

Questions with Solutions

Time: 3 Hours

Total Marks: 720

General Instructions:

1. The test is of **3 hours** duration.
2. The Test Paper contains **180** questions. There are **three** parts in the question paper consisting of **Physics and Chemistry** having **45** questions each and **Biology** with **90 questions**.
3. Each question carries **4 marks**. For each correct response, the candidate will get **4 marks**. For each incorrect response, **1 mark** will be deducted from the total scores. The maximum marks are **720**.
4. Out of the four options given for each question, only one option is the correct answer. If more than one response is marked in any question, it will be treated as wrong response and marked up for wrong response will be deducted.
5. No deduction from the total score will be made if no response is indicated for an item in the answer box.
6. Use of Electronic/Manual Calculator is prohibited.

PHYSICS

Q 1. In Young's double slit experiment, the slits are 2mm apart and are illuminated by photons of two wavelength $\lambda_1 = 12000 \text{ \AA}$ and $\lambda_2 = 10000 \text{ \AA}$. At what minimum distance from the common central bright fringe on the screen 2m from the slit will a bright fringe from one interference pattern coincide with a bright fringe from the other?

- Option A 3 mm
 Option B 8 mm
 Option C 6 mm
 Option D 4 mm

Correct Option C

Solution: According to question $n_1\lambda_1 = n_2\lambda_2$

$$\frac{n_1\lambda_1 D}{d} = \frac{n_2\lambda_2 D}{d}$$

Therefore

$$\frac{n_1}{n_2} = \frac{\lambda_2}{\lambda_1} = \frac{10000}{12000} = \frac{5}{6}$$

The minimum value n_1 and n_2 can have is 5 and 6 respectively.

$$X_{\min} = \frac{n_1\lambda_1 D}{d} = \frac{5(12000 \times 10^{-10})(2)}{2 \times 10^{-3}}$$

$$= 6 \times 10^{-3} \text{ m} = 6 \text{ mm}$$

Q 2. In a common emitter (CE) amplifier having a voltage gain G, transistor used has trans conductance 0.02 mho and current gain 20, the voltage gain will be-

- Option A $\frac{5}{4} G$
 Option B $\frac{2}{3} G$
 Option C 1.5 G
 Option D $\frac{1}{3} G$

Correct Option B

Solution:

$$\text{Voltage gain } A_v = \frac{\Delta V_c}{\Delta V_B} = \frac{R_L \Delta I_c}{\Delta V_B} = g_m R_L$$

$$\frac{A_{v_1}}{A_{v_2}} = \frac{g_{m_1}}{g_{m_2}} \Rightarrow \frac{G}{A_{v_2}} = \frac{0.03}{0.02} \Rightarrow A_{v_2} = \frac{2}{3} G$$

Q 3. A certain mass of hydrogen is changed to Helium by the process of fusion. The mass defect in fusion reaction is 0.02866 u. The energy liberated per u is: (given 1u = 931 MeV)

- Option A 13.35 MeV
 Option B 2.67 MeV
 Option C 26.7 MeV
 Option D 6.675 MeV

Correct Option D

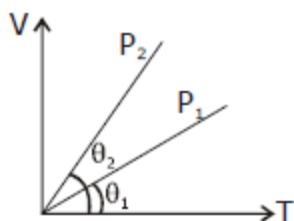
Solution:

Energy released per u

$$= \frac{\Delta m}{4} \times 931 \text{ MeV}$$

$$= \left(\frac{0.02866}{4} \right) (931 \text{ MeV}) = 6.675 \text{ MeV}$$

Q 4. In the given (V-T) diagram, what is the relation between pressure P₁ and P₂?



- Option A Cannot be predicted
 Option B $P_2 = P_1$
 Option C $P_2 > P_1$
 Option D $P_2 < P_1$

Correct Option D

Solution:

$$PV = nRT \Rightarrow V = \left(\frac{nR}{P}\right)T \Rightarrow \text{slope} = \frac{nR}{P}$$

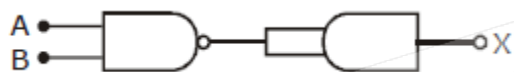
Slope is inversely proportional to P

As $\theta_2 > \theta_1$

Therefore

$$P_2 < P_1$$

Q 5. The output (X) of the logic circuit shown in figure will be:



Option A $X = \overline{A + B}$

Option B $X = \overline{\overline{A} \cdot \overline{B}}$

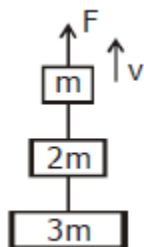
Option C $X = \overline{A \cdot B}$

Option D $X = A \cdot B$

Correct Option B, D

Solution: $X = \overline{\overline{A \cdot B}} = A \cdot B$

Q 6. Three blocks with masses m, 2m and 3m are connected by strings, as shown in the figure. After an upward force F is applied on block m, the masses move upward at constant speed v. What is the net force on the block of mass 2m? (g is the acceleration due to gravity)



Option A 6 mg

Option B zero

Option C 2 mg

Option D 3 mg

Correct Option B

Solution:

$$F = \text{mass} \times \text{acceleration}$$

Here the blocks are moving with constant velocity

hence there will be no acceleration

$$F_{net} = m \times 0 = 0$$

Q 7. In a n-type semiconductor, which of the following statement is true:

- Option A Holes are majority carriers and trivalent atoms are dopants
- Option B Electrons are majority carriers and trivalent atoms are dopants
- Option C Electron are minority carriers and pentavalent atoms are dopants
- Option D Holes are minority carriers and pentavalent atoms are depends.

Correct Option D

Solution: In a n-type semiconductor Holes are minority carriers and pentavalent atoms are depends.

Q 8. The half-life of radioactive isotope 'X' is 20 years. It decays to another element 'Y' which is stable. The two elements 'X' and 'Y' were found to be in the ratio 1:7 in a sample of a given rock. The age of the rock is estimated to be:

- Option A 100 years
- Option B 40 years
- Option C 60 years
- Option D 80 years

Correct Option C

Solution:

Let the number of nuclei present at the beginning be N_0
when X decays

Let N_1 be the number of nuclei that decays

Therefore number of nuclei remaining in X is $N - N_1$

Number of nuclei in y N_1

$$\frac{N_0 - N_1}{N_1} = \frac{1}{7}$$

$$7N_0 - 7N_1 = N_1$$

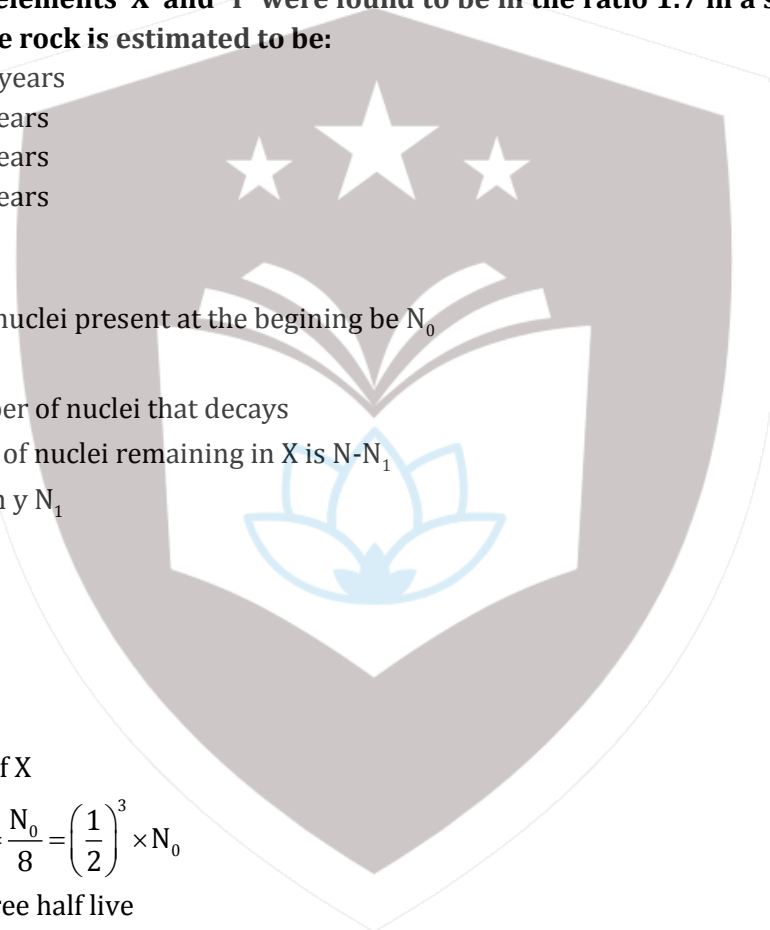
$$\frac{N_0}{N_1} = \frac{8}{7}$$

Remaining nuclei of X

$$N_0 - N_1 \Rightarrow N_0 - \frac{7N_0}{8} = \frac{N_0}{8} = \left(\frac{1}{2}\right)^3 \times N_0$$

hence there are three half live

total time = $3 \times 20 \text{ yrs} = 60 \text{ yrs}$



Q 9. The molar specific heats of an ideal gas at constant pressure and volume are denoted by

C_p and C_v respectively. If $\gamma = \frac{C_p}{C_v}$ and R is the universal gas constant, then C_v is equal to:

Option A γR

Option B $\frac{1 + \gamma}{1 - \gamma}$

Option C $\frac{R}{(\gamma - 1)}$

Option D $\frac{(\gamma - 1)}{R}$

Correct Option C

Solution

$$C_p - C_v = R \text{ --- (1)}$$

$$\text{and } \gamma = \frac{C_p}{C_v}$$

Dividing equation 1 by C_v

$$\therefore \frac{C_p}{C_v} - \frac{C_v}{C_v} = \frac{R}{C_v}$$

$$\gamma - 1 = \frac{R}{C_v}$$

$$C_v = \frac{R}{\gamma - 1}$$

Q 10. The wavelength λ_e of an electron and λ_p of a photon of same energy E are related by:

Option A $\lambda_p \propto \frac{1}{\sqrt{\lambda_e}}$

Option B $\lambda_p \propto \lambda_e^2$

Option C $\lambda_p \propto \lambda_e$

Option D $\lambda_p \propto \sqrt{\lambda_e}$

Correct Option B

Solution:

For electron

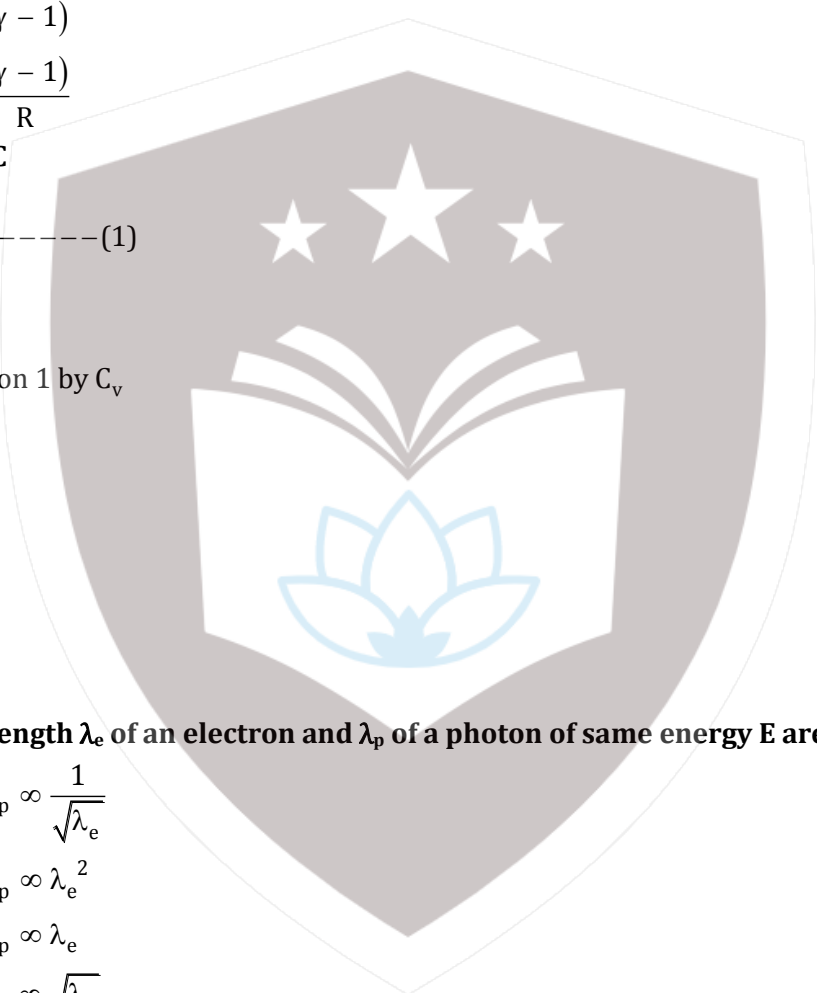
$$\lambda_e = \frac{h}{p} = \frac{h}{\sqrt{2mE}} \text{ --- (1)}$$

