sqrt{3}$$

Solution:

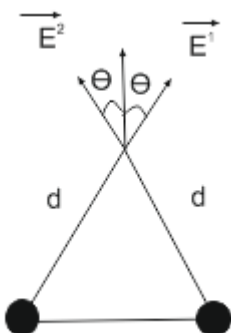
As we learn

Superposition of Electric field -

The resultant electric field at any point is equal to the vector sum of all the electric fields.

- wherein

$$\vec{E} = \vec{E}_1 + \vec{E}_2 + \vec{E}_3 + \dots \vec{E}_n$$



Net electric field at third vertex in

$$E_1 \cos \theta + E_2 \cos \theta$$

$$2E \cos \theta$$

$$2 \times \frac{1}{4\pi\epsilon_0} \frac{1}{d^2} \cos 30$$

$$2 \times \frac{1}{4\pi\epsilon_0} \frac{1}{d^2} \frac{\sqrt{3}}{2} = \sqrt{3} \times \frac{1}{4\pi\epsilon_0} \frac{1}{d^2}$$

Q. 17 The potential at surface of a hollow metallic sphere is 15V. Then the potential at the centre is:

Option 1:

10V

Option 2:

15V

Option 3:

5V

Option 4:

Zero

Correct Answer:

15V

Solution:

As we learn

At the surface of Sphere -

$$V = R$$

$$E_s = \frac{1}{4\pi\epsilon_0} \frac{Q}{R^2} = \frac{\sigma}{\epsilon_0}$$

$$V_s = \frac{1}{4\pi\epsilon_0} \frac{Q}{R} = \frac{\sigma R}{\epsilon_0}$$

-

Potential inside the hollow sphere is constant and equal to potential at surface.

Q. 18

A wire of length l and radius r is recasted to a wire of length $\frac{3l}{4}$ and radius r . Then what is relation between initial and final resistance ?

Option 1:

$$R_1 = \frac{9}{16}R_2$$

Option 2:

$$16R_2 = 9R_1$$

Option 3:

$$3R_1 = 4R_2$$

Option 4:

$$R_2 = \frac{4}{3}R_1$$

Correct Answer:

$$3R_1 = 4R_2$$

Solution:

As we learned

Ratio of resistances -

If length is given

$$r \propto L^2$$

- wherein

$$\frac{R_1}{R_2} = \left(\frac{l_1}{l_2}\right)^2$$

$$R_1 = \frac{\rho l}{A}$$

$$R_2 = \frac{\rho 3l}{4A}$$

$$\frac{R_1}{R_2} = \frac{4}{3}$$

$$3R_1 = 4R_2$$

Q. 19 An electron experience no deflection if subjected to an electric field of $6.4 \times 10^4 \text{ V/m}$ and a magnetic field of $1.6 \times 10^{-3} \text{ wb/m}^2$

Electric field , magnetic field and velocity of electron are mutually perpendicular then the value of v is

Option 1:

$$4 \times 10^7 \text{ m/s}$$

Option 2:

$$2 \times 10^7 \text{ m/s}$$

Option 3:

$$8 \times 10^5 \text{ m/s}$$

Option 4:

$$6 \times 10^6 \text{ m/s}$$

Correct Answer:

$$4 \times 10^7 \text{ m/s}$$

Solution:

As we have learned

Magnetic field If V(vector), E (vector) and B (vector) are mutually perpendicular -

$$F_e = F_m$$

$$V = \frac{E}{B}$$

-

$$E_m = E_e$$

$$Bev = E_e$$

$$v = E/B \Rightarrow \frac{6.4 \times 10^4}{1.6 \times 10^{-3}}$$

$$v = 4 \times 10^7 \text{ m/s}$$

Q. 20 Six dipoles of magnitude of charge e are placed inside a cube . The total electric flux coming out of the cube will be

Option 1:

$$\frac{8e}{\epsilon_0}$$

Option 2:

$$\frac{16e}{\epsilon_0}$$

Option 3:

$$\frac{e}{\epsilon_0}$$

Option 4:

zero

Correct Answer:

zero

Solution:

As we have learned

Gauss law for closed surface -

$$\oint \vec{B} \cdot d\vec{s} = 0$$

-

$$\oint \vec{E} \cdot d\vec{A} = \frac{q}{\epsilon_0}$$

q enclosed = 0

$$\phi = \oint E \cdot d\vec{A} = 0$$

Q. 21 A 5 metre wire kept in the east-west direction is falling with velocity 5m/s perpendicular to the field $0.5 \times 10^{-4} \text{ Wb/m}^2$. The induced emf across the terminal will be?

Option 1:

$$1.25V$$

Option 2:

$$1.25mV$$

Option 3:

$$1.5mV$$

Option 4:

1.75V

Correct Answer:

1.25mV

Solution:

As we have learnt,

Motional EMF -

$$\varepsilon = Blv$$

- wherein

$B \rightarrow$ magnetic field

$L \rightarrow$ length

$u \rightarrow$ velocity of u perpendicular to uniform magnetic field.

$$\text{Induced emf} = Blv$$

$$= 0.5 \times 10^{-4} \times 5 \times 5$$

$$= 1.25 \times 10^{-3} \text{V}$$

Q. 22 The ratio of secondary to primary turns is 10:6 then the ratio of voltage output to voltage input is equal to

Option 1:

10:6

Option 2:

6:10

Option 3:

10:5

Option 4:

1:1

Correct Answer:

10:6

Solution:

As we have learnt,

Step down transformer If decrease voltage and increase current -

$$N_s < N_P$$

-

$$\frac{V_S}{V_P} = \frac{N_S}{N_P} = \frac{10}{6}$$

Q. 23 The peak value of electric field of light coming from sun is 8×10^2 N/M then the average total density of the electromagnetic wave is $P\epsilon_o \times 10^4$ then the value of P is

Option 1:

16

Option 2:

8

Option 3:

32

Option 4:

64

Correct Answer:

32

Solution:

Energy density =

$$\frac{1}{2}\epsilon_o E^2 = \frac{1}{2}\epsilon_o (8 \times 10^2)^2 = \frac{1}{2}\epsilon_o \times 64 \times 10^4$$

$$= 32 \times \epsilon_o \times 10^4$$

So, P = 32

Q. 24

A ray of light propagates from glass $\left(\mu_g = \frac{3}{2}\right)$ to water $\left(\mu_w = \frac{4}{3}\right)$. The value of critical angle is

Option 1:

$$\sin^{-1} \frac{8}{9}$$

Option 2:

$$\sin^{-1} \frac{3}{4}$$

Option 3:

$$\sin^{-1} \frac{2}{3}$$

Option 4:

$$0$$

Correct Answer:

$$\sin^{-1} \frac{2}{3}$$

Solution:

As we learn

Critical angle -

$$\sin i_c = \text{Refractive index of rarer medium} / \text{Refractive index of denser medium} = n_{21}$$

- wherein

When angle of incidence of a travelling from a dense medium to rarer medium is greater than critical angle, no refraction occurs.

$$\sin I_c = \frac{\mu_w}{\mu_g} = \frac{4/3}{3/2} = \frac{8}{9}$$

$$I_c = \sin^{-1} \left[\frac{8}{9} \right]$$

Q. 25

In Young's experiment the distance between the two slit is made half, then the fringe width will become

Option 1:

Unchanged

Option 2:

Double

Option 3:

One fourth

Option 4:

Half

Correct Answer:

Double

Solution:

As we learn

Fringe Width -

$$\beta = \frac{\lambda D}{d}$$

- wherein

$$\beta = y_{n+1} - y_n$$

$$y_{n+1} = \text{Distance of } (n+1)^{th}$$

$$\text{Maxima} = (n+1) \frac{\lambda D}{d}$$

$$y_n = \text{Distance of } n^{th}$$

$$\text{maxima} = \frac{n\lambda D}{d}$$

$$\beta \propto \frac{1}{d}$$

Q. 26 The work function of metal A and B are in ratio 3:2 then what is the ratio of their corresponding threshold wavelength :

Option 1:

3:2

Option 2:

2:3

Option 3:

1:3

Option 4:

3:1

Correct Answer:

2:3

Solution:

As we learn

Work function -

Energy used to overcome the surface barrier and come out of metal surface.

$$\phi = h\nu_0$$

- wherein

$h = \text{Plank's constant}$

$\nu_0 = \text{threshold frequency}$

$$\frac{\phi_1}{\phi_2} = \frac{3}{2} = \frac{\frac{hc}{\lambda_1}}{\frac{hc}{\lambda_2}} = \frac{\lambda_2}{\lambda_1}$$

$$\frac{\lambda_2}{\lambda_1} = \frac{3}{2}$$

$$\frac{\lambda_1}{\lambda_2} = \frac{2}{3}$$

$$\lambda_1 : \lambda_2 = 2 : 3$$

Q. 27 If 13.6 eV energy is required to ionize the hydrogen atom, then the energy required (in eV) to remove an electron from $n = 2$ is

Correct Answer:

3.4

Solution:

Energy required to move an electron from n^{th} orbit to $n=\infty$ is called the Binding energy of n^{th} orbit

$$B.E._{n^{\text{th}} \text{ orbit}} = \frac{13.6z^2}{n^2} \text{eV}$$

For an electron to be removed from orbit $n=2$ of hydrogen atom ($z=1$)

$$B.E._{2^{\text{nd}} \text{ orbit}} = \frac{13.6}{2^2} \text{eV} = 3.4 \text{eV}$$

The correct option is 1.

Q. 28 The ratio of radius of nuclei ${}_{13}\text{Al}^{27}$ and ${}_{52}\text{Te}^{125}$ is:

Option 1:

$$\frac{3}{5}$$

Option 2:

$$\frac{5}{3}$$

Option 3:

$$\frac{9}{25}$$

Option 4:

$$\frac{25}{9}$$

Correct Answer:

$$\frac{3}{5}$$

Solution:

$$R \propto A^{\frac{1}{3}}$$

$$\Rightarrow \frac{R_{\text{Al}}}{R_{\text{Te}}} = \left[\frac{A_{\text{Al}}}{A_{\text{Te}}} \right]^{\frac{1}{3}} = \left[\frac{27}{125} \right]^{\frac{1}{3}} = \frac{3}{5}$$

Q. 29 $\overline{E + \overline{CD}} =$

Option 1:

$$E \cdot (C + D)$$

Option 2:

$$\overline{E} \cdot (\overline{C} + \overline{D})$$

Option 3:

$$\overline{E} \cdot (C + \overline{D})$$

Option 4:

None of these

Correct Answer:

$$\overline{E} \cdot (C + \overline{D})$$

Solution:

As we learn

D'morgan's Theorem -

$$1) \quad \overline{A + B} = \overline{A} \cdot \overline{B}$$

$$2) \quad \overline{A \cdot B} = \overline{A} + \overline{B}$$

$$3) \quad \overline{\overline{A} + \overline{B}} = A \cdot B$$

$$4) \quad \overline{\overline{A} \cdot \overline{B}} = A + B$$

- wherein

A and B are input.

$$\begin{aligned} \overline{E + \overline{C}D} &= \overline{E} \cdot \overline{\overline{C}D} \\ &= \overline{E}(\overline{\overline{C}} + \overline{D}) \\ &= \overline{E}(C + \overline{D}) \end{aligned}$$

Q. 30 range in communication is defined as

Option 1:

largest distance between the source and destination

Option 2:

shortest distance between the source and destination

Option 3:

distance between two transmitter

Option 4:

the distance between two receiver

Correct Answer:

largest distance between the source and destination

Solution:

as we learn

Communication range -

It is largest distance between a source and a destination upto which the signal is received with sufficient strength.

-

.

-

Q. 31 In a region of space of electric field is given by $\vec{E} = 8\hat{i} + 4\hat{j} + 3\hat{k}$. The electric flux through a surface of area of 100 units in x- y plne is:

Option 1:

800 unit

Option 2:

400 unit

Option 3:

300 unit

Option 4:

1500 unit

Correct Answer:

300 unit

Solution:

As we learn

Electric field E through any area A -

$$\phi = \vec{E} \cdot \vec{A} = EA \cos \Theta$$

$$S.I \text{ unit} - (\text{volt}) m \text{ or } \frac{N - m^2}{c}$$

$$d\phi = \int \vec{E} d\vec{A}$$

$$\phi = \vec{E} \cdot \vec{A} \quad \vec{A} = 100\hat{z}$$

$$\phi = (8\hat{i} + 4\hat{j} + 3\hat{k}) \cdot (100\hat{z}) = 300 \text{ units}$$

Q. 32 The capacity of parallel plate capacitor increases with the

Option 1:

increases of its area

Option 2:

decrease of its area

Option 3:

increases of distance between the plate

Option 4:

none of the these

Correct Answer:

increases of its area

Solution:

As we learn

Parallel Plate Capacitor -

$$C = \frac{\epsilon_0 A}{d}$$

- wherein

Area - A separation between two plates.

$$C = \frac{\epsilon_0 A}{d}$$

$$C \propto A$$

$$C \propto \frac{1}{d}$$

Q. 33 A resistance of 2Ω is connected across a cell of internal resistance 0.5Ω . The current in the circuit is found to be 2A. The emf of the cell is

Option 1:

4V

Option 2:

5V

Option 3:

2V

Option 4:

0.5V

Correct Answer:

5V

Solution:

As we learned

Current given by the cell -

$$i = \frac{E}{R + r}$$

- wherein

R — External resistance

R — internal resistance

$$i = \frac{E}{R + r}$$

$$2 = \frac{E}{2.5}$$

$$E = 5V$$

Q. 34 In the given diagram current I is flowing in wire as shown . The direction of magnetic field at point p will be in



Option 1:

outwards to the plane of paper

Option 2:

inwards to the plane of paper

Option 3:

towards the wire

Option 4:

Away from the wire

Correct Answer:

inwards to the plane of paper

Solution:

As we have learned

Right Hand Thumb Rule -

If straight current carrying conductor is held in the right hand such that the thumb of the hand represents the direction of current flow where folding figures give direction of magnetic lines of force.

According to the right hand thumb rule the direction of magnetic field at p will be inwards to the plane of paper

Q. 35 The magnetic moment of diamagnetic substances is:

Option 1:

very high

Option 2:

equal to one

Option 3:

very low(≈ 0)

Option 4:

in the range of 10^3

Correct Answer:

very low(≈ 0)

Solution:

As we learn

Magnetic moment (m) -

Very low= 0 (In diamagnetic substance)

-

Value of M is very low (≈ 0) for diamagnetic substance.

Q. 36

A conductor of 3 m in length is moving perpendicularly to magnetic field of 10^{-3} Tesla with

the speed of 10^2 m/s , then the e.m.f. produced across the ends of conductor will be

Option 1:

0.03 volt

Option 2:

0.3 volt

Option 3:

3×10^{-3} volt

Option 4:

3 volt

Correct Answer:

0.3 volt

Solution:

$$e = Bvl = 3 \times 10^{-3} \times 10^2 = 0.3 \text{ volt}$$

Q. 37

An alternative voltage $e = 200 \sin 100t$ is applied to a inductor of 400mH. the inductive reactance of circuit is:

Option 1:

50 ω

Option 2:

30 ω

Option 3:

40 ω

Option 4:

25 ω

Correct Answer:

40 ω

Solution:

$$X_L = \omega L = 100 \times 400 \times 10^{-3} = 40\Omega$$

Q. 38 In a region, the electric field was found to oscillate with an amplitude of 9 v/m. The magnitude of the oscillating magnetic field will be

Option 1:

$$3 \times 10^{-8}$$

Option 2:

$$27 \times 10^8$$

Option 3:

$$3 \times 10^8$$

Option 4:

$$8 \times 10^{-8}$$

Correct Answer:

$$3 \times 10^{-8}$$

Solution:

As we learned

Relation between E_o and B_o -

$$E_o = c.B_o$$

- wherein

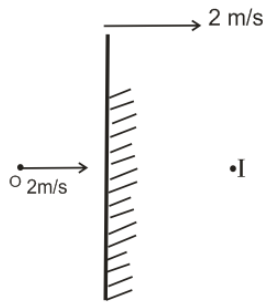
E_o = Electric field amplitude

B_o = Magnetic field amplitude

C = Speed of light in vacuum

$$B = \frac{E}{C} = \frac{9}{3 \times 10^8} = 3 \times 10^{-8}$$

Q. 39



In the given diagram the mirror and object is moving with speed 2 m/s

as shown then the velocity of image with respect to object

Option 1:

0 m/s

Option 2:

5 m/s

Option 3:

2 m/s

Option 4:

4 m/s

Correct Answer:

0 m/s

Solution:

As we learn

Relation between object and image velocity if object is moving along principal axis -

$$\vec{V}_{im} = \frac{-v^2}{u^2} \vec{V}_{om}$$

$$\vec{V}_{im} = \vec{V}_i - \vec{V}_m$$

$$\vec{V}_{om} = \vec{V}_o - \vec{V}_m$$

- wherein

$\vec{V}_o$ = velocity of light

$\vec{V}_i$ = velocity of image

$\vec{V}_m$ = velocity of mirror

$\vec{V}_{om}$ = velocity of object w.r.t. mirror

$\vec{V}_{im}$ = velocity of image w.r.t. mirror

$$V_i = 2V_m - V_o \Rightarrow V_i = 4 - 2 = 2\text{m/s}$$

$$V_{i/o} = V_i - V_o = 2 - 2 = 0$$

Q. 40 Unpolarized light of intensity I is incident on a system of two polarizers, A followed by B. The intensity of emergent light is $I/2$. If a third polarizer C is placed between A and B, the intensity of emergent light is reduced to $I/3$. The angle between the polarizers A and C is θ . Then :

Option 1:

$$\cos \Theta = \left(\frac{2}{3}\right)^{1/2}$$

Option 2:

$$\cos \Theta = \left(\frac{2}{3}\right)^{1/4}$$

Option 3:

$$\cos \Theta = \left(\frac{1}{3}\right)^{1/2}$$

Option 4:

$$\cos \Theta = \left(\frac{1}{3}\right)^{1/4}$$

Correct Answer:

$$\cos \Theta = \left(\frac{2}{3}\right)^{1/4}$$

Solution:

As we have learned

Malus Law -

$$I = I_0 \cdot \cos^2 \theta$$

θ = angle made by E vector with transmission axis.

- wherein

i = Intensity of transmitted light after polarisation .

I_0 = Intensity of incident light.

both A and B should have same orientation of transmission axis only then we will have intensity of $I/2$

let c makes angle θ with A then $I/2 \cos^2 \theta \cdot \cos^2 \theta = I/3$

or

$$\cos \theta = (2/3)^{1/4}$$

Q. 41 The de Broglie wavelength of a proton and α - particle are equal. The ratio of their velocities is :

Option 1:

4:1

Option 2:

4:2

Option 3:

1:4

Option 4:

4:3

Correct Answer:

4:1

Solution:

The de-Broglie equation is given by:

$$\lambda = \frac{h}{mv}$$

So, If the de-Broglie wavelength for both the proton and alpha particle is the same then

$$\Rightarrow \lambda_1 = \lambda_2$$

$$\Rightarrow \left(\frac{h}{m_1 v_1} \right) = \left(\frac{h}{m_2 v_2} \right)$$

And using $m_2 = 4m_1$

$$m_1 v_1 = m_2 v_2$$

$$\Rightarrow m_1 v_1 = 4m_1 v_2$$

$$\Rightarrow v_1 = 4v_2$$

$$\therefore \frac{v_1}{v_2} = \frac{4}{1}$$

Q. 42 The total energy of an electron in the first excited state of hydrogen is about -3.4eV. Its kinetic energy (in eV) in this state is:

Correct Answer:

3.4

Solution:

As we learn

Relation between K.E., P.E. & Total energy -

 K.E. = - \left(\text{Total energy} \right) = -\frac{1}{2} \left(\text{Potential energy} \right)

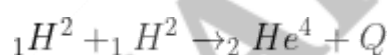
- wherein

Potential Energy and total energy are negative. While kinetic energy is positive

Total KE = - (Total energy of electron in that orbit)

$$= - (-3.4\text{eV}) = 3.4\text{eV}$$

Q. 43 The Q value for the given reaction is equal to -



Binding energy per nuclear for deutron (${}_1^2\text{H}$) = 1.1 Mev

Binding energy per nuclear for Helium (${}_2^4\text{He}$) = 7 Mev

Option 1:

10.5 Mev

Option 2:

13.4 Mev

Option 3:

23.6 Mev

Option 4:

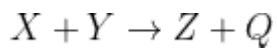
9.7 Mev

Correct Answer:

23.6 Mev

Solution:

Q value -



$$Q = (M_x + M_y - M_z)C^2$$

M_x and M_y are mass of reactant

M_z is mass of product

So,

Q value -

$$= \Sigma BE_{Prod} - \Sigma BE_{React}$$

$$= (4 \times 7) - 2(2 \times 1.1) = 23.6 \text{ Mev}$$

Q. 44

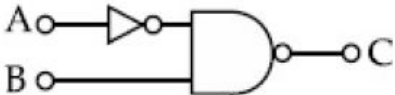


The logic circuit shown above is equivalent to :

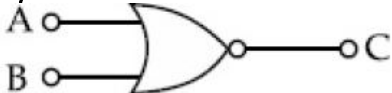
Option 1:



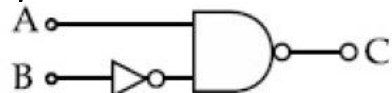
Option 2:



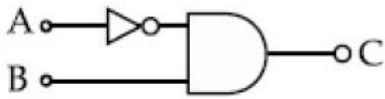
Option 3:



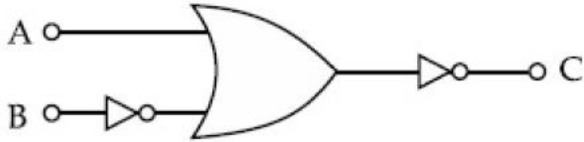
Option 4:



Correct Answer:



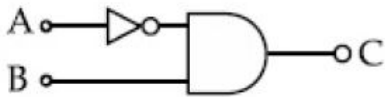
Solution:



For above circuit

$$C = \overline{A + \overline{B}} = \overline{A} \cdot \overline{\overline{B}} = \overline{A} \cdot B$$

and



For above circuit

$$C = \overline{A} \cdot B$$

Q. 45 In a sinusoidal carrier voltage maximum and minimum modulated carrier amplitude of 110v & 90v respectively then modulation index given by

Option 1:

0.2

Option 2:

0.1

Option 3:

0.3

Option 4:

0.4

Correct Answer:

0.1

Solution:

as we learn

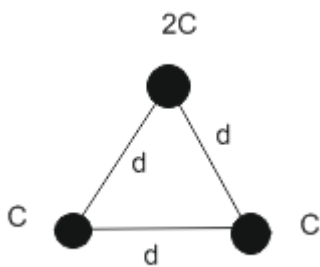
Modulation Index if the maximum and minimum amplitude is given -

$$m_a = \frac{E_{max} - E_{min}}{E_{max} + E_{min}}$$

so

$$m_a = \frac{E_{max} - E_{min}}{E_{max} + E_{min}} = \frac{110 - 90}{110 + 90} = \frac{20}{200} = 0.1$$

Q. 46



Three charge particles of charge 1C , 1C and 2C are placed at the vertices of an equilateral triangle of side d as shown in the diagram. Then net force on charge 2C is $P \times \frac{1}{4\pi\epsilon_0 d^2}$ then the value of P is:

Option 1:

$$\frac{\sqrt{3}}{2}$$

Option 2:

$$\sqrt{3}$$

Option 3:

$$2\sqrt{3}$$

Option 4:

$$4$$

Correct Answer:

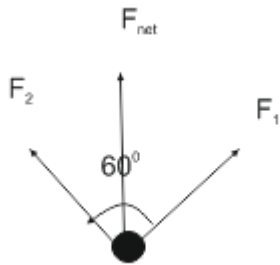
$$2\sqrt{3}$$

Solution:

As we learn

Magnitude of the Resultant force -

$$F_{net} = \sqrt{F_1^2 + F_2^2 + 2F_1F_2 \cos \Theta}$$

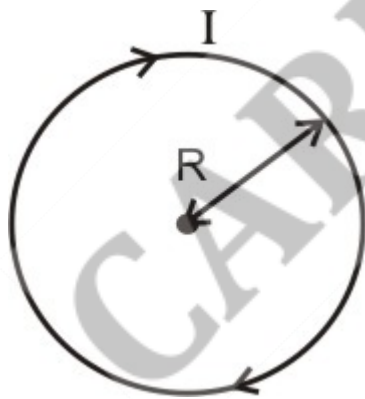


$$F_1 = F_2 = \frac{1 \times 1 \times 2}{4\pi\epsilon_0 d^2} = \frac{2}{4\pi\epsilon_0 d^2}$$

$$F_{net} = \sqrt{F_1^2 + F_2^2 + 2F_1F_2 \cos \theta} = \sqrt{2F^2 + 2F^2 \cos 60} = \sqrt{2F^2 + 2F^2 \frac{1}{2}}$$

$$F_{net} = \sqrt{3}F = \sqrt{3} \frac{2}{4\pi\epsilon_0 d^2} = 2\sqrt{3} \frac{1}{4\pi\epsilon_0 d^2}$$

- Q. 47** In the figure shown the magnetic field at the centre of the circle of radius 20 cm and current 10A will be equal to -



Option 1:

$$25\mu_o$$

Option 2:

$$10\mu_o$$

Option 3:

$$15\mu_o$$

Option 4:

$$20\mu_o$$

Correct Answer:

$$25\mu_o$$

Solution:

At the center of the circle

$$B = \frac{\mu_o I}{2R} \Rightarrow \frac{\mu_o \times 10}{2 \times 20 \times 10^{-2}} = \frac{\mu_o \times 10 \times 100}{2 \times 20} = 25\mu_o$$

Q. 48 A loop of magnetic moment M is placed in a magnetic field B . If the loop is rotated through an angle 180° from its equilibrium position then required work will be-

Option 1:

$$MB$$

Option 2:

$$\frac{MB}{2}$$

Option 3:

$$2MB$$

Option 4:

$$0$$

Correct Answer:

$$2MB$$

Solution:

As we learn

If $\theta = 180^\circ$ -

$$N_{\max} = 2MB$$

$$W = MB(1 - \cos\Theta)$$

$$\text{For } \Theta = 180^\circ$$

$$W_{\max} = 2MB$$

Q. 49 If a north pole of a magnet is approaching to a closed loop then the direction of induced current will be such that:

Option 1:

it will attract the north pole

Option 2:

it will repel the north pole

Option 3:

it will repel the south pole

Option 4:

none of the above

Correct Answer:

it will repel the north pole

Solution:

as we learn

induced current in closed loop circuit -

When N pole of a bar magnet move towards the coil the flux associated with loop increases and an emf is induced in it.

According to the Len's law it will repel north pole.

Q. 50 Two convex lens of focal length 20 Cm and 25 Cm are placed in contact with each other then the combination of lens will behave like

Option 1:
plane slab

Option 2:
converging lens

Option 3:
diverging lens

Option 4:
none of these

Correct Answer:
converging lens

Solution:

$$\frac{1}{f} = \frac{1}{20} + \frac{1}{25}$$

$$\frac{1}{f} = \frac{25 + 20}{500} = \frac{45}{500} = \frac{9}{100}$$

$$P = \frac{9}{100} \times 100 = 9D$$

P is positive so it will behave like a converging lens

CUET 2022 - Chemistry Sample Paper

- Q. 1** The mole fraction of glucose ($C_6H_{12}O_6$) in an aqueous binary solution is 0.1. The mass percentage of water in it to the nearest integer is-

Correct Answer:

47

Solution:

Mole fraction of glucose, in $C_6H_{12}O_6 = 0.1$

Now, let's assume we have 10 moles of solution.

Thus, moles of $C_6H_{12}O_6 = 1$

Ans, moles of $H_2O = 9$

Now, the mass of water = number of moles $\times$ molar mass

Thus, the mass of water $= 9 \times 18 = 162$ g

Mass of $C_6H_{12}O_6 = 180$ gm

Now, mass percent of water is given as:

$$\text{Mass \% of water} = \frac{\text{Mass of water}}{\text{Mass of water} + \text{mass of glucose}} \times 100$$

$$\text{Mass \% of water} = \frac{162}{180 + 162} \times 100$$

$$\text{Mass \% of water} = 47.3\%$$

Thus, the correct answer is 47.

- Q. 2** The density (*in $g\ mL^{-1}$*) of a 3.60 M sulphuric acid solution that is 29% H_2SO_4 (*molar mass = $98\ g\ mol^{-1}$*) by mass will be

Correct Answer:

1.22

Solution:

Let,

Mass of solution = 100 gm

Mass of solute = 29 gm

$$\text{Volume of solution} = \frac{100}{\text{density}} \text{ ml}$$

$$\text{Molarity} = \frac{\text{Moles of solute}}{\text{Volume of solution in Litre}}$$

$$M = \frac{(29/98) \times \text{density} \times 1000}{100} = 3.6$$

$$\text{Density} = \frac{3.6 \times 98}{29 \times 10} = 1.216 \text{ g/ml}$$

The correct option is 1.

Q. 3 Units of the rate constant of first and zero-order reactions in terms of molarity M unit are respectively.

Option 1:

$$\text{sec}^{-1}, M \text{sec}^{-1},$$

Option 2:

$$\text{sec}^{-1}, M$$

Option 3:

$$M \text{sec}^{-1}, \text{sec}^{-1},$$

Option 4:

$$M, \text{sec}^{-1},$$

Correct Answer:

$$\text{sec}^{-1}, M \text{sec}^{-1},$$

Solution:

For zero-order reaction

$$-\frac{\Delta [R]}{\Delta t} = k [R]^0$$

unit of k is $M \text{sec}^{-1}$

For first-order reaction

$$-\frac{\Delta [R]}{\Delta t} = k [R]^1$$

unit of k is sec^{-1}

Q. 4 The rate equation for the reaction $2A + B \rightarrow C$ is found to be : $\text{rate} = k[A][B]$. The correct statement in relation to this reaction is that the

Option 1:

unit of k must be s^{-1}

Option 2:

$t_{1/2}$ is a constant

Option 3:

rate of formation of C is twice the rate of disappearance of A

Option 4:

value of k is independent of the initial concentrations of A and B

Correct Answer:

value of k is independent of the initial concentrations of A and B

Solution:

Given,

$$\text{Rate} = k[A][B]$$

According to the rate law equation order of reaction with respect to A and with respect to B is first order.

So, Order of the reaction = $1 + 1 = 2$.

For second-order reaction -

$$\text{Unit of } k = \text{L mole}^{-1}\text{sec}^{-1}$$

And

$$t_{1/2} = \frac{1}{k[A]_0}$$

The half-life period is not constant. It is inversely proportional to the concentration of reactants.

And

$$-\frac{1}{2} \frac{dA}{dt} = \frac{dC}{dt}$$

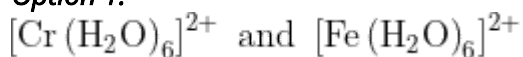
The rate of formation of C is one-half the rate of disappearance of A.

So, the value of k is independent of the initial concentration of A and B, it changes when the temperature changes.

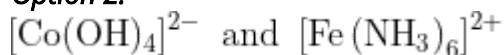
Option 4 is correct.

Q. 5 The pair in which both the species have the same magnetic moment (spin only) is:

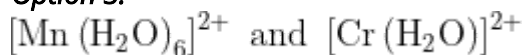
Option 1:



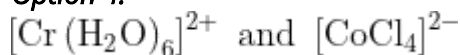
Option 2:



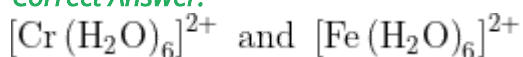
Option 3:



Option 4:



Correct Answer:



Solution:

For solving need to know the concept of WFL (weak field ligand) and SFL (strong field ligand).

Electronic configuration and unpaired electrons of given complexes-

Complex	e ⁻ configuration	no. of unpaired e ⁻
$[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$	$\begin{array}{ c c c } \hline \uparrow & \uparrow & \uparrow \\ \hline \end{array} \text{eg}$	5
WFL	$\begin{array}{ c c c } \hline \uparrow & \uparrow & \uparrow \\ \hline \end{array} \text{t}_2\text{g}$	
$[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$	$\begin{array}{ c c } \hline \uparrow & \uparrow \\ \hline \end{array} \text{eg}$	4
WFL	$\begin{array}{ c c c } \hline \uparrow & \uparrow & \uparrow \\ \hline \end{array}$	
$[\text{CoCl}_4]^{2-}$	$\begin{array}{ c c c } \hline \uparrow & \uparrow & \uparrow \\ \hline \end{array} \text{t}_2$	3
Tetrahedral	$\begin{array}{ c c } \hline \uparrow\downarrow & \uparrow\downarrow \\ \hline \end{array} \text{e}$	
$[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$	$\begin{array}{ c c } \hline \uparrow & \uparrow \\ \hline \end{array} \text{eg}$	4
WFL	$\begin{array}{ c c c } \hline \uparrow\downarrow & \uparrow & \uparrow \\ \hline \end{array} \text{t}_2\text{g}$	
$[\text{Co}(\text{OH})_4]^{2-}$	$\begin{array}{ c c c } \hline \uparrow & \uparrow & \uparrow \\ \hline \end{array} \text{t}_2$	3
WFL	$\begin{array}{ c c } \hline \uparrow\downarrow & \uparrow\downarrow \\ \hline \end{array} \text{e}$	
Tetrahedral	$\begin{array}{ c c } \hline \uparrow & \uparrow \\ \hline \end{array}$	4
$[\text{Fe}(\text{NH}_3)_6]^{2+}$	$\begin{array}{ c c c } \hline \uparrow\downarrow & \uparrow & \uparrow \\ \hline \end{array}$	

Thus complex $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ have the same no. of unpaired e⁻ and hence same magnetic moment (spin only).

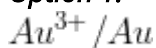
Therefore, the correct option is (1).

Q. 6 For the cell $Zn(s) | Zn^{2+}(aq) || M^{x+}(aq) | M(s)$, different half cells and their standard electrode potential are given below :

$M^{x+}(aq)/M(s)$	$Au^{3+}(aq)/Au(s)$	$Ag^+(aq)/Ag(s)$	$Fe^{3+}(aq)/Fe^{2+}(aq)$	$Fe^{2+}(aq)/Fe(s)$
$E^\circ_{M^{x+}/M}/(V)$	1.40	0.80	0.77	-0.44

If $E^\circ_{Zn^{2+}/Zn} = -0.76V$, which cathode will give a maximum value of E°_{cell} per electron transferred?