For photon

$$\lambda_p = \frac{h}{p} = \frac{hc}{E}$$

Squaring equation 1 and substituting we get

$$\lambda_e^2 \propto \lambda_p$$



Q 11. Ratio of longest wavelength corresponding to Lyman and Balmer series in hydrogen spectrum is-

Option A $\frac{9}{31}$

Option B $\frac{5}{27}$

Option C $\frac{3}{23}$

Option D $\frac{7}{29}$

Correct Option B

Solution:

$$\Delta E = \frac{hc}{\lambda}$$

For longest wavelength the energy difference should be minimum, and it becomes minimum when electron jumps from next higher orbital

$$\frac{1}{\lambda_{\text{Lyman}}} = R \left(\frac{1}{1^2} - \frac{1}{2^2} \right)$$

$$\frac{1}{\lambda_{\text{Balmer}}} = R \left(\frac{1}{2^2} - \frac{1}{3^2} \right)$$

$$\left(\frac{\lambda_{\text{Lyman}}}{\lambda_{\text{Balmer}}} \right)_{\text{max}} = \frac{\left(\frac{1}{2^2} - \frac{1}{3^2} \right)}{\left(\frac{1}{1^2} - \frac{1}{2^2} \right)} = \frac{5/36}{3/4} = \frac{5}{27}$$

Q 12. A current loop in a magnetic field -

Option A Can be in equilibrium in two orientations, one stable while the other is unstable.

Option B Experiences a torque whether the field is uniform or non-uniform in all orientation

Option C Can be in equilibrium in one orientation

Option D Can be equilibrium in two orientations, both the equilibrium states are unstable

Correct Option A

Solution:

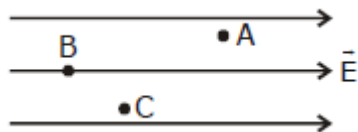
Energy of current loop in magnetic field is given by

$$U(\theta) = -\vec{\mu} \cdot \vec{B} = \mu B \cos \theta$$

Hence there are two position high energy and low energy

And therefore two types of equilibrium unstable and stable.

Q 13. A, B and C are three points in a uniform electric field. The electric potential is-

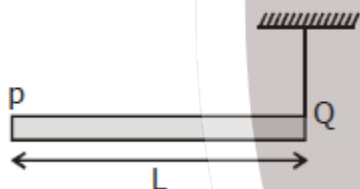


- Option A Same at all the three points A, B and C
- Option B Maximum at A
- Option C Maximum at B
- Option D Maximum at C

Correct Option C

Solution: Electric potential decrease as we move in the direction of electric field.

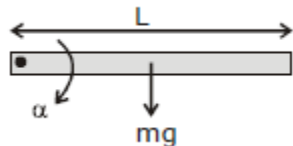
Q 14. A rod PQ of mass M and length L is hinged at end P. The rod is kept horizontal by a massless string tied to point Q as shown in figure. When string is cut, the initial angular acceleration of the rod is-



- Option A $\frac{2g}{3L}$
- Option B $\frac{3g}{2L}$
- Option C g/L
- Option D $2g/L$

Correct Option B

Solution:



$$\tau = \vec{r} \times \vec{F}$$

$$\tau = I\alpha$$

$$\text{For rod } I = \frac{ML^2}{3}$$

$$\Rightarrow Mg \left(\frac{L}{2} \right) = \left(\frac{ML^2}{3} \right) \alpha \Rightarrow \alpha = \frac{3g}{2L}$$

Q 15. A wire of resistance 4Ω is stretched to twice its original length. The resistance of stretched wire would be-

- Option A 16Ω
- Option B 2Ω
- Option C 4Ω
- Option D 8Ω

Correct Option A

Solution:

$$R = \frac{\rho \ell}{A}$$

$$R = \frac{\rho \ell^2}{Al}$$

$$R = \frac{\rho \ell^2}{V}$$

As we know the volume will remain constant

$$\Rightarrow R \propto \ell^2$$

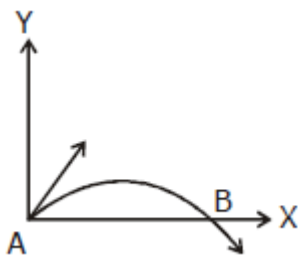
$$\frac{R'}{R} = \frac{\ell^2}{(2\ell)^2}$$

$$R' = 4R$$

$$R' = 4 \times 4 = 16\Omega$$

Q 16. The velocity of a projectile at the initial point A is $(2\hat{i} + 3\hat{j})$ m/s. It's velocity (in m/s) at point B is-

- Option A $2\hat{i} + 3\hat{j}$
- Option B $-2\hat{i} - 3\hat{j}$
- Option C $-2\hat{i} + 3\hat{j}$
- Option D $2\hat{i} - 3\hat{j}$



Correct Option D

Solution: The x- component of velocity will remain same but y-component changes its direction.

Q 17. A body of mass 'm' is taken from the earth's surface to the height equal to twice the radius (R) of the earth. The change in potential energy of body will be -

Option A $\frac{1}{3} mgR$

Option B $mg2R$

Option C $\frac{2}{3} mgR$

Option D $3 mgR$

Correct Option C

Solution:

$$PE_{\text{final}} = -\frac{GMm}{R+2R} = -\frac{GMm}{3R}$$

$$PE_{\text{initial}} = \left(-\frac{GMm}{R}\right)$$

$$\Delta PE = -\frac{GMm}{3R} - \left(-\frac{GMm}{R}\right) = \frac{2}{3} \frac{GMm}{R} = \frac{2}{3} mgR$$

Q 18. A stone falls freely under gravity. It covers distances h_1 , h_2 and h_3 in the first 5 seconds, the next 5 seconds and the next 5 seconds respectively. The relation between h_1 , h_2 and h_3 is-

Option A $h_1 = h_2 = h_3$

Option B $h_1 = 2h_2 = 3h_3$

Option C $h_1 = \frac{h_2}{3} = \frac{h_3}{5}$

Option D $h_2 = 3h_1$ and $h_3 = 3h_2$

Correct Option C

Solution:

$$h_1 = 5u + \frac{1}{2} g (5)^2 = 125m \text{ -----(u = 0)}$$

$$h_1 + h_2 = 10u + \frac{1}{2} g (10)^2$$

$$\therefore h_2 = 5u + 375 = 375m \text{ -----(u = 0)}$$

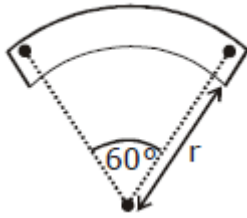
$$h_1 + h_2 + h_3 = 15u + \frac{1}{2} g (15)^2 = 1125m$$

$$h_3 = 625m$$

Therefore

$$h_1 = \frac{h_2}{3} = \frac{h_3}{5}$$

Q 19. A bar magnet of length ' ℓ ' and magnetic dipole moment ' M ' is bent in the form of an arc as shown in figure. The new magnetic dipole moment will be-



- Option A $\frac{M}{2}$
 Option B M
 Option C $\frac{3}{\pi} M$
 Option D $\frac{2}{\pi} M$

Correct Option C

Solution:

Let magnetic pole strength be m then

$$M = m\ell$$

In new situation

$$M' = (M) \left(2r \sin \frac{60^\circ}{2} \right)$$

$$\theta = \frac{\text{arc}}{\text{radius}}$$

$$r \left(\frac{\pi}{3} \right) = \ell$$

$$\text{radius} = \frac{\text{arc length}}{\theta}$$

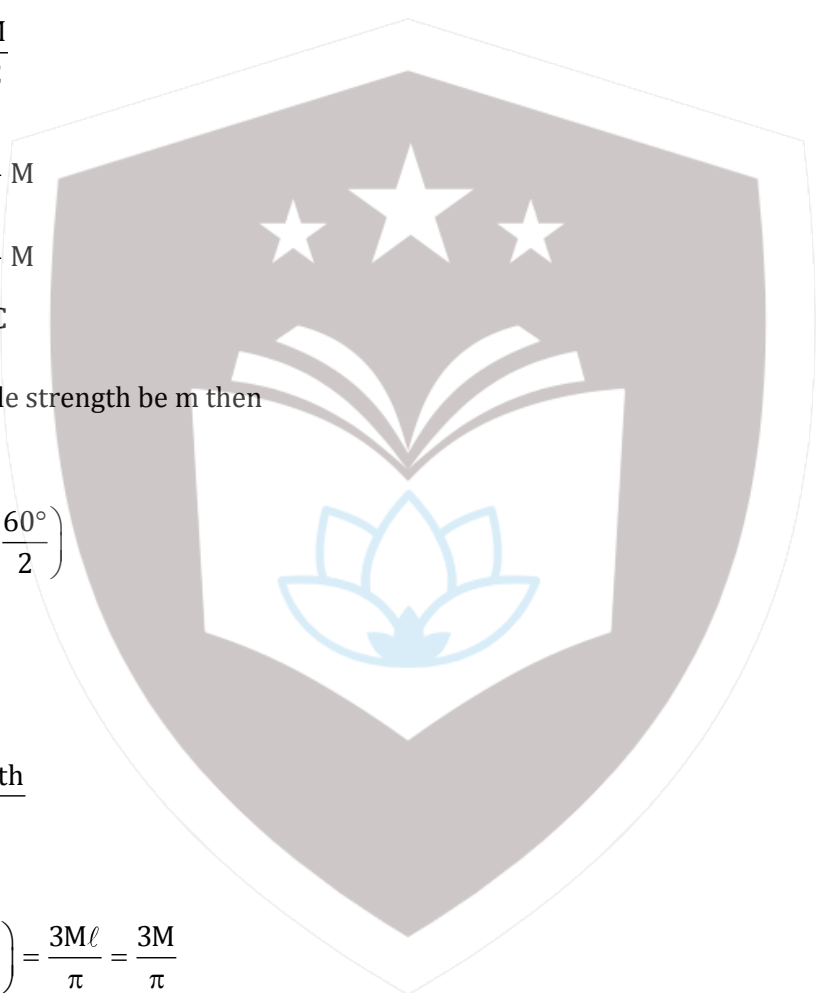
$$r = \frac{3}{\pi} \ell$$

$$M' = 2M \left(\frac{3\ell}{\pi} \right) \left(\frac{1}{2} \right) = \frac{3M\ell}{\pi} = \frac{3M}{\pi}$$

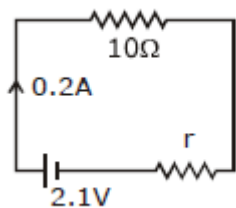
Q 20. The internal resistance of a 2.1 V cell which gives a current of 0.2 A through a resistance of 10Ω is-

- Option A 1.0Ω
 Option B 0.2Ω
 Option C 0.5Ω
 Option D 0.8Ω

Correct Option C



Solution:



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

$$0.2 = \frac{2.1}{r + 10}$$

$$0.2 \times (r + 10) = 2.1$$

$$r = 0.5\Omega$$

Q 21. For photoelectric emission from certain metal the cutoff frequency is ν . If radiation of frequency 2ν impinges on the metal plate, the maximum possible velocity of the emitted electron will be (m is the electron mass)-

Option A $2\sqrt{h\nu / m}$

Option B $\sqrt{h\nu / (2m)}$

Option C $\sqrt{h\nu / m}$

Option D $\sqrt{2h\nu / m}$

Correct Option D

Solution:

$$\frac{1}{2}mv_{\max}^2 = h(2\nu) - h\nu$$

$$\frac{1}{2}mv_{\max}^2 = h\nu$$

$$v_{\max} = \sqrt{\frac{2h\nu}{m}}$$

Q 22. During an adiabatic process, the pressure of a gas found to be proportional to the cube of its temperature. The ratio of $\frac{C_p}{C_v}$ for the gas is -

Option A $3/2$

Option B $4/3$

Option C 2

Option D $5/3$

Correct Option A

Solution:

$$P\mu T^3$$

And we know that

$$PV = nRT$$

$$P\mu (PV)^3$$

$$P^2 V^3 = \text{constant}$$

$$PV^{\frac{3}{2}} = \text{constant}$$

for adiabatic process

$$PV^\gamma = \text{constant}$$

Hence

$$\gamma = \frac{3}{2}$$

$$\text{and } \gamma = \frac{C_p}{C_v} = \frac{3}{2}$$

Q 23. The following four wires are made of the same material. Which of these will have the largest extension when the same tension is applied?