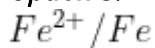
Option 1:



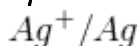
Option 2:



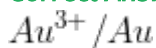
Option 3:



Option 4:



Correct Answer:



Solution:

We know that

$$\Delta_r G^\ominus = \Delta_1 G^\ominus + \Delta_2 G^\ominus$$

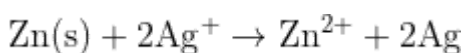
And

$$\Delta_r G^\ominus = -nFE^\ominus_{(cell)}$$

from above

$$nE^\ominus_{(cell)} = n_1E^\ominus_1 + n_2E^\ominus_2$$

For Ag^{2+}/Ag



Electron transfer :

$$n(\text{reaction}) = 2, n_1(Zn) = 2, n_2(Ag) = 1$$

and

$$\text{Given } E_{\text{Zn}^{2+}/\text{Zn}}^{\circ} = -0.76$$

$$\text{So, } E_{\text{Zn}/\text{Zn}^{2+}}^{\circ} = 0.76$$

After putting the value:

$$2 \times E_{(\text{cell})}^{\circ} = 2 \times (0.76) + 1 \times 0.80$$

$$2 \times E_{(\text{cell})}^{\circ} = 2.32$$

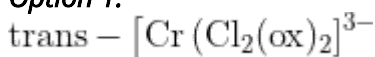
$$E_{(\text{cell})}^{\circ} = 1.16$$

After calculating the other 1.16 will be the maximum.

Therefore, option(4) is correct

Q. 7 The complex that can show optical activity is:

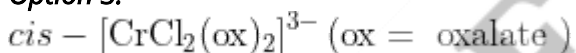
Option 1:



Option 2:



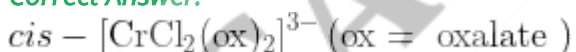
Option 3:



Option 4:

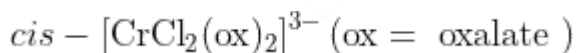


Correct Answer:



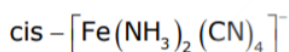
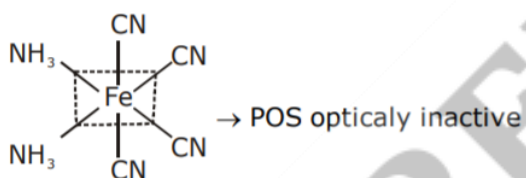
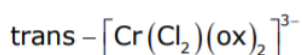
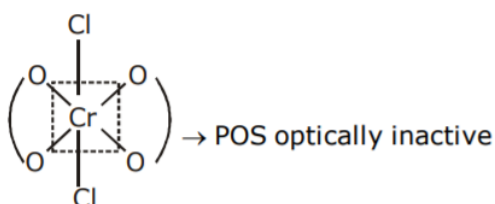
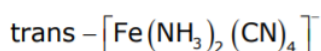
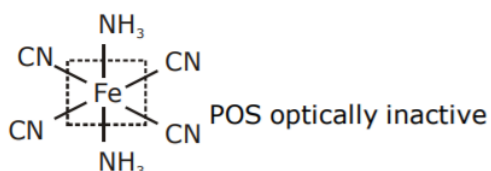
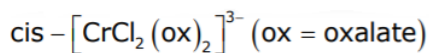
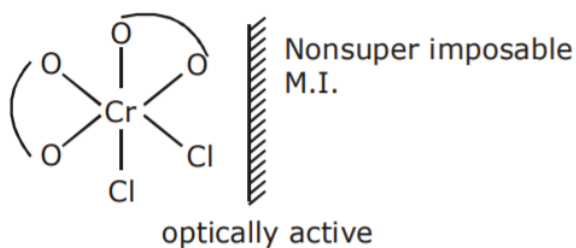
Solution:

The complex that can show optical activity is:



The structure is given below:

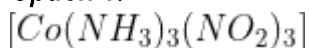
This compound has 2 forms, i.e, d, and l. Hence it is optically active.



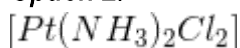
Therefore, Option(3) is correct.

Q. 8 The complex that can show *fac*- and *mer*- isomers is:

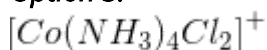
Option 1:



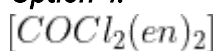
Option 2:



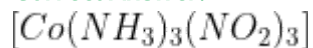
Option 3:



Option 4:



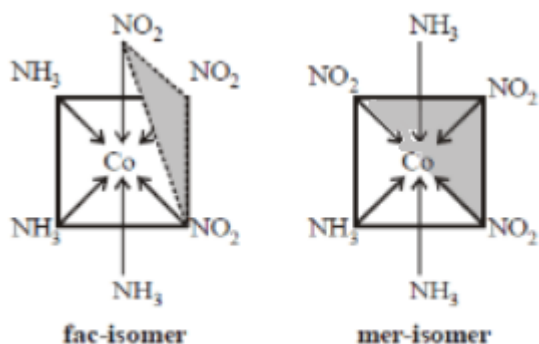
Correct Answer:



Solution:

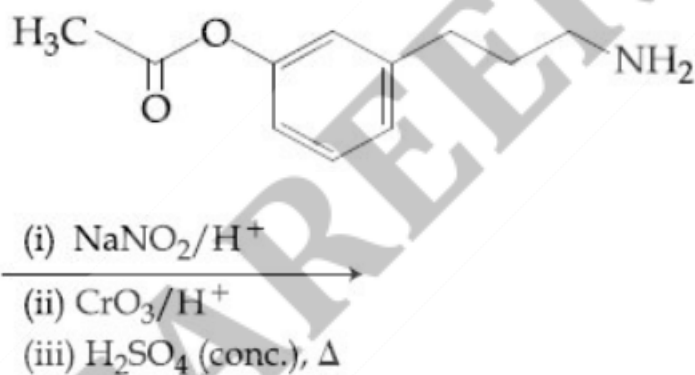
Complexes of the type $[Ma_3b_3]$ exist in two geometrical forms which are named as facial (*fac*-) and meridional (*mer*-).

The complex $[Co(NH_3)_3(NO_2)_3]^+$ can be represented in *fac*- and *mer*- isomeric forms as follows:

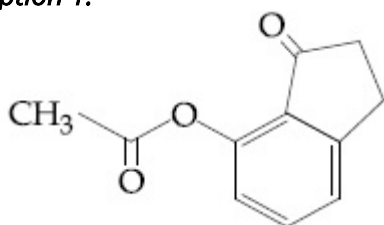


Therefore, Option(1) is correct.

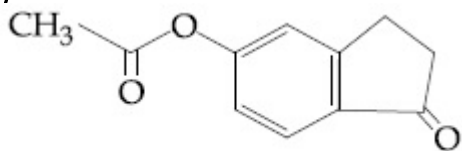
Q. 9 The major product of the following reaction is :



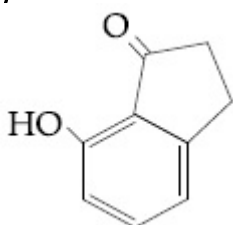
Option 1:



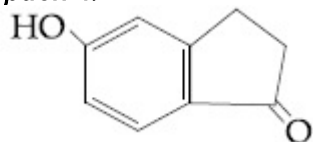
Option 2:



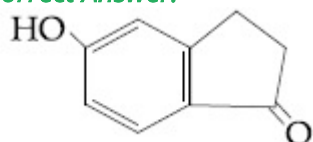
Option 3:



Option 4:

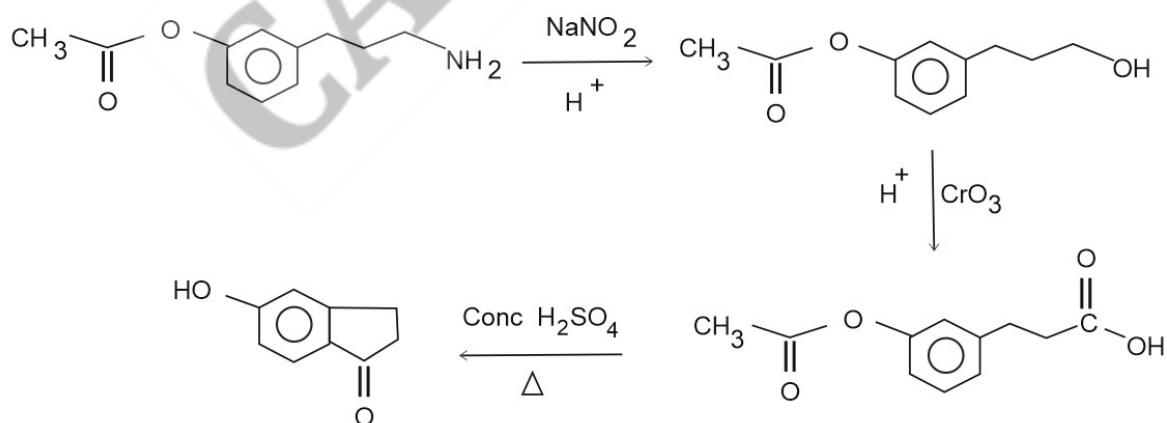


Correct Answer:



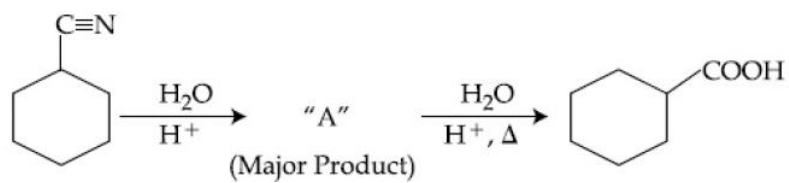
Solution:

As we have learned



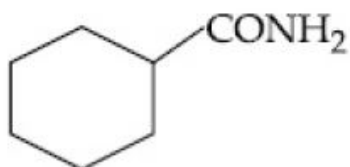
Therefore, **option(4) is correct.**

Q. 10

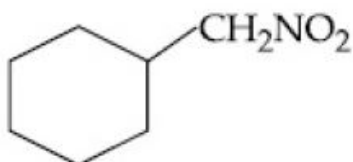


Consider the above chemical reaction and identify product "A" :

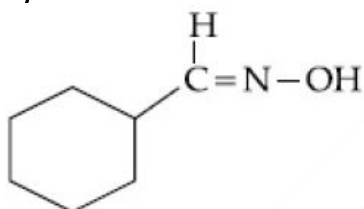
Option 1:



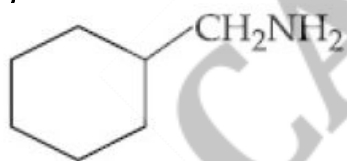
Option 2:



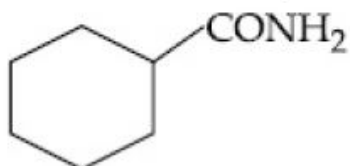
Option 3:



Option 4:

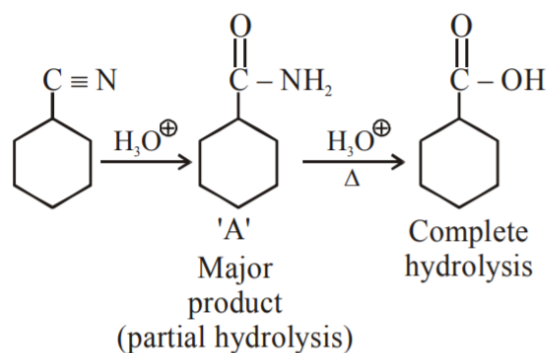


Correct Answer:



Solution:

The reaction will be-



Therefore, the Correct option is (1)

Q. 11 $t_{1/4}$ can be taken as the time taken for the concentration of a reactant to drop to 3/4 of its initial value. If the rate constant for a first order reaction is k , the $t_{1/4}$ can be written as

Option 1:

$$0.10/k$$

Option 2:

$$0.29/k$$

Option 3:

$$0.69/k$$

Option 4:

$$0.75/k$$

Correct Answer:

$$0.29/k$$

Solution:

The formula for the first-order reaction is -

$$k = \frac{2.303}{t} \log \frac{a_0}{a_t}$$

Then,

$$k = \frac{2.303}{t_{\frac{1}{4}}} \log \frac{1}{\frac{3}{4}}$$

$$t_{\frac{1}{4}} = \frac{2.303}{k} \log \frac{4}{3}$$

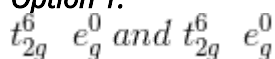
$$t_{\frac{1}{4}} = \frac{2.303}{k} \times 0.125$$

$$t_{\frac{1}{4}} = \frac{0.29}{k}$$

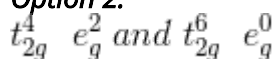
The correct option is (2).

Q. 12 The d-electron configuration of $[Ru(en)_3] Cl_2$ and $[Fe(H_2O)_6] Cl_2$, respectively are :

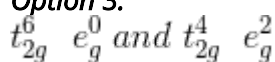
Option 1:



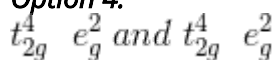
Option 2:



Option 3:



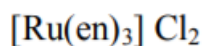
Option 4:



Correct Answer:



Solution:

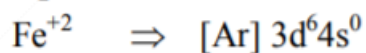
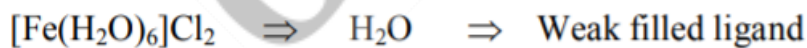


$Ru \Rightarrow 4d$ series

$en \Rightarrow$ chelating ligand

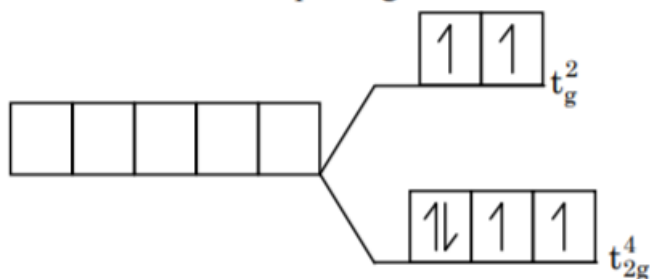
CN = 6, octahedral splitting

hence laye splitting of d-subshell



less plitting

CN = 6 octahedral splitting



Therefore, Option 3 is correct.

Q. 13 Consider that d^6 metal ion (M^{2+}) forms a complex with aqua ligands, and the spin only magnetic moment of the complex is 4.90 BM. The geometry and the crystal field stabilization energy of the complex is :

Option 1:

octahedral and $-2.4\Delta_0 + 2P$

Option 2:

tetrahedral and $-0.6\Delta_t$

Option 3:

octahedral and $-1.6\Delta_0$

Option 4:

tetrahedral and $-1.6\Delta_t + 1P$

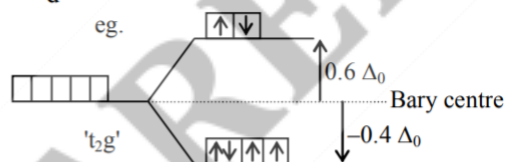
Correct Answer:

tetrahedral and $-0.6\Delta_t$

Solution:

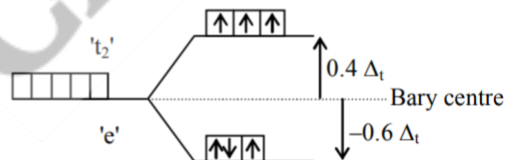
If spin only magnetic moment of the complex is 4.90 BM, it means number of unpaired electrons should be 4.

(A) In octahedral complex: $[M(H_2O)_6]^{2+}$
 d^6



$$\begin{aligned} \text{C.F.S.E.} &= (-0.4 \Delta_0) \times 4 + (+0.6 \Delta_0) \times 2 + 0 \times P \\ &= -0.4 \Delta_0 \end{aligned}$$

(B) In tetrahedral complex: $[M(H_2O)_4]^{2+}$
 d^6



$$\begin{aligned} \text{C.F.S.E.} &= (-0.6 \Delta_t) \times 3 + (+0.4 \Delta_t) \times 3 + 0 \times P \\ &= -0.6 \Delta_t \end{aligned}$$

Option matching: tetrahedral and $-0.6\Delta_t$

Therefore, Option 2 is correct.

Q. 14 Which one of the following aqueous solutions will exhibit highest boiling point?

Option 1:
 $0.01M Na_2SO_4$

Option 2:
 $0.01M KNO_3$

Option 3:
 $0.015M Urea$

Option 4:
 $0.015M glucose$

Correct Answer:
 $0.01M Na_2SO_4$

Solution:

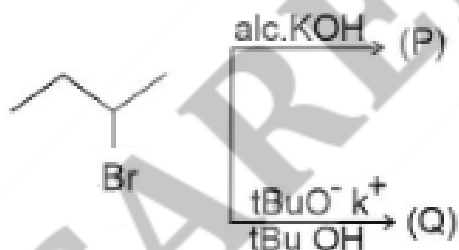
Elevation in Boiling point $\propto i \times m$

For Na_2SO_4 , $i = 3$, will be highest among these given aqueous solutions.

So, In $0.01 M Na_2SO_4$ the $i \times m$ value will be 0.03 which is the highest in the given options.

The correct option is 1.

Q. 15 Consider the reaction of 2-Bromobutane with alc. KOH and $t-BuO^-K^+$ as given below.



($t-BuO^-K^+$ is Potassium Tertiary Butoxide)

Option 1:
Identical

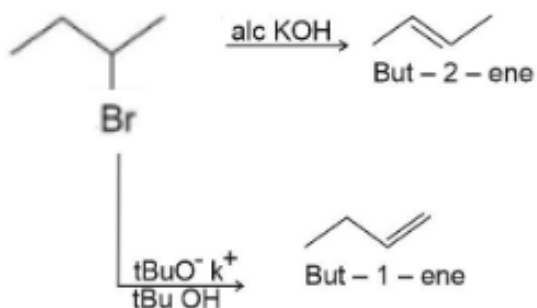
Option 2:
Chain isomers

Option 3:
Positional isomers

Option 4:
Not isomeric

Correct Answer:
Positional isomers

Solution:



tBuO^- is a bulky base and extracts least hindered $\beta - \text{H}$ from the substrate giving the Hoffman's alkene while alc. KOH will give the Saytzeff's product

(P) and (Q) are thus positional isomers .

Therefore, **the correct answer is Option (3).**

Q. 16 Which of the following is least basic?

Option 1:
 $(\text{C}_2\text{H}_5)_2\ddot{\text{N}}\text{H}$

Option 2:
 $(\text{CH}_3\text{CO})_2\ddot{\text{N}}\text{H}$

Option 3:
 $(\text{C}_2\text{H}_5)_3\ddot{\text{N}}$

Option 4:
 $(\text{CH}_3\text{CO})\ddot{\text{N}}\text{HC}_2\text{H}_5$

Correct Answer:
 $(\text{CH}_3\text{CO})_2\ddot{\text{N}}\text{H}$

Solution:

For the given compounds :

(1) $\text{CH}_3\text{-CH}_2\text{-}\ddot{\text{N}}\text{H-CH}_2\text{-CH}_3$; L.P. on Nitrogen is localised.

(2) $\text{CH}_3\text{-}\overset{\overset{\text{O}}{\parallel}}{\text{C}}\text{-}\ddot{\text{N}}\text{H-}\overset{\overset{\text{O}}{\parallel}}{\text{C}}\text{-CH}_3$; L.P. on Nitrogen is
delocalised due to conjugation with both $\text{-}\overset{\overset{\text{O}}{\parallel}}{\text{C}}\text{-}$
(Hence least basic)

(3) $\text{CH}_3\text{CH}_2\text{-}\ddot{\text{N}}\text{-CH}_2\text{CH}_3$; L.P. on Nitrogen is localised.
 $\quad \quad \quad \text{CH}_2\text{CH}_3$

(4) $\text{CH}_3\text{-}\overset{\overset{\text{O}}{\parallel}}{\text{C}}\text{-}\ddot{\text{N}}\text{H-C}_2\text{H}_5$; L.P. on Nitrogen is delocalised.

Therefore, Option 2 is correct.

Q. 17 Which are true about fibrous proteins ?

- a) polypeptide chains coil around.
- b) generally insoluble in water.
- c) eg . myosin

Option 1:

a,b

Option 2:

a,b,c

Option 3:

b,c

Option 4:

a,c

Correct Answer:

b,c

Solution:

As we have learned

Fibrous proteins -

Several spiral shaped polypeptide chains run parallel and are held together by H — bonds and disulphide bonds

- wherein

Eg. Keratin , Collagen Myosin (muscle protein)

Polypeptide chains run parallel and are held together by hydrogen and disulphide bonds

Rest are correct.

Q. 18 108 g of silver (molar mass 108 g mol^{-1}) is deposited at cathode from $\text{AgNO}_3(\text{aq})$ solution by a certain quantity of electricity. The volume (in L) of oxygen gas produced at 273K and 1 bar pressure from water by the same quantity of electricity is _____.

Option 1:

5.675 L

Option 2:

-

Option 3:

-

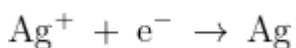
Option 4:

-

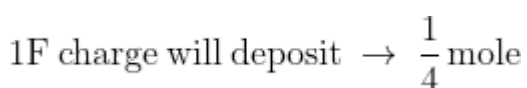
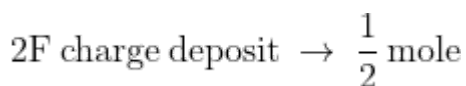
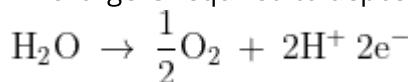
Correct Answer:

5.675 L

Solution:



1F charge is required to deposit 1 mole of Ag



$$V_{O_2} = \frac{nRT}{P}$$

$$V_{O_2} = \frac{1}{4} \times \frac{0.08341 \times 273}{1}$$

$$V_{O_2} = \frac{1}{4} \times 22.7$$

$$V_{O_2} = 5.675L$$

Q. 19 A current of 10.0 A flows for 2.00 h through an electrolytic cell containing a molten salt of metal X. This results in the decomposition of 0.250 mol of metal X at the cathode. The oxidation state of X in the molten salt is : (F= 96,500 C)

Option 1:

1+

Option 2:

2+

Option 3:

3+

Option 4:

4+

Correct Answer:

3+

Solution:

i = 10 A, t = 2hr

$$\text{No. of moles} = \frac{It}{96500 \times (n - \text{factor})}$$

$$\therefore \text{moles of } e^- = \frac{10 \times 2 \times 60 \times 60}{96500 \times n - \text{factor}}$$

$$\therefore 0.25 = \frac{10 \times 2 \times 60 \times 60}{96500 \times X}$$

$$\therefore 0.75 = 0.25 \times (X)$$

$$\Rightarrow X = 3$$

$\therefore$ Metal X is present in the form of X^{3+}

Therefore, the correct option is (3).

Q. 20 A mixture of 100 m mol of $Ca(OH)_2$ and 2 g of sodium sulphate was dissolved in water and the volume was made up to 100 mL. The mass of calcium sulphate formed and the concentration of OH^- in resulting solution, respectively, are : (Molar mass of $Ca(OH)_2$, Na_2SO_4 and $CaSO_4$ are 74, 143 and 136 g mol^{-1} , respectively ; K_{sp} of $Ca(OH)_2$ is 5.5×10^{-6})

Option 1:

1.9 g, 0.28 mol L^{-1}

Option 2:

13.6g, 0.28 mol L^{-1}

Option 3:

1.9g, 0.14 mol L^{-1}

Option 4:

13.6g, 0.14 mol L^{-1}

Correct Answer:

1.9 g, 0.28 mol L^{-1}

Solution:

Given,

Mol of $Na_2SO_4 = 2/142 = 14$ m mol



$$\text{Mass of } CaSO_4 = \frac{14 \times 136}{1000} = 1.9 \text{ gm}$$

$$\text{Molarity of } OH^- = \frac{28}{100} = 0.28 \text{ mol / L}$$

Q. 21 Which complex has square planar structure?

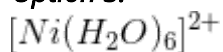
Option 1:

$Ni(CO)_4$

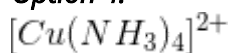
Option 2:

$[NiCl_4]^{2-}$

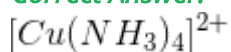
Option 3:



Option 4:



Correct Answer:



Solution:

$[Cu(NH_3)_4]^{2+}$ is dsp^2 hybridised and thus has a square planar structure

$Ni(CO)_4$ and $[Ni(Cl)_4]^{2-}$ are sp^3 hybridised and are tetrahedral

$[Ni(H_2O)_6]^{2+}$ is sp^3d^2 hybridised and is an octahedral complex

Therefore, **Option (4) is correct**

Q. 22

Resistance of 0.2 M solution of an electrolyte is $50\ \Omega$. The specific conductance of the solution is $1.4\ S\ m^{-1}$. The resistance of 0.5 M solution of the same electrolyte is $280\ \Omega$. The molar conductivity of 0.5 M solution of the electrolyte in $S\ m^2\ mol^{-1}$ is :

Option 1:

$$5 \times 10^{-4}$$

Option 2:

$$5 \times 10^{-3}$$

Option 3:

$$5 \times 10^3$$

Option 4:

$$5 \times 10^2$$

Correct Answer:

$$5 \times 10^{-4}$$

Solution:

Specific conductance,

$$\sigma = 1.4\ S\ m^{-1} = 1.4 \times 10^{-2}\ S\ cm^{-1}$$

Resistivity,

$$\rho = \frac{1}{\kappa} = \frac{1}{1.4 \times 10^{-2}}\ \Omega\ cm$$

Resistance, $R = \frac{\rho l}{A}$

Now, for a 0.5 M solution, $R=280\ \Omega$

$$\kappa = \frac{1}{\rho} = \frac{1}{R} \times \frac{l}{A} = \frac{1}{280} \times 50 \times 1.4 \times 10^{-2}$$

$$= 2.5 \times 10^{-3} \text{ S cm}^{-1}$$

$\therefore$ molar conductivity,

$$\mu = \frac{\kappa \times 1000}{c} = \frac{2.5 \times 10^{-3} \times 1000}{0.5}$$

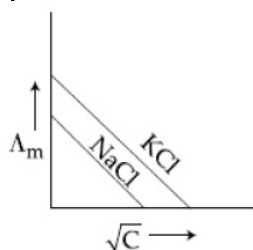
$$= 5 \text{ S cm}^2 \text{ mol}^{-1}$$

$$= 5 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$$

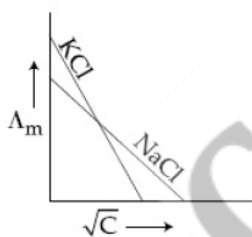
Therefore, the correct option is (1).

Q. 23 Which one of the following graphs between molar conductivity (Λ_m) versus $\sqrt{C}$ is correct?

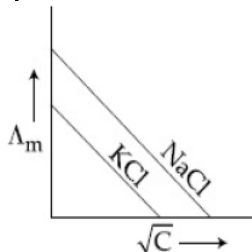
Option 1:



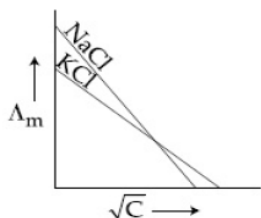
Option 2:



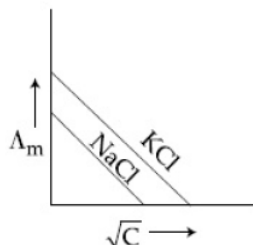
Option 3:



Option 4:

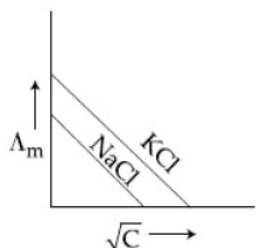


Correct Answer:



Solution:

molar conductivity increases with a decrease in concentration.



$$(\Lambda_m^0)_{K^+} > (\Lambda_m^0)_{Na^+}$$

Both NaCl and KCl are strong electrolytes but Na^+ has less conductance than K^+ due to more hydration therefore the graph (1) is showing the correct trend.

Therefore, **Option(1) is correct.**

Q. 24 Which of the following represents a very fast reaction?

Option 1:

Precipitation of silver chloride by mixing of aqueous solutions of silver nitrate and sodium chloride

Option 2:

Rusting of Iron

Option 3:

Inversion of Cane Sugar

Option 4:

Conversion of Diamond to Graphite

Correct Answer:

Precipitation of silver chloride by mixing of aqueous solutions of silver nitrate and sodium chloride

Solution:

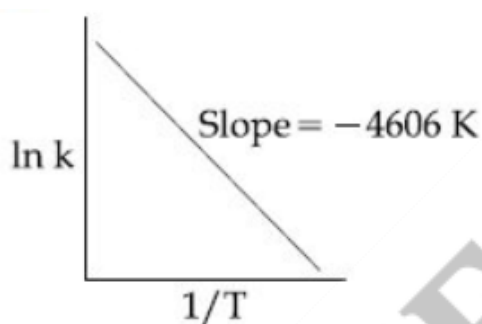
Ionic reactions such as precipitation of AgCl upon mixing AgNO_3 and NaCl proceed very rapidly.

Reactions such as rusting of iron and conversion of diamond to graphite are very slow reactions.

Reactions such as inversion of cane sugar are moderately paced reactions.

Hence, **the correct answer is Option(1)**

- Q. 25** For a reaction, consider the plot of $\ln k$ versus $1/T$ given in the figure. If the rate constant of this reaction at 400 K is 10^{-5} s^{-1} , then the rate constant at 500 K is :



Option 1:

$$10^{-6} \text{ s}^{-1}$$

Option 2:

$$2 \times 10^{-4} \text{ s}^{-1}$$

Option 3:

$$10^{-4} \text{ s}^{-1}$$

Option 4:

$$4 \times 10^{-4} \text{ s}^{-1}$$

Correct Answer:

$$10^{-4} \text{ s}^{-1}$$

Solution:

The formula of rate constant

$$\ln k = \ln A - \frac{E_a}{RT}$$

From the graph, the slope $(-E_a/R) = -4606K$

$$\ln k = \ln A - \frac{4606}{T}$$

Now,

$$\ln \left(\frac{k_2}{k_1} \right) = -\frac{E_a}{R} \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$$

$$\ln \left(\frac{k_2}{k_1} \right) = \frac{E_a}{R} \left(\frac{T_2 - T_1}{T_1 \times T_2} \right)$$

If the rate constant at 400 K is 10^{-5} s^{-1} , then the rate constant at 500 K is

$$\ln \left(\frac{k}{10^{-5}} \right) = \left(\frac{E_a}{R} \right) \times \frac{500 - 400}{500 \times 400}$$

$$\ln \left(\frac{k}{10^{-5}} \right) = 4606 \times \frac{1}{2000} = 2.303$$

$$\ln \left(\frac{k}{10^{-5}} \right) = \ln 10$$

$$k = 10^{-4} \text{ s}^{-1}$$

Option 3 is correct.

Q. 26 For a reaction scheme $A \xrightarrow{k_1} B \xrightarrow{k_2} C$, if the rate of formation of B is set to be zero then the concentration of B is given by:

Option 1:

$$(k_1 - k_2) [A]$$

Option 2:

$$k_1 k_2 [A]$$

Option 3:

$$(k_1 + k_2) [A]$$

Option 4:

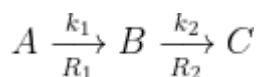
$$\left(\frac{k_1}{k_2} \right) [A]$$

Correct Answer:

$$\left(\frac{k_1}{k_2}\right) [A]$$

Solution:

Reaction:



Given,

$$\frac{d[B]}{dt} = 0$$

Question [B]=?

$$R_1 = k_1 [A]$$

$$R_2 = k_2 [B]$$

So, Net rate of formation of

$$B = \frac{d[B]}{dt} = R_1 - R_2$$

$$k_1 [A] - k_2 [B] = 0$$

$$k_1 [A] = k_2 [B]$$

$$[B] = \left(\frac{k_1}{k_2}\right) [A]$$

Correct Option is 4.

Q. 27 The correct match between Item - I and Item - II is :

	Item - I		Item - II
(a)	Natural Rubber	(I)	1, 3-butadiene + styrene
(b)	Neoprene	(II)	1,3-butadiene +acrylonitrile
(c)	Buna - N	(III)	Chloroprene
(d)	Buna-S	(IV)	Isoprene

Option 1:

(a) - (III), (b) - (IV), (c) - (I), (d) - (II)

Option 2:

(a) - (III), (b) - (IV), (c) - (II), (d) - (I)

Option 3:

(a) - (IV), (b) - (III), (c) - (II), (d) - (I)

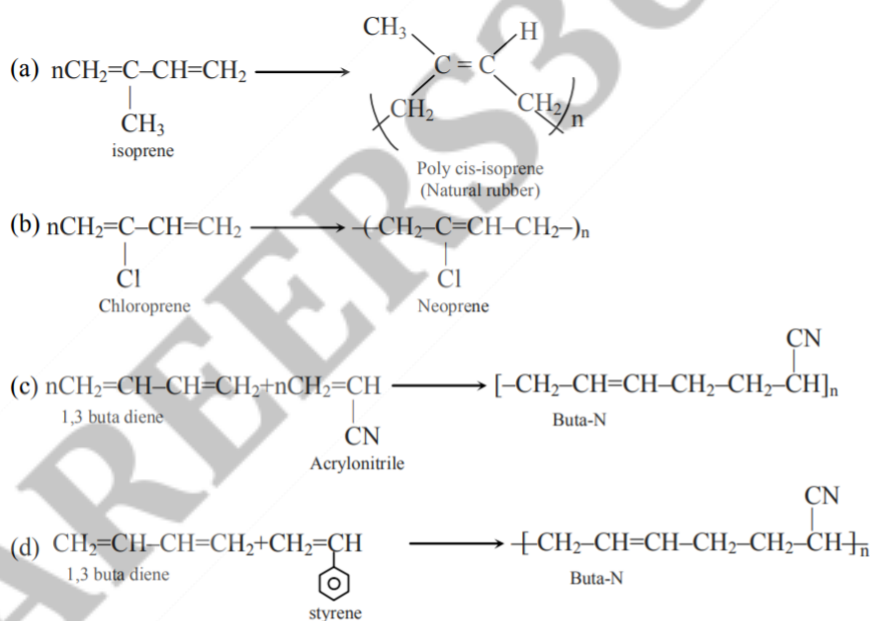
Option 4:

(a) - (IV), (b) - (III), (c) - (I), (d) - (II)

Correct Answer:

(a) - (IV), (b) - (III), (c) - (II), (d) - (I)

Solution:



We know these polymers -

Correct match : (a) - (IV), (b) - (III), (c) - (II), (d) - (I)

Therefore, the correct option is (3).

Q. 28

For the reaction $2A + 3B + \frac{3}{2}C \rightarrow 3P$, Which statement is correct ?

Option 1:

$$\frac{dn_A}{dt} = \frac{3}{2} \frac{dn_B}{dt} = \frac{3}{4} \frac{dn_C}{dt}$$

Option 2:

$$\frac{dn_A}{dt} = \frac{dn_B}{dt} = \frac{dn_C}{dt}$$

Option 3:

$$\frac{dn_A}{dt} = \frac{2}{3} \frac{dn_B}{dt} = \frac{4}{3} \frac{dn_C}{dt}$$

Option 4:

$$\frac{dn_A}{dt} = \frac{2}{3} \frac{dn_B}{dt} = \frac{3}{4} \frac{dn_C}{dt}$$

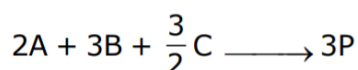
Correct Answer:

$$\frac{dn_A}{dt} = \frac{2}{3} \frac{dn_B}{dt} = \frac{4}{3} \frac{dn_C}{dt}$$

Solution:

For $aA + bB \rightarrow cC$;

$$\frac{-1}{a} \frac{d[A]}{dt} = \frac{-1}{b} \frac{d[B]}{dt} = \frac{1}{c} \frac{d[C]}{dt}$$



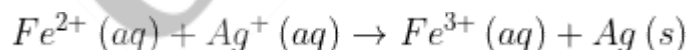
$$\therefore \frac{-1}{2} \frac{d[A]}{dt} = \frac{-1}{3} \frac{d[B]}{dt} = \frac{-2}{3} \frac{d[C]}{dt} = \frac{1}{3} \frac{d[P]}{dt}$$

$$ROR = \frac{1}{2} \left[\frac{-d[n_A]}{dt} \right] = \frac{1}{3} \left[\frac{-d[n_B]}{dt} \right] = \frac{2}{3} \left[\frac{-d[n_C]}{dt} \right] = \frac{1}{3} \left[\frac{+d[n_P]}{dt} \right]$$

$$\left[\frac{-dn_A}{dt} \right] = \frac{2}{3} \left[\frac{-d[n_B]}{dt} \right] = \frac{4}{3} \left[\frac{-d[n_P]}{dt} \right]$$

Therefore, Option 3 is correct.

Q. 29 Calculate the standard cell potential (in V) of the cell in which following reaction takes place:



Given that

$$E_{Ag^+/Ag}^0 = xV$$

$$E_{Fe^{2+}/Fe}^0 = yV$$

$$E_{Fe^{3+}/Fe}^0 = zV$$

Option 1:

x-z

Option 2:

x-y

Option 3:

x+2y-3z

Option 4:

x+y-z

Correct Answer:

x+2y-3z

Solution:

Gibbs energy of the reaction -

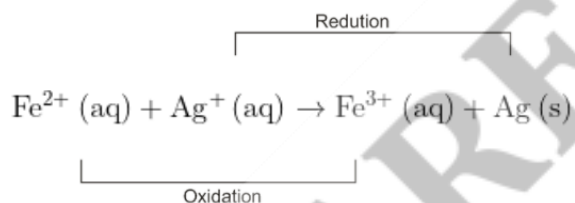
$$\Delta_r G = -nF E_{cell}$$

Where,

$\Delta_r G$ = Gibbs energy of the reaction

E_{cell} = emf of the cell

nF = amount of charge passed



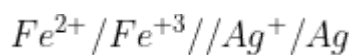
Given

$$E_{\text{Ag}^+/\text{Ag}}^0 = xV$$

$$E_{\text{Fe}^{2+}/\text{Fe}}^0 = yV$$

$$E_{\text{Fe}^{3+}/\text{Fe}}^0 = zV$$

⇒ Cell equation:-



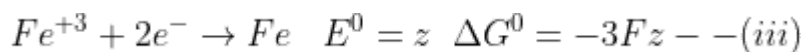
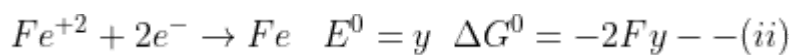
(Oxidation)

(Reduction)

⇒ Std. EMF of given cell reaction:-

$$E^0 = E_{\text{Ag}^+/\text{Ag}}^0 - E_{\text{Fe}^{3+}/\text{Fe}^{2+}}^0 \text{ --- (i)}$$

$$E_{\text{Ag}^+/\text{Ag}}^0 = x(\text{given})$$



Now, (iii-ii)



$$\Delta G^0 = -nFE^0$$

$$-1 \times F \times E^0 = -3Fz + 2Fy$$

$$E^0 = 3z - 2y$$

Put this in eqⁿ (i)

$$(Fe^{3+}/Fe^{2+})$$

$$E^0 = x - (3z - 2y) = x + 2y - 3z$$

Therefore, option(3) is correct

Q. 30 For an electrochemical cell

$Sn(s) | Sn^{2+}(aq, 1M) || Pb^{2+}(aq, 1M) | Pb(s)$ the ratio $\frac{[Sn^{2+}]}{[Pb^{2+}]}$ When this cell attains equilibrium is ____.

$$(Given : E_{Sn^{2+}|Sn}^0 = -0.14V,$$

$$E_{Pb^{2+}|Pb}^0 = -0.13V, \frac{2.303RT}{F} = 0.06)$$

Option 1:

2.1544

Option 2:

1.11

Option 3:

7.15

Option 4:

3.14

Correct Answer:

2.1544

Solution:

As we have learnt,

Nernst Equation -

This equation gives the relationship between electrode potential and concentration of ions in the solution. In other words, it shows the dependency of electrode potential on the concentration of the ions with which the electrode is reversible.

For a single electrode involving the reduction process,

The Nernst equation is

$$E = E^\circ + \frac{2.303RT}{nF} \log_{10} \frac{[M^{n+}]}{[M]}$$

Or

$$E = E^\circ - \frac{2.303RT}{nF} \log_{10} \frac{[M]}{[M^{n+}]}$$

At 25°C or 298K

$$E = E^\circ + \frac{2.303 \times 8.314 \times 298}{n \times 96500} \log_{10} \frac{[M^{n+}]}{[M]}$$

$$E = E^\circ + \frac{0.059}{n} \log_{10} \frac{[M^{n+}]}{[M]}$$

$$E = E^\circ - \frac{0.059}{n} \log_{10} \frac{[M]}{[M^{n+}]}$$

Here R = Gas constant

T = Absolute temperature

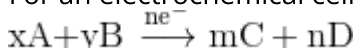
E° = emf of the cell

E = Electrode potential of cell

F = Faraday number

n = number of electrons transferred

- If electrode is solid its active mass is taken as one.
- For an electrochemical cell having net reaction:



The emf can be calculated as

$$E_{\text{cell}} = E^\circ_{\text{cell}} + \frac{0.059}{n} \log \frac{[A]^x [B]^y}{[C]^m [D]^n}$$

In using the above equation, the following facts should be kept in mind.

- Concentration or activity of gases is expressed in terms of their partial pressures.
- n, the number of electrons transferred should be calculated from the balanced net cell reaction.
- Concentration or activity of solids is taken to be unity.

$$\text{Sn} + \text{Pb}^{2+} \longrightarrow \text{Sn}^{2+} + \text{Pb}$$

$$0 = 0.01 - \frac{0.06}{2} \log \left\{ \frac{[\text{Sn}^{2+}]}{[\text{Pb}^{2+}]} \right\}$$

$$0.01 = \frac{0.06}{2} \log \left\{ \frac{[\text{Sn}^{2+}]}{[\text{Pb}^{2+}]} \right\}$$

$$\frac{1}{3} = \log \left\{ \frac{[\text{Sn}^{2+}]}{[\text{Pb}^{2+}]} \right\} \Rightarrow \frac{[\text{Sn}^{2+}]}{[\text{Pb}^{2+}]} = 10^{1/3} = 2.1544$$

Hence, the option number (1) is correct.

Q. 31 Henry's constant (in K bar) for four gases α, β, γ and δ in water at 298 K is given below:

	α	β	γ	δ
K_H	50	2	2×10^{-5}	0.5

(density of water = 10^3 kg/m^3 at 298 K) This table implies that

Option 1:

α has the highest solubility in water at a given pressure

Option 2:

Solubility of γ at 308 K is lower than at 298 K

Option 3:

The pressure of a 55.5 molal solution of γ is 1 bar

Option 4:

The pressure of a 55.5 molal solution of Δ is 250 bar

Correct Answer:

The pressure of a 55.5 molal solution of Δ is 250 bar

Solution:

(1) $K_H \downarrow$ solubility $\uparrow$ and lowest K_H is for γ .

So, γ has the greatest solubility as it has the least value of Henry's constant.

(2) On increasing temperature solubility of gases decreases, solubility of γ is greater at 298K than 308K although that is not implied by the table.

(3) Now,

We know this formula.

$$P_{\gamma} = K_H X_Y$$

$$P_{\gamma} = 2 \times 10^{-5} \times \frac{55.5}{55.5 + \frac{1000}{18}} = 10^{-5} \text{ kbar}$$

$$P_{\gamma} = 10^{-2} \text{ bar} \neq 1 \text{ bar}$$

$$(4) P_{\delta} = K_H X_{\delta}$$

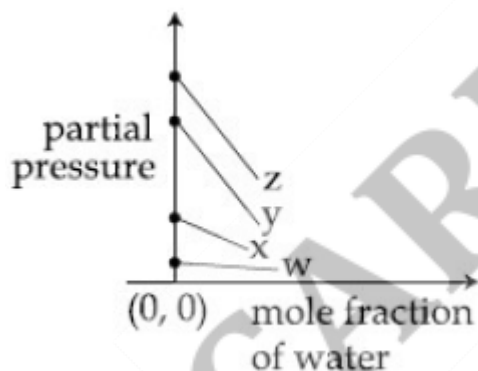
$$P_{\delta} = 0.5 \times \frac{55.5}{55.5 + \frac{1000}{18}} = 0.25 \text{ kbar} = 250 \text{ bar}$$

The Correct Statement: The pressure of a 55.5 molal solution of δ is 250 bar

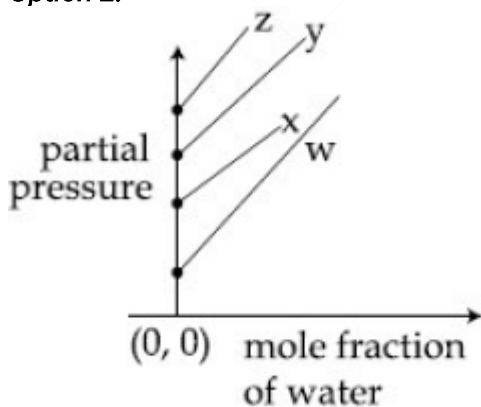
Therefore, Option(4) is correct.

- Q. 32** For the solution of the gases, w,x,y and z in water at 298 K, the henry's law constants (K_H) are 0.5,2,35 and 40 kbar, respectively. The correct plot for the given data is

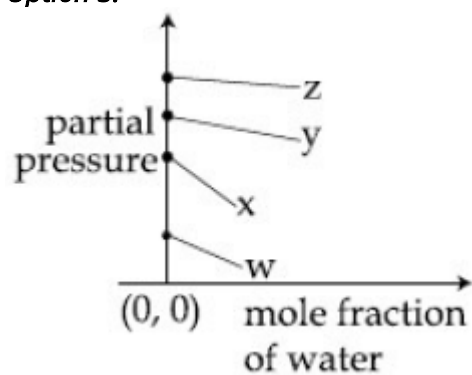
Option 1:



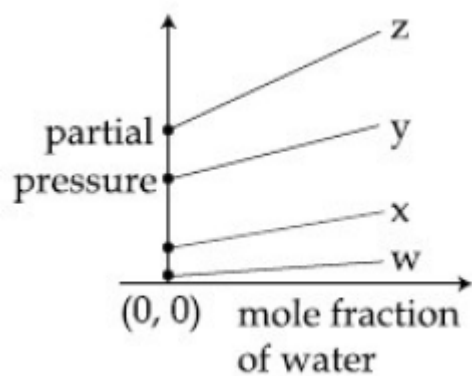
Option 2:



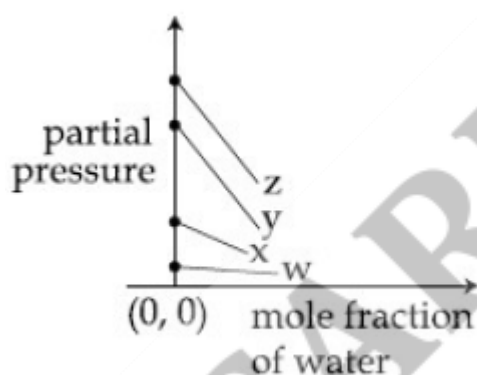
Option 3:



Option 4:



Correct Answer:



Solution:

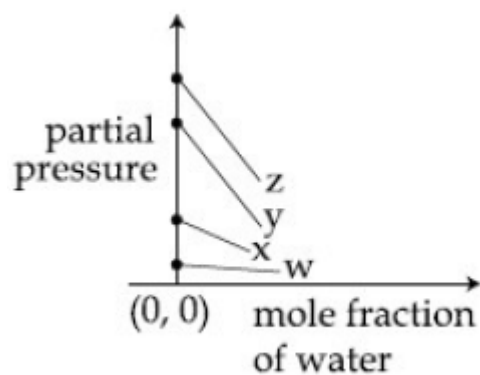
$$P_{gas} = K_H \times \text{mole fraction of gas}$$

$$= K_H \times X_{gas} = K_H (1 - X_{H_2O}) = K_H - K_H X_{H_2O}$$

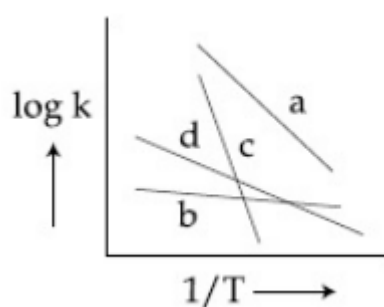
$$P_{gas} = K_H - K_H X_{H_2O}$$

$$y = mx + c$$

$$m = -K_H = \text{slope is negative}$$



- Q. 33** Consider the following plots of rate constant versus $\frac{1}{T}$ for four different reactions. Which of the following orders is correct for the activation energies of these reactions ?



Option 1:

$$E_b > E_a > E_d > E_c$$

Option 2:

$$E_a > E_c > E_d > E_b$$

Option 3:

$$E_b > E_d > E_c > E_a$$

Option 4:

$$E_c > E_a > E_d > E_b$$

Correct Answer:

$$E_c > E_a > E_d > E_b$$

Solution:

The formula of rate constant -

$$\log k = \log A - \frac{E_a}{2.303RT}$$

$$\text{Slope} = -\frac{E_a}{2.303R}$$

From graph :

Negative Slope : $c > a > d > b$

More the negative slope more will be the value of activation energy.

So,

$$E_c > E_a > E_d > E_b$$

Therefore, **Option(4) is correct.**

Q. 34 Which one of the following substances has the highest proton affinity?

Option 1:



Option 2:



Option 3:



Option 4:



Correct Answer:



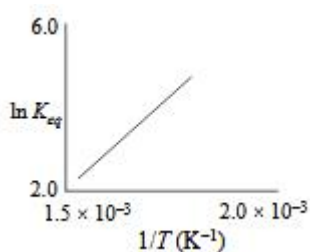
Solution:

The stability of the conjugate acid will give us the compound with highest proton affinity.

NH_4^+ is the most stable conjugate acid of all and hence Ammonia is the most basic among all the given compounds.

Therefore, **option (3) is correct.**

- Q. 35** A schematic plot of $\ln K_{eq}$ versus inverse of temperature for a reaction is shown in the figure. The reaction must be



Option 1:

exothermic

Option 2:

endothermic

Option 3:

one with negligible enthalpy change

Option 4:

highly spontaneous at ordinary temperature

Correct Answer:

exothermic

Solution:

Arrhenius Equation -

$$k = Ae^{-E_a/RT}$$

$$\ln k = \ln A - \frac{E_a}{RT}$$

From the graph,

$$\ln \left(\frac{k_2}{k_1} \right) = \frac{\Delta H}{R} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$$

$$\ln \left(\frac{6}{2} \right) = \frac{\Delta H}{R} (-0.5 \times 10^{-3})$$

$$\Delta H = \ln(3) R (-0.5 \times 10^{-3})$$

$$\Delta H = \text{negative}$$

Hence the reaction is an exothermic reaction.

Option 1 is correct.

Q. 36 Cerium ($Z = 58$) is an important member of the lanthanoids. Which of the following statements about cerium is incorrect?

Option 1:

The common oxidation states of cerium are +3 and +4.

Option 2:

The +3 oxidation state of cerium is more stable than +4 oxidation state.

Option 3:

The +4 oxidation state of cerium is not known in solutions.

Option 4:

Cerium (IV) acts as an oxidising agent.

Correct Answer:

The +4 oxidation state of cerium is not known in solutions.

Solution:

i) Common oxidation state of Ce is +3 and +4.

ii) +3 oxidation state is more stable than +4 for Ce.

iii) Ce(IV) can oxidise water but the rate of reaction is very slow and hence Ce(IV) acts as a good analytical reagent

iv) Ce(IV) acts as an oxidising agent.

Hence, **the correct answer is Option (3)**

Q. 37 The oxidation states of Cr in $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$, $[\text{Cr}(\text{C}_6\text{H}_6)_2]$, and $\text{K}_2[\text{Cr}(\text{CN})_2(\text{O})_2(\text{O}_2)(\text{NH}_3)]$ respectively are :

Option 1:

+3, 0, and +4

Option 2:

+3, +4, and +6

Option 3:

+3, +2, and +4

Option 4:

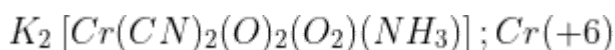
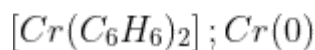
+3, 0, and +6

Correct Answer:

+3, 0, and +6

Solution:

The oxidation states of the elements in the given complexes are:



The third complex contains an oxo and a peroxo ligand. The charge balance equation can be written as

$$2 + x - 2 - 4 - 2 + 0 = 0$$

$$\Rightarrow x = 6$$

Therefore, **option (4) is correct.**

- Q. 38** $[Pd(F)(Cl)(Br)(I)]^{2-}$ has n number of geometrical isomers. Then, the spin-only magnetic moment and crystal field stabilisation energy [CFSE] of $[Fe(CN)_6]^{n-6}$, respectively are ;

[Note : Ignore the pairing energy]

Option 1:

$$1.73BM \text{ and } -2.0\Delta_0$$

Option 2:

$$2.84 BM \text{ and } -1.6\Delta_0$$

Option 3:

$$0 BM \text{ and } -2.4\Delta_0$$

Option 4:

$$5.92 BM \text{ and } 0$$

Correct Answer:

$$1.73BM \text{ and } -2.0\Delta_0$$

Solution:

As we have learnt,

Square planar complexes of type $[Mabcd]$ have 3 geometrical isomers:

(a trans b); (a trans c); (b trans c)

Therefore, number of Geometrical Isomers in square planar $[PdFClBrI]^{2-}$ is 3

Hence, $n = 3$

Now, the given complex is $[Fe(CN)_6]^{3-}$ which contains Fe^{3+} having a d^5 configuration. According to CFT, the configuration is $t_{2g}^5 e_g^0$ and the central ion has only 1 unpaired electron.

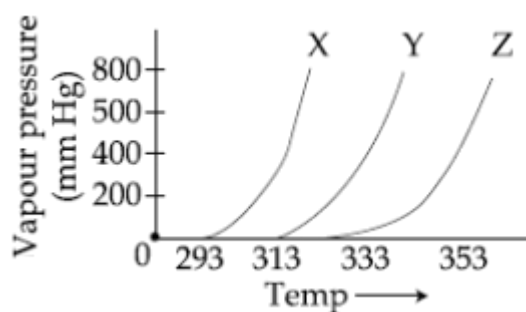
$$\mu = \sqrt{n(n+2)} = 1.73B.M$$

$$CFSE = -0.4\Delta_0 \times nt_{2g} + 0.6\Delta_0 \times n_{eg}$$

$$= -0.4\Delta_0 \times 5 = -2.0\Delta_0$$

Hence, **the option number (1) is correct.**

- Q. 39** The graph of vapour pressure and temperature for three different liquids X, Y, and Z is shown below:



The following inferences are made:

- (A) X has higher intermolecular interactions compared to Y.
- (B) X has lower intermolecular interactions compared to Y
- (C) Z has lower intermolecular interactions compared to Y

The correct inference(s) is /are :

Option 1:

(C)

Option 2:

(A)

Option 3:

(B)

Option 4:

(A) and (C)

Correct Answer:

(B)

Solution:

Vaporizing starting means boiling started.

Given in the graph, at zero vapour pressure the boiling starting point.

So, the Order of B.P. is $Z > Y > X$

If the boiling point is low it will easily vaporize due to weak intermolecular force of attraction.

Order of Intermolecular Interaction : $Z > Y > X$.

the intermolecular force of attraction increases, the boiling point increases then vapour pressure decreases.

So, X has lower intermolecular interactions compared to Y and Z

Therefore, Option(3) is correct.

Q. 40 Tyndall effect is observed when:

Option 1:

The diameter of dispersed particles is much larger than the wavelength of light used.

Option 2:

The diameter of dispersed particles is much smaller than the wavelength of light used

Option 3:

The refractive index of dispersed phase is greater than that of the dispersion medium

Option 4:

The diameter of dispersed particles is similar to the wavelength of light used

Correct Answer:

The diameter of dispersed particles is similar to the wavelength of light used

Solution:

For the Tyndall effect to be observed, the refractive indices of the dispersed phase and dispersion medium should be greatly differing in magnitude and the diameter of the dispersed particles is similar to the wavelength of light used.

Therefore, Option(4) is correct.

Q. 41 Match List I with List II

List I	List II
a. Siderite	i. Cu
b. Calamite	ii. Ca
c. Malachite	iii. Fe
d. Cryolite	iv. Al
	v. Zn

Choose the correct answer from the options given below

Option 1:

a-iii, b-v, c-i, d-iv

Option 2:

a-iii, b-i, c-v, d-ii

Option 3:

a-i, b-ii, c-iii, d-iv

Option 4:

a-i, b-ii, c-v, d-iii

Correct Answer:

a-iii, b-v, c-i, d-iv

Solution:

Siderite - FeCO_3

Calamine - ZnCO_3

Malachite - $\text{CuCO}_3 \cdot \text{Cu(OH)}_2$

Cryolite - Na_3AlF_6

Q. 42 The number of bridging CO ligands(s) and Co-Co bond(s) in $\text{Co}_2(\text{CO})_8$, respectively are:

Option 1:

2 and 1

Option 2:

4 and 0

Option 3:

0 and 2

Option 4:

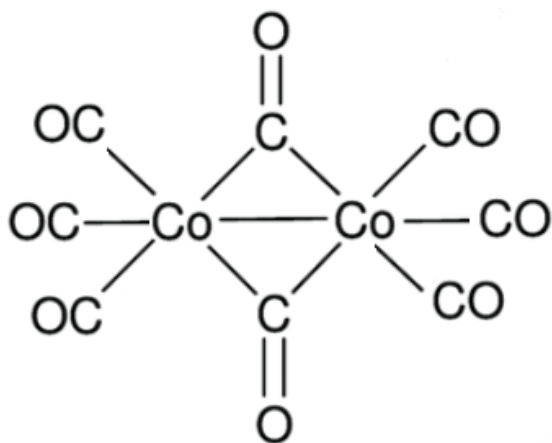
2 and 0

Correct Answer:

2 and 1

Solution:

The structure of dicobalt octacarbonyl is given as



No. of Co-Co bond = 1

No. of Bridging carbonyl groups = 2

Therefore, **option (1) is correct.**

Q. 43 Which of the following compounds will most readily be dehydrated to give alkene under acidic condition ?

Option 1:

1-Pentanol

Option 2:

4-Hydroxypentan-2-one

Option 3:

3-Hydroxypentan-2-one

Option 4:

2-Hydroxycyclopentanone

Correct Answer:

4-Hydroxypentan-2-one

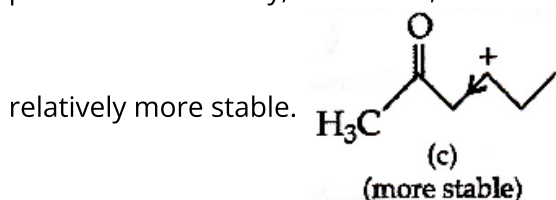
Solution:

As we learnt, dehydration of alkenes involves carbocationic intermediate

The ease of dehydration of the given compounds can be explained on the basis of the stability of the carbocation formed.

In case of options (3) and (4), a secondary carbocation is formed but the presence of an electron withdrawing $>\text{C}=\text{O}$ group adjacent to the positively charged carbon, intensifies the charge and hence destabilises the species.

However in Option (2), a secondary carbocation is formed, but the electron withdrawing $>\text{C}=\text{O}$ group is present farther away, as a result, the effect of this group is diminished and hence the carbocation is



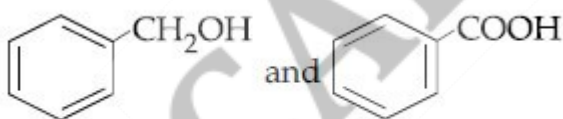
Also the alkene produced in (3) is conjugated with the carbonyl group which increases the product stability.

Therefore, **option (2) is correct.**

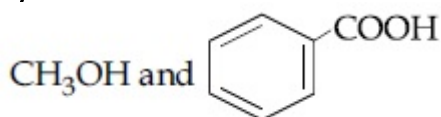
Q. 44 Major products of the following reaction are:



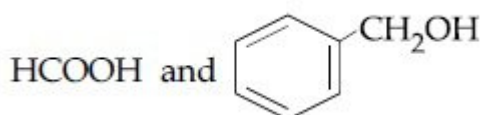
Option 1:



Option 2:



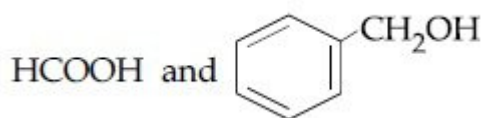
Option 3:



Option 4:

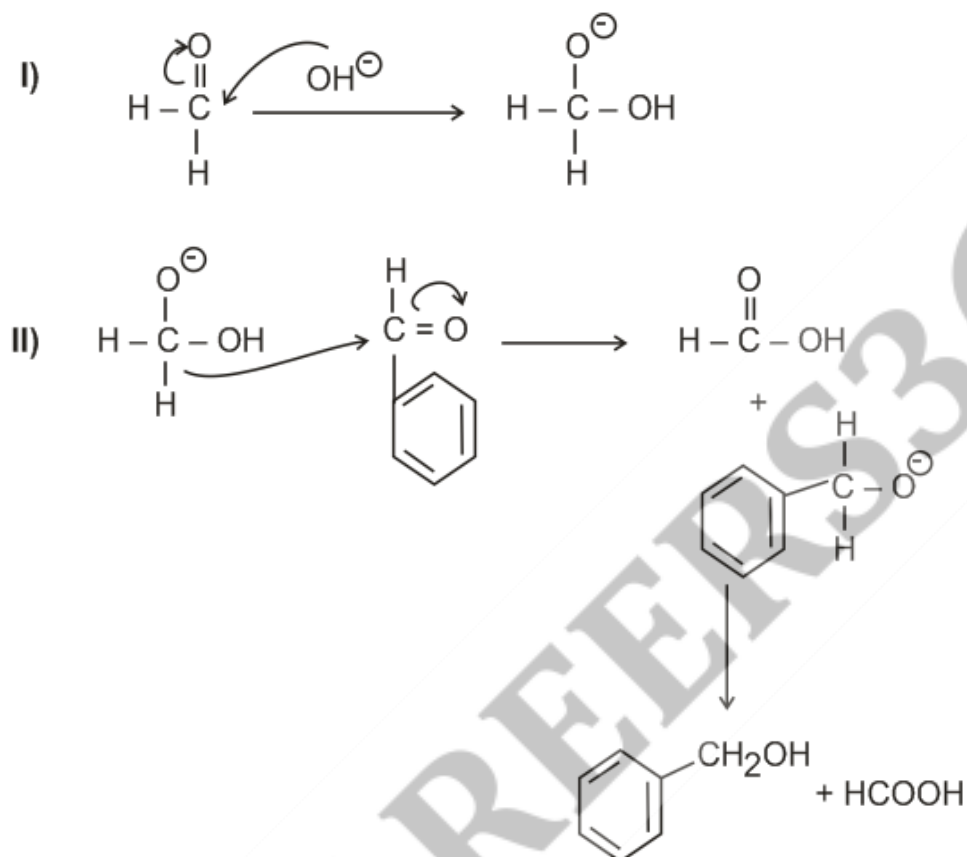


Correct Answer:



Solution:

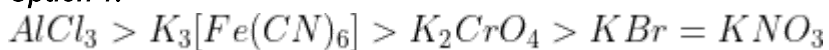
It is an example of Intermolecular Cannizzaro's reaction. HCHO is always oxidised if it is one of the substrates undergoing Cross Cannizzaro reaction because of kinetic factors



Therefore, **Option(3) is correct.**

Q. 45 As per Hardy-Schulze formulation, the flocculation values of the following for ferric hydroxide sol are in the order:

Option 1:



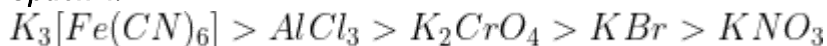
Option 2:



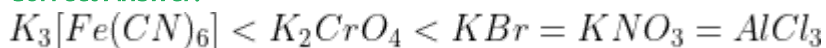
Option 3:



Option 4:



Correct Answer:



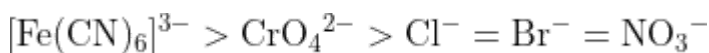
Solution:

As per Hardy Schulze rules coagulation power.

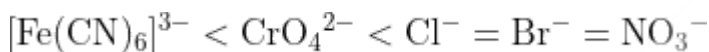
$$\text{Coagulation value or flocculation value} \propto \frac{1}{\text{Coagulation power}}$$

Since $Fe(OH)_3$ is positively charged sol, hence, the anionic charge will flocculate.

As per Hardy Schulze rules coagulation power of anion follows the order :

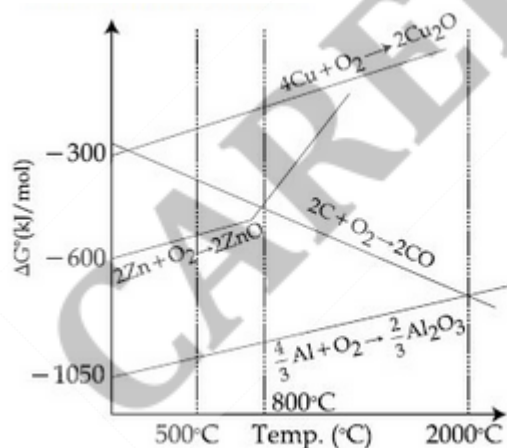


Higher the coagulation power lower will be its flocculation value therefore order will be :



Therefore, Option(3) is correct.

Q. 46 The correct statement regarding the given Ellingham diagram is :



Option 1:

At $500^\circ C$, coke can be used for the extraction of Zn from ZnO

Option 2:

At $1400^\circ C$, Al can be used for the extraction of Zn from ZnO

Option 3:

At $800^\circ C$, Cu can be used for the extraction of Zn from ZnO.

Option 4:

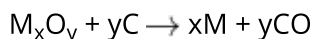
Coke cannot be used for the extraction of Cu from Cu_2O .

Correct Answer:

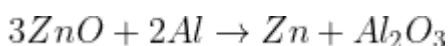
At $1400^{\circ}C$, Al can be used for the extraction of Zn from ZnO

Solution:

For extraction of less electropositive metals such as Pb, Zn, Fe, Sn, etc by powerful reducing agents such as C, H_2 , CO, Water gas, Na, K, Mg, Al may be used.



From the diagram, Al can reduce ZnO to Zn



Therefore, option number (2) is correct.

Q. 47 What is the IUPAC name of $[Co(NH_3)_5NO_2]Cl_2$?

Option 1:

Pentamminenitrocobalt (III) chloride

Option 2:

Pentamminenitrosocobalt (III) chloride

Option 3:

Pentamminenitrocobalt (II) chloride

Option 4:

None of these

Correct Answer:

Pentamminenitrocobalt (III) chloride

Solution:

As we have learnt,

Writing the name of Complex compound formula -

(i) The cation is named first

(ii) ligands are named in alphabetical order before the name of the central metal atom.

(iii) Prefixes, mono, di, tri are used to indicate the no of ligands

(iv) when the name of ligand used a numerical prefix, then term bis, tris, tetrakis are used.

eg: $[Ni Cl_2 (PPh_3)_2]$ is named as dichlorobis (triphenylphosphine)nickel(II)

(v) Oxidation state is represented by Roman numerical in parenthesis

(vi) If the complex ion is an anion, the name of metal ends with the suffix -ate

eg: Co in complex anion $[Co(SCN)_4]^{2-}$ is called cobaltate

-

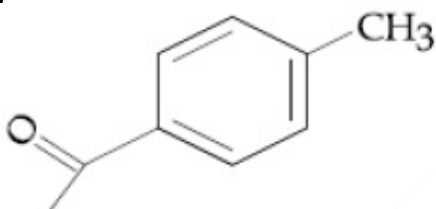
In the compounds $[Co(NH_3)_5NO_2]Cl_2$ the oxidation state of cobalt is +3 and it has five NH_3 and one NO_2 attached as ligands to the central atom.