Option A length = 300 cm, diameter = 3 mm

Option B length = 50 cm, diameter = 0.5 mm

Option C length = 100 cm, diameter = 1 mm

Option D length = 200 cm, diameter = 2 mm

Correct Option B

Solution:

$$Y = \frac{F/A}{\Delta l / l}$$

$$\Delta l = \frac{F l}{YA} = \frac{F l}{Y \pi R^2}$$

$$\Delta l \propto \frac{l}{D^2}$$

On comparing all the choices the most appropriate choice is

For $l = 50 \text{ cm}$ & diameter = 0.5 mm

Q 24. The resistances of the four arms P,Q,R and S in a Wheatstone's bridge are 10 ohm, 30 ohm, 30 ohm and 90 ohm, respectively. The e. m. f. and internal resistance of the cell are 7 volt and 5 ohm respectively. If the galvanometer resistance is 50 ohm, the current drawn from the cell will be-

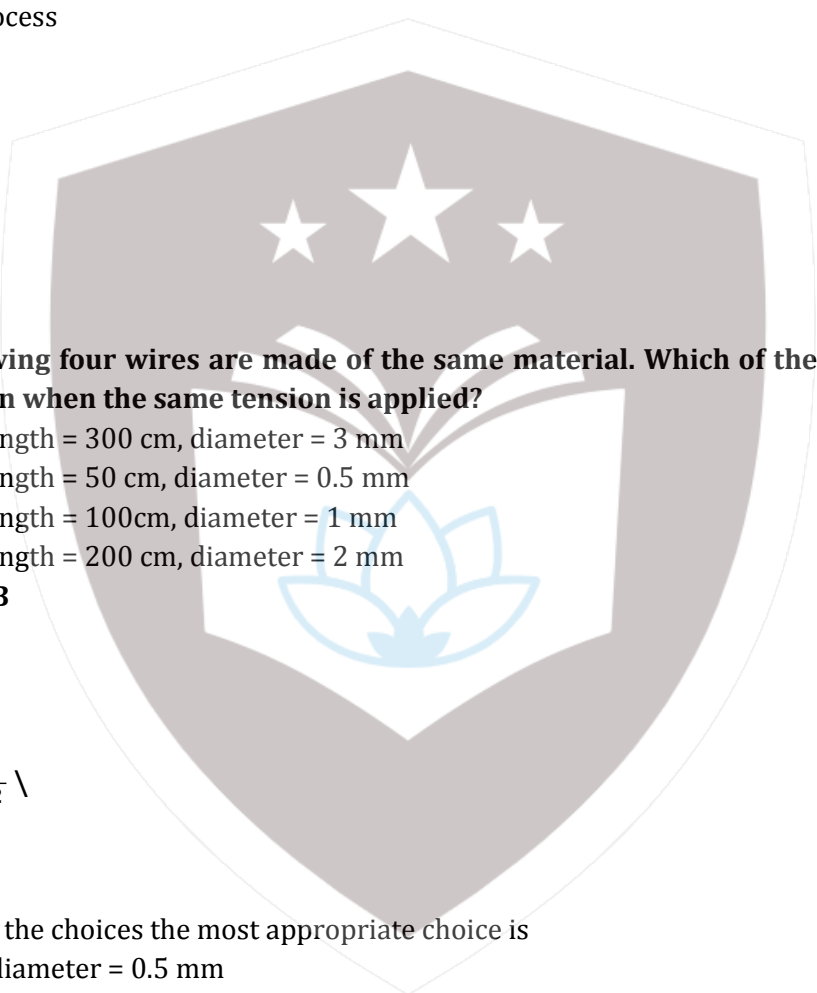
Option A 2.0 A

Option B 1.0 A

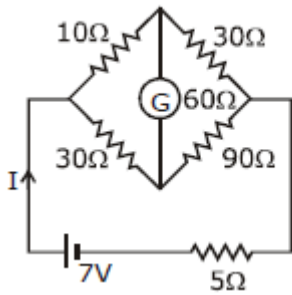
Option C 0.2 A

Option D 0.1 A

Correct Option C



Solution:



Effective resistance of Wheatstone bridge

$$= \frac{(40)(120)}{40 + 120} = 30 \Omega$$

$$R_{\text{effective}} = 30\Omega + 5\Omega = 35\Omega$$

$$\text{Current drawn} = \frac{7V}{(5 + 30) \Omega}$$

$$= \frac{1}{5} \text{ A} = 0.2 \text{ A}$$

Q 25. The amount of heat energy required to raise the temperature of 1 g of Helium at NTP, from T_1 K to T_2 K is-

Option A $\frac{3}{4} N_a k_B \left(\frac{T_2}{T_1} \right)$

Option B $\frac{3}{8} N_a k_B (T_2 - T_1)$

Option C $\frac{3}{2} N_a k_B (T_2 - T_1)$

Option D $\frac{3}{4} N_a k_B (T_2 - T_1)$

Correct Option B

Solution:

$$\text{Number of moles in 1 g He} = \frac{1}{4}$$

Amount of heat energy required to raise its temperature from T_1 K to T_2 K

$$= nC_v \Delta T$$

For mono atomic

$$C_v = \frac{3}{2} R$$

$$= \left(\frac{1}{4} \right) \left(\frac{3}{2} R \right) (T_2 - T_1)$$

$$= \frac{3}{8} k_B N_A (T_2 - T_1)$$

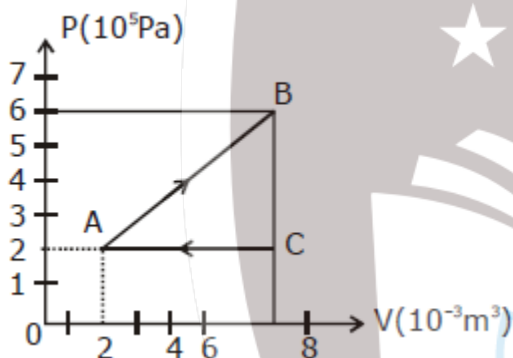
Q 26. A piece of iron is heated in a flame. It first become dull red then becomes reddish yellow and finally turns to white hot. The correct explanation for the above observation is possible by using:-

- Option A Newton's law of cooling
- Option B Stefan's law
- Option C Wien's law
- Option D Kirchhoff's law

Correct Option C

Solution: By using Wien's displacement law $\lambda_m T = .$ we can say that temperature and wavelength are related. Hence the above observation can be correctly answered by it.

Q 27. A gas taken through the cycle A → B → C → A, as shown, what is the net work done by the gas?



- Option A -2000 J
- Option B 2000 J
- Option C 1000 J
- Option D zero

Correct Option C

Solution:

In cyclic process

Net work done = Area of triangle ABC

If the process is clockwise then work done would be positive otherwise negative. Here the process is clockwise.

$$= \frac{1}{2} \times [(7 - 2) \times 10^{-3}] [(6 - 2) \times 10^5]$$

$$= 1000 \text{ J}$$

Q 28. The condition under which a microwave oven heats up a food item containing water molecules most efficiently is-

- Option A Infra-red waves produce heating in a microwave oven
- Option B The frequency of the microwaves must match the resonant frequency of the water molecules
- Option C The frequency of the microwaves has no relation with natural frequency of the water molecules
- Option D Microwaves are heat waves, so always produce heating

Correct Option B

Solution:

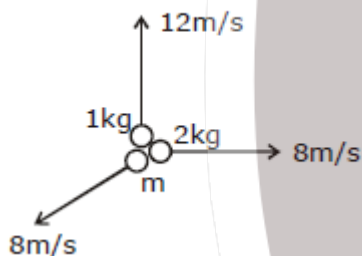
More effective heating takes place when frequency of microwave matches the resonant frequency of molecules.

Q 29. An explosion breaks a rock into three parts in a horizontal plane. Two of them go off at right angles to each other. The first part of mass 1 kg moves with a speed of 12 ms⁻¹ and the second part of mass 2kg moves with 8 ms⁻¹ speed. If the third part flies off with 4 ms⁻¹ speed, then its mass is-

- Option A 17 kg
- Option B 3 kg
- Option C 5 kg
- Option D 7 kg

Correct Option C

Solution:



From conservation of momentum
Momentum will remain conserved

$$\vec{P}_1 + \vec{P}_2 + \vec{P}_3 = 0$$

On calculating we get

$$\sqrt{(m_1 v_1)^2 + (m_2 v_2)^2} = m_3 v_3$$

$$\sqrt{(1 \times 12)^2 + (2 \times 8)^2} = m (4)$$

$$m = 5\text{kg}$$

Q 30. In an experiment four quantities a, b, c and d are measured with percentage error 1%, 2%, 3% and 4% respectively. Quantity P is calculated as follows $P = \frac{a^3 b^2}{cd}$ % error in P is

- Option A 4 %
- Option B 14 %
- Option C 10 %
- Option D 7 %

Correct Option B

Solution:

$$p = \frac{a^3 b^2}{cd} \Rightarrow \frac{\Delta P}{P} = \pm \left(3 \frac{\Delta a}{a} + 2 \frac{\Delta b}{b} + \frac{\Delta c}{c} + \frac{\Delta d}{d} \right)$$

$$= \pm (3 \times 1 + 2 \times 2 + 3 + 4)$$

$$= \pm 14 \%$$

Q 31. A small object of uniform density rolls up a curved surface with an initial velocity 'v'. It reaches up to a maximum heights of $\frac{3v^2}{4g}$ with respect to the initial position. The object is

- Option A Disc
Option B Ring
Option C Solid sphere
Option D hollow sphere

Correct Option A

Solution:

From conservation of mechanical energy

$$\frac{I\omega^2}{2} + \frac{1}{2}mv^2 = mgh$$

We know that $v = \omega R$

$$\frac{I v^2}{2 R^2} + \frac{1}{2}mv^2 = mgh$$

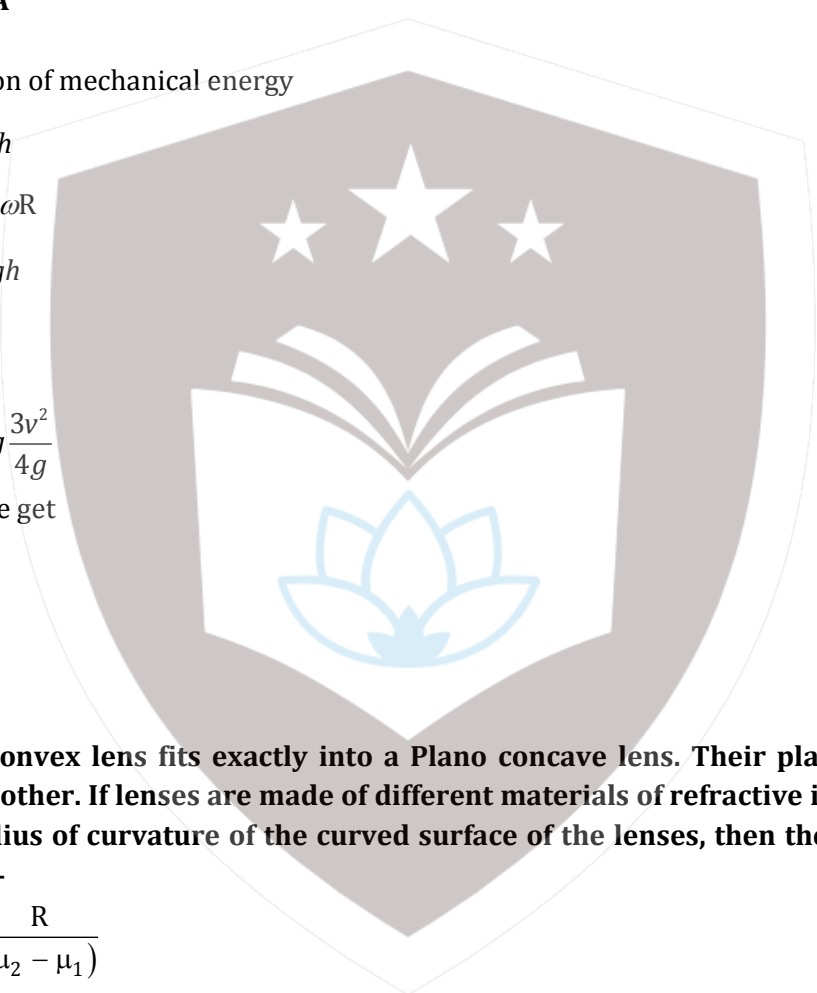
$$\therefore h = \frac{3v^2}{4g}$$

$$\frac{I v^2}{2 R^2} + \frac{1}{2}mv^2 = mg \frac{3v^2}{4g}$$

On calculating we get

$$I = \frac{mR^2}{2}$$

which is for disc



Q 32. A Plano convex lens fits exactly into a Plano concave lens. Their plane surfaces are parallel to each other. If lenses are made of different materials of refractive indices μ_1 and μ_2 and R is the radius of curvature of the curved surface of the lenses, then the focal length of combination is -

- Option A $\frac{R}{(\mu_2 - \mu_1)}$
Option B $\frac{R}{2(\mu_2 - \mu_1)}$
Option C $\frac{R}{(\mu_1 - \mu_2)}$
Option D $\frac{R}{(\mu_1 - \mu_2)}$

Correct Option D

Solution:

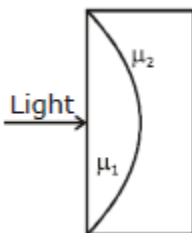
Effective focal length is given by $\frac{1}{f_{\text{eff}}} = \frac{1}{f_1} + \frac{1}{f_2}$

Lens makers formula

$$\frac{1}{f_{\text{eff}}} = (\mu - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

$$\frac{1}{f_{\text{eff}}} = (\mu_1 - 1) \left(\frac{1}{\infty} - \frac{1}{-R} \right) + (\mu_2 - 1) \left(\frac{1}{-R} - \frac{1}{\infty} \right)$$

$$\Rightarrow f_{\text{eff}} = \frac{R}{\mu_1 - \mu_2}$$



Q 33. A parallel beam of fast moving electrons is incident normally on a narrow slit. A fluorescent screen is placed at a large distance from the slit. If the speed of the electrons is increased, which of the following statements is correct?

- Option A The angular width of central maximum will be unaffected
- Option B Diffraction pattern is not observed on the screen in the case of electrons
- Option C The angular width of the central maximum
- Option D The angular width of the central maximum will decrease

Correct Option D

Solution: As speed of electrons is increases the wavelength of electrons will decrease and hence the angular width ($\propto \lambda$) of the central maximum of diffraction pattern will decrease.

Q 34. For a normal eye, the cornea of eye provides a converging power of 40 D and the least converging power of the eye lens behind the cornea is 20 D. Using this information, the distance between the retina and the cornea-eye lens can be estimated to be -

- Option A 1.5 cm
- Option B 5 cm
- Option C 2.5 cm
- Option D 1.67 cm

Correct Option D

Solution: For a normal eye, rays coming from infinity should go the retina without effort when we look at infinity, lens offers minimum power and hence combination gives $40D + 20D = 60D$
Distance between the retina and the cornea eye = focal length.

$$f = \frac{1}{60} \text{ m} = 1.67 \text{ cm}$$

Q 35. The upper half of an inclined plane of inclination θ is perfectly smooth while lower half is rough. A block starting from rest at the top of the plane will again come to rest at the bottom, if the coefficient of friction between the block and lower half of the plane is given by

Option A $\mu = \tan \theta$

Option B $\mu = \frac{1}{\tan \theta}$

Option C $\mu = \frac{2}{\tan \theta}$

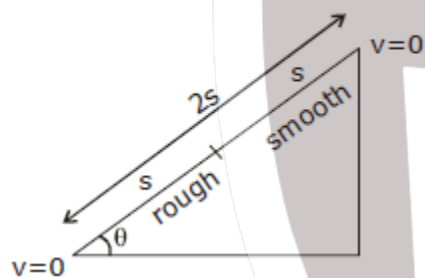
Option D $\mu = 2 \tan \theta$

Correct Option D

Solution: From work energy theorem ($W = \Delta KE$)

$$(mg \sin \theta) (2s) - (\mu mg \cos \theta) (s) = 0 - 0$$

$$\Rightarrow \mu = 2 \tan \theta$$



Q 36. A wave travelling in the +ve x-direction having displacement along y-direction as 1 m, wavelength 2π m and frequency of $\frac{1}{\pi}$ Hz is represented by:

Option A $y = \sin (2\pi x + 2\pi t)$

Option B $y = \sin (x - 2t)$

Option C $y = \sin (2\pi x - 2\pi t)$

Option D $y = \sin (10\pi x + 20\pi t)$

Correct Option B

Solution:

$$A = 1\text{m}, \lambda = 2\pi\text{m}, \text{frequency} = \frac{1}{\pi} \text{Hz}$$

$$k = \frac{2\pi}{\lambda} = \frac{2\pi}{2\pi} = 1 \text{ and } \omega = 2\pi f = (2\pi) \left(\frac{1}{\pi} \right) = 2$$

$$\text{So equation of wave } y = A \sin (kx - \omega t) = \sin (x - 2t)$$

Q 37. A source of unknown frequency gives 4 beats / s, when sounded with a source of known frequency 250 Hz, the second harmonic of the source of unknown frequency gives five beats per second, when sounded with a source of frequency 513 Hz, the unknown is-

- Option A 260 Hz
- Option B 254 Hz
- Option C 246 Hz
- Option D 240 Hz

Correct Option B

Solution: Frequency of unknown source $f = 246$ Hz or 254 Hz

Second harmonic of the source = 492 Hz or 508 Hz

When sounded with a source of frequency 513 Hz, gives 5 beats per second,

Therefore unknown frequency = 254 Hz

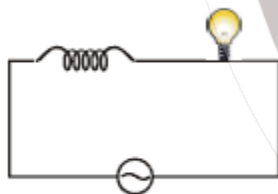
Q 38. A coil having self-inductance L is connected in series with a bulb B and an AC source.

Brightness of the bulb decrease when-

- Option A and iron rod is inserted in the coil
- Option B frequency of the AC source is decreased
- Option C number of turns in the coil is reduced
- Option D A capacitance of reactance $X_C = X_L$ is included in the same circuit.

Correct Option A

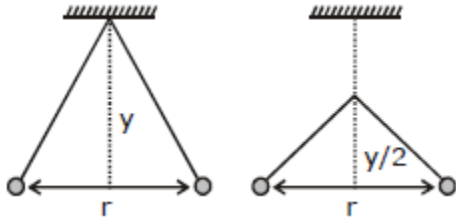
Solution:



Brightness of the bulb

When iron rod inserted magnetic field inside the inductor increases.. Therefore inductance of the coil increases. Hence the reactance increases. So large amount of Voltage appears across the inductor leaving less voltage across bulb as a result brightness of the bulb decreases.

Q 39. Two pith balls carrying equal charges are suspended from a common point by strings of equal length, the equilibrium separation between them is e . Now the strings are rigidly clamped at half the height. The equilibrium separation between the balls now become-



Option A $\left(\frac{2r}{3}\right)$

Option B $\left(\frac{1}{\sqrt{2}}\right)^2$

Option C $\left(\frac{r}{\sqrt[3]{2}}\right)$

Option D $\left(\frac{2r}{\sqrt{3}}\right)$

Correct Option C

Solution:

$$T \cos \theta = mg$$

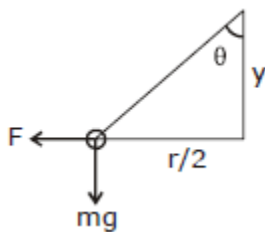
$$T \sin \theta = \frac{Kq^2}{r^2}$$

$$\tan \theta = \frac{Kq^2}{r^2 mg}$$

$$\Rightarrow \frac{r/2}{y} = \frac{kq^2}{r^2 mg}$$

$$\Rightarrow y \propto r^3$$

$$\text{Therefore } \left(\frac{r'}{r}\right)^3 = \frac{y/2}{y} \Rightarrow r' = r \left(\frac{1}{2}\right)^{1/3}$$



Q 40. If we study the vibration of a pipe open at both ends, then the following statements is not true:

- Option A Pressure change will be maximum at both ends
- Option B Open end will be antinode
- Option C Odd harmonics of the fundamental frequency will be generated
- Option D All harmonics of the fundamental frequency will be generated

Correct Option A

Solution: Pressure change will be minimum at both open ends

Q 41. When a proton is released from rest in a room, it starts with an initial acceleration a_0 towards west. When it is projected towards north with a speed v_0 it moves with an initial acceleration $3a_0$ towards west. The electric and magnetic fields in the room are:

- Option A $\frac{ma_0}{e}$ east, $\frac{3ma_0}{ev_0}$ down
- Option B $\frac{ma_0}{e}$ west, $\frac{2ma_0}{ev_0}$ up
- Option C $\frac{ma_0}{e}$ west, $\frac{2ma_0}{ev_0}$ down
- Option D $\frac{ma_0}{e}$ east, $\frac{3ma_0}{ev_0}$ up

Correct Option C

Solution:

Acceleration of proton

$$\vec{a} = \frac{q}{m} \left(\vec{E} + \vec{v} \times \vec{E} \right)$$

Released from rest $\Rightarrow \vec{a} = \frac{q}{m} \vec{E} = a_0$ (west)

$$\Rightarrow \vec{E} = \frac{ma_0}{e} \text{ (west)}$$

$$F_1 + F_2 = 3ma_0$$

$$ma_0 + F_2 = 3ma_0$$

$$F_2 = 2ma_0$$

$$eVB_0 = 2ma_0$$

Therefore magnetic field = $\frac{2ma_0}{ev_0}$ (down)

Q 42. A wire loop is rotated in magnetic field. The frequency of change of direction of the induced e. m. f. is-

- Option A six times per revolution
- Option B once per revolution
- Option C twice per revolution
- Option D four times per revolution

Correct Option C

Solution:

$$\phi = B\pi r^2 \cos \omega t$$

$$emf = B\pi r^2 \sin \omega t$$

This becomes zero when

$$\omega t = n\pi$$

ωt becomes zero at $0, \pi, 2\pi, 3\pi, \dots$

Hence the change of direction of induced emf is twice per revolution

Q 43. A uniform force of $(3\hat{i} + \hat{j})$ newton acts on a particle of mass 2kg. Hence the particle is

displaced from position $(2\hat{i} + \hat{k})$ meter to position $(4\hat{i} + 3\hat{j} + \hat{k})$ meter. The work done by

the force on the particle is -

- Option A 15 J
- Option B 9 J
- Option C 6 J
- Option D 13 J

Correct Option B

Solution:

$$\begin{aligned} W &= \vec{F} \cdot \vec{S} \\ &= (3\hat{i} + \hat{j}) \cdot \left((4\hat{i} + 3\hat{j} + (-1)\hat{k}) - (2\hat{i} + \hat{k}) \right) \\ &= (3\hat{i} + \hat{j}) \cdot (2\hat{i} + 3\hat{j} - 2\hat{k}) \\ &= 3(2) + 1(3) + 0(-2) = 9 \text{ J} \end{aligned}$$

Q 44. The wettability of a surface by a liquid depends primarily on-

- Option A angle of contact between the surface and the liquid
- Option B viscosity
- Option C surface tension
- Option D density

Correct Option A

Solution: It depends on angle of contact between the surface and the liquid.