Therefore its name is Pentamminenitrocobalt(III)chloride

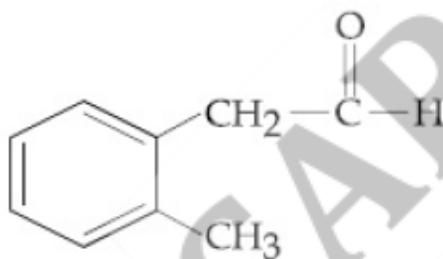
Hence, **the correct answer is Option(1)**

Q. 48 Compound A ($C_9H_{10}O$) shows positive iodoform test. Oxidation of A with $KMnO_4/KOH$ gives acid B ($C_8H_6O_4$). Anhydride of B is used for the preparation of phenolphthalein. Compound A is :

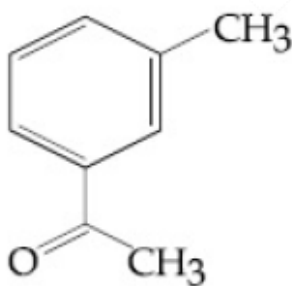
Option 1:



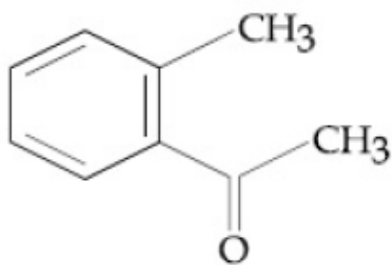
Option 2:



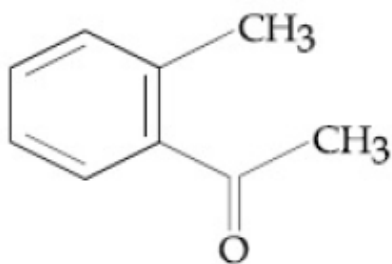
Option 3:



Option 4:

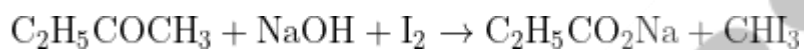


Correct Answer:



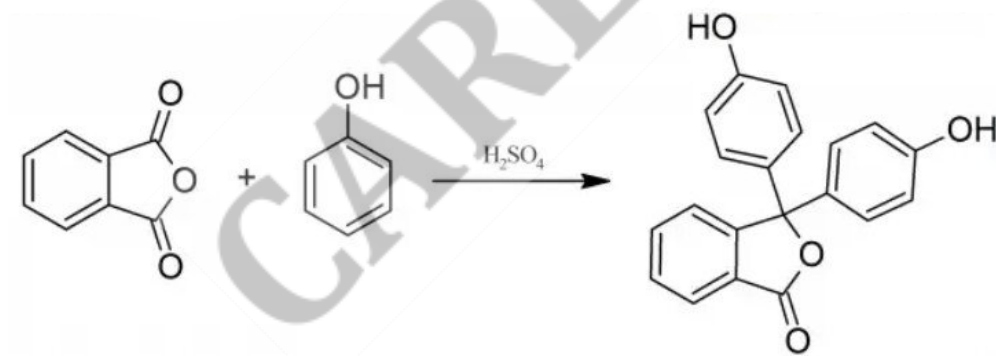
Solution:

Haloform reaction -

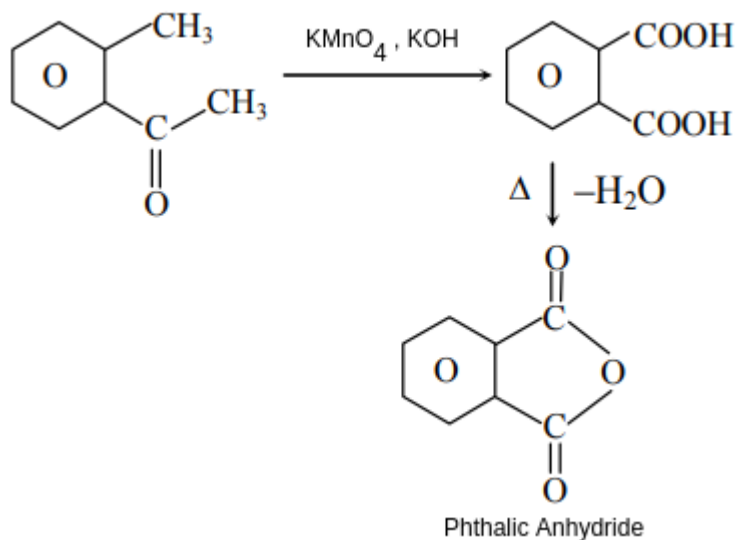


Methyl ketones give this test

Phthalein Reaction -



The reaction occurs as follows :



Therefore, **option (4) is correct.**

Q. 49 During smelting an additional substance is added which combines with impurities to form a fusible product which is known as

Option 1:
mud

Option 2:
slag

Option 3:
flux

Option 4:
gangue

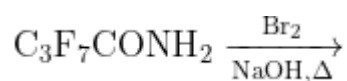
Correct Answer:
slag

Solution:

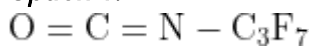
The fusible material, formed by the reaction of flux and gangue is slag.

So, Option 2 is correct.

Q. 50 What will be the product of this reaction?



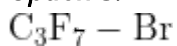
Option 1:



Option 2:



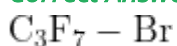
Option 3:



Option 4:

None of these.

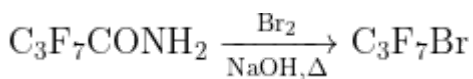
Correct Answer:



Solution:

Special Case of Hoffmann Bromamide Reaction -

Since only primary amides undergo Hoffmann Bromamide reaction but secondary amides do not undergo this reaction. But secondary diamide undergoes this reaction. Thus, it is considered as the special case of Hoffmann Bromamide reaction. The reaction occurs as follows:



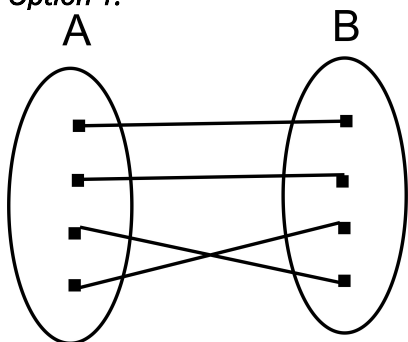
If the amide contains an electron-withdrawing group (-I), the product is bromide.

Therefore the correct option is (3).

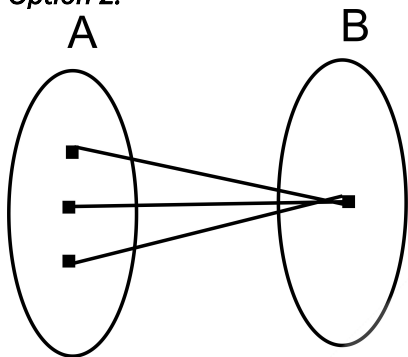
CUET 2022 - Maths Sample Paper

Q. 1 Which of the following is the mapping for into function ?

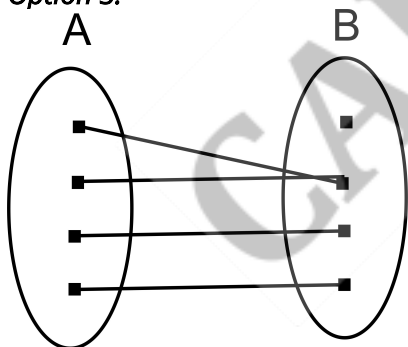
Option 1:



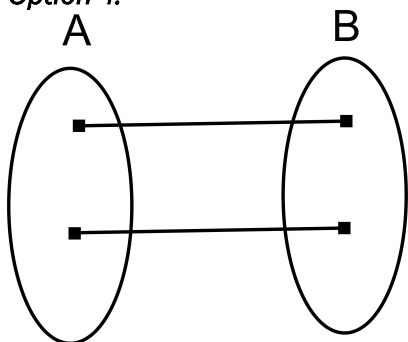
Option 2:



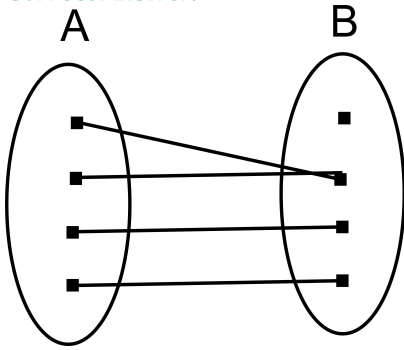
Option 3:



Option 4:



Correct Answer:



Solution:

In option C,

there is one element in co-domain which is not mapped to an element in domain, so it is not onto

(Here range does not equal co-domain)

Q. 2 Which of the following is not a surjective function ?

Option 1:

$$f(x) = \sin x \forall x \in [-1, 1]$$

Option 2:

$$f(x) = \csc x \forall x \in \mathbb{R}$$

Option 3:

$$f(x) = \tan x \forall x \in \mathbb{R}$$

Option 4:

$$f(x) = \cos x \forall x \in [-1, 1]$$

Correct Answer:

$$f(x) = \csc x \forall x \in \mathbb{R}$$

Solution:

As we have learned

Function Check Graphically -

A line parallel to y - axis cuts the curve at most one point is called function.

-

$$f(x) = \operatorname{cosec} x \text{ has range } \in (-\infty, -1] \cup [1, \infty)$$

Thus

Range $\neq$ codomain

Q. 3 If $f(x) = x^2 + 2$, $h(x) = 2x + 1$ and $g(x) = \frac{3}{x}$, then find $(g \circ f) \circ h(x)$

Option 1:

$$\frac{4x^2 + 2x + 3}{3}$$

Option 2:

$$\frac{4x^2 + 4x + 3}{3}$$

Option 3:

$$\frac{8x^2 + 8x + 11}{4x^2 + 2x + 3}$$

Option 4:

$$\frac{8x^2 + 8x + 11}{4x^2 + 4x + 3}$$

Correct Answer:

$$\frac{4x^2 + 4x + 3}{3}$$

Solution:

As we have learned

Properties of composite function -

The composition of function is associative.

- wherein

$$(f \circ g) \circ h = f \circ (g \circ h)$$

$$(g \circ f) \circ h(x) = g \circ (f \circ h)(x)$$

$$g \circ (f \circ h)(x) = g(f(h(x)))$$

$$f(h(x)) = f(2x + 1) = (2x + 1)^2 + 2 = 4x^2 + 4x + 3$$

$$g(f(h(x))) = g(4x^2 + 4x + 3) = \frac{3}{4x^2 + 4x + 3}$$

Q. 4 If $f(x) = x^3$; $g(x) = 2x$. Then evaluate $g \circ f(x) + f \circ g(x)$

Option 1:

$$8x^3 + x^9$$

Option 2:

$$10x^3$$

Option 3:

$$3x^3$$

Option 4:

$$5x^2$$

Correct Answer:

$$10x^3$$

Solution:

As we have learned

Properties of composite function -

The composition of function is not commutative.

- wherein

$$f \circ g \neq g \circ f$$

$$f \circ g(x) = f(2x) = (2x)^3$$

$$g \circ f(x) = g(x^3) = (x^3)^2$$

$$\Rightarrow f \circ g(x) + g \circ f(x) = 8x^3 + 2x^3 = 10x^3$$

Q. 5

The value of $\tan \left(2 \tan^{-1} \left(\frac{3}{5} \right) + \sin^{-1} \left(\frac{5}{13} \right) \right)$ is equal to :

Option 1:

$$\frac{-181}{69}$$

Option 2:

$$\frac{220}{21}$$

Option 3:

$$\frac{-291}{76}$$

Option 4:

$$\frac{151}{63}$$

Correct Answer:

$$\frac{220}{21}$$

Solution:

$$\tan \left(2 \tan^{-1} \left(\frac{3}{5} \right) + \sin^{-1} \left(\frac{5}{13} \right) \right)$$

$$\text{Let } \tan^{-1} \left(\frac{3}{5} \right) = A \text{ and } \sin^{-1} \left(\frac{5}{13} \right) = B$$

$$= \tan(2A + B)$$

$$= \frac{\tan(2A) + \tan(B)}{1 - \tan(2A) \tan B} \quad \text{--- (i)}$$

$$\text{Now } \tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$$

$$\text{As } \tan^{-1} \left(\frac{3}{5} \right) = A \Rightarrow \tan A = \frac{3}{5}.$$

$$\Rightarrow \tan 2A = \frac{2 \cdot \frac{3}{5}}{1 - \left(\frac{3}{5} \right)^2} = \frac{6 \cdot 25}{5(25 - 9)} = \frac{30}{16} = \frac{15}{8}$$

$$\text{and } \sin^{-1} \left(\frac{5}{13} \right) = B$$

$$\Rightarrow \sin B = \frac{5}{13} \Rightarrow \tan B = \frac{5}{12}$$

Using (i)

$$\tan(2A + B) = \frac{\frac{15}{8} + \frac{5}{12}}{1 - \left(\frac{15}{8}\right)\left(\frac{5}{12}\right)} = \frac{220}{21}$$

Hence option (2) is correct.

Q. 6 The number of real roots of the equation $\tan^{-1} \sqrt{x(x+1)} + \sin^{-1} \sqrt{x^2 + x + 1} = \frac{\pi}{4}$ is :

Option 1:

1

Option 2:

2

Option 3:

4

Option 4:

0

Correct Answer:

0

Solution:

$$\tan^{-1} \sqrt{x(x+1)} + \sin^{-1} \sqrt{x^2 + x + 1} = \frac{\pi}{4}.$$

Domain

$$1, \quad x(x+1) \geq 0$$

$$\Rightarrow x \in (-\infty, -1] \cup [0, \infty)$$

$$2. \quad x^2 + x + 1 \geq 0 \Rightarrow x \in R$$

$$3. \quad \sqrt{x^2 + x + 1} \leq 1$$

$$\Rightarrow x^2 + x + 1 \leq 1$$

$$\Rightarrow x^2 + x \leq 0$$

$$\Rightarrow x(x+1) \leq 0$$

$$\Rightarrow x \in [-1, 0]$$

Overall domain is intersection of these 3

$$\Rightarrow \text{domain} = \{-1, 0\}.$$

For $x = -1$

Equation is $\tan^{-1}(0) + \sin^{-1}(1) = \frac{\pi}{2} \Rightarrow \frac{\pi}{2} \neq \frac{\pi}{4}$

So $x = -1$ do not satisfy it

For $x = 0$

Equation is $\tan^{-1}(0) + \sin^{-1}(1) = \frac{\pi}{2} \Rightarrow \frac{\pi}{2} \neq \frac{\pi}{4}$

$x = 0$ also does not satisfy it

So, no solution

Hence, the correct answer is option (4)

Q. 7 Value of $\tan^{-1}(\tan \frac{4\pi}{3})$ is

Option 1:
 $\frac{4\pi}{3}$

Option 2:
 $\frac{\pi}{3}$

Option 3:
Both option 1 and option 2

Option 4:
None of these

Correct Answer:
 $\frac{\pi}{3}$

Solution:

$\tan^{-1}(\tan \frac{4\pi}{3}) \neq \frac{4\pi}{3}$ as $\frac{4\pi}{3}$ is not in the range of $(-\frac{\pi}{2}, \frac{\pi}{2})$

We can write it as $\tan^{-1}(\tan(\pi + \frac{\pi}{3})) = \tan^{-1}(\tan(\frac{\pi}{3})) = \frac{\pi}{3}$
(as $\frac{\pi}{3}$ lies in $(-\frac{\pi}{2}, \frac{\pi}{2})$)

Q. 8 The value of $\sin^2(\cos^{-1} \frac{1}{\sqrt{2}}) + \cos^2(\sin^{-1} \frac{1}{2})$ is

Correct Answer:
1.25

Solution:

We have learnt that

Function $f(f^{-1}(x))$, where $f(x)$ is a trigonometric function

1. $\sin(\sin^{-1}(x)) = x$ for all $x \in [-1, 1]$
2. $\cos(\cos^{-1}(x)) = x$ for all $x \in [-1, 1]$
3. $\tan(\tan^{-1}(x)) = x$ for all $x \in \mathbb{R}$
4. $\cot(\cot^{-1}(x)) = x$ for all $x \in \mathbb{R}$
5. $\sec(\sec^{-1}(x)) = x$ for all $x \in \mathbb{R} - (-1, 1)$
6. $\csc(\csc^{-1}(x)) = x$ for all $x \in \mathbb{R} - (-1, 1)$

Now,

$$\begin{aligned} & \sin^2\left(\cos^{-1}\frac{1}{\sqrt{2}}\right) + \cos^2\left(\sin^{-1}\frac{1}{2}\right) \\ &= \left(1 - \cos^2\left(\cos^{-1}\frac{1}{\sqrt{2}}\right)\right) + \left(1 - \sin^2\left(\sin^{-1}\frac{1}{2}\right)\right) \\ &= \left(1 - \frac{1}{2}\right) + \left(1 - \frac{1}{4}\right) \\ &= \frac{5}{4} \end{aligned}$$

Q. 9 Choose the correct statement

$$A = \begin{bmatrix} x+2 & y^2+2 \\ -6 & 0 \end{bmatrix}, \quad B = \begin{bmatrix} 2x+1 & 3y \\ y^2-5y & 0 \end{bmatrix}$$

Option 1:

If $x=1, y=1$ matrix A is equal to matrix B

Option 2:

If $x = -\frac{1}{2}$ and $y = 0$ matrix B is null matrix

Option 3:

Both are square matrix

Option 4:

All of the above

Correct Answer:

All of the above

Solution:

Equal Matrices: Two matrices are said to be equal if they have the same order and each element of one matrix is equal to the corresponding elements of another matrix or we can say $a_{ij} = b_{ij}$ where a is the element of one matrix and b is the element of another matrix.

option (a)

If matrix A is equal to matrix B then,

$$\begin{bmatrix} x+2 & y^2+2 \\ -6 & 0 \end{bmatrix} = \begin{bmatrix} 2x+1 & 3y \\ y^2-5y & 0 \end{bmatrix}$$

$$\Rightarrow x+2 = 2x+1 \quad \dots(i)$$

$$y^2+2 = 3y \quad \dots(ii)$$

$$-6 = y^2-5y \quad \dots(iii)$$

$$\Rightarrow x = 1 \quad [\text{from eq(i)}]$$

$$y = 2 \text{ or } y = 1 \quad [\text{from eq(ii)}]$$

$$y = 2 \text{ or } y = 3 \quad [\text{from eq(iii)}]$$

$$\Rightarrow x = 1 \text{ and } y = 2$$

option (b)

put $x = -\frac{1}{2}$ and $y = 0$ in matrix B

$$B = \begin{bmatrix} 2x+1 & 3y \\ y^2-5y & 0 \end{bmatrix}$$

$$B = \begin{bmatrix} 2(-\frac{1}{2})+1 & 3(0) \\ (0)^2-5(0) & 0 \end{bmatrix}$$

$$B = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

B is null matrix at $x = -\frac{1}{2}$ and $y = 0$

option (c)

Both matrices are of order 2×2

Hence all the statements are correct

correct option is (4)

Q. 10 Find A-B if $A = \begin{bmatrix} 8 & 6 & 5 \\ 5 & 6 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 5 & 3 & 4 \\ 2 & 4 & 0 \end{bmatrix}$

Option 1:

$$A - B = \begin{bmatrix} 3 & 3 & 1 \\ 2 & 2 & 1 \end{bmatrix}$$

Option 2:

$$A - B = \begin{bmatrix} 3 & 1 & 3 \\ 3 & 1 & 2 \end{bmatrix}$$

Option 3:

$$A - B = \begin{bmatrix} -3 & -3 & -1 \\ -3 & -2 & -1 \end{bmatrix}$$

Option 4:

$$A - B = \begin{bmatrix} 3 & 3 & 1 \\ 3 & 2 & 1 \end{bmatrix}$$

Correct Answer:

$$A - B = \begin{bmatrix} 3 & 3 & 1 \\ 3 & 2 & 1 \end{bmatrix}$$

Solution:

Addition and Subtraction of Matrices -

Subtraction of matrices: Two matrices can be subtracted only when they are of the same order ($m \times n$ or order of matrix with m rows, n columns.) If A and B are a matrix of order $m \times n$ then their difference will also be a matrix of the same order and in subtraction, corresponding elements of A and B get subtracted. So if

$$A = [a_{ij}]_{m \times n}, B = [b_{ij}]_{m \times n} \text{ Then, } A - B = [a_{ij} - b_{ij}]_{m \times n} \text{ for all } i, j$$

-

$$A = \begin{bmatrix} 8 & 6 & 5 \\ 5 & 6 & 1 \end{bmatrix}, B = \begin{bmatrix} 5 & 3 & 4 \\ 2 & 4 & 0 \end{bmatrix}$$

$$A - B = \begin{bmatrix} 8-5 & 6-3 & 5-4 \\ 5-2 & 6-4 & 1-0 \end{bmatrix}$$

$$A - B = \begin{bmatrix} 3 & 3 & 1 \\ 3 & 2 & 1 \end{bmatrix}$$

Q. 11

Let $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ are two matrices such that $AB = BA$ and $c \neq 0$, then value of $\frac{a-d}{3b-c}$ is:

Correct Answer: -1

Solution:

Multiplication of matrices -

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \times \begin{pmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{pmatrix} =$$

$$\begin{pmatrix} a_{11}b_{11}+a_{12}b_{21}+a_{13}b_{31} & a_{11}b_{12}+a_{12}b_{22}+a_{13}b_{32} & a_{11}b_{13}+a_{12}b_{23}+a_{13}b_{33} \\ a_{21}b_{11}+a_{22}b_{21}+a_{23}b_{31} & a_{21}b_{12}+a_{22}b_{22}+a_{23}b_{32} & a_{21}b_{13}+a_{22}b_{23}+a_{23}b_{33} \\ a_{31}b_{11}+a_{32}b_{21}+a_{33}b_{31} & a_{31}b_{12}+a_{32}b_{22}+a_{33}b_{32} & a_{31}b_{13}+a_{32}b_{23}+a_{33}b_{33} \end{pmatrix}$$

-

$$AB = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \begin{bmatrix} a & b \\ c & d \end{bmatrix} = \begin{bmatrix} a+2c & b+2d \\ 3a+4c & 3b+4d \end{bmatrix}$$

$$BA = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} = \begin{bmatrix} a+3b & 2a+4b \\ c+3d & 2c+4d \end{bmatrix}$$

$$\text{if } AB = BA, \text{ then } a+2c = a+3b$$

$$\Rightarrow 2c = 3b \Rightarrow b \neq 0$$

$$b+2d = 2a+4b$$

$$\Rightarrow 2a-2d = -3b$$

$$\frac{a-d}{3b-c} = \frac{-\frac{3}{2}b}{3b-\frac{3}{2}b} = -1$$

Q. 12 If A is a square matrix of order 3 such that $|A| = 2$ then $|(adj A^{-1})^{-1}|$ is

Correct Answer:

4

Solution:

Inverse of a matrix -

$$A^{-1} = \frac{1}{|A|} \cdot adj A$$

-

Property of adjoint of A -

$$|adj A| = |A|^{n-1}$$

- wherein

$adj A$ denotes adjoint of A and $|A|$ denotes determinant of A and n is the order of the matrix

$$|adj A^{-1}| = |A^{-1}|^2 = \frac{1}{|A|^2}$$

$$|(adj A^{-1})^{-1}| = \frac{1}{|adj A^{-1}|} = |A|^2 = 2^2 = 4$$

Q. 13 Let α and β be the roots of the equation $x^2 + x + 1 = 0$. Then for $y \neq 0$ in r ,

$$\begin{vmatrix} y+1 & \alpha & \beta \\ \alpha & y+\beta & 1 \\ \beta & 1 & y+\alpha \end{vmatrix} \text{ is equal to :}$$

Option 1:

$$y(y^2 - 1)$$

Option 2:

$$y(y^2 - 3)$$

Option 3:

$$y^3$$

Option 4:

$$y^3 - 1$$

Correct Answer:

$$y^3$$

Solution:

Sum of Roots in Quadratic Equation -

$$\alpha + \beta = \frac{-b}{a}$$

- wherein

α and β are root of quadratic equation

$$ax^2 + bx + c = 0$$

$$a, b, c \in \mathbb{C}$$

Product of Roots in Quadratic Equation -

$$\alpha\beta = \frac{c}{a}$$

- wherein

α and β are roots of quadratic equation:

$$ax^2 + bx + c = 0$$

$$a, b, c \in \mathbb{C}$$

Property of determinant -

If to each element of a line (row or column) of a determinant be added the equimultiples of the corresponding elements of one or more parallel lines , the determinant remains unaltered

- wherein

$$\text{i.e. } \begin{vmatrix} a_1 + la_2 + ma_3 & a_2 & a_3 \\ b_1 + lb_2 + mb_3 & b_2 & b_3 \\ c_1 + lc_2 + mc_3 & c_2 & c_3 \end{vmatrix} = \begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}.$$

α, β are roots of $x^2 + x + 1 = 0$

$$\alpha + \beta = -1, \alpha\beta = 1$$

$$\begin{vmatrix} y+1 & \alpha & \beta \\ \alpha & y+\beta & 1 \\ \beta & 1 & y+\alpha \end{vmatrix}$$

$$C_1 \rightarrow C_1 + C_2 + C_3$$

$$\begin{vmatrix} y+1+\alpha+\beta & \alpha & \beta \\ \alpha+y+\beta+1 & y+\beta & 1 \\ \beta+1+y+\alpha & 1 & y+\alpha \end{vmatrix}$$

$$(y+1+\alpha+\beta) \begin{vmatrix} 1 & \alpha & \beta \\ 1 & y+\beta & 1 \\ 1 & 1 & y+\alpha \end{vmatrix}$$

$$= (y+1+\alpha+\beta) [(y+\beta)(y+\alpha) - \alpha(y+\alpha-1) + \beta(1-y-\beta)]$$

$$\Rightarrow (y+1+\alpha+\beta) [y^2 + y(\alpha+\beta) + \alpha\beta - 2y - 2^2 + 2 + \beta - y\beta - \beta^2]$$

$$\Rightarrow (y+1-1) [y^2 + y(-1) + 1 - y(-1) - (\alpha^2 + \beta^2) - 1]$$

$$\Rightarrow y^3$$

Q. 14 If the system of equations $2x + 3y - z = 0$, $x + ky - 2z = 0$ and $2x - y + z = 0$ has a non-trivial solution (x, y, z) , then $\frac{x}{y} + \frac{y}{z} + \frac{z}{x} + k$ is equal to :

Correct Answer: 0.5

Solution:

Cramer's rule for solving system of linear equations -

When $\Delta = 0$ and $\Delta_1 = \Delta_2 = \Delta_3 = 0$,

then the system of equations has infinite solutions.

- wherein

$$a_1x + b_1y + c_1z = d_1$$

$$a_2x + b_2y + c_2z = d_2$$

$$a_3x + b_3y + c_3z = d_3$$

and

$$\Delta = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

$\Delta_1, \Delta_2, \Delta_3$ are obtained by replacing column 1,2,3 of Δ by (d_1, d_2, d_3) column

for non-trivial solution $A=0$

$$\begin{vmatrix} 2 & 3 & -1 \\ 1 & k & -1 \\ 2 & -1 & 1 \end{vmatrix} = 0$$

$$2(k - 2) - 3(1 + 4) - 1(-1 - 2k) = 0$$

$$2k - 4 - 15 + 1 + 2k = 0$$

$$4k = 18$$

$$k = \frac{9}{2}$$

$$2x + 3y - z = 0$$

$$x = \frac{z - 3y}{2}$$

$$2x + 2y - 2 = 0 \text{ --- (I)}$$

$$x + \frac{9}{2}y - 2z = 0 \text{ --- (II)}$$

$$2x - y + z = 0 \text{ --- (III)}$$

from (I) and (II)

$$I + III$$

$$4x + 2y = 0$$

$$2y = -4x$$

$$\frac{x}{y} = -\frac{2}{4} = -\frac{1}{2}$$

$$I - III$$

$$4y = 2z$$

$$\frac{y}{z} = \frac{2}{4} = \frac{1}{2}$$

$$I + 3(III)$$

$$= 8x + 2z = 0$$

$$8x = -2z$$

$$\frac{x}{z} = \frac{-1}{4}$$

so

$$\frac{x}{y} + \frac{y}{z} + \frac{z}{x} + k =$$

$$\frac{-1}{2} + \frac{1}{2} - 4 + \frac{9}{2}$$

$$\frac{1}{2}$$

Q. 15 Let λ be a real number for which the system of linear equations

$$x + y + z = 6$$

$$4x + \lambda y - \lambda z = \lambda - 2$$

$$3x + 2y - 4z = -5$$

has infinitely many solutions. Then λ is a root of the quadratic equation :

Option 1:

$$\lambda^2 + 3\lambda - 4 = 0$$

Option 2:

$$\lambda^2 - 3\lambda - 4 = 0$$

Option 3:

$$\lambda^2 + \lambda - 6 = 0$$

Option 4:

$$\lambda^2 - \lambda - 6 = 0$$

Correct Answer:

$$\lambda^2 - \lambda - 6 = 0$$

Solution:

Cramer's rule for solving system of linear equations -

When $\Delta = 0$ and $\Delta_1 = \Delta_2 = \Delta_3 = 0$,

then the system of equations has infinite solutions.

- wherein

$$a_1x + b_1y + c_1z = d_1$$

$$a_2x + b_2y + c_2z = d_2$$

$$a_3x + b_3y + c_3z = d_3$$

and

$$\Delta = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

$\Delta_1, \Delta_2, \Delta_3$ are obtained by replacing column 1,2,3 of Δ by (d_1, d_2, d_3) column

linear equations

$$x + y + z = 6$$

$$4x + \lambda y - \lambda z = \lambda - 2$$

$$3x + 2y - 4z = -5$$

$$\Delta = \begin{vmatrix} 1 & 1 & 1 \\ 4 & \lambda & -\lambda \\ 3 & 2 & -4 \end{vmatrix}$$

$$= (-4\lambda + 2\lambda) - 1(-16 + 3\lambda) + 1(8 - 3\lambda)$$

$$= -2\lambda + 16 - 3\lambda + 8 - 3\lambda$$

$$= -8\lambda + 24$$

Now, using cramer's law for infinite solution

$\Delta, \Delta_1, \Delta_2$ all will be zero

$$-8\lambda + 24 = 0$$

$$\lambda = 3$$

Now put $\lambda = 3$ in options and check for the correct one

$$(1) \lambda^2 + 3\lambda - 4 = (3)^2 + 3 \cdot 3 - 4 \neq 0$$

$$(2) \lambda^2 - 3\lambda - 4 = (3)^2 - 3 \cdot 3 - 4 \neq 0$$

$$(3) \lambda^2 + \lambda - 6 = (3)^2 + 3 - 6 \neq 0$$

$$(4) \lambda^2 - \lambda - 6 = (3)^2 - 3 - 6 = 0$$

So, option (4) is correct.

Q. 16 If the system of linear equations

$$x + y + z = 5$$

$$x + 2y + 2z = 6$$

$$x + 3y + \lambda z = \mu, (\lambda, \mu \in \mathbb{R}), \text{ has infinitely}$$

many solutions, then the value of $\lambda + \mu$ is :

Correct Answer: 10

Solution:

Solution of a non-homogeneous system of linear equations by matrix method -

If A is a singular matrix and $\text{adj}(A) \cdot b = 0$ then the system of equations given by $Ax = b$ has infinitely many solutions or no solution.

- wherein

The solution of n simultaneous linear equations with n unknowns

$$\begin{aligned} a_{11}x_1 + a_{12}x_2 + \dots + a_{1n}x_n &= b_1 \\ a_{21}x_1 + a_{22}x_2 + \dots + a_{2n}x_n &= b_2 \\ &\vdots \\ a_{n1}x_1 + a_{n2}x_2 + \dots + a_{nn}x_n &= b_n \end{aligned}$$

In matrix notation $Ax = b$, when

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix} \quad x = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} \quad b = \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_n \end{bmatrix}$$

The linear system is said to be of order n and has a unique solution if $\det(A) \neq 0$.

3

$$x + 3y + \lambda z - \mu = p(x + y + z - 5) + q(x + 2y + 2z - 6)$$

On comparing the coefficients

$$p + q = 1 \quad \text{and} \quad p + 2q = 3$$

$$\Rightarrow (p, q) = (-1, 2)$$

Hence, $x + 3y + \lambda z - \mu = x + 3y + 3z - 7$

$$\Rightarrow \lambda = 3, \mu = 7$$

$$\Rightarrow \lambda + \mu = 10$$

So, option (4) is correct.