Q 45. Infinite number of bodies, each of mass 2kg are situated on x-axis at distance 1 m, 2m, 4m,8m....., respectively, from the origin. The resulting gravitational potential due to this system at the origin will be-

- Option A -4 G
 Option B -G
 Option C $-\frac{8}{3} G$
 Option D $-\frac{4}{3} G$

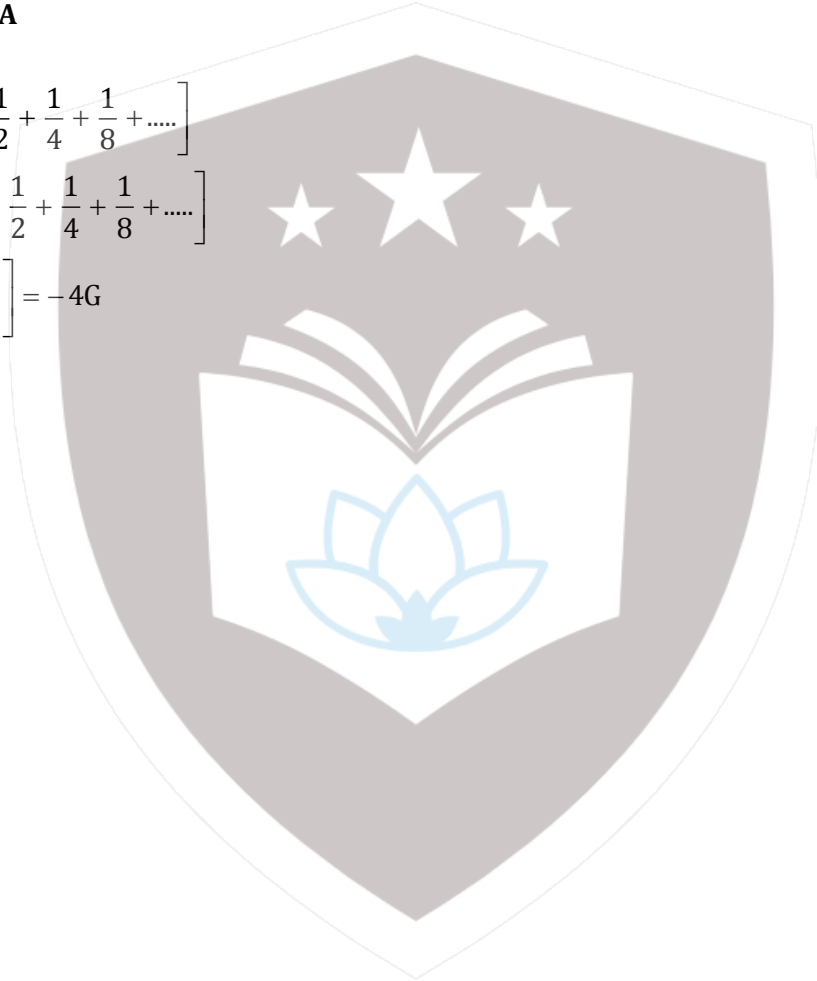
Correct Option A

Solution:

$$V = -Gm \left[\frac{1}{1} + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \dots \right]$$

$$V = -G(2) \left[\frac{1}{1} + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \dots \right]$$

$$= -2G \left[\frac{1}{1 - 1/2} \right] = -4G$$



CHEMISTRY

Q 1. The value of Planck's constant is 6.63×10^{-34} Js. The speed of light is 3×10^{17} nm s⁻¹. Which value is closest to the wavelength in nanometer of a quantum of light with frequency of 6×10^{15} s⁻¹?

- Option A 75
- Option B 10
- Option C 25
- Option D 50

Correct Option D

Solution:

Given:

Planck's constant $h = 6.63 \times 10^{-34}$

Speed of light $c = 3 \times 10^{17}$ nms⁻¹

Frequency of quanta $\nu = 6 \times 10^{15}$ s⁻¹

$\lambda = ?$

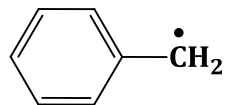
$$\nu = \frac{c}{\lambda}$$

$$\lambda = \frac{c}{\nu}$$

$$\lambda = \frac{3 \times 10^{17}}{6 \times 10^{15}}$$

$$\lambda = 0.5 \times 10^2 \text{ nm} = 50 \text{ nm}$$

Q 2. The radical,



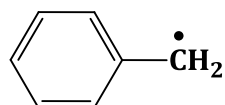
is aromatic

Because it has:

- Option A 6p-orbital and 7 unpaired electrons
- Option B 6p-orbital and 6 unpaired electrons
- Option C 7p-orbital and 6 unpaired electrons
- Option D 7p-orbital and 7 unpaired electrons

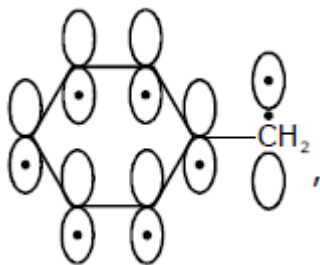
Correct Option B

Solution:



The free radical of Benzyl is aromatic.

It satisfies the Huckel's rule, according to which it has 6π electrons present in p-orbital of carbon atoms also these electrons are delocalized in p-orbital.



6π electrons in 6 P orbitals.

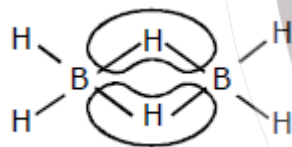
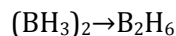
Q 3. Which of the following is electron-deficient?

- Option A PH_3
- Option B $(\text{CH}_3)_2$
- Option C $(\text{SiH}_3)_2$
- Option D $(\text{BH}_3)_2$

Correct Option D

Solution:

In the given molecules all have completed their octet except $(\text{BH}_3)_2$. In $(\text{BH}_3)_2$ boron has 6 valence electrons when it dimerises which means its octet is incomplete. Hence $(\text{BH}_3)_2$ is electron-deficient compound.



(3 centre – $2e^-$ bond)
electron deficient

Q 4. Which of the following statements about the interstitial compounds is incorrect?

- Option A They have higher melting points than the pure metal
- Option B They retain metallic conductive
- Option C They are chemically reactive
- Option D They are much harder than the pure metal

Correct Option C

Solution: They are chemically reactive

Q 5. How many grams of concentrated nitric acid solution should be used to prepare 250 mL of 2.0 M HNO_3 ?

- Option A 54.0 conc. HNO_3
- Option B 45.0 conc. HNO_3
- Option C 90.0 conc. HNO_3
- Option D 70.0 conc. HNO_3

Correct Option B

Solution:

$$M = \frac{w \times 1000}{M_w \times v_{\text{solution}} (\text{mL})}$$

$$2 = \frac{W \times 1000}{63 \times 250}$$

$$W = 31.5 \text{ g}$$

Required mass of $\text{HNO}_3 = 31.5 \text{ gm}$

70% HNO_3 means 70g HNO_3 is present in 100g solution

So 1 gm will be present in $\frac{100}{70}$ gm of solution.

$$\therefore 31.5 \text{ gHNO}_3 \text{ will be present in } \frac{100}{70} \times 31.5 \\ = 45 \text{ g of solution}$$

Q 6. Which of the following lanthanoid ions is diamagnetic?

(At. No., Ce = 58, Sm = 62, Vb = 70)

Option A Yb^{2+}

Option B Ce^{2+}

Option C Sm^{2+}

Option D Eu^{2+}

Correct Option A

Solution:

Diamagnetic = No unpaired electrons

$\text{Ce} (58) = \text{Ce}^{2+} = [\text{Xe}] 4f^2 5d^0 6s^2$, unpaired $e^- = 2$

$\text{Sm} (62) = \text{Sm}^{2+} = [\text{Xe}] 4f^6 5d^0 6s^2$, unpaired $e^- = 6$

$\text{Eu} (63) = \text{Eu}^{2+} = [\text{Xe}] 4f^7 5d^0 6s^2$, unpaired $e^- = 7$

$\text{Yb} (70) = \text{Yb}^{2+} = [\text{Xe}] 4f^{14} 5d^0 6s^2$ unpaired $e^- = 0$

Since Yb^{2+} ion has zero unpaired electrons hence it is diamagnetic in nature.

Q 7. Which one of the following molecules contains no π bond?

Option A NO_2

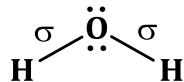
Option B CO_2

Option C H_2O

Option D SO_2

Correct Option C

Solution: In H_2O molecule, the central atom oxygen has no d-orbitals for π -bonding.



Q 8. Based on equation $E = - 2.178 \times 10^{-18} \left(\frac{Z^2}{n^2} \right)$ certain conclusions are written. Which of

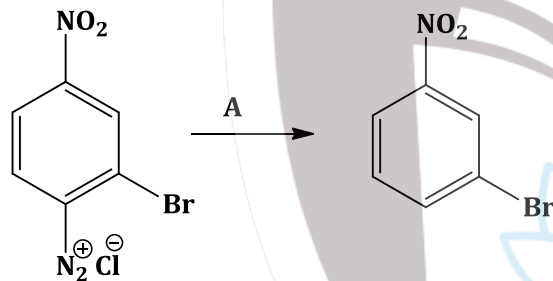
them is not correct?

- Option A For $n = 1$, the electron has a more negative energy than it does for $n = 6$ which means that the electron is more loosely bound in the smallest allowed orbit.
- Option B The negative sign in equation simply means that the energy of electron bound to the nucleus is lower than it would be if the electrons were at the infinite distance from the nucleus
- Option C Larger the value of n , the larger is the orbit radius
- Option D Equation can be used to calculate the change in energy when the electron change orbit

Correct Option A

Solution: Energy of an electron at infinite distance from the nucleus is zero. As an electron approaches the nucleus, the electron attraction increases and hence the energy of electron decreases and thus becomes negative. Thus as the value of 'n' decreases, i.e. lower the orbit is, more negative is the energy of the electron in it.

Q 9. In the reaction

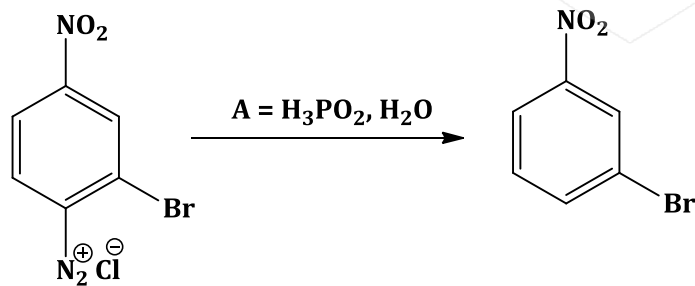


A is

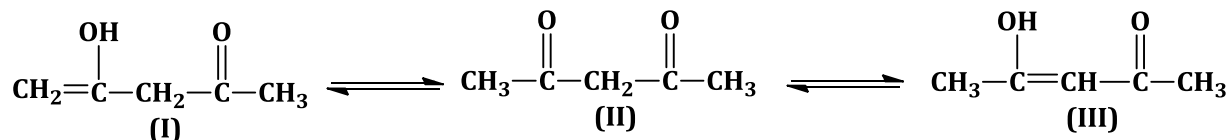
- Option A H^+/H_2O
- Option B $HgSO_4/H_2SO_4$
- Option C Cu_2Cl_2
- Option D H_3PO_2 and H_2O

Correct Option D

Solution:



Q 10. The order of stability of the following tautomeric compounds is:



Option A II > III > I

Option B I > II > III

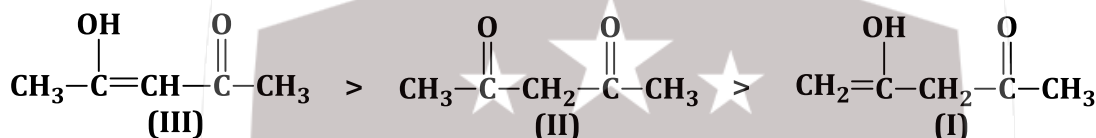
Option C III > II > I

Option D II > I > III

Correct Option C

Solution:

Stability order is



Intramolecular H-Bonding and conjugated diene and it has involved more acidic -H[-CH₂-]

(No conjugated diene)

Involvement of less acidic -H in tautomerism

Q 11. Nylon is an example of:-

Option A Polythene

Option B Polyester

Option C Polysaccharide

Option D Polyamide

Correct Option D

Solution: Nylon is formed by condensation reaction of amines and carboxylic acid groups with polyimide linkage.

Q 12. XeF₂ is isostructural with:

Option A BaCl₂

Option B TeF₂

Option C ICl₂⁻

Option D SbCl₃

Correct Option C

Solution: Species having same number of bond pair and lone pair are called isostructural. According to following table XeF₂ is isostructural with ICl₂⁻.

Structure of the compound/ion	Hybridisation	Geometry
$\text{F}-\overset{\cdot\cdot}{\underset{\cdot\cdot}{\text{Xe}}}-\text{F}$	<i>sp³d</i>	Linear
$\text{Cl}-\overset{\ominus}{\underset{\cdot\cdot}{\text{I}}}-\text{Cl}$	<i>sp³d</i>	Linear

	sp^3	Pyramidal
	sp^3	V-shaped

Q 13. The basic structural unit of silicates is:

Option A SiO_4^{2-}

Option B SiO^-

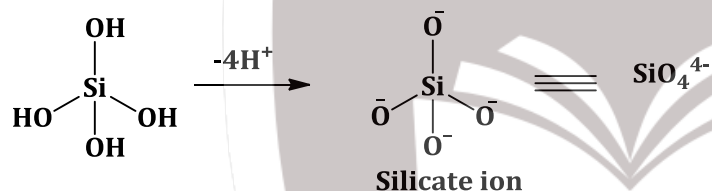
Option C SiO_4^{4-}

Option D SiO_3^{2-}

Correct Option C

Solution:

Silicates – salt of silicic acid H_4SiO_4



The basic structural unit of silicates is SiO_4^{4-} .

Q 14. Which of the following structure is similar to graphite?

Option A B_2H_6

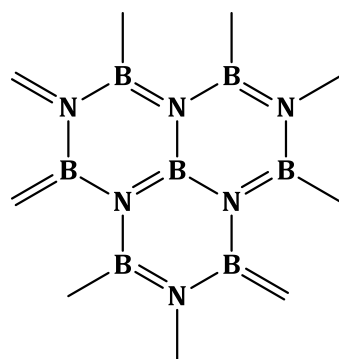
Option B BN

Option C B

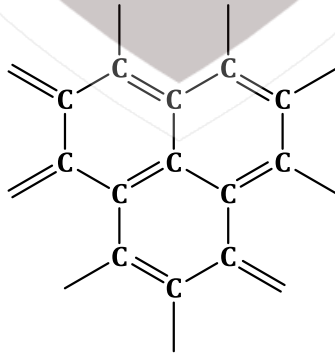
Option D B_4C

Correct Option B

Solution: Boron nitride, $(\text{BN})_x$ is known as inorganic graphite and has structure similar to graphite.

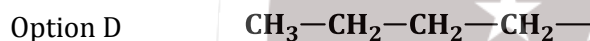
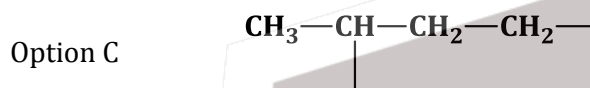
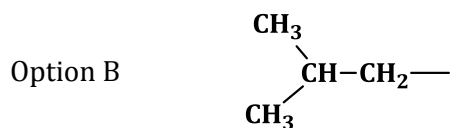
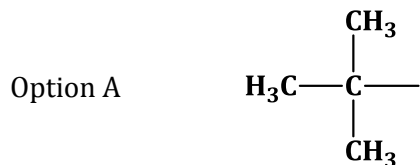


Boron nitride



Graphite

Q 15. The structure of isobutyl group in an organic compounds is:



Correct Option B

Solution:

$\begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{C}- \\ \\ \text{CH}_3 \end{array}$ <p>t-butyl</p>	$\begin{array}{c} \text{CH}_3 \\ \diagdown \\ \text{CH}-\text{CH}_2- \\ \diagup \\ \text{CH}_3 \end{array}$ <p>isobutyl</p>	$\begin{array}{c} \text{CH}_3-\text{CH}-\text{CH}_2-\text{CH}_2- \\ \\ \text{CH}_3 \end{array}$ <p>sec-butyl</p>	$\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-$ <p>n-butyl</p>
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Q 16. The number of carbon atoms per unit cell of diamond is:

- Option A 1
Option B 4
Option C 8
Option D 6

Correct Option C

Solution: In the diamond cubic unit cell, there are eight corner atoms, six face centered atoms and four more atoms inside the structure.

\therefore No. of atoms contributed by the corner atoms to an unit cell is $\frac{1}{8} \times 8 = 1$

No. of atoms contributed by the face centered atoms to the unit cell is $\frac{1}{2} \times 6 = 3$

And Atoms inside the structure = 4

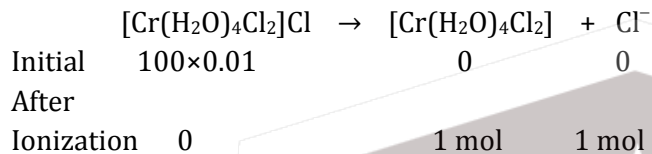
So total number of atoms present in a diamond cubic unit cell is $1 + 3 + 4 = 8$

Q 17. An excess of AgNO_3 is added to 100 mL of a 0.01 M solution of dichlorotetraqua chromium (II) chloride. The number of moles of AgCl precipitated would be:-

- Option A 0.01
Option B 0.001
Option C 0.002
Option D 0.003

Correct Option B

Solution:



So 1 mol of Cl^- ions will react with 1 mol of AgNO_3

Mole of $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl}$ 0.1 M 100ml solution is,

$$\begin{aligned} \text{No. of moles} &= \text{Molarity} \times \text{Volume} \\ &= 0.01 \times 0.1 \\ &= 0.001 \text{ mol} \end{aligned}$$

Hence 0.001mol of Cl^- ions will reacts with 0.001 mole AgNO_3

So, number of mole of AgCl formed is 0.001 mol.

Q 18. What is the maximum numbers of electrons that can be associated with the following set of quantum numbers?

$n = 3, l = 1$ and $m = -1$

- Option A 2
Option B 10
Option C 6
Option D 4

Correct Option A

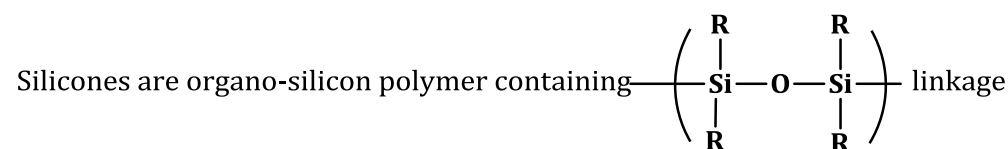
Solution: $n = 3, l = 1$ and $m = -1$ represent a 3p-orbital so maximum 2 electrons with opposite spin can be accommodate in it.

Q 19. Which of these is not a monomer for a high molecular mass silicone polymer?

- Option A PhSiCl_3
Option B Me_2SiCl_2
Option C MeSiCl_3
Option D Me_3SiCl

Correct Option D

Solution:



Since Me_3SiCl contain only one Cl therefore it can't form high molecular mass silicon polymer because on hydrolysis it generates Me_3SiOH which contains only one reacting site so that reaction stops there. It act a chain terminating organ silane.

Q 20. A reaction having equal energies of activation for forward and reverse reactions has:-

- Option A $\Delta H = \Delta G = \Delta S = 0$
 Option B $\Delta S = a$
 Option C $\Delta G = 0$
 Option D $\Delta H = 0$

Correct Option D

Solution:

$$\text{Given: } (E_a)_f = (E_a)_b$$

$$\Delta H = (E_a)_f - (E_a)_b$$

$$\therefore \Delta H = 0$$

Q 21. At 25°C molar conductance of 0.1 molar aqueous solution of ammonium hydroxide is 9.54 ohm⁻¹ cm² mol⁻¹ and at infinite dilution its molar conductance is 238 ohm⁻¹ cm² mol⁻¹. The degree of ionization of ammonium hydroxide at the same concentration and temperature is:-

- Option A 40.800%
 Option B 2.080%
 Option C 20.800%
 Option D 4.008%

Correct Option D

Solution:

Given:

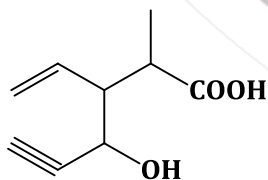
Molar conductance at 0.1 M concentration, $\lambda_c = 9.54 \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$

Molar conductance at infinite concentration, $\lambda_\infty = 238 \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$

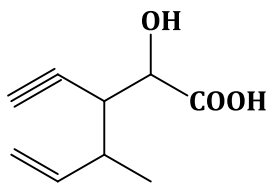
$$\% \alpha = \frac{\lambda_c}{\lambda_\infty} \times 100 = \frac{9.54}{238} \times 100 = 4.008\%$$

Q 22. Structure of the compound whose IUPAC name is 3-Ethyl-2-hydroxy-4-methylhex-3-en-5-ynoic acid is:-

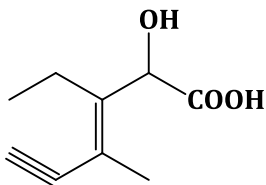
Option A



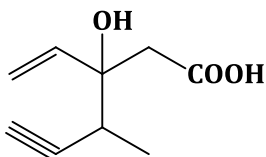
Option B



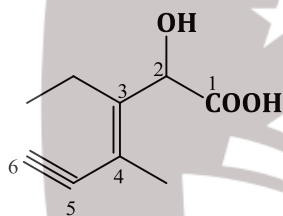
Option C



Option D



Correct Option C
Solution:



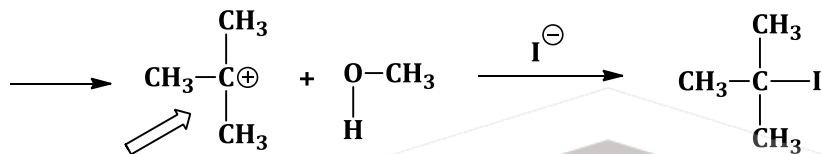
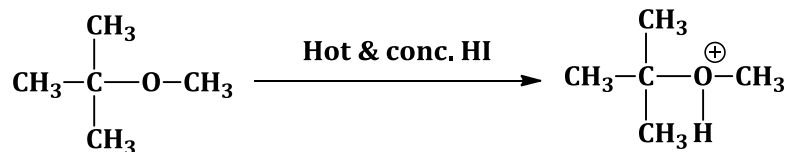
3-Ethyl-2-hydroxy-4-methylhex-3-ex-5-ynonic acid

Q 23. Among the following ethers, which one will produce methyl alcohol on treatment with hot concentrated HI?

Option A	$\begin{array}{c} \text{CH}_3-\text{CH}-\text{CH}_2-\text{O}-\text{CH}_3 \\ \\ \text{CH}_3 \end{array}$
Option B	$\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{O}-\text{CH}_3$
Option C	$\begin{array}{c} \text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}-\text{O}-\text{CH}_3 \\ \\ \text{CH}_3 \end{array}$
Option D	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3-\text{C}-\text{O}-\text{CH}_3 \\ \\ \text{CH}_3 \end{array}$

Correct Option D

Solution: Carbocation is the reaction intermediate in this reaction, The order of stability of carbocation is $3^\circ > 2^\circ > 1^\circ$.



3° carbocation
more stable

Q 24. Antiseptics and disinfectants either kill or prevent growth of microorganisms. Identify which of the following statements is not true:-

- Option A Disinfectants harm the living tissues
 Option B A 0.2 % solution of phenol is an antiseptic while 1% solution acts as a disinfectant
 Option C Chlorine and Iodine are used as strong disinfectants
 Option D Dilute solutions of Boric acid and Hydrogen Peroxide are strong antiseptics

Correct Option D

Solution: Dilute solutions of Boric acid and Hydrogen Peroxide are weak antiseptics.