Q. 17 Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be defined as

$$f(x) = \begin{cases} 2 \sin - \left(\frac{\pi x}{2}\right) & \text{if } x < -1 \\ |ax^2 + x + b| & \text{if } -1 \leq x \leq 1 \\ \sin(\pi x) & \text{if } x > 1 \end{cases}$$

If $f(x)$ is continuous on $\mathbb{R}$, then $a + b$ equals:

Option 1:

-1

Option 2:

-3

Option 3:

1

Option 4:

3

Correct Answer:

-1

Solution:

$f(x)$ is continuous on $\mathbb{R}$

$$\Rightarrow f(1^-) = f(1) = f(1^+)$$

$$|a + 1 + b| = \lim_{x \rightarrow 1} \sin(\pi x)$$

$$|a + 1 + b| = 0 \Rightarrow a + b = -1 \quad \dots (1)$$

$$\Rightarrow \text{Also } f(-1^-) = f(-1) = f(-1^+)$$

$$\lim_{x \rightarrow -1} 2 \sin \left(\frac{-\pi x}{2} \right) = |a - 1 + b| = 2$$

Either $a - 1 + b = 2$ or $a - 1 + b = -2$

$$a + b = 3 \quad \dots (2) \text{ or } a + b = -1 \quad \dots (3)$$

from (1) and (2)

$$a + b = 3 = -1 (\text{reject})$$

from (1) and (3)

$$a + b = -1$$

Q. 18 If Rolle's theorem holds for the function $f(x) = x^3 - ax^2 + bx - 4, x \in [1, 2]$ with $f'\left(\frac{4}{3}\right) = 0$, then ordered pair (a,b) is equal to:

Option 1:

$$(5, -8)$$

Option 2:

$$(-5, -8)$$

Option 3:

$$(5, 8)$$

Option 4:

$$(-5, 8)$$

Correct Answer:

$$(5, 8)$$

Solution:

$$f(1) = f(2)$$

$$\Rightarrow 1 - a + b - 4 = 8 - 4a + 2b - 4$$

$$\Rightarrow 3a - b = 7$$

$$\text{Also } f'\left(\frac{4}{3}\right) = 0 \quad (\text{given})$$

$$\Rightarrow (3x^2 - 2ax + b)_{x=\frac{4}{3}} = 0$$

$$\Rightarrow \frac{16}{3} - \frac{8a}{3} + b = 0$$

$$\Rightarrow 8a - 3b - 16 = 0$$

Solving (1) and (2)

$$a = 5, b = 8$$

Q. 19 Let $f : R \rightarrow R$ be defined as

$$f(x) = \begin{cases} -55x & \text{if } x < -5 \\ 2x^3 - 3x^2 - 120x & \text{if } -5 \leq x \leq 4 \\ 2x^3 - 3x^2 - 36x - 336, & \text{if } x > 4, \end{cases}$$

Let $A = \{x \in R : f \text{ is increasing}\}$. Then A is equal to :

Option 1:

$$(-5, \infty)$$

Option 2:

$$(-5, -4) \cup (4, \infty)$$

Option 3:

$$(-\infty, -5) \cup (4, \infty)$$

Option 4:

$$(-\infty, -5) \cup (-4, \infty)$$

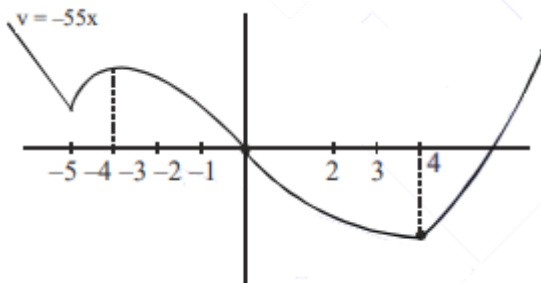
Correct Answer:

$$(-5, -4) \cup (4, \infty)$$

Solution:

$$f(x) = \begin{cases} -55x & \text{if } x < -5 \\ 2x^3 - 3x^2 - 120x & \text{if } -5 \leq x \leq 4 \\ 2x^3 - 3x^2 - 36x - 336, & \text{if } x > 4, \end{cases}$$

$$f'(x) = \begin{cases} -55; & x < -5 \\ 6(x-5)(x+4); & -5 < x < 4 \\ 6(x-3)(x+2); & x > 4 \end{cases}$$



$f(x)$ is increasing in
 $x \in (-5, -4) \cup (4, \infty)$

Q. 20 The number of points, at which the function $f(x) = |2x + 1| - 3|x + 2| + |x^2 + x - 2|, x \in R$ is not differentiable, is _____

Correct Answer:

2

Solution:

$$\begin{aligned} f(x) &= |2x + 1| - 3|x + 2| + |x^2 + x - 2| \\ &= |2x + 1| - 3|x + 2| + |x + 2||x - 1| \\ &= |2x + 1| + |x + 2|(|x - 1| - 3) \end{aligned}$$

Critical points are $x = \frac{-1}{2}, -2, -1$

but $x = -2$ is making a zero twice in product

So, points of non differentiability are $x = \frac{-1}{2}$ and $x = -1$

Q. 21 A helicopter flying the curve given by $y - x^{\frac{3}{2}} = 7, (x \geq 0)$. A soldier positioned at the point $\left(\frac{1}{2}, 7\right)$ wants to shoot down the helicopter when its nearest to him. Then the nearest distance is:

Option 1:

$$\frac{\sqrt{5}}{6}$$

Option 2:

$$\frac{1}{6}\sqrt{\frac{7}{3}}$$

Option 3:

$$\frac{1}{3}\sqrt{\frac{7}{3}}$$

Option 4:

$$\frac{1}{2}$$

Correct Answer:

$$\frac{1}{6}\sqrt{\frac{7}{3}}$$

Solution:

Equation of Normal -

Equation of normal to the curve $y = f(x)$ at the point $P(x_1, y_1)$ on the curve having a slope M_N is

$$(y - y_1) = M_N(x - x_1)$$

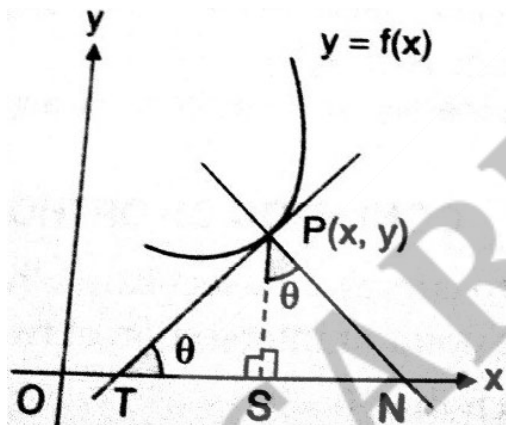
$$= \frac{-1}{\frac{dy}{dx}(x_1, y_1)}(x - x_1)$$

-

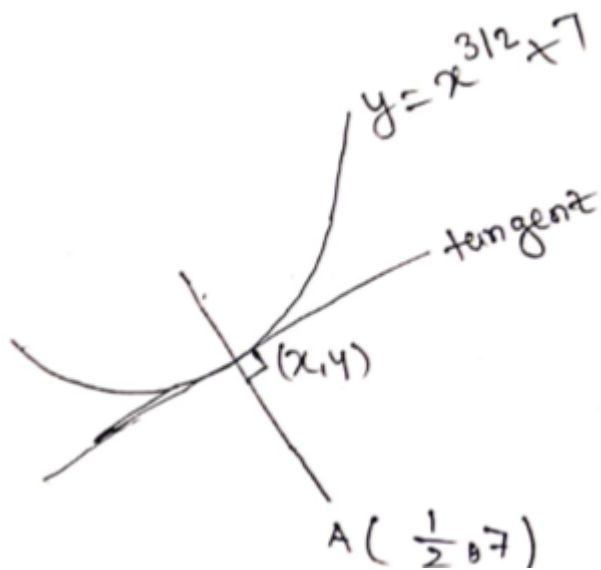
Length of Tangent -

$$L_T = \frac{y}{y'} \sqrt{1 + y'^2}$$

- wherein



Where $y' = \frac{dy}{dx}$



Given equation of curve

$$y - x^{\frac{3}{2}} = 7 \quad (x \geq 0)$$

from the concept

$$\frac{dy}{dx} = \frac{3}{2}\sqrt{x}$$

condition for perpendicular of two line

$$\Rightarrow \left(\frac{3}{2}\sqrt{x}\right)\left(\frac{7-4}{\frac{1}{2}-x}\right) = -1$$

$$\Rightarrow \left(\frac{3}{2}\sqrt{x}\right)\left(\frac{-x^{\frac{3}{2}}}{\frac{1}{2}-x}\right) = -1$$

$$\Rightarrow \frac{3}{2}x^2 = \frac{1}{2} - x$$

$$\Rightarrow 3x^2 + 2x - 1 = 0$$

$$\Rightarrow (x+1)(3x-1) = 0$$

$$x = -1 \text{ is rejected } \because x \geq 0$$

So,

$$x = \frac{1}{3}$$

$$y = 7 + \left(\frac{1}{3}\right)^{\frac{3}{2}}$$

$$l_{AB} = \sqrt{\left(\frac{1}{2} - \frac{1}{3}\right)^2} = \sqrt{\frac{1}{36} + \frac{1}{27}} = \frac{1}{6}\sqrt{\frac{7}{3}}$$

Q. 22 The tangent to the curve, $y = xe^{x^2}$ passing through the point (1,e) also passes through the point:

Option 1:

(2,3e)

Option 2:

(3,6e)

Option 3:

$\left(\frac{4}{3}, 2e\right)$

Option 4:

$\left(\frac{5}{3}, 2e\right)$

Correct Answer:

$\left(\frac{4}{3}, 2e\right)$

Solution:

Equation of the tangent -

To find the equation of the tangent we need either one slope + one point or two points.

$$\therefore (y - y_0) = m(x_0 - y_0)$$

$$\text{or } (y - y_2) = \frac{y_2 - y_1}{x_2 - x_1}(x - x_2)$$

- wherein

Where (x_0, y_0) is the point on the curve and $M = M_T$ slope of tangent.

Given curve,

$$y = xe^{x^2}$$

from the concept of tangent

$$\frac{dy}{dx}_{(1,e)} = (e^{x^2} \cdot 2x + e^{x^2})_{(1,e)} = 2e + e = 3e$$

$\therefore$ Equation of tangent

$$(y - e) = 3e(x - 1)$$

$$y = 3e(x) - 2e$$

$(\frac{4}{3}, 2e)$ lies on it.

Q. 23

The maximum volume (in cu.m) of the right circular cone having slant height 3 m is:

Option 1:

$$6\pi$$

Option 2:

$$3\sqrt{3}\pi$$

Option 3:

$$\frac{4}{3}\pi$$

Option 4:

$$2\sqrt{3}\pi$$

Correct Answer:

$$2\sqrt{3}\pi$$

Solution:

Method for maxima or minima -

By second derivative method :

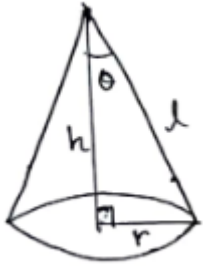
Step 1. find values of x for $\frac{dy}{dx} = 0$

Step 2. $x = x_0$ is a point of local maximum if $f''(x) < 0$ and local minimum if $f''(x) > 0$

- wherein

Where $y = f(x)$

$$\frac{dy}{dx} = f'(x)$$



$$l = 3m \text{ (slant height)}$$

$$h = 3 \cos (\theta)$$

$$r = 3 \sin (\theta)$$

Volume of right circular cone

$$V = \frac{1}{3} \pi r^2 h$$

$$= \frac{1}{3} \pi (3 \sin (\theta))^2 (3 \cos (\theta))$$

$$V = \frac{\pi}{3} 9 \sin^2 \theta \cdot 3 \cos (\theta) = 9 \pi \sin^2 \theta \cdot \cos \theta$$

for maximum volume

$$\frac{dv}{d\theta} = 0, \quad \frac{dv}{d\theta} = -9 \pi \sin (\theta) [\sin^2 (\theta) - 2 \cos^2 (\theta)] = 0$$

$$\sin (\theta) = \sqrt{\frac{2}{3}}$$

$$\frac{d^2 v}{d\theta^2} = -ve \text{ at } \sin (\theta) = \sqrt{\frac{2}{3}}$$

$$\text{Volume is maximum when } \sin (\theta) = \sqrt{\frac{2}{3}}$$

$$\therefore V_{max} = 2\sqrt{3}\pi \text{ (cu.m)}$$

Q. 24 Let $f(x) = x^3 - x^2 + x$ then number of points which are either local maxima or local minima is ?

Option 1:

0

Option 2:

1

Option 3:

2

Option 4:

3

Correct Answer:

0

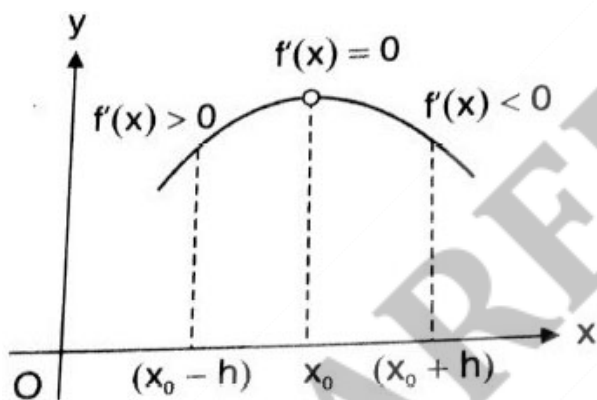
Solution:

As we have learned

Methods to find points of Local maxima and Local minima -

At points of local maxima and local minima the slope of tangent drawn to the curve is zero. For local maximum dy/dx changes from positive to negative and for local minimum dy/dx changes from negative to positive.

- wherein



$$f'(x) = 3x^2 - 2x + 1$$

$$\therefore 3 > 0 \text{ and } D = (-2)^2 - 4(3)(1) = -8 < 0$$

$$\therefore f'(x) > 0 \forall x \in \mathbb{R}$$

so derivative doesn't change sign

$\therefore$ no local maxima and minima

Q. 25

The value of the definite integral $\int_{\pi/24}^{5\pi/24} \frac{dx}{1 + \sqrt[3]{\tan 2x}}$ is :

Option 1:

$$\frac{\pi}{3}$$

Option 2:

$$\frac{\pi}{6}$$

Option 3:

$$\frac{\pi}{12}$$

Option 4:

$$\frac{\pi}{18}$$

Correct Answer:

$$\frac{\pi}{12}$$

Solution:

$$I = \int_{\frac{\pi}{24}}^{\frac{5\pi}{24}} \frac{dx}{1 + \sqrt[3]{\tan 2x}} \text{ --- (i)}$$

$$\Rightarrow I = \int_{\frac{\pi}{24}}^{\frac{5\pi}{24}} \frac{dx}{1 + \sqrt[3]{\tan 2\left(\frac{\pi}{4} - x\right)}} \text{ (Using King's property)}$$

$$\Rightarrow I = \int_{\frac{\pi}{24}}^{\frac{5\pi}{24}} \frac{dx}{1 + \sqrt[3]{\tan\left(\frac{\pi}{2} - 2x\right)}}$$

$$\Rightarrow I = \int_{\frac{\pi}{24}}^{\frac{5\pi}{24}} \frac{\sqrt[3]{\tan 2x}}{1 + \sqrt[3]{\tan 2x}} \text{ --- (ii)}$$

Adding (i) & (ii)

$$\Rightarrow 2I = \int_{\frac{\pi}{24}}^{\frac{5\pi}{24}} 1 dx$$

$$\Rightarrow 2I = \frac{\pi}{6}$$

$$\Rightarrow I = \frac{\pi}{12}$$

Ans 3

Q. 26

The value of $\int \frac{\sin^8 x - \cos^8 x}{1 - 2 \sin^2 x \cos^2 x} dx$ is :

Option 1:

$$\frac{1}{2} \sin 2x + C$$

Option 2:

$$-\frac{1}{2} \sin 2x + C$$

Option 3:

$$-\frac{1}{2} \sin x + C$$

Option 4:

$$-\sin^2 x + C$$

Correct Answer:

$$-\frac{1}{2} \sin 2x + C$$

Solution:

Integration of trigonometric function of power m -

$$\int \sin^m x dx \quad \text{and}$$

$$\int \cos^m x dx$$

- wherein

for $m = 2$,

$$\sin^2 x = \frac{1 - \cos 2x}{2}$$

for $m = 3$,

$$\sin 3x = 3 \sin x - 4 \sin^3 x$$

$$\int \frac{\sin^8 x - \cos^8 x}{\sin^4 x + \cos^4 x} dx = \int (\sin^4 x - \cos^4 x) dx$$

$$= \int (\sin^2 x - \cos^2 x) dx = -\frac{1}{2} \sin 2x + C$$

Q. 27 The value of the definite integral

$$\int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} \frac{dx}{(1 + e^{x \cos x})(\sin^4 x + \cos^4 x)}$$

is equal to:

Option 1:

$$-\frac{\pi}{2}$$

Option 2:

$$\frac{\pi}{2\sqrt{2}}$$

Option 3:

$$-\frac{\pi}{4}$$

Option 4:

$$\frac{\pi}{\sqrt{2}}$$

Correct Answer:

$$\frac{\pi}{2\sqrt{2}}$$

Solution:

$$I = \int_{-\pi/4}^{\pi/4} \frac{dx}{(1 + e^{x \cos x})(\sin^4 x + \cos^4 x)} \quad \text{--- (i)}$$

Using King's Rule.

$$I = \int_{-\pi/4}^{\pi/4} \frac{dx}{(1 + e^{-x \cos x})(\sin^4 x + \cos^4 x)}$$

$$\Rightarrow I = \int_{-\pi/4}^{\pi/4} \frac{e^{x \cos x}}{(1 + e^{x \cos x})(\sin^4 x + \cos^4 x)} - \text{ (ii)}$$

(i) + (ii)

$$\Rightarrow 2I = \int_{-\pi/4}^{\pi/4} \frac{dx}{\sin^4 x + \cos^4 x}$$

$$\Rightarrow 2I = 2 \int_0^{\pi/4} \frac{dx}{\sin^4 x + \cos^4 x}$$

$$\Rightarrow I = \int_0^{\pi/4} \frac{(1 + \tan^2 x) \sec^2 x dx}{\tan^4 x + 1}$$

$$\text{Let } \tan x = t \Rightarrow \sec^2 x dx = dt$$

$$I = \int_0^1 \frac{(1 + t^2)}{(1 + t^4)} dt$$

$$I = \int_0^1 \frac{(1 + \frac{1}{t^2})}{(t^2 + \frac{1}{t^2})} dt$$

$$I = \int_0^1 \frac{(1 + \frac{1}{t^2})}{(t - \frac{1}{t})^2 + 2} dt$$

$$\text{Let } t - \frac{1}{t} = u \Rightarrow \left(1 + \frac{1}{t^2}\right) dt = du$$

$$I = \int_{-\infty}^0 \frac{du}{u^2 + 2}$$

$$I = \frac{1}{\sqrt{2}} \tan^{-1} \left(\frac{\mu}{\sqrt{2}} \right) \Big|_{-\infty}^0 = \frac{\pi}{2\sqrt{2}}$$

Hence option (2) is correct.

Q. 28 $\int \frac{dx}{(x-b)^3 (x-a)^2} =$

Option 1:

$$-\frac{1}{(a-b)^4} \left[t - 3 \ln |t| + \frac{3}{t} - \frac{1}{2t^2} \right] \text{ where } t = \frac{x-b}{x-a}$$

Option 2:

$$-\frac{1}{(a-b)^4} \left[t - 3 \ln |t| - \frac{3}{t} - \frac{1}{2t^2} \right] \text{ where } t = \frac{x-b}{x-a}$$

Option 3:

$$-\frac{1}{(a-b)^4} \left[t - 3\ln|t| - \frac{3}{t} + \frac{1}{2t^2} \right] \text{ where } t = \frac{x-b}{x-a}$$

Option 4:

$$-\frac{1}{(a-b)^4} \left[t + 3\ln|t| + \frac{3}{t} + \frac{1}{2t^2} \right] \text{ where } t = \frac{x-b}{x-a}$$

Correct Answer:

$$-\frac{1}{(a-b)^4} \left[t - 3\ln|t| - \frac{3}{t} + \frac{1}{2t^2} \right] \text{ where } t = \frac{x-b}{x-a}$$

Solution:

As we learnt

Case for special type of indefinite integration -

$$\int x^m (a + bx^n)^p dx$$

When P is an integer if $P > 0$ then apply expanded form

$P < 0$ then we put $x = t^k$

- wherein

Where k is the common denominator of m and n

Put $x - b = t(x - a)$

$$\therefore x = \frac{at - b}{t - 1} \therefore dx = \frac{b - a}{(t - 1)^2} dt$$

$$\text{Also, } x - a = \frac{a - b}{t - 1} \text{ and } x - b = \frac{(a - b)t}{t - 1}$$

$$\text{Hence } I = \int \frac{(t - 1)^3}{(a - b)^3 t^3} \cdot \frac{(t - 1)^2}{(a - b)^2} \cdot \frac{b - a}{(t - 1)^2} dt$$

$$\begin{aligned} &= -\frac{1}{(a - b)^4} \int \frac{t^3 - 3t^2 + 3t - 1}{t^3} dt = -\frac{1}{(a - b)^4} \int \left(1 - \frac{3}{t} + \frac{3}{t^2} - \frac{1}{t^3} \right) dt. \\ &= -\frac{1}{(a - b)^4} \left[t - 3\ln|t| - \frac{3}{t} + \frac{1}{2t^2} \right] \text{ where } t = \frac{x - b}{x - a} \end{aligned}$$

Q. 29 The area bounded by the curves $y = \cos x$ and $y = \sin x$ between the ordinates $x = 0$ and $x = \frac{3\pi}{2}$ is

Option 1:

$$4\sqrt{2} - 2$$

Option 2:

$$4\sqrt{2} + 2$$

Option 3:

$$4\sqrt{2} - 1$$

Option 4:

$$4\sqrt{2} + 1$$

Correct Answer:

$$4\sqrt{2} - 2$$

Solution:

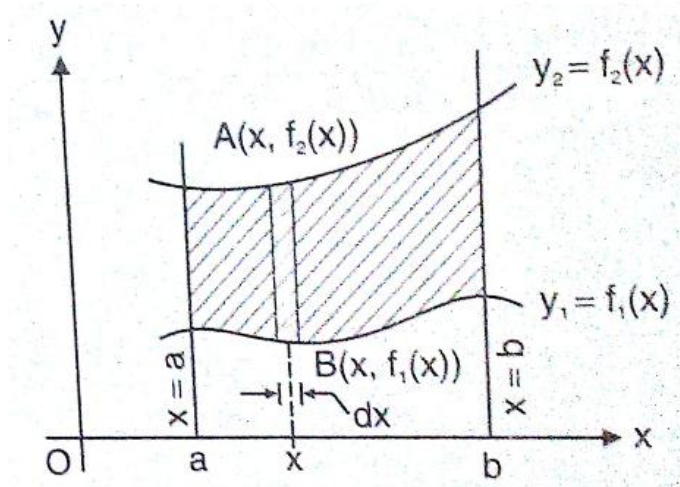
As we learnt in

Area along x axis -

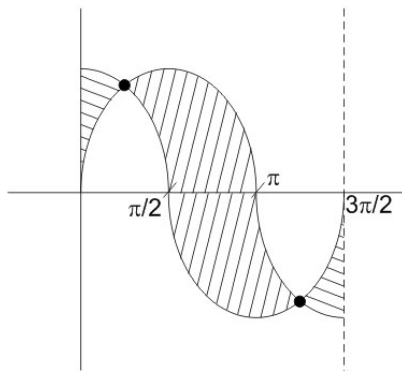
Let $y_1 = f_1(x)$ and $y_2 = f_2(x)$ be two curve then area bounded between the curves and the lines $x = a$ and $x = b$ is

$$\left| \int_a^b \Delta y \, dx \right| = \left| \int_a^b (y_2 - y_1) \, dx \right|$$

- wherein



Where $\Delta y = f_2(x) - f_1(x)$



$$\begin{aligned}
 \text{Area} &= \int_0^{\frac{\pi}{4}} (\cos x - \sin x) dx + \int_{\frac{\pi}{4}}^{\frac{5\pi}{4}} (\sin x - \cos x) dx + \int_{\frac{5\pi}{4}}^{\frac{3\pi}{2}} (\cos x - \sin x) dx \\
 &= [\sin x + \cos x]_0^{\frac{\pi}{4}} + [-\cos x - \sin x]_{\frac{\pi}{4}}^{\frac{5\pi}{4}} + [\sin x + \cos x]_{\frac{5\pi}{4}}^{\frac{3\pi}{2}} \\
 &= \sqrt{2}^{-1} + [\sqrt{2} + \sqrt{2}] + 1(-1) + \sqrt{2} \\
 &= 4\sqrt{2} - 2
 \end{aligned}$$

Q. 30 The area bounded between the parabolas $x^2 = \frac{y}{4}$ and $x^2 = 9y$ and the straight line $y = 2$ is

Option 1:
 $20\sqrt{2}$

Option 2:
 $\frac{10\sqrt{2}}{3}$

Option 3:
 $\frac{20\sqrt{2}}{3}$

Option 4:
 $10\sqrt{2}$

Correct Answer:
 $\frac{20\sqrt{2}}{3}$

Solution:

$$x^2 = \frac{y}{4}, x^2 = 9y$$

Area bounded by the parabolas and $y = 2$

$$= 2 \times \int_0^2 \left(3\sqrt{y} - \frac{\sqrt{y}}{2} \right) dy = 5 \int_0^2 \sqrt{y} dy$$

$$= 5 \times \frac{(y)^{3/2}}{3/2} = \frac{10}{3} \times 2\sqrt{2} = \frac{20\sqrt{2}}{3}$$

Q. 31 The area (in square units) bounded by the curves $y = \sqrt{x}$, $2y - x + 3 = 0$, x - axis, and lying in the first quadrant is :

Option 1:
 $\frac{27}{4}$

Option 2:
 9

Option 3:
 36

Option 4:
 18

Correct Answer:
 9

Solution:

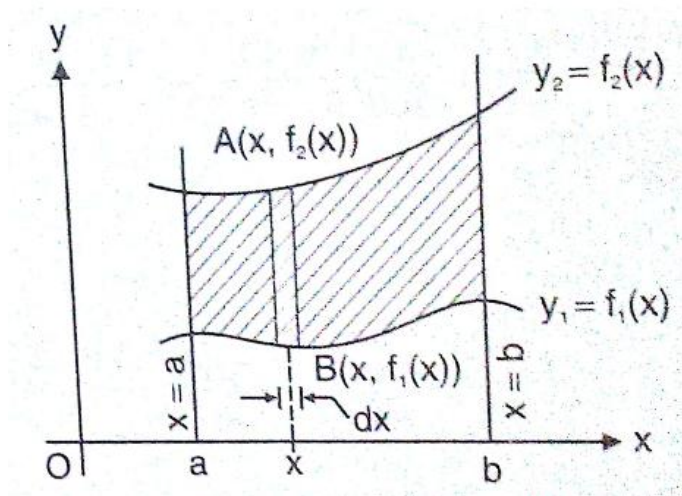
As learnt in concept

Area along x axis -

Let $y_1 = f_1(x)$ and $y_2 = f_2(x)$ be two curve then area bounded between the curves and the lines $x = a$ and $x = b$ is

$$\left| \int_a^b \Delta y \, dx \right| = \left| \int_a^b (y_2 - y_1) \, dx \right|$$

- wherein



Where $\Delta y = f_2(x) - f_1(x)$

$$\begin{aligned}
 \text{Area} &= \int_0^9 \sqrt{x} dx - \int_3^9 \frac{(x-3)}{2} dx \\
 &= \left[\frac{x^{\frac{3}{2}}}{\frac{3}{2}} \right]_0^9 - \frac{1}{2} \left[\frac{x^2}{2} \right]_3^9 + \frac{3}{2} (x)_3^9 \\
 &= 18 - \frac{1}{2} \times 36 + \frac{3}{2} \times 6 \\
 &= 9
 \end{aligned}$$

Q. 32 The area of the region described by $A = \{(x, y) : x^2 + y^2 \leq 1 \text{ and } y^2 \leq 1 - x\}$ is:

Option 1:

$$\frac{\pi}{2} - \frac{2}{3}$$

Option 2:

$$\frac{\pi}{2} + \frac{2}{3}$$

Option 3:

$$\frac{\pi}{2} + \frac{4}{3}$$

Option 4:

$$\frac{\pi}{2} - \frac{4}{3}$$

Correct Answer:

$$\frac{\pi}{2} + \frac{4}{3}$$

Solution:

as LEARNT IN CONCEPT

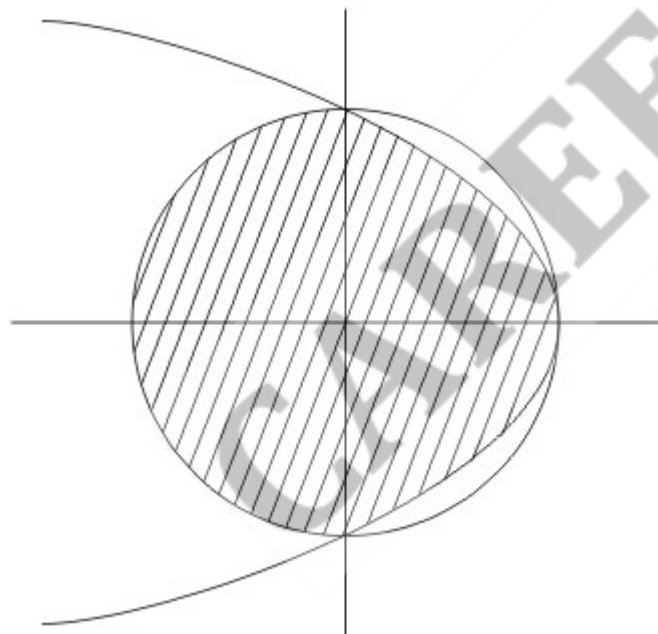
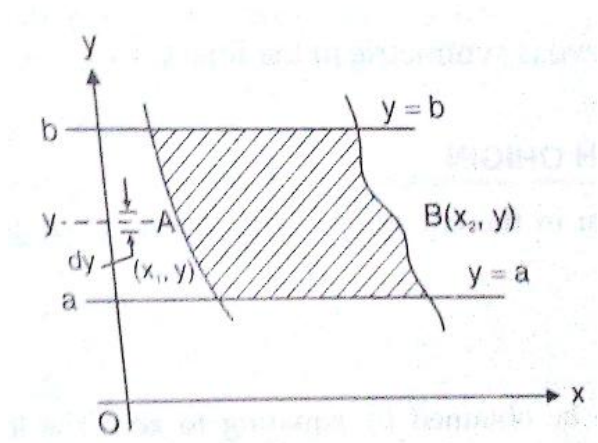
Area along y axis -

Let $y_1 = f_1(x)$ and $y_2 = f_2(x)$ be two curve, then area bounded by the curves and the lines

$y = a$ and $y = b$ is

$$A = \int_a^b (x_2 - x_1) dy$$

- wherein



$$Area = \frac{\pi}{2} + 2 \int_0^1 \sqrt{1-x} dx$$

$$Area = \frac{\pi}{2} - 2 \left[\frac{2(1-x)^{\frac{3}{2}}}{3} \right]_0^1$$

$$Area = \frac{\pi}{2} + \frac{2}{3} \times 2 = \frac{\pi}{2} + \frac{4}{3}$$

Q. 33 Solution of differential equation $xdx + ydy = \sqrt{x^4 + x^2y^2}dx$ is

Option 1:

$$2\sqrt{x^2 + y^2} - x^2 = c$$

Option 2:

$$2\sqrt{x^2 + y^2} + x^2 = c$$

Option 3:

$$2\sqrt{x^2 + y^2} - x = c$$

Option 4:

$$2\sqrt{x^2 + y^2} + x = c$$

Correct Answer:

$$2\sqrt{x^2 + y^2} - x^2 = c$$

Solution:

As we have learnt,

General form of Variable Separation -

$$d\left(\sqrt{x^2 + y^2}\right) = \frac{xdx + ydy}{\sqrt{x^2 + y^2}}$$

Given equation can be written as -

$$\begin{aligned} xdx + ydy &= x\sqrt{x^2 + y^2}dx \\ \Rightarrow \frac{xdx + ydy}{\sqrt{x^2 + y^2}} &= xdx \\ \Rightarrow d\left(\sqrt{x^2 + y^2}\right) &= xdx \end{aligned}$$

On Integrating we get

$$\begin{aligned} \sqrt{x^2 + y^2} &= \frac{x^2}{2} + c \\ \Rightarrow 2\sqrt{x^2 + y^2} - x^2 &= c \end{aligned}$$

Q. 34 Solution of differential equation $(x^2 - xy)dy = (xy + y^2)dx$ is

Option 1:

$$\ln(xy) - y/x = C$$

Option 2:

$$\ln(xy) + x/y = C$$

Option 3:

$$\ln(xy) + y/x = C$$

Option 4:

$$\ln(xy) - x/y = C$$

Correct Answer:

$$\ln(xy) + x/y = C$$

Solution:

As we have learned

General form of Variable Separation -

$$d(\log xy) = \frac{ydx + xdy}{xy}$$

-

Given equation can be written as

$$x^2 dy - xy dx = xy dy + y^2 dx$$

$$\Rightarrow x(xdy - ydx) = y(xdy + ydx)$$

$$\Rightarrow x(xdy - ydx)/y = (xdy + ydx)$$

dividing both sides by xy we get

$$\Rightarrow (xdy - ydx)/y^2 = (xdy + ydx)/xy$$

$$\Rightarrow -((xdy - ydx)/y^2) = d(\ln xy)$$

$$\Rightarrow -(d(x/y)) = d(\ln xy)$$

On integrating both sides we get

$$\Rightarrow -x/y = \ln xy + C$$

$$\Rightarrow \ln(xy) + x/y = C$$

Q. 35 Which of the following is a linear differential equation ?

Option 1:

$$\sin x \frac{dy}{dx} = \cos x(1 - y)$$

Option 2:

$$\sin x \frac{dy}{dx} = \cos y(1 - x)$$

Option 3:

$$\sin y \frac{dy}{dx} = \cos x(1 - y)$$

Option 4:

None of these

Correct Answer:

$$\sin x \frac{dy}{dx} = \cos x(1 - y)$$

Solution:

As we have learned

Linear Differential Equation -

$$\frac{dy}{dx} + Py = Q$$

- wherein

P, Q are functions of x alone.

$$(A) \rightarrow \sin x \frac{dy}{dx} = \cos x(1 - y) \Rightarrow dy/dx = \cot x(1 - y)$$

$$\Rightarrow dy/dx + (\cot x)y = \cot x$$

where P and Q both are one function of x alone

$$(B) \rightarrow \sin x \frac{dy}{dx} = \cos y(1 - x)$$

$$\Rightarrow dy/dx = \cos y / \sin x - \left(\frac{\cos y}{\sin x} \right) x = \frac{\cos y}{\sin x}$$

It is not a form of linear differential equation

$$(C) \rightarrow \sin y \frac{dy}{dx} = \cos x (1 - y)$$

$$\Rightarrow dy/dx = \cos x / \sin y - \left(\frac{\cos x}{\sin y} \right) y = \frac{\cos x}{\sin y}$$

here P and Q are not function of x alone

Q. 36

Let $y = y(x)$ be the solution of the differential equation, $x \frac{dy}{dx} + y = x \log_e x$, ($x > 1$).

If $2y(2) = \log_e 4 - 1$, then $y(e)$ is equal to :

Option 1:

$$\frac{e^2}{4}$$

Option 2:

$$-\frac{e}{2}$$

Option 3:

$$-\frac{e^2}{2}$$

Option 4:

$$\frac{e}{4}$$

Correct Answer:

$$\frac{e}{4}$$

Solution:

Linear Differential Equation -

$$\frac{dy}{dx} + Py = Q$$

- wherein

P, Q are functions of x alone.

Linear Differential Equation -

Multiply by $e^{\int P dx}$ which is the Integrating factor

- wherein

P is the function of x alone

$$x \frac{dy}{dx} + y = x \log_e x, \quad (x > 1).$$

$$\frac{dy}{dx} + \frac{y}{x} = \log_e x$$

$$I.F. = e^{\int \frac{dx}{x}} = x$$

$$yx = \int x \log_e x \, dx$$

$$\Rightarrow xy = (\log_e x) \times \frac{x^2}{2} - \frac{x^2}{4} + C$$

Putting $x = 2$ we get $C = 0$

$$y = \frac{x}{2} \log_e x - \frac{x}{4}$$

$$y(e) = \frac{e}{2} - \frac{e}{4} = \frac{e}{4}$$

Q. 37 Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = \hat{i} - \hat{j} - \hat{k}$, $\vec{c} = 2\hat{i} + \hat{j} - \hat{k}$ then a vector in the place of $\vec{b}$ and $\vec{c}$ are perpendicular to $\vec{a}$ is

Option 1:

$$4\hat{i} - \hat{j} - 3\hat{k}$$

Option 2:

$$4\hat{i} + \hat{j} + 3\hat{k}$$

Option 3:

$$4\hat{i} - \hat{j} + 3\hat{k}$$

Option 4:

$$4\hat{i} + \hat{j} - 3\hat{k}$$

Correct Answer:

$$4\hat{i} - \hat{j} - 3\hat{k}$$

Solution:

As we have learned

Vector Triple Product -

$\vec{a} \times (\vec{b} \times \vec{c})$ is a vector perpendicular to the plane containing $\vec{a}, \vec{b}, \vec{c}$ are three vectors.