Q 25. A magnetic moment of 1.73 BM will be shown by one among the following:-

- Option A $[\text{CoCl}_6]^{4-}$
 Option B $[\text{Cu}(\text{NH}_3)_4]^{2+}$
 Option C $[\text{Ni}(\text{CN})_4]^{2-}$
 Option D TiCl_4

Correct Option B

Solution:

Magnetic moment 1.73 BM

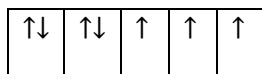
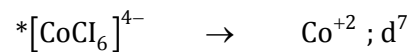
$$\mu = \sqrt{n(n+2)} \text{ B.M}$$

n = no. of unpaired e^-

$$\mu = 1.73$$

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

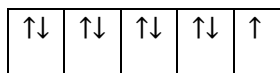
$$n = 1$$



Cl^- (weak field

ligand) $t_{2g}^5 e_g^2$ unpaired $e^- = 3$

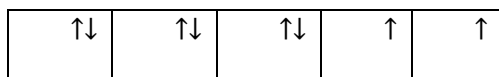
b) $[\text{Cu}(\text{NH}_3)_4]^{2+}$ $\text{Cu}^{+2} - d^9$



NH_3 strong field ligand, hybridization dsp^2

One e^- of 3d jumps into 4p subshell. Unpaired $e^- = 1$

c) $[\text{Ni}(\text{CN})_4]^{2-} \rightarrow \text{Ni}^{+2} - d^8$ unpaired $e^- = 0$



d) $\text{TiCl}_4 \rightarrow \text{Ti}^{+4} =$

d^0 unpaired $e^- = \text{zero}$.

Q 26. KMnO_4 can be prepared from K_2MnO_4 as per the reaction:-

$3\text{MnO}_4^{2-} + 2\text{H}_2\text{O} \rightleftharpoons 2\text{MnO}_4^- + \text{MnO}_2 + 4\text{OH}^-$ The reaction can go to completion by removing

OH⁻ ions by adding:

Option A SO_2

Option B HCl

Option C KOH

Option D CO_2

Correct Option D

Solution:

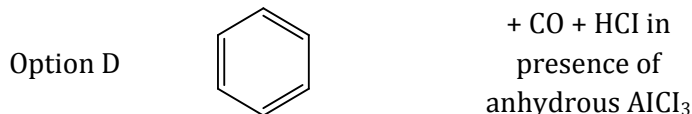
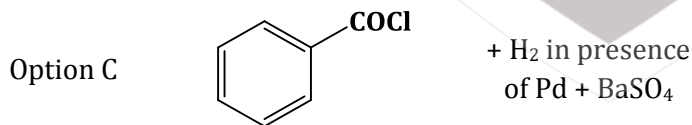
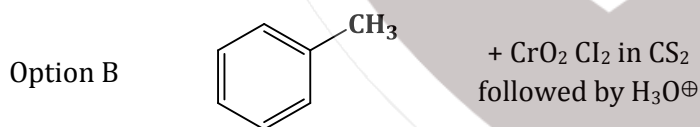
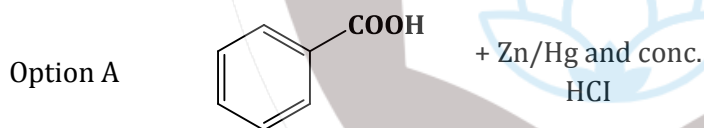
A) SO_2 = will react with water to form H_2SO_4

B) HCl = being acid it will reverse the reaction

C) KOH = Being base it will increase the concentration of OH^- ion.

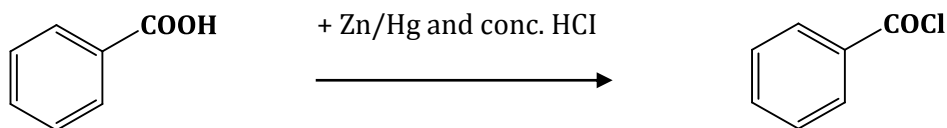
D) CO_2 = will combine with OH^- ions from the solution to form carbonate which is easily removable.

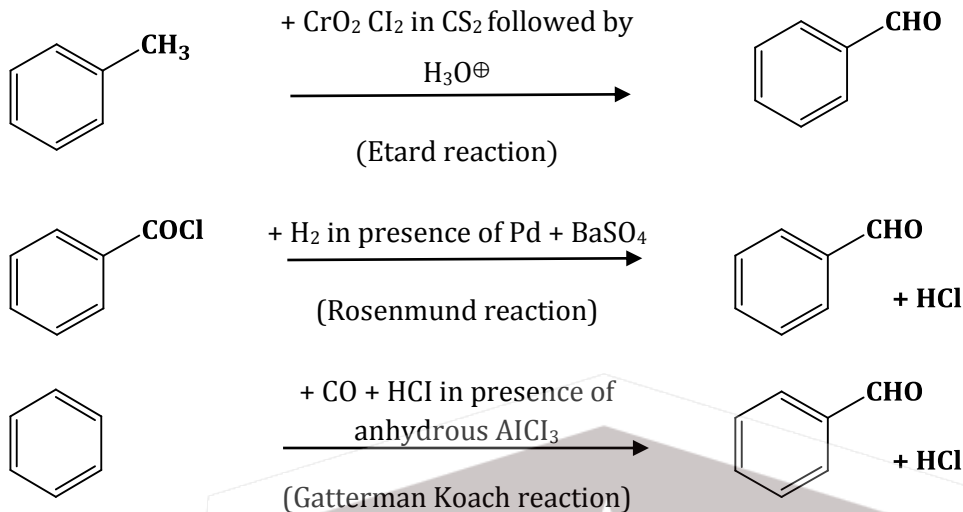
Q 27. Reaction by which Benzaldehyde cannot be prepared:-



Correct Option A

Solution: In presence of Zn-Hg and conc. HCl reduction is useful especially for aldehyde and ketone but carboxylic group remains unaffected



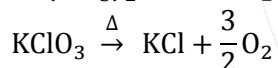
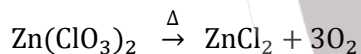


Q 28. Which of the following does not give oxygen on heating?

- Option A $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$
 Option B KClO_3
 Option C $\text{Zn}(\text{ClO}_3)_2$
 Option D $\text{K}_2\text{Cr}_2\text{O}_7$

Correct Option A

Solution: $(\text{NH}_4)_2\text{Cr}_2\text{O}_7 \xrightarrow{\Delta} \text{N}_2 + \text{Cr}_2\text{O}_3 + 4 \text{H}_2\text{O}$ do not produce O_2 . Whereas,



Q 29. A metal has a fcc lattice. The edge length of the unit cell is 404 pm. The density of the metal is 2.72 g cm^{-3} . The molar mass of the metal is:-

- Option A 20 g mol^{-1}
 Option B 40 g mol^{-1}
 Option C 30 g mol^{-1}
 Option D 27 g mol^{-1}

Correct Option D

Solution:

Given, cell is fcc, so $Z = 4$

Edge length, $a = 404 \text{ pm} = 4.04 \times 10^{-8} \text{ cm}$

Density of metal, $d = 2.72 \text{ g cm}^{-3}$

$N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$

Molar mass of the metal, $M = ?$

$$P = \frac{Z \times M}{N_A \times a^3} \text{ for FCC, } Z = 4$$

$$a = 404 \text{ pm} = 404 \times 10^{-10} \text{ cm.}$$

$$2.72 = \frac{4 \times M}{6.02 \times 10^{23} \times (404 \times 10^{-10})^3}$$

$$M = 27 \text{ gmol}^{-1}$$

Q 30. Dipole induced dipole interactions are present in which of the following pairs:-

- Option A SiF₄ and He atoms
 Option B H₂O and alcohol
 Option C Cl₂ and CCl₄
 Option D HCl and He atoms

Correct Option D

Solution:

Dipole – induced dipole occurs between polar & Non-polar molecule. In the given options Except HCl and He atoms rest are non-polar molecules.

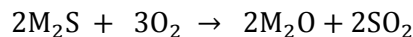
HCl	He
Polar	Non-polar
$\mu \neq 0$	$\mu = 0$

Q 31. Roasting of sulphides gives the gas X as a byproduct. This is colourless gas with choking smell of brunt Sulphur and causes great damage to respiratory organs as a result of acid rain. Its aqueous solution is acidic, acts as reducing agent and its acid has never been isolated. The gas X is:-

- Option A SO₃
 Option B H₂S
 Option C SO₂
 Option D CO₂

Correct Option C

Solution: During roasting of sulphide ore SO₂ gas is obtained, reaction occurs as,



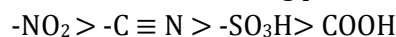
X = SO₂ is a colourless gas with choking smell of brunt Sulphur and causes great damage to respiratory organs as a result of acid rain. Its aqueous solution is acidic, acts as reducing agent and its acid has never been isolated.

Q 32. Some meta-directing substituents in aromatic substitution are given. Which one is most deactivating?

- Option A -NO₂
 Option B -C≡N
 Option C -SO₃H
 Option D -COOH

Correct Option A

Solution: Deactivating power:



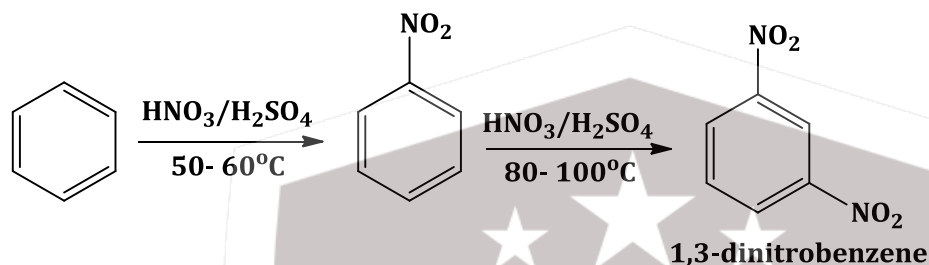
Thus, -NO₂ is the most deactivating group due to -I and -M effect.

Q 33. Nitrobenzene on reaction with conc. $\text{HNO}_3/\text{H}_2\text{SO}_4$ at $80-100^\circ\text{C}$ forms which one of the following products?

- Option A 1, 2, 4-Trinitrobenzene
 Option B 1, 2-Dinitrobenzene
 Option C 1, 3- Dinitrobenzene
 Option D 1, 4- Dinitrobenzene

Correct Option C

Solution: Nitrobenzene on reaction with conc. $\text{HNO}_3/\text{H}_2\text{SO}_4$ at $80-100^\circ\text{C}$ forms 1,3-dinitrobenzene.

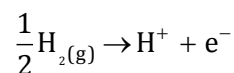


Q 34. A hydrogen gas electrode is made by dipping platinum wire in a solution of HCl of pH = 10 and by passing hydrogen gas around the platinum wire at one atm pressure. The oxidation potential of electrode would be?

- Option A 1018 V
 Option B 0.059 V
 Option C 0.59 V
 Option D 0.118 V

Correct Option C

Solution:



$$E_{\text{o.p.}} = E_{\text{o.p.}}^\circ - \frac{0.059}{n} \log \frac{[\text{H}^+]}{(\text{P}_{\text{H}_2})^{1/2}}$$

$$E_{\text{o.p.}} = E_{\text{o.p.}}^\circ - \frac{0.059}{1} \log \frac{10^{-10}}{(1)^{1/2}}$$

$$(\text{pH} = 10, [\text{H}^+] = 10^{-10} \text{M})$$

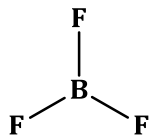
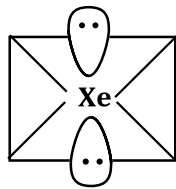
$$E_{\text{o.p.}} = 0.59 \text{ V}$$

Q 35. Which of the following is a polar molecule?