-

Required vector can be either in direction of $\vec{a} \times (\vec{b} \times \vec{c})$ or in opposite direction

$$\vec{a} \times (\vec{b} \times \vec{c}) = (\vec{a} \cdot \vec{c})\vec{b} - (\vec{a} \cdot \vec{b})\vec{c} =$$

$$2(\hat{i} - \hat{j} - \hat{k}) - (-1)(2\hat{i} + \hat{j} - \hat{k}) = 4\hat{i} - \hat{j} - 3\hat{k}$$

Q. 38 Let $\vec{a}, \vec{b}$ and $\vec{c}$ are vector then a vector which is such that, it is not perpendicular to $\vec{c}$ and $\vec{a} \times \vec{b}$ together is

Option 1:

$$\vec{c} \times (\vec{a} \times \vec{b})$$

Option 2:

$$(\vec{a} \times \vec{b}) \times \vec{c}$$

Option 3:

$$\frac{\vec{c} \times (\vec{a} \times \vec{b})}{|\vec{c} \times (\vec{a} \times \vec{b})|}$$

Option 4:

none

Correct Answer:

none

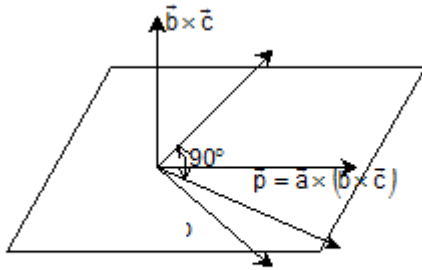
Solution:

As we have learned

Vector Triple Product -

$\vec{a} \times (\vec{b} \times \vec{c})$ is a vector perpendicular to $\vec{a}$ and $(\vec{b} \times \vec{c})$

- wherein



IN (A), (B) and (C) vector has direction perpendicular to both $\vec{c}$ and $(\vec{a} \times \vec{b})$

Q. 39 $\vec{a}, \vec{b}, \vec{c}$ are three vectors , then $\vec{a} \times (\vec{b} \times \vec{c}) - (\vec{a} \times \vec{b}) \times \vec{c}$ equals

Option 1:

$$\vec{0}$$

Option 2:

$$(\vec{c} \cdot \vec{b})\vec{a} + (\vec{a} \cdot \vec{b})\vec{c}$$

Option 3:

$$(\vec{a} \cdot \vec{b})\vec{c} - (\vec{c} \cdot \vec{b})\vec{a}(\vec{a} \times \vec{b}) \times \vec{c}$$

Option 4:

$$(\vec{c} \cdot \vec{b})\vec{a} - (\vec{a} \cdot \vec{b})\vec{c}$$

Correct Answer:

$$(\vec{c} \cdot \vec{b})\vec{a} - (\vec{a} \cdot \vec{b})\vec{c}$$

Solution:

As we have learned

Vector Triple Product (VTP) -

$$\vec{a} \times (\vec{b} \times \vec{c}) \neq (\vec{a} \times \vec{b}) \times \vec{c}$$

- wherein

$\vec{a}, \vec{b}, \vec{c}$ are three vectors.

$$\vec{a} \times (\vec{b} \times \vec{c}) = (\vec{a} \cdot \vec{c})\vec{b} - (\vec{a} \cdot \vec{b})\vec{c}$$

$$(\vec{a} \times \vec{b}) \times \vec{c} = (\vec{c} \cdot \vec{a})\vec{b} - (\vec{c} \cdot \vec{b})\vec{a}$$

$$\vec{a} \times (\vec{b} \times \vec{c}) - (\vec{a} \times \vec{b}) \times \vec{c} = (\vec{c} \cdot \vec{b})\vec{a} - (\vec{a} \cdot \vec{b})\vec{c}$$

Q. 40 A tetrahedron has centroid $\hat{i} + 2\hat{j} + \hat{k}$ with position vector $\hat{i} - \hat{j}, 2\hat{i} + \hat{j}, -3\hat{i} + \hat{k}$.

Then fourth vector has position vector

Option 1:

$$4\hat{i} - 8\hat{j} + 8\hat{k}$$

Option 2:

$$4\hat{i} + 8\hat{j} + 3\hat{k}$$

Option 3:

$$4\hat{k}$$

Option 4:

$$4\hat{i} - 8\hat{j} - 3\hat{k}$$

Correct Answer:

$$4\hat{i} + 8\hat{j} + 3\hat{k}$$

Solution:

As we have learned

Centroid of tetrahedron -

$$\text{Position Vector of tetrahedron} = \frac{1}{4} [\vec{a} + \vec{b} + \vec{c} + \vec{d}]$$

- wherein

$\vec{a}, \vec{b}, \vec{c}, \vec{d}$ are four vectors.

$$\hat{i} + 2\hat{j} + \hat{k} = 1/4(\hat{i} - \hat{j} + 2\hat{i} + \hat{j} - \hat{i} + \hat{k} + \vec{r})$$

$$\hat{i} + 2\hat{j} + \hat{k} = 1/4(\vec{k} + \vec{r}) \Rightarrow \vec{r} = 4\hat{i} + 8\hat{j} + 3\hat{k}$$

Q. 41 The equation of the plane containing the straight line $x/2 = y/3 = z/4$ and the perpendicular to the plane containing the straight lines $x/3 = y/4 = z/2$ and $x/4 = y/2 = z/3$ is:

Option 1:

$$5x + 2y - 4z = 0$$

Option 2:

$$x + 2y - 2z = 0$$

Option 3:

$$x - 2y + z = 0$$

Option 4:

$$3x + 2y - 3z = 0$$

Correct Answer:

$$x - 2y + z = 0$$

Solution:

Equation of any plane passing through the line of intersection of two planes (Cartesian form) -

The equation of any plane passing through the line of intersection of two planes

$$ax + by + cz + d = 0 \text{ and}$$

$$a_1x + b_1y + c_1z + d_1 = 0 \text{ is given by}$$

$$(ax + by + cz + d) + \lambda(a_1x + b_1y + c_1z + d_1) = 0$$

-

From the concept we have learned vector along the normal to the plane containing the lines

$$\frac{x}{3} = \frac{y}{4} = \frac{z}{2} \text{ and } \frac{x}{4} = \frac{y}{2} = \frac{z}{3} \text{ is}$$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 4 & 2 \\ 4 & 2 & 3 \end{vmatrix} = 8\hat{i} - \hat{j} - 10\hat{k}$$

vector perpendicular to the vectors $2\hat{i} + 3\hat{j} + 4\hat{k}$ and $8\hat{i} - \hat{j} - 10\hat{k}$ is

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 8 & -1 & -10 \\ 2 & 3 & 4 \end{vmatrix} = 26\hat{i} - 52\hat{j} + -26\hat{k}$$

So, the required plane is

$$26x - 52y + 26z = 0 \text{ or } x - 2y + z = 0$$

Q. 42

The plane containing the line $\frac{x-3}{2} = \frac{y+2}{-1} = \frac{z-1}{3}$ and also containing its projection on the plane $2x + 3y - z = 5$, contains which one of the following points?

Option 1:

(0,-2,2)

Option 2:

(-2,2,2)

Option 3:

(2,0,-2)

Option 4:

(2,2,0)

Correct Answer:

(2,0,-2)

Solution:

Plane passing through a point and a line (vector form) -

Let the plane passes through $A(\vec{a})$ and a line $\vec{r} = \vec{b} + \lambda\vec{c}$, then the plane is given by

$$[r \ b \ c] + [r \ c \ a] = [a \ b \ c]$$

- wherein

$$\vec{n} = (\vec{b} - \vec{a}) \times (\vec{c})$$

$$(\vec{r} - \vec{a}) \cdot (\vec{b} - \vec{a}) \times (\vec{c}) = 0$$

Normal vector of the plane is

$$(2\hat{i} - \hat{j} + 3\hat{k}) \times (2\hat{i} + 3\hat{j} - \hat{k}) = 8(-\hat{i} + \hat{j} + \hat{k})$$

Hence, the equation of plane is

Equation of plane :

$$-(x - 3) + (y + 2) + (z - 1) = 0$$

$$-x + 3 + y + 2 + z - 1 = 0$$

$$-x + y + z + 4 = 0$$

(2,0,-2) satisfies the plane

Q. 43 The perpendicular distance from the origin to the plane containing the two lines,
 $\frac{x+2}{3} = \frac{y-2}{5} = \frac{z+5}{7}$ and $\frac{x-1}{1} = \frac{y-4}{4} = \frac{z+4}{7}$ is :

Option 1:

$$\frac{11}{\sqrt{6}}$$

Option 2:

$$6\sqrt{11}$$

Option 3:

$$11$$

Option 4:

$$11\sqrt{6}$$

Correct Answer:

$$\frac{11}{\sqrt{6}}$$

Solution:

Condition for line to be lie in plane -

$$\vec{b} \cdot \vec{n} = 0 \text{ and } \vec{a} \cdot \vec{n} = d \text{ or}$$

$$a_1a + b_1b + c_1c = 0 \text{ and } a_1x_1 + b_1y_1 + c_1z_1 + d = 0$$

L_1 pass through $(-2, 2, -5)$ and L_2 pass through $(1, 4, -4)$

Direction ratio of L_1 i.e. $D_1 = (3, 5, 7)$ and Direction ratio of L_2 , $D_2 = (1, 4, 7)$

Equation of plane will be.

$$P = \begin{vmatrix} x - (-2) & y - 2 & z - (-5) \\ 3 & 5 & 7 \\ 1 & 4 & 7 \end{vmatrix} = 0$$

$$P = x - 2y + z + 11 = 0$$

Now, perpendicular distance from the origin $(0, 0, 0)$

$$\frac{|11|}{\sqrt{(1)^2 + (-2)^2 + (1)^2}} = \frac{11}{\sqrt{6}}$$

Q. 44 If an angle between the line, $\frac{x+1}{2} = \frac{y-2}{1} = \frac{z-3}{-2}$ and the plane, $x - 2y - kz = 3$ is $\cos^{-1}\left(\frac{2\sqrt{2}}{3}\right)$, then a value of k is :

Option 1:

$$-\frac{3}{5}$$

Option 2:

$$\sqrt{\frac{5}{3}}$$

Option 3:

$$-\frac{5}{3}$$

Option 4:

$$\sqrt{\frac{3}{5}}$$

Correct Answer:

$$\sqrt{\frac{5}{3}}$$

Solution:

Angle between line and Plane (Cartesian form) -

The angle between a line and the line

$$\frac{x - x_1}{a} = \frac{y - y_1}{b} = \frac{z - z_1}{c} \text{ plane}$$

$a_1x + b_1y + c_1z + d = 0$ is given by

$$\sin \Theta = \frac{a_1a + b_1b + c_1c}{\sqrt{a_1^2 + b_1^2 + c_1^2} \sqrt{a^2 + b^2 + c^2}}$$

$$\cos(90 - \Theta) = \frac{\vec{n}_1 \cdot \vec{v}}{|\vec{n}_1| |\vec{v}|}$$

$$\sin \Theta = \frac{(\hat{i} - 2\hat{j} - k\hat{k})(2\hat{i} + \hat{j} - 2\hat{k})}{\sqrt{4 + 1 + k^2} \sqrt{4 + 4 + 1}}$$

$$\frac{1}{3} = \frac{|2 - 2 + 2k|}{3\sqrt{5 + k^2}}$$

$$|2k| = \sqrt{5 + k^2}$$

$$\Rightarrow k = \pm \sqrt{5/3}$$

-

Q. 45 Equation of plane parallel to $2x - 3y + 4z + 5 = 0$ and also passing through $(1, 1, 1)$ is

Option 1:

$$2x - 3y + 4z = 3$$

Option 2:

$$2x + 3y - 5z = 0$$

Option 3:

$$x + 2y - 3z = 0$$

Option 4:

$$x + 4y + 5z = 10$$

Correct Answer:

$$2x - 3y + 4z = 3$$

Solution:

As we have learned

Equation of plane parallel to given plane -

The equation of plane parallel to

$$ax + by + cz + d = 0 \text{ is given by}$$

$$ax + by + cz + k = 0$$

-

Required plane will be of form $2x - 3y + 4z + k = 0$ But it will satisfy (1,1,1) so on putting it, we get $k = -3$

$\therefore 2x - 3y + 4z = 3$ is the required plane

Q. 46 The probability that 4th power of a positive integer ends in the digit 6 is:

Option 1:

10 %

Option 2:

20 %

Option 3:

25 %

Option 4:

40 %

Correct Answer:

40 %

Solution:

Probability of occurrence of an event -

Let S be the sample space then the probability of occurrence of an event E is denoted by P(E) and it is defined as

$$P(E) = \frac{n(E)}{n(S)}$$

$$P(E) \leq 1$$

$$P(E) = \lim_{n \rightarrow \infty} \left(\frac{r}{n} \right)$$

- wherein

Where n repeated experiment and E occurs r times.

Last place can be occupied by (0 – 9) 10 methods.

to get '6' at unit place of x^4 Last digit should be 2, 4, 6 or 8 is 4 ways

$$\Rightarrow p = \frac{4}{10} = 40\%$$

Q. 47 What is the probability of getting 9 Heads if Total coin toss = 11 ?

Option 1:

$$110 \times \left(\frac{1}{2} \right)^{11}$$

Option 2:

$$55 \times \left(\frac{1}{2} \right)^{10}$$

Option 3:

$$55 \times \left(\frac{1}{2} \right)^9$$

Option 4:

$$110 \times \left(\frac{1}{2} \right)^{12}$$

Correct Answer:

$$110 \times \left(\frac{1}{2}\right)^{12}$$

Solution:

As we learned

Probability of occurrence of an event -

Let S be the sample space then the probability of occurrence of an event E is denoted by P(E) and it is defined as

$$P(E) = \frac{n(E)}{n(S)}$$

$$P(E) \leq 1$$

$$P(E) = \lim_{n \rightarrow \infty} \left(\frac{r}{n}\right)$$

- wherein

Where n repeated experiment and E occurs r times.

$$\text{So } P(H) = \frac{1}{2} = P(T)$$

$$P(9 \text{ Heads}) = {}^{11}C_9 \left(\frac{1}{2}\right)^{11} = 55 \times \left(\frac{1}{2}\right)^{11} = 110 \times \left(\frac{1}{2}\right)^{12}$$

Q. 48 It is given that the events A and B are such that $P(A) = \frac{1}{4}$, $P(A | B) = \frac{1}{2}$ and $P(B | A) = \frac{2}{3}$. Then $P(B)$ is:

Option 1:

$$\frac{1}{2}$$

Option 2:

$$\frac{1}{6}$$

Option 3:

$$\frac{1}{3}$$

Option 4:

$$\frac{2}{3}$$

Correct Answer:

$$\frac{1}{3}$$

Solution:

As we learnt in

Conditional Probability -

$$P\left(\frac{A}{B}\right) = \frac{P(A \cap B)}{P(B)}$$

and

$$P\left(\frac{B}{A}\right) = \frac{P(A \cap B)}{P(A)}$$

- wherein

where $P\left(\frac{A}{B}\right)$ probability of A when B already happened.

$$P(B|A) P(A) = P(A|B) P(B) = P(A \cap B)$$

$$\Rightarrow \frac{1}{4} \times \frac{2}{3} = \frac{1}{2} \times P(B)$$

$$\Rightarrow P(B) = \frac{1}{3}$$

Q. 49 A problem in mathematics is given to three students A, B, C and their respective probability of solving the problem is $1/2, 1/3$ and $1/4$. Probability that the problem is solved is

Option 1:

$$3/4$$

Option 2:

1/2

Option 3:

2/3

Option 4:

1/3

Correct Answer:

3/4

Solution:

Let A be the event that A solves the problem,

B be the event that B solves the problem and

C be the event that C solves the problem.

Now, P(problem is solved)

= 1 - P(problem is not solved by anyone)

= 1 - P(A' ∩ B' ∩ C')

= 1 - P(A').P(B').P(C') [As A, B, C are independent events]

$$= 1 - \frac{1}{2} \times \frac{2}{3} \times \frac{3}{4}$$

$$= 1 - \frac{1}{4}$$

$$= \frac{3}{4}$$

Q. 50

An unbiased coin is tossed. If the outcome is a head then a pair of unbiased dice is rolled and the sum of the numbers obtained on them is noted. If the toss of the coin results in tails then a card from a well-shuffled pack of nine cards numbered 1,2,3,...,9 is randomly picked and the number on the card is noted. The probability that the noted number is either 7 or 8 is:

Option 1:

13/36

Option 2:

15/72

Option 3:

19/72

Option 4:

19/36

Correct Answer:

19/72

Solution:

Probability of occurrence of an event -

Let S be the sample space then the probability of occurrence of an event E is denoted by P(E) and it is defined as

$$P(E) = \frac{n(E)}{n(S)}$$

$$P(E) \leq 1$$

$$P(E) = \lim_{n \rightarrow \infty} \left(\frac{r}{n} \right)$$

- wherein

Where n repeated experiment and E occurs r times.

Independent events -

If A and B are independent events then probability of occurrence of A is not affected by occurrence or non occurrence of event B.

$$\therefore P\left(\frac{A}{B}\right) = P(A)$$

$$\text{and } \therefore P(A \cap B) = P(B) \cdot P\left(\frac{A}{B}\right)$$

$$\text{so } \therefore P(A \cap B) = P(A) \cdot P(B) = P(AB)$$

-

From the concept

getting head or tail, probability is $\frac{1}{2}$

Now,

$$\text{Start } \xrightarrow{\frac{1}{2}} \text{H} \rightarrow \text{sum 7 or 8} \Rightarrow \frac{11}{36}$$

$$\xrightarrow{\frac{1}{2}} \text{T} \rightarrow \text{number 7 or 8} \Rightarrow \frac{2}{9}$$

$$P(A) = \frac{1}{2} \times \frac{11}{36} + \frac{1}{2} \times \frac{2}{9}$$

$$= \frac{19}{72}$$

CAREERS360

CUET 2022 - Biology Sample Paper

Q. 1 Which of the following statements are correct w.r.t chlamydospores?

Option 1:

These are thick-walled spores that are produced directly through budding.

Option 2:

These are thick-walled spores that are produced directly from the hyphal cells.

Option 3:

These can multiply by budding.

Option 4:

These are always intercalary in position.

Correct Answer:

These are thick-walled spores that are produced directly from the hyphal cells.

Solution:

As we have learnt:

Chlamydospores:

- These are thick-walled spores that are produced directly from the hyphal cells.
- These can be terminal or intercalary in position.
- These are seen in *Rhizopus* and mushrooms.

Hence, the option b is correct.

Q. 2 Read the following statements and choose the option with correct statements:

- a) Conidia are exogenous spores in basidiomycetes.
- b) Zoospores are flagellated spores in many algal species.
- c) Oidia are produced directly from hyphal cells.
- d) Oidia can multiply by budding.

Option 1:

a & b

Option 2:

b & d

Option 3:

b & d

Option 4:

b & c

Correct Answer:

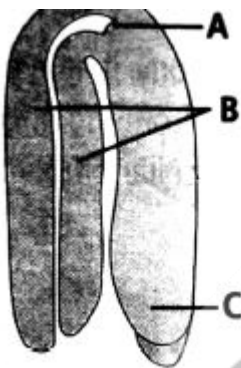
b & d

Solution:

- Zoospores are motile and flagellated spores produced in zoosporangia. These generally lack a cell wall. These are seen in Phycomycetes and many algae.
- Conidia are formed in ascomycetes fungi. These are non-motile spores that can be formed singly or in a chain on special branches called conidiophores. These are produced exogenously.
- Oidia are formed when the hyphae break and each fragment forms a spore. These can multiply by budding.

Hence, only statements b & d are correct.

Q. 3 Identify the different parts of typical dicot embryo labelled as A, B and C and select the correct option.



Option 1:

A – plumule B – cotyledons C – radicle

Option 2:

A – radicle B – cotyledons C – plumule

Option 3:

A – cotyledons B – plumule C – radicle

Option 4:

A – cotyledons B – radicle C – plumule

Correct Answer:

A – plumule B – cotyledons C – radicle

Solution:

As we learn

Dicotyledonous embryo -

A dicotyledonous embryo, consists of an embryonal axis and two cotyledons. The portion of embryonal axis above the level of cotyledons is the epicotyl, which terminates with the plumule or stem tip. The cylindrical portion below the level of cotyledons is that terminates at its lower end in the radicle or root tip. The root tip is covered with a root cap.

Hence, the correct answer is option a, i.e., A – plumule B – cotyledons C – radicle

Q. 4 In which of the following plants double fertilization occurs?

Option 1:

Pinus

Option 2:

Marchantia

Option 3:

Ferns

Option 4:

Maize

Correct Answer:

Maize

Solution:

As we have learnt in Double Fertilization -

- After entering one of the synergids, the pollen tube releases the two male gametes into the cytoplasm of the synergid.
- One of the male gametes moves towards the egg cell and fuses with its nucleus thus completing the syngamy.
- This results in the formation of a diploid cell, the zygote.
- The other male gamete moves towards the two polar nuclei located in the central cell and fuses with them to produce a triploid primary endosperm nucleus (PEN).
- As this involves the fusion of three haploid nuclei it is termed triple fusion.
- Since two types of fusions, syngamy and triple fusion take place in an embryo sac the phenomenon is termed double fertilisation, an event unique to flowering plants.
- The central cell after triple fusion becomes the primary endosperm cell (PEC) and develops into the endosperm while the zygote develops into an embryo.

Double fertilization is a characteristic feature of angiosperms, the flowering plants. Maize is an angiosperm, hence option d is correct answer.

Q. 5 Self-incompatibility:

- a) Provides a biochemical block to self-fertilization.
- b) Ensures cross-fertilization.
- c) Is governed by pollen-pistil interaction.
- d) Is governed by series of multiple alleles.
- e) Prevents self pollen (from the same flower or other flowers of the same plant) from fertilizing the ovules inhibiting pollen germination or pollen tube growth in the pistil.

Option 1:

All are correct

Option 2:

a, b & e are correct

Option 3:

a, b & c are correct

Option 4:

None of these are correct

Correct Answer:

All are correct

Solution:

As we have learnt in Self Incompatibility -

- Self-incompatibility or intraspecific incompatibility is a well-designed genetic mechanism by which certain plants recognize and reject their own pollen thus forcing outbreeding.
- It is defined as "the inability of the plant producing functional gametes to set seeds upon self-pollination".
- Gametophytic self-incompatibility is due to the genotype of pollen, for example, Liliaceae, Solanaceae, Poaceae.
- Sporophytic self-incompatibility is due to the genotype of sporophytic or stigmatic tissues, for example, Brassicaceae.

Hence, the correct answer is option a.

Q. 6 _____ microspores are needed to make 200 pollen grains and _____ microspore mother cells are needed to make 200 microspores.

Choose the correct option to fill up the blanks:

Option 1:

50; 200

Option 2:

200; 200

Option 3:

200; 50

Option 4:

200; 100

Correct Answer:

200; 50

Solution:

200 microspores will form 200 pollen grains and 50 microspore mother cells will undergo meiosis to form 200 microspores.

Hence, the correct answer is option c.

Q. 7 Out of hPL, relaxin , testosterone , LH and FSH. How many hormones release during pregnancy?

Option 1:

1

Option 2:

4

Option 3:

2

Option 4:

All of these

Correct Answer:

2

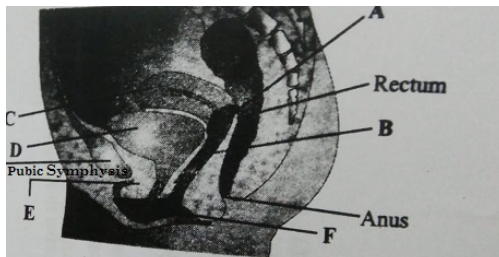
Solution:

As we have discussed in Placentation -

- Placenta acts as an endocrine tissue and produces several hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogens, progestogens, etc.
- In the later phase of pregnancy, a hormone called relaxin is also secreted by the ovary.
- The hCG, hPL and relaxin are produced in women during pregnancy.
- In addition, during pregnancy the levels of other hormones like estrogens, progestogens, cortisol, prolactin, thyroxine, etc. are increased several folds in the maternal blood.
- Increased production of these hormones is essential for supporting the fetal growth, metabolic changes in the mother and maintenance of pregnancy.

Hence, the correct option is (c).

Q. 8 Identify the parts labelled as A to F from the given diagram of human female reproductive system and select the correct option.



Option 1:

A – Cervix , B – Vagina, C – Uterus , D – Urinary bladder , E – Clitoris , F – Vaginal orifice

Option 2:

A – Vagina , B - Cervix , C - Urinary bladder , D – Uterus, E - Vaginal orifice, F – Clitoris

Option 3:

A – Urethra , B – Vagina , C - Urinary bladder , D - Cervix , E – Uterus, F - Clitoris

Option 4:

A - Vaginal orifice, B - Cervix , C - Uterus, D - Urethra , E – Clitoris, F - Urinary bladder

Correct Answer:

A – Cervix , B – Vagina, C – Uterus , D – Urinary bladder , E – Clitoris , F – Vaginal orifice

Solution:

As we learn

Female reproductive system -

The female reproductive system consists of a pair of ovaries along with a pair of oviducts, uterus, cervix, vagina and the external genitalia located in the pelvic region.

- wherein

These parts of the system along with a pair of the mammary glands are integrated structurally and functionally to support the processes of ovulation, fertilisation, pregnancy, birth and child care.

Q. 9 Given below are three statements each with one or two blanks . Select the option which correctly fills up the blanks in any two statements

A) In human beings , menstrual cycle ceases around 50 years of age ; this is termed as (i) _____

B) The milk produced during the initial few days of lactation is called (i)_____ which contains several (ii)_____ absolutely essential to develop resistance for the new-born babies

C) At the completion of the (i)_____ division the primary oocyte divides into secondary oocytes and (ii)_____

Option 1:

A(i) menarche , B(i) lactation , B(ii) minerals

Option 2:

B(i) Colostrum , B(ii) antibodies , C(i) first meiotic , C(ii) first polar body

Option 3:

A(i) menopause , C(i) second meiotic , C(ii) second polar body

Option 4:

A(i) menopause , B(i) Corpus luteum , B(ii) Antibodies

Correct Answer:

B(i) Colostrum , B(ii) antibodies , C(i) first meiotic , C(ii) first polar body

Solution:

As we have learned

Lactation -

The mammary glands of the female undergo differentiation during pregnancy and starts producing milk towards the end of pregnancy by the process called lactation

- wherein

This helps the mother in feeding the newborn.

B(i) Colostrum , B(ii) antibodies , C(i) first meiotic , C(ii) first polar body

Q. 10 Match the items given in Column I with those in Column II and select the correct option given below :

	Column I		Column II
a.	Proliferative Phase	i.	Breakdown of endometrial lining
b.	Secretory Phase	ii.	Follicular Phase
c.	Menstruation	iii.	Luteal Phase

Option 1:

a	b	c
ii	iii	i

Option 2:

a	b	c
i	iii	ii

Option 3:

a	b	c
iii	ii	i

Option 4:

a	b	c
iii	i	ii

Correct Answer:

a	b	c
ii	iii	i

Solution:

As we learnt in

Follicular phase -

The menstrual phase is followed by the follicular phase. During this phase, the primary follicles in the ovary grow to become a fully mature Graafian follicle and simultaneously the endometrium of uterus regenerates through proliferation.

- wherein

(i) This phase usually includes cycle days 6-13 or 14 in a 28 days cycle.

(ii) The follicle stimulating hormone (FSH) secreted by the anterior lobe of the pituitary gland stimulates the ovarian follicle to secrete oestrogens.

(iii) Oestrogen stimulates the proliferation of the endometrium of the uterine wall.

(iv) The endometrium becomes thicker by rapid cell multiplication and this is accompanied by an increase in uterine glands & blood vessels

Luteal phase -

The ovulation (ovulatory phase) is followed by the luteal phase during which the remaining parts of the Graafian follicle transform as the corpus luteum.

During proliferative phase, the follicles start developing, hence, called follicular phase. Secretory phase is also called as luteal phase mainly controlled by progesterone secreted by corpus luteum. Estrogen further thickens the endometrium maintained by progesterone.

Menstruation occurs due to decline in progesterone level and involves breakdown of overgrown endometrial lining.

- Q. 11** Identify the parts labelled as A,B,C,D and E in the given diagram of human sperm and select the correct option.



Option 1:

A – nucleus, B – tail , C – mitochondria , D – acrosome , E – centriole

Option 2:

A - acrosome , B – nucleus , C – centriole , D – mitochondria , E – plasma membrane

Option 3:

A - nucleus , B - mitochondria , C – plasma membrane , D – centriole , E – neck

Option 4:

A - acrosome , B – centriole , C – mitochondria , D – plasma membrane , E – tail

Correct Answer:

A - acrosome , B – nucleus , C – centriole , D – mitochondria , E – plasma membrane

Solution:

As we learn

Structure of a sperm -

A sperm is composed of a head, neck, a middle piece and a tail. A plasma membrane envelops the whole body of sperm.

- wherein

Therefore, A - acrosome , B – nucleus , C – centriole , D – mitochondria in middle piece, E – plasma membrane.

Q. 12 Veneral diseases can spread through:

- (a) Using sterile needles
- (b) Transfusion of blood from infected person
- (c) Infected mother of foetus
- (d) Kissing
- (e) Inheritance

Choose the correct answer from the options given below.

Option 1:

(a), (b) and (c) only

Option 2:

(b), (c) and (d) only

Option 3:

(b) and (c) only

Option 4:

(a) and (c) only

Correct Answer:

(b) and (c) only

Solution:

Correct option is (c)

Veneral diseases are STD's

Q. 13 In case of a couple, where the male is having a very low sperm count , which technique will be suitable for fertilisation?

Option 1:

Intrauterine transfer

Option 2:

Gamete intracytoplasmic fallopian transfer

Option 3:

Artificial insemination

Option 4:

Intracytoplasmic sperm injection

Correct Answer:

Artificial insemination

Solution:

As discussed in Intrauterine Insemination -

Intrauterine Insemination:

- Infertility cases either due to inability of the male partner to inseminate the female or due to very low sperm count in the ejaculates could be corrected by artificial insemination (AI).
 - Intrauterine Insemination is the process of transfer of a man's sperm into a woman's uterus with the help of a long narrow tube.
 - It is possible to apply this method in combination with stimulation of ovulation. Together the processes can sometimes increase the chances of pregnancy.
- Hence, the correct option is (c).

Q. 14 Select the correct statement w.r.t natural contraceptive methods

1. Natural methods are irreversible contraceptive methods.
2. Condoms , diaphragms are natural contraceptives.
3. Couple abstains coitus when a female is at the most fertile stage.
4. Natural methods are not grouped under temporary methods.

Option 1:

2

Option 2:

4

Option 3:

1

Option 4:

3

Correct Answer:

3

Solution:

As we have already discussed in Temporary Methods of Birth Control - Natural Methods

Natural methods are grouped under temporary methods because this method does not involve the permanent cessation of pregnancy and is based on natural physiological procedures. Types of natural methods are periodic abstinence, coitus interruptus and lactation amenorrhea. Hence, the correct option is (d).

Q. 15 Fill in the blank

Mendel proposed that ____ were being stably passed down , unchanged from parent to offspring these ____ pass through the gametes over successive generation

Option 1:

Genes

Option 2:

Genotypes

Option 3:

Factors

Option 4:

Alleles

Q. 16 Find out the gene sequence on a chromosome based on the following data:

Linked Gene Pair	Cross-Over Value
T and U	25
T and V	5
V and U	30
V and W	10

Option 1:

VTWU

Option 2:

TVWU

Option 3:

BTWVU

Option 4:

VWTU

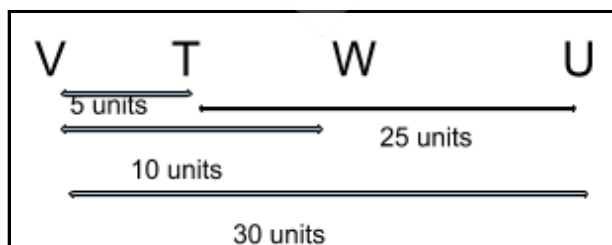
Correct Answer:

VTWU

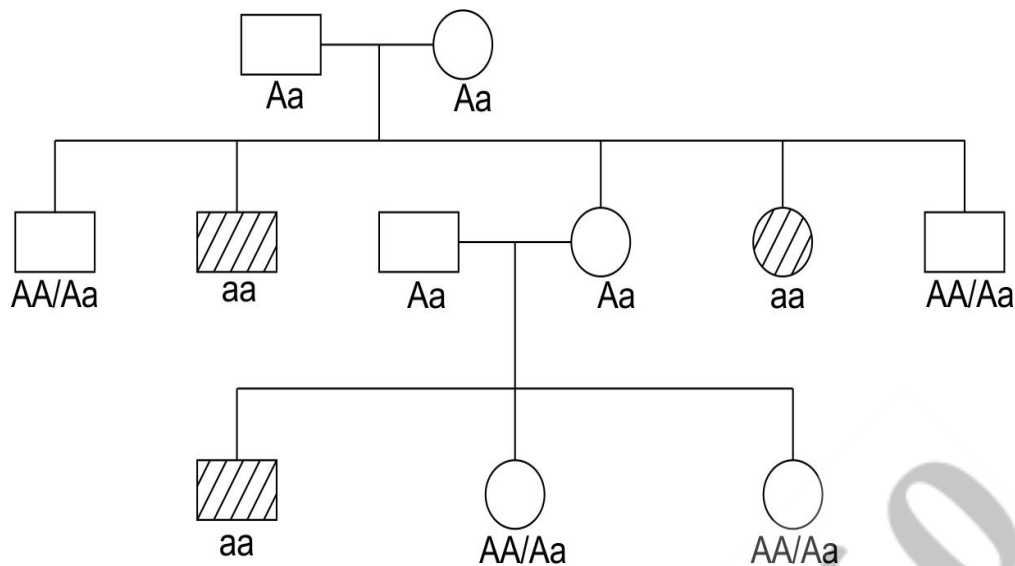
Solution:

As we have already studied in Gene Mapping -

In the given question, Genes V and U would be at the extreme owing to the maximum distance between them. Based on the data given, the gene sequence would be:



Q. 17 Study the pedigree chart given below: What does it show?



Option 1:

inheritance of a condition like phenylketonuria as an autosomal recessive trait

Option 2:

The pedigree chart is wrong as this is not possible

Option 3:

Inheritance of a recessive sex - linked disease like haemophilia

Option 4:

Inheritance of a sex - linked inborn error of metabolism like phenylketonuria

Correct Answer:

inheritance of a condition like phenylketonuria as an autosomal recessive trait

Solution:

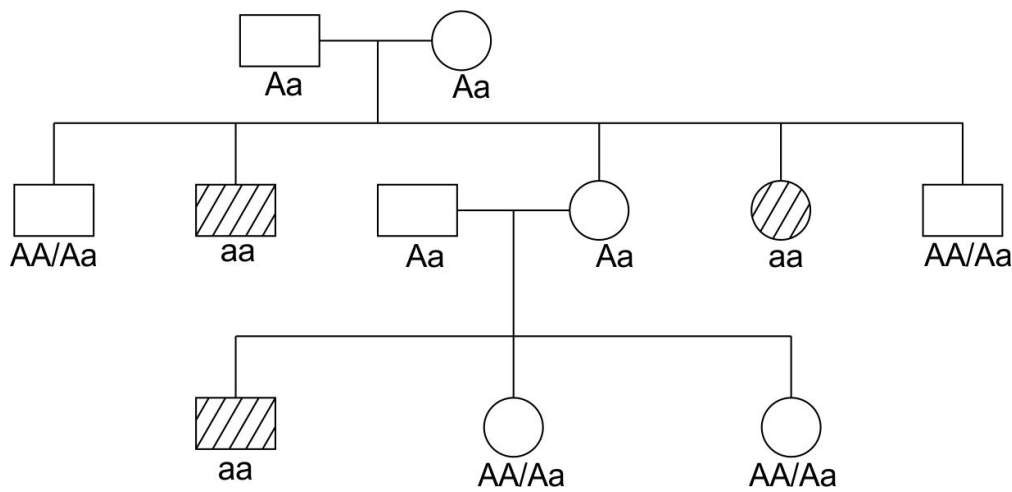
As we learnt in

phenylketonuria -

This is an inborn error of metabolism, also inherited as autosomal recessive trait.

- wherein

Also a kind of mendelian disorder



Pedigree shows autosomal recessive trait.

Q. 18 If a plant is having a genotype AABbCC, how many different types of gametes can be produced?

Option 1:

3

Option 2:

4

Option 3:

9

Option 4:

2

Correct Answer:

2

Solution:

As discussed in Polygenic Inheritance -

- ABC and abc are the two types of gametes that can be produced by a plant having a genotype of AABbCC.
- Alternatively, we can also use the formula 2^n , where n = number of heterozygous genes.
- Here, heterozygous gene is Bb, so $n = 1$
- $2^n = 2^1 = 2$
- So, only two types of gametes are possible.
- Hence, the correct option is (d).

Q. 19 If the offspring of a cross show a 9/16 to 3/16 to 3/16 to 1/16 ratio (9:3:3:1), the parents of the cross have the genotypes

Option 1:
AaBb x AaBb

Option 2:
AaBb x aaBB

Option 3:
aaBb x aabb

Option 4:
aaBb x Aabb

Correct Answer:
AaBb x AaBb

Solution:

As we have discussed in Dihybrid Cross -

- 9:3:3:1 represents the typical phenotypic ratio obtained in F₂ generation when the parents are heterozygous for both the genes.

Hence, the correct option is (a).

Q. 20 Select the correct option

Direction of RNA Synthesis	Direction of reading of the template DNA strand
----------------------------	---

Option 1:

5' - 3'	3' - 5'
---------	---------

Option 2:

3' - 5'	5' - 3'
---------	---------

Option 3:

5' - 3'	5' - 3'
---------	---------

Option 4:

3' - 5'	3' - 5'
---------	---------

Correct Answer:

5' - 3'	3' - 5'
---------	---------

Solution:

As we learnt in

Process of Transcription -

There is a single DNA dependent RNA polymerase that catalyses transcription of all types of RNA in bacteria.

Q. 21 The two antiparallel strands in a DNA double helix are held together by :

Option 1:

Hydrogen bond

Option 2:

electrostatic force of attraction

Option 3:

gravitational force

Option 4:

van der Waals force

Correct Answer:
Hydrogen bond

Solution:

As learnt in Salient Features of Double-Helix Structure of DNA -

The bases in two strands are paired through hydrogen bond (H-bonds) forming base pairs (bp). Adenine forms two hydrogen bonds with Thymine from the opposite strand and vice-versa. Similarly, Guanine is bonded with Cytosine with three H-bonds.

Hence, the correct option is (a).

Q. 22 Select the two correct statements out of the four (a-d) given below about lac operon.

- a. Glucose or galactose may bind with the repressor and inactivate it
- b. In the absence of lactose the repressor binds with the operator region
- c. The z-gene codes for permease
- d. This was elucidated by Francois Jacob and Jacque Monod

The correct statements are

Option 1:

(a) and (b)

Option 2:

(b) and (c)

Option 3:

(a) and (c)

Option 4:

(b) and (d)

Correct Answer:

(b) and (d)

Q. 23 Which of the following refer to correct example(s) of organisms which have evolved due to changes in the environment brought about by anthropogenic action?

- A Darwin's Finches of Galapagos islands.
- B Herbicide-resistant weeds
- C Drug-resistant eukaryotes
- D Man created breeds of domesticated animals like dogs

Option 1:

only (a)

Option 2:

(a) and (c)

Option 3:

(b),(c) and (d)

Option 4:

only (d)

Correct Answer:

(b),(c) and (d)

Solution:

Anthropogenic actions are due to the direct or indirect effects of human actions on the environment. Resistance due to antibiotics, use of herbicide and artificial breeding of domesticated animals are examples of anthropogenic actions. Hence, the correct option is (c).

Q. 24 A Hominid fossil discovered in Java in 1891, now extinct, having cranial capacity of about 900 cc was:

Option 1:

Neanderthal man

Option 2:

Homo sapiens

Option 3:

Australopithecus

Option 4:

Homo erectus

Correct Answer:

Homo erectus

Solution:

- Homo erectus fossil were discovered in Java near Indonesia in 1891. The cranial capacity was 900 c.c
 - This was named by Eugene Dubois
 - Mayer named it as Homo erectus erectus
 - They were the first to use fire for hunting and cooking
-

Q. 25 In a population of 1000 individuals 360 belong to genotype AA, 480 to Aa and the remaining 160 to aa. Based on this data, the frequency of allele A in the population is:

Option 1:

0.4

Option 2:

0.5

Option 3:

0.6

Option 4:

0.7

Correct Answer:

0.6

Solution:

As we learnt in

The Hardy-Weinberg formulas -

This formula allows detecting frequencies that change from generation thus allowing a simplified method of determining that evolution is occurring.

- wherein

In a population at equilibrium for a locus of two alleles D and d having frequencies p and q respectively, the genotype frequencies are:

$$DD=p^2,$$

$$Dd= 2 pq,$$

$$dd= q^2$$

$$\text{and } p+q =1$$

$$p^2+2 pq +q^2 = 1$$

According to Hardy - Weinberg principle

In a population at equilibrium for a locus of two alleles D and d having frequencies p and q respectively, the genotype frequencies are:

$$DD=p^2,$$

$$Dd= 2 pq,$$

$$dd= q^2$$

and $p+q = 1$

$$p^2 + 2pq + q^2 = 1$$

so,

$$p^2 = 36 \text{ out of } 100 \text{ individual}$$

$$q^2 = 16 \text{ out of } 100$$

$$q = 0.16^{1/2} = 0.4$$

$$\text{now, } p + q = 1$$

$$p + 0.4 = 1$$

$$\text{therefore, } p = 0.6$$

Q. 26 Which of the following is affected by the infection of *Wuchereria bancrofti*?

Option 1:

Lymphatic vessels

Option 2:

Respiratory system

Option 3:

Nervous system

Option 4:

Blood circulation

Correct Answer:

Lymphatic vessels

Solution:

Effects of elephantiasis -

In elephantiasis, there is slow developing chronic inflammation of the organs in which the worms live for many years, usually the lymphatic vessels of the lower limbs.

- wherein

The genital organs are also often affected, resulting in gross deformities.

Q. 27 Study carefully the following stages of life cycle of malaria parasite i.e. **Plasmodium**. Arrange these stages in the correct sequence and select the correct answer.

1. Sporozoites leave the blood stream and enter the liver cells of man.
2. Sporozoites present in the salivary glands of female **Anopheles** mosquito are injected into the blood stream of man.
3. The parasite reproduces asexually in RBCs, resulting in bursting of RBCs and causing the cycles of fever; released parasites infect new RBCs.
4. The parasite reproduces asexually in liver cells, ultimately causing the rupturing of cells.
5. Two types of gametocytes i.e., microgametocytes and macrogametocytes develop in the RBCs.
6. Female **Anopheles** mosquito takes up the gametocytes with blood meal of an infected person.
7. Mature infective stage of the parasite i.e., sporozoites escape from intestine and migrate to the mosquito's salivary glands.
8. Fertilization and developmental stages of the parasite take place in mosquito's stomach.

Option 1:

2-1-4-3-5-6-8-7

Option 2:

2-4-1-3-5-6-7-8

Option 3:

1-2-4-3-5-6-8-7

Option 4:

6-8-7-4-5-2-3-1

Correct Answer:

2-1-4-3-5-6-8-7

Solution:

female Anopheles -

Female Anopheles is the carrier of the protozoa causing malaria.

- wherein

The malarial parasite requires two hosts – human and mosquitoes – to complete its life cycle. The female Anopheles mosquito is the vector (transmitting agent) too.

Q. 28 Match column I and column II and select the correct answer from codes given below.

Column I

- A. Allergy
- B. Helper T- cells
- C. AIDS virus
- D. X- Rays
- E. Treatment of cancer

Column II

- i) activation of B- cells
- ii) immunotherapy
- iii) carcinogens
- iv) IgE
- v) single stranded RNA

Option 1:

A- (iv), B- (i), C- (v), D- (iii), E- (ii)

Option 2:

A- (ii), B- (i), C- (v), D- (iii), E- (iv)

Option 3:

A- (iv), B- (v), C- (iii), D- (ii), E- (i)

Option 4:

A- (ii), B- (v), C- (iii), D- (i), E- (iv)

Correct Answer:

A- (iv), B- (i), C- (v), D- (iii), E- (ii)

Solution:

Treatment of cancer -

Chemotherapy (chemo) is a type of treatment that includes a medication or combination of medications to treat cancer

- wherein

The goal of chemo is to stop or slow the growth of cancer cells. Chemo is considered a systemic therapy. This means it may affect your entire body. Chemo medications attack rapidly growing cancer cells, but they can also affect healthy cells that grow rapidly.

Q. 29 Breeding of crops with high levels of minerals, vitamins and proteins is called

Option 1:

Micropropagation

Option 2:

Somatic hybridisation

Option 3:

Biofortification

Option 4:

Biomagnification

Correct Answer:

Biofortification

Q. 30 Fill up the blanks in the following paragraph by selecting the correct option.

Inbreeding increases (i)_____. Thus inbreeding is necessary if we want to evolve a (ii)_____ in any animal. Inbreeding exposes harmful (iii)_____ genes that are eliminated by selection.

Option 1:

(i) Heterozygosity, (ii) pure line, (iii) dominant

Option 2:

(i) Heterozygosity, (ii) breed, (iii) recessive

Option 3:

(i) Homozygosity, (ii) pure line, (iii) recessive

Option 4:

(i) Homozygosity, (ii) breed, (iii) dominant

Correct Answer:

(i) Homozygosity, (ii) pure line, (iii) recessive

Solution:

As we have learnt,

Advantages of Inbreeding -

1. Inbreeding exposes harmful recessive genes that are eliminated by selection.
2. Inbreeding increases homozygosity.
3. It also helps in accumulation of superior genes and elimination of less desirable genes.
4. this approach, where there is selection at each step, increases the productivity of inbred population

Q. 31 Which of the following is not an objective of Biofortification in crops ?

Option 1:

Improve protein content

Option 2:

Improve resistance to diseases

Option 3:

Improve vitamin content

Option 4:

and mineral content

Correct Answer:

Improve resistance to diseases

Solution:

Correct option is (b)

Improve resistance to diseases

Q. 32 match the following columns and select the correct option

Column -I	Column -II
(a) Eosinophils	(i) Immune response
(b) basophils	(ii) Phagocytes
(c) Neutrophils	(iii) Release histamine, destructive enzymes
(d) Lymphocytes	(iv) Release granules containing histamine

Option 1:

(a)	(b)	(c)	(d)
iii	iv	ii	i

Option 2:

(a)	(b)	(c)	(d)
iv	i	ii	iii

Option 3:

(a)	(b)	(c)	(d)
i	ii	iv	iii

Option 4:

(a)	(b)	(c)	(d)
ii	i	iii	iv

Correct Answer:

(a)	(b)	(c)	(d)
iii	iv	ii	i

Solution:

- a. Eosinophils - release histamine, destructive enzymes
- b. Basophils - release granules containing histamine
- c. Neutrophils - Phagocytes
- d. Lymphocytes - Immune response

Hence, the correct option is (a).

Q. 33 Match of the following columns and select the correct otion.

Column I	Column II
(a) Clostridium butylicum	(i) Cyclosporin - A
(b) Trichoderma polysprom	(ii) Butyric acid
(c) Monascus purpureus	(iii) Citric acid
(d) Aspergillus niger	(iv) Blood cholestrol lowering agent

Option 1:

(a)	(b)	(c)	(d)
iii	iv	ii	i

Option 2:

(a)	(b)	(c)	(d)
ii	i	iv	iii

Option 3:

(a)	(b)	(c)	(d)
i	ii	iv	iii

Option 4:

(a)	(b)	(c)	(d)
iv	iii	ii	i

Correct Answer:

(a)	(b)	(c)	(d)
ii	i	iv	iii

Solution:

- a. Clostridium butylicum - Butyric acid
 - b. Trichoderma polysporum - Cyclosporin - A
 - c. Monascus purpureus - Blood cholesterol lowering agent
 - d. Aspergillus niger - Citric acid
-

Q. 34 The term 'Biotechnology' was coined by

Option 1:

Charles Darwin

Option 2:

Stanley Cohen

Option 3:

Karl Ereky

Option 4:

Paul Berg

Correct Answer:

Karl Ereky

Solution:

As discussed in Biotechnology & Its Principles -

- The term 'biotechnology' was coined in 1917 by Karl Ereky. Hence, the correct option is (c).
-

Q. 35 pBR322 was the first artificial cloning vector to be constructed. What does "BR" stand for ?

Option 1:

Bacteriophage and Recombinant

Option 2:

Boliver and Rodriguez

Option 3:

Boyer and Replicative

Option 4:

None of these

Correct Answer:

Boliver and Rodriguez

Solution:

As we have learned

Naming of plasmid -

1st letter indicates plasmid 2nd and 3rd letters indicates name of scientists who discovered . Numbers decide the number of trials.

- wherein

P B R 3 2 2

P=plasmid

B=Boliver

R=Rodriguez

322=No. of trials

Q. 36 In a ploymerase chain reaction , temprature required for the steps

- 1) Denaturation,
- 2) Annealing and
- 3) Extension are respectively

Option 1:

1) 94°C 2) 40°C 3) 72°C

Option 2:

1) 40°C 2) 72°C 3) 94°C

Option 3:

1) 94°C 2) 72°C 3) 40°C

Option 4:

1) 72°C 2) 94°C 3) 40°C

Correct Answer:

1) 94°C 2) 40°C 3) 72°C

Solution:

As we have learned

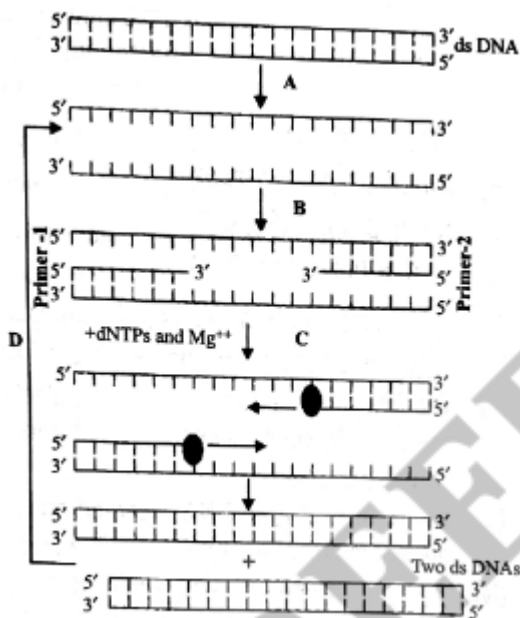
Annealing -

(Anneal=Join). In this step two complementary oligonucleotides primers hybridize to each of the single stranded DNA template.

- wherein

This step is carried out at low temperature $\sim 50^{\circ}\text{C}$

Q. 37 Given figure represents the steps involved in polymerase chain reaction (PCR). Identify the steps A, B, C and D and select the correct option



Option 1:

- A - Denaturation at $94-96^{\circ}\text{C}$
- B - Extension through *Taq* polymerase at 72°C
- C - Repetition of denaturation and annealing
- D - Annealing at 72°C

Option 2:

- A - Denaturation at $94-96^{\circ}\text{C}$
- B - Annealing at $40-60^{\circ}\text{C}$
- C - Extension through *Taq* polymerase at 72°C
- D - Repetition of denaturation and annealing

Option 3:

- A - Denaturation at $40-60^{\circ}\text{C}$
- B -
- C - Extension through *Taq* polymerase at $94-96^{\circ}\text{C}$
- D - Repetition of denaturation and annealing

Option 4:

- A - Extension through **Taq** polymerase at 72°C
- B - Denaturation at 40°C
- C - Annealing at 72°C
- D - Repetition of denaturation and annealing

Correct Answer:

- A - Denaturation at 94-96°C
- B - Annealing at 40-60°C
- C - Extension through **Taq** polymerase at 72°C
- D - Repetition of denaturation and annealing

Solution:

As we have learned

Steps in PCR -

PCR is performed in a temperature controlling machine, called as thermocycler. Denaturation, primer annealing and primer extension are three steps of PCR

Q. 38 Match the organisms with its use in biotechnology

- | | |
|--------------------------------------|----------------------------------|
| (a) <i>Bacillus thuringiensis</i> | (i) Cloning vector |
| (b) <i>Thermus aquaticus</i> | (ii) Construction of first r DNA |
| (c) <i>Agrobacterium tumefaciens</i> | (iii) DNA polymerase |
| (d) <i>Salmonella typhimurium</i> | (iv) Cry proteins |

Select the correct option from the following :

Option 1:

- | | | | |
|------------|------------|------------|------------|
| (a) | (b) | (c) | (d) |
| (ii) | (iv) | (iii) | (i) |

Option 2:

- | | | | |
|------------|------------|------------|------------|
| (a) | (b) | (c) | (d) |
| (iv) | (iii) | (i) | (ii) |

Option 3:

- | | | | |
|------------|------------|------------|------------|
| (a) | (b) | (c) | (d) |
| (iii) | (ii) | (iv) | (i) |

Option 4:

- | | | | |
|------------|------------|------------|------------|
| (a) | (b) | (c) | (d) |
| (iii) | (iv) | (i) | (ii) |

Correct Answer:

- | | | | |
|------------|------------|------------|------------|
| (a) | (b) | (c) | (d) |
| (iv) | (iii) | (i) | (ii) |

Solution:

Bacillus thuringiensis produces cry protein and that is given only in option 2.

Q. 39 If '+' sign is assigned to beneficial interaction, '-' sign to detrimental and '0' sign to neutral interaction, then the population interaction represented by '+' '-' refers to

Option 1:
mutualism

Option 2:
amensalism

Option 3:
commensalism

Option 4:
parasitism

Correct Answer:
parasitism

Solution:

As we learnt in

Parasitism -

Parasitism is a relationship between species, where one organism, the parasite, lives on or other organisms, the host causing it some harm, and is adapted structurally to this way of life.

Parasitism is a relationship between two living organism of different species in which one organism i.e parasite obtain its food directly from the host. In this relationship the parasite is benefitted (+) and the host is harmed (-) so this type of population interaction is represented by (+) and (-)

Q. 40 The following graph depicts changes in two populations (A and B) of herbivores in a grassy field. A possible reason for these changes is that:

Option 1:
Population A produced more offspring than population B

Option 2:

Population A consumed the members of population B

Option 3:

Both plant populations in this habitat decreased

Option 4:

Population B competed more successfully for food than population A

Correct Answer:

Population B competed more successfully for food than population A

Solution:

As we learnt in

The two populations A and B are herbivores which are competing for the same food. Population A decreased as it was not well adapted as population B. Population B was able to strive for the available food.

Q. 41 Consider the following statements (A) - (D) each with one or two blanks.

(A) Bears go into --(1) -- during winter to --(2) -- cold weather

(B) A conical age pyramid with a broad base represent --(3) -- human population

(C) A wasp pollinating a fig flower is an example of --(4) --

(D) An area with high levels of species richness is known as ---(5)---

which one of the following option give the correct fill ups for the respective blank numbers from (1) to (5) in the statements

Option 1:

(2) - stable (4) commensalism, (5) marsh

Option 2:

(1) - aestivation , (5) - escape, (3) - stable, (4) - mutualism

Option 3:

(3) - expanding, (4) - commensalism, (5) biodiversity park

Option 4:

(1)- hibernation, (2) - escape, (3) expanding, (5) hot spot

Correct Answer:

(1)- hibernation, (2) - escape, (3) expanding, (5) hot spot

Solution:

As we have already learnt in Responses to Abiotic Factors: Migrate & Suspend -

Suspend in animals -

In animals, the organism, if unable to migrate, might avoid the stress by escaping in time.

- wherein

The familiar case of bears going into hibernation during winter is an example of escape in time.

Some snails and fish go into aestivation to avoid summer-related problems-heat and desiccation. Under unfavourable conditions, many zooplankton species in lakes and ponds are known to enter diapause, a stage of suspended development.

Hot Spots -

Hot Spots refer to the area with high density of diversity or mega diversity which are threatened at present." There are around 16 hot spots, out of which two are located in India by the name Western Ghats and North-East Himalayas. These hot spots are determined on the basis of four factors

- wherein

- Degree of expectation
- Degree of endemism
- Number of species diversity
- Degree of threat to habitat as a result of fragmentation and degradation.

Hence, the correct option is (d).

Q. 42 The primary producers of the deep-sea hydrothermal vent ecosystem are

Option 1:
green algae

Option 2:
chemosynthetic bacteria

Option 3:
blue-green algae

Option 4:
coral reefs

Correct Answer:
chemosynthetic bacteria

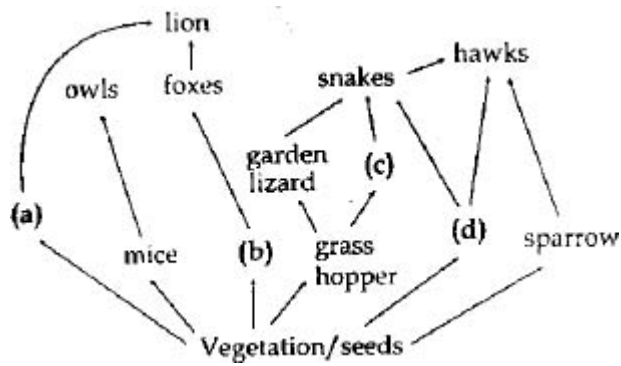
Solution:

As discussed in Functions of Ecosystem: Energy Flow -

The primary producers of the deep-sea hydrothermal vents ecosystem are archaebacteria. These have a chemosynthetic mode of nutrition.

Hence, the correct option is (b).

Q. 43 Identify the likely organisms (a),(b),(c) and (d) in the food web shown below :



Option 1:

Dog	Squirrel	Bat	Deer
-----	----------	-----	------

Option 2:

Rat	Dog	Tortoise	Crow
-----	-----	----------	------

Option 3:

Squirrel	Cat	Rat	Pigeon
----------	-----	-----	--------

Option 4:

Deer	Rabbit	Frog	rat
------	--------	------	-----

Correct Answer:

Deer	Rabbit	Frog	rat
------	--------	------	-----

Solution:

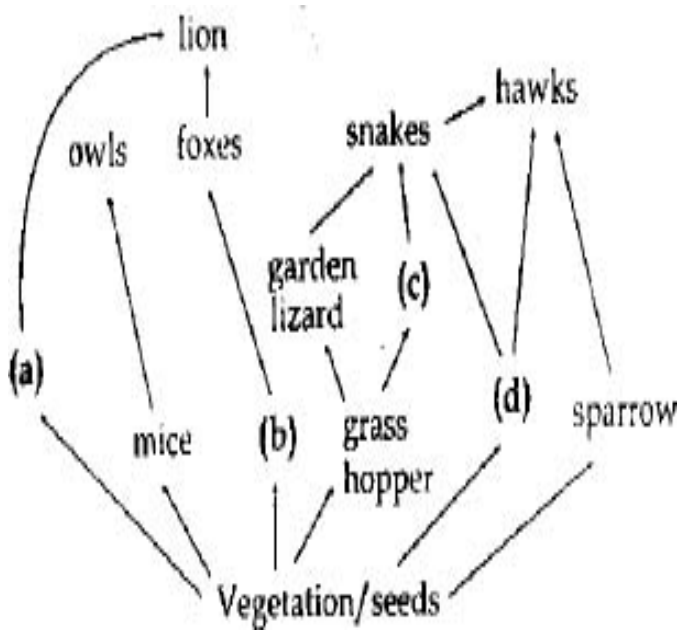
As we learnt in

Trophic Level -

Based on the source of their nutrition or food, organisms occupy a specific place in the food chain that is known as their trophic level.

- wherein

Producers belong to the first trophic level, herbivores (primary consumer) to the second and carnivores (secondary consumer) to the third.



Q. 44 Succession of plant is called

Option 1:

Hydrarch

Option 2:

Mesarch

Option 3:

Xerarch

Option 4:

More then one correct answer

Correct Answer:

More then one correct answer

Solution:

As we have already studied in Succession of Plants -

Based on the nature of the habitat – whether it is water (or very wet areas) or it is on very dry areas.

- wherein

succession of plants is called hydrarch or xerarch, respectively.

Hence, the correct option is (d).

Q. 45 The ecosystem services include

Option 1:

maintenance of biodiversity

Option 2:

pollination of crop

Option 3:

spiritual, cultural and aesthetic values

Option 4:

all of these

Correct Answer:

all of these

Solution:

As learnt in Ecosystem Services -

The products of ecosystem processes are named as ecosystem services.

- wherein

For example, healthy forest ecosystems purify air and water, mitigate droughts and floods, cycle nutrients, generate fertile soils, provide wildlife habitat, maintain biodiversity, pollinate crops, provide storage site for carbon and also provide aesthetic, cultural and spiritual values. Though value of such services of biodiversity is difficult to determine, it seems reasonable to think that biodiversity should carry a hefty price tag.

Hence, the correct option is (d).

Q. 46 Biochemical Oxygen Demand (BOD) may **not** be a good index for pollution for water bodies receiving effluents from

Option 1:

domestic sewage

Option 2:

dairy industry

Option 3:

petroleum industry

Option 4:

sugar industry

Correct Answer:
petroleum industry

Solution:

As we learnt in

Causes of water pollution -

Oil pollution

Oil is a source of pollution in sea-water. Oil pollution is due to ship accidents, loading and discharging of oil at the harbour, oil refineries and off-shore oil production. Degree of impurity of water due to organic matter is measured in terms of BOD (Biochemical Oxygen Demand). It is the demand for O_2 to decompose organic wastes in liter of water. Petroleum industry waste is rich in radium-based toxic substances that do not favor algal and plankton growth and no effect on BOD.

Hence, the correct answer is 'Petroleum Industry'

Q. 47 In the following in each set a conservation approach and an example of method of conservation are given

- (a) In-situ conservation - Biosphere Reserve
- (b) Ex-situ conservation - Sacred groves
- (c) In situ conservation - Seed bank
- (d) Ex-situ conservation - Cryopreservation

Select the option with correct match of approach and method

Option 1:

(a) and (d)

Option 2:

(b) and (d)

Option 3:

(a) and (b)

Option 4:

(a) and (c)

Correct Answer:
(a) and (d)

Q. 48 We conserve biodiversity because it provides

Option 1:

Biological resources

Option 2:

Ecosystem services

Option 3:

Social and Spiritual benefits

Option 4:

All of these

Correct Answer:

All of these

Solution:

as we learned

Why should we conserve Biodiversity? -

It is important to conserve biodiversity because of its several benefits it offers that are essential to live.

- wherein

It provides biological resources, ecosystem services, social and spiritual benefits.

Q. 49 The highest DDT concentration in aquatic food chain shall occur in

Option 1:

phytoplankton

Option 2:

seagull

Option 3:

crab

Option 4:

eel

Correct Answer:

seagull

Solution:

As we have already discussed in Water Pollution & Its Causes : Industrial Effluents & Biomagnification -

Biomagnification -

Biomagnification refers to an increase in the concentration of the toxicant at successive trophic levels. This happens because a toxic substance accumulated by an organism cannot be metabolised or excreted, and is thus passed on to the next higher trophic level. Phytoplankton is primary producers while Seagull is top consumers among the given option that feed on dead or live fishes and will exhibit the highest DDT concentration.

Hence, the correct option is (b).

Q. 50 Which of the following protocols did aim for reducing emissions of chlorofluorocarbons into the atmosphere?

Option 1:
Montreal protocol

Option 2:
Kyoto protocol

Option 3:
Gothenburg protocol

Option 4:
Geneva protocol

Correct Answer:
Montreal protocol

Solution:
Montreal Protocol -

Recognising the deleterious affects of ozone depletion, an international conference treaty, known as the Montreal Protocol, was signed at Montreal (Canada).

- wherein

In 1987 (effective in 1989) to control the emission of ozone depleting substances. Subsequently many more efforts have been made and protocols have laid down definite roadmaps, separately for developed and developing countries, for reducing the emission of CFCs and other ozone depleting chemicals.

- Montreal Protocol is an international treaty signed in 1987 to control the emission of ozone depleting substances, such as chlorofluorocarbons (CFCs)
- Kyoto protocol commits the party states to reduce the emission of greenhouse gases.
- Gothenburg protocol was signed to reduce acidification, eutrophication and ground level ozone.
- Geneva protocol prohibits the use of chemical and biological weapons as warfare methods.

CUET 2022 - General Test Sample Paper

Current Affairs

Q. 1 Which vaccine manufacturer received approval to conduct Phase-III clinical trials of an intranasal booster dose?

Option 1:

Serum Institute

Option 2:

Bharat Biotech

Option 3:

Dr Reddy's Laboratories

Option 4:

Zydus Cadila

Correct Answer:

Bharat Biotech

Solution:

Bharat Biotech received approval to conduct Phase-III clinical trials of an intranasal booster dose.

So **correct option is A.**

Q. 2 The Government of India has done 'Conversion or Switch operations' with which institution?

Option 1:

INTERPOL

Option 2:

Reserve Bank of India

Option 3:

International Court of Justice

Option 4:

World Bank

Correct Answer:

Reserve Bank of India

Solution:

Government of India has done 'Conversion or Switch operations' with Reserve Bank of India.

So, the **correct option is B.**

Q. 3 'DESH-Stack' is an Online Platform associated with which field?

Option 1:

Investment

Option 2:

Skill Development

Option 3:

GST

Option 4:

Nutrition

Correct Answer:

Skill Development

Solution:

'DESH-Stack' is an Online Platform associated with Skill Development.

So, the **correct option is B.**

Q. 4 'Neuroterus Valhalla' is the name of which newly discovered weird species?

Option 1:

Bird

Option 2:

Wasp

Option 3:

Turtle

Option 4:

Spider

Correct Answer:

Wasp

Solution:

Wasp 'Neuroterus Valhalla' is the name of newly discovered weird species.

So, the **correct option is B.**

Q. 5

Which is the nodal agency of the new scheme 'PM-DevINE'?

Option 1:

NABARD

Option 2:

North-Eastern Council

Option 3:

NITI Aayog

Option 4:

IRDAI

Correct Answer:

North-Eastern Council

Solution:

North-Eastern Council is the nodal agency of the new scheme 'PM-DevINE'.

So, the **correct option is B.**

Q. 6 99-million-years old Flowers have been discovered in protected state in which country?

Option 1:

India

Option 2:

Myanmar

Option 3:

Sri Lanka

Option 4:

USA

Correct Answer:

Myanmar

Solution:

99-million-years old Flowers have been discovered in protected state in Myanmar country.

So the **correct option is B.**

Q. 7 An ancient temple dating from the early centuries of Buddhism has been unearthed in Swat valley of which country?

Option 1:

India

Option 2:

Pakistan

Option 3:

Sri Lanka

Option 4:

Nepal

Correct Answer:
Pakistan

Solution:

In Pakistan An ancient temple dating from the early centuries of Buddhism has been unearthed in Swat valley.

So, the **correct option is B.**

Q. 8 Which institution released the report on 'Global analysis of health care waste in the context of COVID-19'?

Option 1:
NITI Aayog

Option 2:
WHO

Option 3:
John Hopkins University

Option 4:
FDA

Correct Answer:
WHO

Solution:

WHO has released the report on 'Global analysis of health care waste in the context of COVID-19'.

So, the **correct option is B.**

Q. 9 Punaaura Dham, which was seen in the news recently, is located in which state?

Option 1:
Bihar

Option 2:

Uttar Pradesh

Option 3:

Madhya Pradesh

Option 4:

Odisha

Correct Answer:

Bihar

Solution:

Punaaura Dham, is located in Bihar state?

So, the **correct option is A.**

Q. 10 'CAR T-cell therapy' which was seen in the news, is used to treat which disease?

Option 1:

Tuberculosis

Option 2:

Cancer

Option 3:

Diphtheria

Option 4:

Sickle Cell Anaemia

Correct Answer:

Cancer

Solution:

'CAR T-cell therapy' is used to treat cancer.

So, the **correct option is B.**

Q. 11 Vishnu Vaman Shirwadkar, who was seen in the news, was associated with which field?

Option 1:

Sports

Option 2:

Politics

Option 3:

Literature

Option 4:

Music

Correct Answer:

Literature

Solution:

Visnhu Vaman Shirwadkar was associated with Literature field.

So, the **correct answer is C.**

Q. 12 Which state/UT hosted India's First Ice Wall Climbing Competition?

Option 1:

Himachal Pradesh

Option 2:

Ladakh

Option 3:

Uttarakhand

Option 4:

Sikkim

Correct Answer:
Ladakh

Solution:

Ladakh hosted India's First Ice Wall Climbing Competition.

So, the **correct answer is B.**

Q. 13 What does 'U' stand for in the Logistics Platform ULIP, announced in the Union Budget 2022-23?

Option 1:
Unit

Option 2:
Unified

Option 3:
Universal

Option 4:
Unique

Correct Answer:
Unified

Solution:

In the Logistics Platform ULIP U stands for Unified.

So the **correct answer is B.**

Q. 14 Bhagat Singh Koshyari, who was seen in the news, is the Governor of which state?

Option 1:
Tamil Nadu

Option 2:
West Bengal

Option 3:

Maharashtra

Option 4:

Karnataka

Correct Answer:

Maharashtra

Solution:

Bhagat Singh Koshiyari is the Governor of Maharashtra.

So, the correct answer is C.

Q. 15 Which Institution organised the 'National Innovation Conclave on Low Carbon Technologies'?

Option 1:

NITI Aayog

Option 2:

Bureau of Energy Efficiency

Option 3:

ASSOCHAM

Option 4:

IIT Madras

Correct Answer:

Bureau of Energy Efficiency

Solution:

Bureau of Energy Efficiency organised the 'National Innovation Conclave on Low Carbon Technologies'?

So the **correct answer is B.**

Q. 16 Which institution released the 'State of India's Environment Report 2022'?

Option 1:
NITI Aayog

Option 2:
Centre for Science and Environment

Option 3:
Ministry of Environment, Forest and Climate Change

Option 4:
UNDP

Correct Answer:
Centre for Science and Environment

Solution:

Centre for Science and Environment released the 'State of India's Environment Report 2022'.
So the **correct option is B.**

Q. 17 'Zaporizhzhia Nuclear Power Plant', which was seen in the news recently, is located in which country?

Option 1:
Russia

Option 2:
Ukraine

Option 3:
Afghanistan

Option 4:
Belarus

Correct Answer:
Ukraine

Solution:

'Zaporizhzhia Nuclear Power Plant', is located in Ukraine.

So, the **correct option is B.**

Q. 18 Which Ministry approved the 'Modernisation Plan-IV for Central Armed Police Forces (CAPFs)'?

Option 1:

Ministry of Home Affairs

Option 2:

Ministry of Law and Justice

Option 3:

Ministry of Defence

Option 4:

Ministry of External Affairs

Correct Answer:

Ministry of Home Affairs

Solution:

Ministry of Home Affairs has approved the 'Modernisation Plan-IV for Central Armed Police Forces (CAPFs).'

Q. 19 Indian grey hornbills were recently reintroduced in which Indian sanctuary?

Option 1:

Gir National Park

Option 2:

Kaziranga National Park

Option 3:

Jim Corbett National Park

Option 4:

Kanha National Park

Correct Answer:
Gir National Park

Solution:

Indian grey hornbills were recently reintroduced in Gir National Park.

So, the **correct option is A.**

Q. 20 Which country has been recently added to the Grey List of 'Financial Action Task Force'?

Option 1:
Belarus

Option 2:
Russia

Option 3:
UAE

Option 4:
Ukraine

Correct Answer:
Belarus

Solution:

Belarus has been recently added to the Grey List of 'Financial Action Task Force'.

So, the **correct option is A.**

Analytical & Logical Reasoning

Q. 1 Point A is to the north of point B. Point C is to the north of point D. Point E lies midway between B and D. Point B is to the west of point D. In which direction is point C with respect to point E?

Option 1:
North-East

Option 2:
North-West

Option 3:

North

Option 4:

South-West

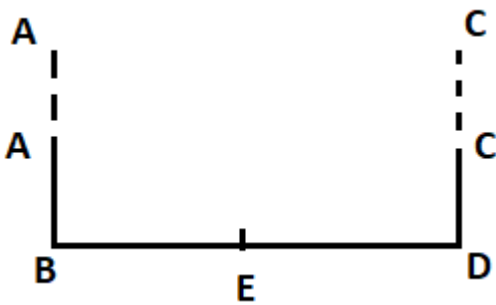
Option 5:

none of these

Correct Answer:

North-East

Solution:



Q. 2 At what time between 9 and 10 o'clock will the hands of a watch be together?

Option 1:

45 min. past 9

Option 2:

50 min. past 9

Option 3:

$49\frac{1}{11}$ min. past 9

Option 4:

48 min. past 9

Option 5:

$48\frac{2}{11}$ min. past 9

Correct Answer:

$49\frac{1}{11}$ min. past 9

Q. 3 Joy was born on Tuesday, 13th February 2018 while his brother Ray was born on 25th May of the same year. On which day of the week was Ray born?

Option 1:
Monday

Option 2:
Friday

Option 3:
Thursday

Option 4:
Saturday

Option 5:
none of these

Correct Answer:
Friday

Solution:

Total number of days = 15 (Feb) + 31 + 30 + 25 = 101 = $7 \times 14 + 3$ = Tuesday + 3 = Friday

Q. 4 A, B, C, D, E and F are six members of a family. A is the son of C and E is the daughter of A. D is the only son of F who is the mother of E. A is father of B. How is C related to D?

Option 1:
Grand Daughter

Option 2:
Grand Mother

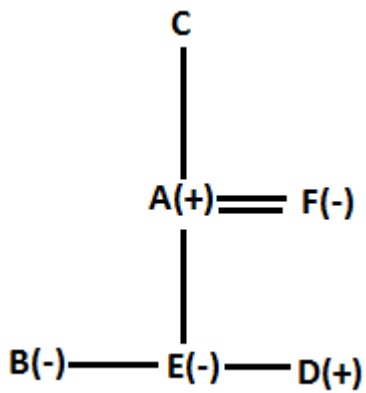
Option 3:
Grand Son

Option 4:
Cannot be determined

Option 5:
none of these

Correct Answer:
none of these

Solution:



Q. 5 In a row of students, if John , who is 16th from the left, and Johnson, who is 8th from the right, interchange their positions, John becomes 33rd from left. How many students are there in a row?

Option 1:

38

Option 2:

39

Option 3:

40

Option 4:

41

Option 5:

none of these

Correct Answer:

none of these

Solution:

After interchanging their places, John's position from right = 8th position of John from left = 33rd So, total number of students = $33 + 8 - 1 = 40$

Q. 6 In below given numerical series, how many even numbers are there, which is immediate preceded and immediately followed by even number? 29245637445893225648832

Option 1:

One

Option 2:

Two

Option 3:

Three

Option 4:

Four

Option 5:

none of these

Correct Answer:

Two

Solution:

648, 488

Q. 7

Five persons viz. Ram, Joy, Kim, Jim and Roy have different weights. Roy is heavier than Joy and Kim. Jim and Ram are lighter than Kim. Jim is not the lightest. Less than two persons are heavier than Joy. How many persons are heavier than Ram?

Option 1:

One

Option 2:

Two

Option 3:

Three

Option 4:

Four

Option 5:

none of these

Correct Answer:

Four

Solution:

Roy (heaviest) > Joy > Kim > Jim > Ram (lightest)

Q. 8

If $59 \$ 61 = 111$ and $74 \$ 28 = 129$, then $23 \$ 59 = ?$

Option 1:

187

Option 2:
127

Option 3:
177

Option 4:
137

Option 5:
none of these

Correct Answer:
127

Solution:

$23 \$ 59 = 32 + 95 = 127$ (We have to replace the units digit with the tens digit)

Q. 9 From the given answer figures, select the one in which the question figure is hidden/ embedded.

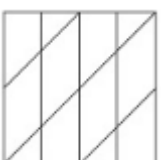
Option 1:



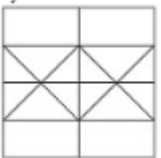
Option 2:



Option 3:



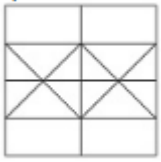
Option 4:



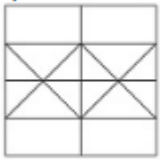
Option 5:

none of these

Correct Answer:



Solution:



Q. 10 Which of the following expressions will be definitely true if it is given that- $T > R$, $P \geq Q = R > S$ and $Q < U$?

Option 1:

$S < T$

Option 2:

$P > T$

Option 3:

$T > U$

Option 4:

$U < S$

Option 5:

none of these

Correct Answer:

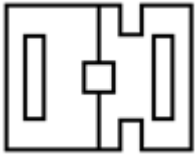
$S < T$

Solution:

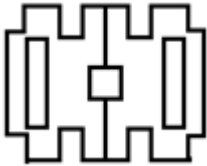
$T > R > S$.

Q. 11 A piece of paper is folded and cut as shown below in the question figures. From the given answer figures, indicate how it will appear when opened.

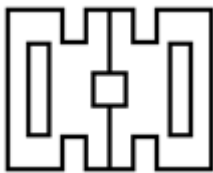
Option 1:



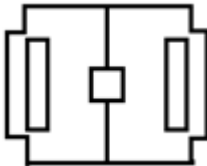
Option 2:



Option 3:



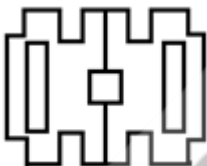
Option 4:



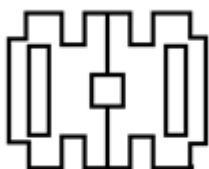
Option 5:

none of these

Correct Answer:



Solution:



Q. 12 A series is given with one term missing. Select the correct alternative from the given ones that will complete the series. ZBC10, YEF22, XHI34, ?

Option 1:

WKL44

WKL46

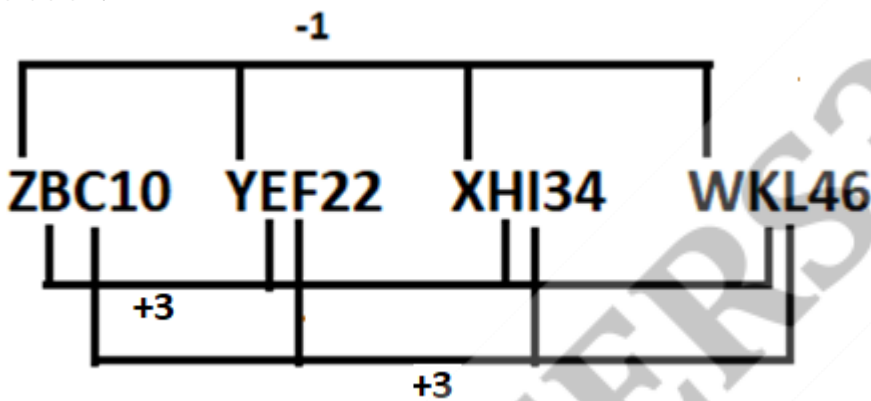
WKL48

WML46

Option 5:
none of these

WKL46

Solution:



Q. 13 Identify the diagram that best represents the relationship among the given classes. Beer, Beverage, Bear

Option 1:



Option 2:



Option 3:



Option 4:



Option 5:

none of these

Correct Answer:



Solution:

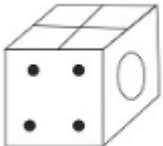


Q. 14 Which of the following cube in the answer figure cannot be made based on the unfolded cube in the question figure?

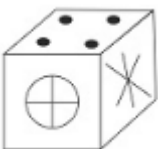
Option 1:



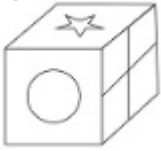
Option 2:



Option 3:



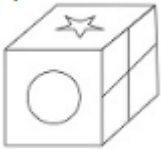
Option 4:



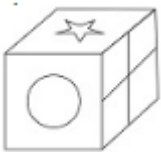
Option 5:

none of these

Correct Answer:



Solution:



Q. 15

In the question three statements are given, followed by two conclusions, I and II. You have to consider the statements to be true even if it seems to be at variance from commonly known facts. You have to decide which of the given conclusions, if any, follows from the given statements. Statement – All point is rectangle. Some point is square. No square is triangle. Conclusion-I-Some triangle is not point. II- Some rectangle is not triangle.

Option 1:

Only conclusion I follows

Option 2:

Only conclusion II follows

Option 3:

Both I and II follow

Option 4:

Either I or II follows

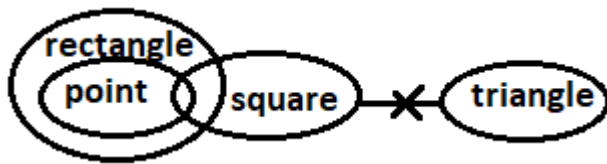
Option 5:

none of these

Correct Answer:

Only conclusion II follows

Solution:



Quantitative, Data Interpretation & Data Sufficiency

Q. 1 Find out the percentage change in the volume of cylinder if radius and height of the cylinder is increased by 50% and 16.66% respectively.

Option 1:

25%

Option 2:

12(1/2)%

Option 3:

162.5%

Option 4:

11(1/9)%

Option 5:

None of these

Correct Answer:

162.5%

Solution:

Let radius of cylinder = $2x$ Let height of cylinder = $6x$ Volume of cylinder = $\pi \times 2x \times 2x \times 6x = 24\pi x^3$ Percent increase in cubic cm radius = $2x \times 150/100 = 3x$ Percentage increase in height = $6x \times 7/6 = 7x$ New volume of cylinder = $\pi \times 3x \times 3x \times 7x = 63\pi x^3$ Percent change in cubic cm of volume = $(63x - 24x)/24x \times 100 = 162.5\%$

Q. 2 10 men and 8 women complete 1/3rd of the work in 7 days. If the remaining work has to be completed in 9 days and the number of women remains same then find how much number of men will be increased. Given that the efficiency of men to women is 2:1?

Option 1:

12 mens

Option 2:

10 mens

Option 3:

20 mens

Option 4:

18 mens

Option 5:

None of these

Correct Answer:

10 mens

Solution:

According to the question, $((10 \times 2 + 16 \times 1) \times 7) / (1/3) = ((x \times 2 + 16 \times 1) \times 9) / (2/3) \rightarrow 504 = 18x + 144 \rightarrow 360 = 18x \rightarrow x = 20$ Required number of males = $20 - 10 = 10$ males

Q. 3

A shopkeeper purchased TV sets from wholesaler at a rate of Rs. 4000 each. He marked up the price of TV sets by 28% and sells each set at a discount of 12% to its customer. Find how much profit he gets on each set of TV.

Option 1:

Rs. 575.60

Option 2:

Rs. 460

Option 3:

Rs. 465.6

Option 4:

Rs. 505.60

Option 5:

None of these

Correct Answer:

Rs. 505.60

Solution:

Cost price of each TV set = Rs.4000. Mark up price of each TV set = $4000 \times 128/100 = \text{Rs } 5120$. Selling price of each set after 12% discount = $5120 \times 88/100 = \text{Rs } 4505.60$. Profit earned by the shopkeeper on each TV set = $4505.60 - 4000 = \text{Rs } 505.60$.

Q. 4

A milkman has a container containing 140 liters of pure milk. Before the selling the milk to his customer he taken out some quantity of pure milk and replaced it with 30 liters of water in such a way that the ratio of milk and water become 11:3 respectively. again 28 liters of mixture was taken out by milkman and replaced by 22 liters of water. Find out what will be the ratio of milk and water after this procedure?

Option 1:

4:3

Option 2:

45:37

Option 3:

23:32

Option 4:

44:23

Option 5:

None of these

Correct Answer:

44:23

Solution:

Let the quantity of milk drawn initially = x liter Amount of water in the container = 0 liters then according to the question, $(140-x)/(0+30) = 11/3 = \text{milk/water} \rightarrow 420 - 3x = 330 \rightarrow x = 30$ liters initially Amount of milk drawn from the container = remaining quantity of milk in 30 liters container = $140 - 30 = 110$ liters According to the question, the mixture taken out by the milkman = 28 liters Quantity of milk drawn by the milkman in the ratio 11:3 is $\rightarrow 11/14 \times 28 = 22$ liters Amount of water taken out $\rightarrow 28 - 22 = 6$ liters After adding 22 liters of water, the ratio in the container becomes $= (110 - 22)/(30 - 6 + 22) = 88/46$ Required Ratio = 44 : 23

Q. 5

Ratio between the downstream speed of a boat to the upstream speed of a boat is 8:5. If the speed of a boat in still water is 26km/h, then find the time taken by the boat to cover a distance of 64 km in downstream?

Option 1:

3 hrs

Option 2:

2 hrs

Option 3:

3.5 hrs

Option 4:

2.5 hrs

Option 5:

None of these

Correct Answer:

2 hrs

Solution:

Let speed of boat in still water = x km/h Speed of stream = y km/h As per question, ratio of speed of boat in downstream direction $(x+y) = 8$ and ratio of speed of boat in upstream direction $(x - y) = 5$ So, here $\rightarrow x + y = 8$ ----(eq1) $x - y = 5$ ----(eq2) From equations 1 and 2, $-x + y = 8$ $x - y = 5$ we find that $x = 6.5$ and $y = 1.5$ Given that speed of boat in still water $(x) = 26$ km/hr Speed of stream (y) will be $= 26/6.5 \times 1.5 = 6$ km/hr 64 km by boat Time taken to cover the distance downstream $= 64/((26+6)) = 2$ hours

Q. 6 In a simultaneous throw of two dice, what is the probability of getting a total of 9 or greater than 9?

Option 1:

5/18

Option 2:

5/36

Option 3:

1/4

Option 4:

1/5

Option 5:

None of these

Correct Answer:

5/18

Solution:

Total number of outcomes $= 6^2 = 36$ Number of favorable outcomes $= (3+6), (4+6), (5+6), (6+6), (4+5), (5+5), (6+5), (5+4), (6+4), (6+3) \rightarrow P(E) = 10/36 = 5/18$

Q. 7 The age of Sumit is as much more than Akshay as the age of Akshay is less than Parveen. If the sum of the ages of Akshay and Sumit is 60 years, what is the difference between the age of Sumit and age of Akshay?

Option 1:

1 year

Option 2:

30 years

Option 3:

5 years

Option 4:

Cannot be determined

Option 5:

None of these

Correct Answer:

Cannot be determined

Solution:

– According to the question, age of Sumit – age of Akshay = age of Parveen – age of Akshay → Sumit – Akshay = Parveen – Akshay → Sumit = Parveen and, sum of ages of Akshay and Sumit = 60 years From all the statements we do not know the desired answer can do

Q. 8 There are 4 consecutive odd numbers and difference between the reciprocal of first odd number and reciprocal of the third is $\frac{4}{525}$. Find the sum of last two odd number.

Option 1:

51

Option 2:

49

Option 3:

48

Option 4:

50

Option 5:

52

Correct Answer:

52

Solution:

Let the consecutive odd numbers $x - 3, x - 1, x + 1, x + 3$. $\frac{1}{(x-3)} - \frac{1}{(x+1)} = \frac{4}{525}$ $\frac{(x+1-x+3)}{(x-3)(x+1)} = \frac{4}{525}$ $\frac{4}{(x^2-2x-3)} = \frac{4}{525}$ $x^2 - 2x - 528 = 0$ $x^2 - 24x + 22x - 528 = 0$ $x(x - 24) + 22(x - 24) = 0$ $x = 24, -22$ Required sum = $(x + 1) + (x + 3) = 25 + 27 = 52$

Q. 9

Ratio of radius of a cylinder and height of the cylinder is 3:5 and the ratio of covered surface area of cylinder and volume of cylinder is given 16:45. Find the volume of another cylinder which radius is 5 cm more than the given radius of cylinder?

Option 1:

8840 cm³

Option 2:

9240 cm³

Option 3:

9760 cm³

Option 4:

8780 cm³

Option 5:

None of these

Correct Answer:

9240 cm³

Solution:

Ratio of radius to height = 3:5 $\rightarrow r/h=3/5$ $h = 5r/3$ As per question, $(2\pi r(r + h))/(\pi r^2 h) = 16/45 \rightarrow (2r(r + 5r/3))/(r^2 \cdot 5r/3) = 16/45 \rightarrow (8r^2)/(r^2 \cdot 5r) = 16/45 \rightarrow 5r = 45 \rightarrow r = 9$ radius = 9 cm Height = 15 cm Required volume of another cylinder whose radius is 5 cm more than the radius of the given cylinder = $\rightarrow (22 \times 14 \times 15)/7 = 9240$ cubic cm

Q. 10 Given that the total surface area of a cube is 864 cm². Find out the total surface area of a right cone if slant height of the cone is 75% more than the side of cube and the ratio between the slant height of the right cone and radius of the right cone is 3:2?

Option 1:

1580 cm²

Option 2:

1480 cm²

Option 3:

1840 cm²

Option 4:

1540 cm²

Option 5:

None of these

Correct Answer:

1540 cm²

Solution:

Total surface area of a cube = $6a^2 = 864 \rightarrow a^2 = 144$ Side of cube (a) = 12 cm Slant height of the right

cone = $12 \times 175/100 = 21$ cm Given that the slant height of the right cone : Ratio of radius of cone = 3 : 2
→ $l/r = 3/2 = 21$ cm $r = 14$ cm → $l = 21$ cm Total surface area of the cone = $\pi r(r+l)$ → $22/7 \times 14(14+21)$ →
 $22/7 \times 14 \times 35$ → 1540 sq cm

Q. 11 Read the following graph carefully and answer the question given below. The given bar graph shows the production of wheat in six states in two consecutive years, 2017 and 2018. What is the ratio of production in Gujarat state in 2018 and Haryana state in 2018 together to the production in Rajasthan state in 2017 and UP state in 2018 together?

Option 1:

12:13

Option 2:

11:12

Option 3:

12:11

Option 4:

11:13

Option 5:

None of these

Correct Answer:

11:12

Solution:

Production of Gujarat State in 2018 and Haryana State in 2018 = $240 + 200 = 440$ Tonnes
Production of Rajasthan State in 2017 and Uttar Pradesh State together in 2018 = $320 + 160 = 480$ Tonne
Required Difference = $440 : 480 \rightarrow 11:12$

Q. 12 Read the following graph carefully and answer the question given below. The given bar graph shows the production of wheat in six states in two consecutive years, 2017 and 2018. Production of wheat in MP state in both years is what % more or less than production of wheat in Rajasthan state in 2018 and Bihar state in 2017 together. (approximately)

Option 1:

8%

Option 2:

10%

Option 3:

2%

Option 4:

4%

Option 5:

None of these

Correct Answer:

2%

Solution:

Production of Wheat in Madhya Pradesh State in both the years = $240 + 260 = 500$ Tons
Production of Wheat in Rajasthan State in 2018 and Bihar State in 2017 together = $280 + 210 = 490$ Tonnes
Required Percentage = $(500-490)/490 \times 100 = 2\%$

Q. 13 Read the following graph carefully and answer the question given below. The given bar graph shows the production of wheat in six states in two consecutive years, 2017 and 2018. If production of wheat of UP state in 2019 increases by 30% in comparison to previous year and production of Haryana state in 2019 increases by 35% in comparison to previous year then what is the sum of production of 2019 for state UP and Haryana together?

Option 1:

508 tons

Option 2:

458 tons

Option 3:

368 tons

Option 4:

478 tons

Option 5:

None of these

Correct Answer:

478 tons

Solution:

Wheat production of the state of Uttar Pradesh in the year 2019 = $130/100 \times 160 = 208$ tonnes
Production of wheat of the state of Haryana in the year 2019 = $135/100 \times 200 = 270$ tonnes
Required sum of production = $208 + 270 = 478$ tonnes

Q. 14 Read the following graph carefully and answer the question given below. The given bar graph shows the production of wheat in six states in two consecutive years, 2017 and 2018. What is the average of sum of wheat production in Bihar state in 2017, Rajasthan state in 2018 and Gujrat state in 2018? (approx.)

Option 1:

343 tons

Option 2:

243 tons

Option 3:

352 tons

Option 4:

323 tons

Option 5:

None of these

Correct Answer:

243 tons

Solution:

Average = $(210+280+240)/3 = 243$ टन

Q. 15 Read the following graph carefully and answer the question given below. The given bar graph shows the production of wheat in six states in two consecutive years, 2017 and 2018. What is the difference between average production of wheat in Haryana for both years and MP for both years.

Option 1:

40 tons

Option 2:

50 tons

Option 3:

60 tons

Option 4:

70 tons

Option 5:

None of these

Correct Answer:

60 tons

Solution:

Difference = $(240+260)/2 - (180+200)/2 \rightarrow 60$ टन

Q. 16 The following table shows the percentage distribution of 25000 professionals according to their professions and the percentage of females among professionals of each profession. Study it carefully and answer the questions given below: What is the difference between total professionals and total male professionals?

Option 1:

11338

Option 2:

12363

Option 3:

11400

Option 4:

12875

Option 5:

None of these

Correct Answer:

12875

Solution:

Total Professionals = 25000
Total Male Professionals = 12125
Required Difference = $25000 - 12125 = 12875$

Q. 17 The following table shows the percentage distribution of 25000 professionals according to their professions and the percentage of females among professionals of each profession. Study it carefully and answer the questions given below: What is the ratio of female engineers to female teachers?

Option 1:

3 : 4

Option 2:

3 : 2

Option 3:

4 : 3

Option 4:

1 : 2

Option 5:

None of these

Correct Answer:

4 : 3

Solution:

Ratio = $3500/2625 = 4/3 = 4 : 3$

Q. 18 The following table shows the percentage distribution of 25000 professionals according to their professions and the percentage of females among professionals of each profession. Study it carefully and answer the questions given below: Among Engineer professionals 25% are from civil background and among civil engineers males are 324 more than females. What is the number of female civil engineers?

Option 1:

435

Option 2:

423

Option 3:

329

Option 4:

330

Option 5:

None of these

Correct Answer:

None of these

Solution:

Number of Civil Engineers = $25/100 \times 5000 = 945$ Number of Female Civil Engineers = $(1250-324)/2 = 463$

Q. 19 The following table shows the percentage distribution of 25000 professionals according to their professions and the percentage of females among professionals of each profession. Study it carefully and answer the questions given below: Total numbers of female professionals are by what percent more or less than total male professionals?

Option 1:
8.76%

Option 2:
7.12%

Option 3:
9.12%

Option 4:
8.15%

Option 5:
6.18%

Correct Answer:
6.18%

Solution:

Percentage = $(12875 - 12125)/12125 \times 100 \approx 6.18\%$

Q. 20 The following table shows the percentage distribution of 25000 professionals according to their professions and the percentage of females among professionals of each profession. Study it carefully and answer the questions given below: What is the average number of male professionals excluding those who are designers?

Option 1:
2880

Option 2:
2275

Option 3:
2380

Option 4:
2900

Option 5:
2485

Correct Answer:
2275

Solution:

Average = $11375/5 = 2275$

	Total	Male	Female
Doctors	6250	4375	1875
Engineers	5000	1500	3500
Architects	3750	1875	1875
Lawyers	5000	2500	2500
Teachers	3750	1125	2625
Designers	1250	750	500

General Knowledge

Q. 1 DIRECTIONS for the question: Mark the best option:

"Turning Points – A Journey Through Challenges" is a book authored by

Option 1:

A) Ratan Tata

Option 2:

B) Nandan Nilekani

Option 3:

C) Sunil Bharti Mittal

Option 4:

D) APJ Abdul Kalam

Correct Answer:

D) APJ Abdul Kalam

Solution:

The answer of this question is D

Q. 2 DIRECTIONS for the question: Mark the best option:

In which state is the Karni Mata temple that is famous for its rats?

Option 1:

A) Rajasthan

Option 2:

B) Gujrat

Option 3:

C)Maharashtra

Option 4:

D)Bihar

Correct Answer:

A)Rajasthan

Solution:

The answer of this question is A

Q. 3 DIRECTIONS for the question: Mark the best option:

Which Pak girl has been in the forefront of a fight against the Taliban to secure children's right to education?

Option 1:

A)Asma Jahangir

Option 2:

B)Jemima Khan

Option 3:

C)Tehmina Jahangir

Option 4:

D)Malala Yousofzai

Correct Answer:

D)Malala Yousofzai

Solution:

The answer of this question is D

Q. 4 DIRECTIONS for the question:Mark the best option:

Which of the following is the correct descending order of the top civilian honours given by the government?

Option 1:

A)Bharat Ratna - Padma Shri - Padam Bhushan - Padam Vibhushan

Option 2:

B)Bharat Ratna - Padam Bhushan - Padam Vibhushan - Padma Shri

Option 3:

C)Bharat Ratna - Padam Bhushan - Padam Shri - Padam Vibhushan

Option 4:

D)Bharat Ratna - Padam Vibhushan - Padam Bhushan - Padma Shri

Correct Answer:

D)Bharat Ratna - Padam Vibhushan - Padam Bhushan - Padma Shri

Solution:

The answer of this question is D

Q. 5 DIRECTIONS for the question:Mark the best option:

In which sport do players follow Marques of Queensberry rules?

Option 1:

A)Boxing

Option 2:

B)Karate

Option 3:

C)Wrestling

Option 4:

D)Taekwondo

Correct Answer:

A)Boxing

Solution:

The answer of this question is A

Q. 6 DIRECTIONS for the question: Mark the best option:

The Satyajit Ray Film and Television Institute is located at

Option 1:

A) Bombay

Option 2:

B) Calcutta

Option 3:

C) Jamshedpur

Option 4:

D) Puna

Correct Answer:

B) Calcutta

Solution:

The answer of this question is B

Q. 7 DIRECTIONS for the question: Mark the best option:

Who among the following was the first lady of the Indian silver screen?

Option 1:

A) Madhu Bala

Option 2:

B) Noorjehan

Option 3:

C) Suraya

Option 4:

D) Devika Rani Roerich

Correct Answer:
D)Devika Rani Roerich

Solution:

The answer of this question is D

Q. 8 DIRECTIONS for the question:Mark the best option:

Ustad Vilayat Ali Khan is known for playing

Option 1:

A)Sitar

Option 2:

B)Flute

Option 3:

C)Sarod

Option 4:

D)Tabla

Correct Answer:

A)Sitar

Solution:

The answer of this question is A

Q. 9 DIRECTIONS for the question:Mark the best option:

Phool Walon Ki Sair is an annual festival of national integration held in

Option 1:

A)Lucknow

Option 2:

B)Hyderabad

Option 3:

C)New Delhi

Option 4:

D)Meerut

Correct Answer:

C)New Delhi

Solution:

The answer of this question is C

Q. 10 DIRECTIONS for the question:Mark the best option.

The book 'The Google Story' has been authored by

Option 1:

A)David A. Vise

Option 2:

B)Eric Newmann

Option 3:

C)Fredrick Forsyth

Option 4:

D)None of these

Correct Answer:

A)David A. Vise

Solution:

The answer of this question is A

Q. 11 DIRECTIONS for the question:Mark the best option:

Which of the following has never held the position of the Chief Justice of India?

Option 1:

A)V. N. Khare

Option 2:

B)Y. K. Sabharwal

Option 3:

C)R. C. Lahoti

Option 4:

D)R. S. Sarkaria

Correct Answer:

D)R. S. Sarkaria

Solution:

The answer of this question is D

Q. 12 DIRECTIONS for the question:Mark the best option:

UNESCO is a United Nations agency. UNESCO stands for _____.

Option 1:

A)United Nations Environmental, Social and Cultural Organisation

Option 2:

B)United Nations Ecological, Scientific and Cultural Organisation

Option 3:

C)United Nations Educational, Scientific and Cultural Organisation

Option 4:

D)United Nations Educational, Social and Cultural Organisation

Correct Answer:

C)United Nations Educational, Scientific and Cultural Organisation

Solution:

The answer of this question is C

Q. 13 DIRECTIONS for the question: Mark the best option:

Which of the following rivers is called the sorrow of Bihar?

Option 1:

A) Gandaki

Option 2:

B) Kosi

Option 3:

C) Brahmaputra

Option 4:

D) Mahananda

Correct Answer:

B) Kosi

Solution:

The answer of this question is B

Q. 14 DIRECTIONS for the question: Mark the best option:

Who among the following Englishmen was the first to visit the Mughal court?

Option 1:

A) Sir Thomas Roe

Option 2:

B) Captain William Hawkins

Option 3:

C) King James

Option 4:

D) None of the above

Correct Answer:

B)Captain William Hawkins

Solution:

The answer of this question is B

Q. 15 DIRECTIONS for the question:Mark the best option:

The Taj Mahal was modelled on

Option 1:

A)Alai Minar

Option 2:

B)Babur's mausoleum

Option 3:

C)Black Taj

Option 4:

D)Humayun's tomb

Correct Answer:

D)Humayun's tomb

Solution:

The answer of this question is D

Q. 16 DIRECTIONS for the question:Mark the best option:

The Sargasso sea is situated in the :

Option 1:

A)Indian Ocean

Option 2:

B)Arctic Ocean

Option 3:

C)Atlantic Ocean

Option 4:

D)Pacific Ocean

Correct Answer:

C)Atlantic Ocean

Solution:

The answer of this question is C

Q. 17 DIRECTIONS for the question:Mark the best option:

The antibiotic Penicillin is obtained from a

Option 1:

A)Virus

Option 2:

B)Protozoan

Option 3:

C)Bacterium

Option 4:

D)Fungus

Correct Answer:

D)Fungus

Solution:

The answer of this question is D

Q. 18 DIRECTIONS for the question: Mark the best option:

Who is fondly known as 'Madiba'?

Option 1:

A)Mahatma Gandhi

Option 2:

B)Aung San Suu Kyi

Option 3:

C)Nelson Mandela

Option 4:

D)Dalai Lama

Correct Answer:

C)Nelson Mandela

Solution:

The answer of this question is C

Q. 19 DIRECTIONS for the question:Mark the best option:

Atoms of a gas X reacts with ozone and converts it into simple oxygen which is unable to absorb UV rays. X is

Option 1:

A)Carbon Dioxide

Option 2:

B)Helium

Option 3:

C)Chlorine

Option 4:

D)Hydrogen

Correct Answer:

C)Chlorine

Solution:

The answer of this question is C

Q. 20 DIRECTIONS for the question: Mark the best option:

The New Economic Policy was introduced in India in the year

Option 1:

2012

Option 2:

2013

Option 3:

1991

Option 4:

2001

Correct Answer:

1991

Solution:

The answer of this question is C

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