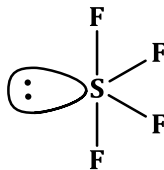
- Option A XeF_4
 Option B BF_3
 Option C SF_4
 Option D SiF_4

Correct Option C

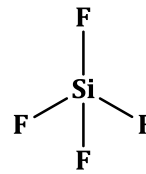
Solution: Unsymmetrical distribution of e^- cloud lead to the formation of polar molecule



$$\mu = 0$$

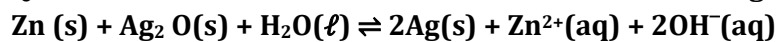


$$\mu \neq 0$$



$$\mu = 0$$

Q 36. A button cell used in watches function as following



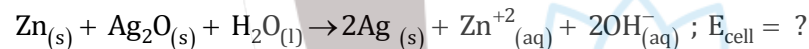
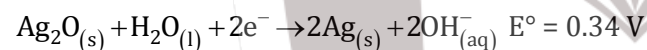
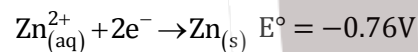
If half-cell potentials are $\text{Zn}^{2+}_{(\text{aq})} + 2\text{e}^- \rightarrow \text{Zn}_{(\text{s})}$ $E^\circ = -0.76\text{V}$

$\text{Ag}_2\text{O}_{(\text{s})} + \text{H}_2\text{O}_{(\text{l})} + 2\text{e}^- \rightarrow 2\text{Ag}_{(\text{s})} + 2\text{OH}^-_{(\text{aq})}$ $E^\circ = 0.34\text{V}$. The cell potential will be:

- Option A 1.34 V
- Option B 1.10 V
- Option C 0.42 V
- Option D 0.84 V

Correct Option B

Solution:



$$E^\circ_{\text{cell}} = (E^\circ_{\text{R.P.}})_{\text{cathode}} - (E^\circ_{\text{R.P.}})_{\text{anode}}$$

$$E^\circ_{\text{cell}} = 0.34 - (-0.76) = 1.10\text{V}$$

$$E^\circ_{\text{cell}} = E^\circ_{\text{cell}} = 1.10\text{V}$$

Q 37. Which of these is least likely to act as a Lewis base?

- Option A PF_3
- Option B CO
- Option C F^-
- Option D BF_3

Correct Option D

Solution: BF_3 is Lewis acid (e^- pair acceptor)

Q 38. Which of the following compounds will not undergo Friedal-Craft's reaction easily:-

- Option A Toluene
- Option B Cumene
- Option C Xylene
- Option D Nitrobenzene

Correct Option D

Solution:

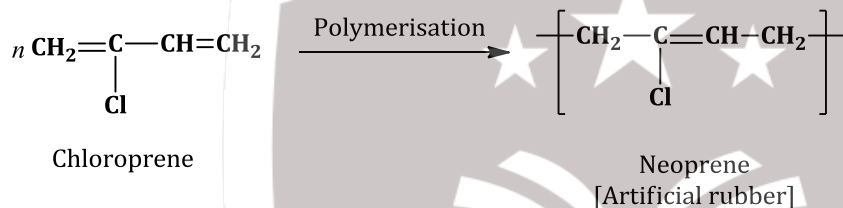
Fridel Craft reaction fails when strong deactivating group like nitro group is attached with benzene ring.

Q 39. Which is the monomer of Neoprene in the following:-

- Option A $\text{CH}_2\equiv\text{CH}-\text{C}\equiv\text{CH}$
- Option B $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$
- Option C $\begin{array}{c} \text{CH}_2=\text{C}-\text{CH}=\text{CH}_2 \\ | \\ \text{CH}_3 \end{array}$
- Option D $\begin{array}{c} \text{CH}_2=\text{C}-\text{CH}=\text{CH}_2 \\ | \\ \text{Cl} \end{array}$

Correct Option D

Solution:



Q 40. 6.02×10^{20} molecule of urea are present in 100mL of its solution. The concentration of solution is:-

- Option A 0.1 M
- Option B 0.02 M
- Option C 0.01 M
- Option D 0.001 M

Correct Option C

Solution:

$$\text{Number of moles} = \frac{\text{number of molecules}}{N_A}$$

$$= \frac{6.02 \times 10^{20}}{6.02 \times 10^{23}} = 10^{-3} \text{ mol}$$

$$\text{Molar conc.} = \frac{n \times 1000}{V_{\text{solution}} (\text{mL})} = \frac{10^{-3} \times 100}{100}$$

$$\text{Molar conc.} = 0.01 \text{ M}$$

Q 41. Maximum deviation from ideal gas is expected from:

- Option A $\text{NH}_3(\text{g})$
- Option B $\text{H}_2(\text{g})$
- Option C $\text{N}_2(\text{g})$
- Option D $\text{CH}_4(\text{g})$

Correct Option A

Solution: NH_3 will show maximum deviation from ideal gas due to dipole-dipole attraction.

Q 42. Which of the following is paramagnetic?

- Option A NO⁺
Option B CO
Option C O₂⁻
Option D CN⁻

Correct Option C

Solution:

O₂⁻ → 15 e⁻ contains one unpaired e⁻ in ABMO.

$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2 \pi^*$

Q 43. Identify the correct order of solubility in aqueous medium:

- Option A Na₂S > ZnS > CuS
Option B CuS > ZnS > Na₂S
Option C ZnS > Na₂S > CuS
Option D Na₂S < CuS > ZnS

Correct Option A

Solution: Ionic character ∝ size of cation

The order of size of given cations: Na²⁺ > Zn²⁺ > Cu²⁺

Hence the order of solubility in aqueous medium is Na₂S > ZnS > CuS

Q 44. What is the activation energy for a reaction if its rate doubles when the temperature is raised from 20°C to 35°C? (R = 8.314 J mol⁻¹K⁻¹)

- Option A 15.1 kJ mol⁻¹
Option B 342 kJ mol⁻¹
Option C 269 kJ mol⁻¹
Option D 34.7 kJ mol⁻¹

Correct Option D

Solution:

$$\log \frac{K_2}{K_1} = \frac{E_a}{2.303R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$$

$$\frac{r_2}{r_1} = \frac{K_2}{K_1} = 2$$

$$\log 2 = \frac{E_a}{2.303 \times 8.314 \times 10^{-3}} \left(\frac{1}{293} - \frac{1}{308} \right)$$

$$E_a = 34.7 \text{ kJ mol}^{-1}$$

Q 45. Which is the strongest acid in the following?

Option A H_2SO_3

Option B H_2SO_4

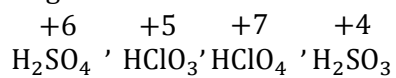
Option C HClO_3

Option D HClO_4

Correct Option D

Solution:

Higher the oxidation number of central atom more the acidity.



As above, HClO_4 has highest oxidation number of Cl, hence HClO_4 is the strongest acid.



BIOLOGY

Q 1. Select the wrong statement:

- Option A Isogametes are similar in structure, function and behaviour.
Option B Anisogametes differ either in structure, function or behaviour.
Option C In oomycetes female gamete is smaller and motile, while male gamete is larger and non-motile.
Option D *Chlamydomonas* exhibits both isogamy and anisogamy and *Fucus* shows oogamy.

Correct Option C

Solution: In oomycetes female gamete is large and non-motile, while male gamete is smaller and motile.

Q 2. Which one of the following is not a correct statement?

- Option A Herbarium houses dried, pressed and preserved plant specimens.
Option B Botanical gardens have a collection of living plants for reference.
Option C A museum has a collection of photographs of plants and animals.
Option D Key is a taxonomic aid for the identification of specimens.

Correct Option C

Solution: A museum has a collection of preserved plant and animal specimens for study and reference.

Q 3. Isogamous condition with non-flagellated gametes is found in

- Option A *Chlamydomonas*
Option B *Spirogyra*
Option C *Volvox*
Option D *Fucus*

Correct Option B

Solution: In *Spirogyra* sexual reproduction takes place through non-flagellated and similar sized gametes, and hence called isogamous.

Q 4. Besides paddy fields, cyanobacteria are also found inside vegetative part of

- Option A *Pinus*
Option B *Cycas*
Option C *Equisetum*
Option D *Psilotum*

Correct Option B

Solution: In *Cycas* small specialised roots called coralloid roots are associated with N₂-fixing cyanobacteria.

Q 5. Megasporangium is equivalent to

- Option A Embryo sac
Option B Fruit
Option C Nucellus
Option D Ovule

Correct Option D

Solution: Megasporangium is commonly called ovule.

Q 6. Read the following statements (A-E) and answer the question which follows them.

- A. In liverworts, mosses, and ferns gametophytes are free-living.
- B. Gymnosperms and some ferns are heterosporous.
- C. Sexual reproduction in *Fucus*, *Volvox* and *Albugo* is oogamous.
- D. The sporophyte in liverworts is more elaborate than that in mosses.
- E. Both *Pinus* and *Marchantia* are dioecious.

How many of the above statements are correct?

- Option A One
- Option B Two
- Option C Three
- Option D Four

Correct Option C

Solution:

- A. In liverworts, mosses, and ferns gametophytes are free-living.
- B. Gymnosperms and some ferns produce two kinds of spores, macro (large) and micro (small) spores, and are known as heterosporous.
- C. Sexual reproduction in *Fucus*, *Volvox* and *Albugo* is oogamous which refers to the fusion between one large, non-motile (static) female gamete and a smaller, motile male gamete.
- D. The sporophyte in mosses is more elaborate than that in liverworts.
- E. *Pinus* is monoecious, having the male and female cones on the same tree whereas *Marchantia* is a dioecious species having male and female organs on different thalli.

Hence, statements A, B and C are correct whereas statements D and E are not correct.

Q 7. Among bitter gourd, mustard, brinjal, pumpkin, china rose, lupin, cucumber, sunnhemp, gram, guava, bean, chilli, plum, *Petunia*, tomato, rose, *Withania*, potato, onion, aloe, and tulip how many plants have hypogynous flower?

- Option A Six
- Option B Ten
- Option C Fifteen
- Option D Eighteen

Correct Option C

Solution: In a hypogynous flower the gynoecium occupies the highest position while the other parts are situated below it. The ovary in such flowers is said to be superior. Mustard, brinjal, china rose, lupin, sunnhemp, gram, bean, chilli, *Petunia*, potato, tomato, *Withania*, onion, aloe and tulip are having hypogynous flower. Hence, fifteen plants out of the given plants have hypogynous flowers.

Q 8. Interfascicular cambium develops from the cells of

- Option A Medullary rays
- Option B Xylem parenchyma
- Option C Endodermis
- Option D Pericycle

Correct Option A

Solution: The cells of medullary rays adjoining the intrafascicular cambium become meristematic and form the interfascicular cambium.

Q 9. In China rose the flowers are

- Option A Actinomorphic, hypogynous with twisted aestivation
- Option B Actinomorphic, epigynous with valvate aestivation
- Option C Zygomorphic, hypogynous with imbricate aestivation
- Option D Zygomorphic, epigynous with twisted aestivation

Correct Option A

Solution: In China rose, the symmetry of the flower is actinomorphic (radial symmetry).

In the hypogynous flower the gynoecium occupies the highest position while the other parts are situated below it. The ovary in such flowers is said to be superior. Example – China rose.

In China rose, one margin of the appendage overlaps that of the next one and so on. This arrangement is called twisted aestivation.

Q 10. Lenticels are involved in

- Option A Transpiration
- Option B Gaseous exchange
- Option C Food transport
- Option D Photosynthesis

Correct Option B

Solution: Lenticels permit the exchange of gases between the outer atmosphere and the internal tissue of the stem.

Q 11. Age of a tree can be estimated by

- Option A Its height and girth
- Option B Biomass
- Option C Number of annual rings
- Option D Diameter of its heartwood

Correct Option C

Solution: Age of a tree can be estimated by the number of concentric rings in the cross section of its trunk.

Q 12. Seed coat is not thin, membranous in

- Option A Maize
- Option B Coconut
- Option C Groundnut
- Option D Gram

Correct Option B

Solution: Seed coat is thin and membranous in maize, groundnut and gram. However, it is thick in coconut.

Q 13. Transition state structure of the substrate formed during an enzymatic reaction is

- Option A Transient but stable
- Option B Permanent but unstable
- Option C Transient but unstable
- Option D Permanent and stable

Correct Option C

Solution: The substrate 'S' binds to the enzyme at the 'active site' within a given cleft or pocket to form an 'ES' complex. During the state where substrate is bound to the enzyme active site, a new

structure of the substrate called transition state structure is formed where the intermediate structural states are unstable. Hence, transition state structure of the substrate formed during an enzymatic reaction is transient but unstable.

Q 14. A phosphoglyceride is always made up of

- Option A Only a saturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached
- Option B Only an unsaturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached
- Option C A saturated or unsaturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached
- Option D A saturated or unsaturated fatty acid esterified to a phosphate group which is also attached to a glycerol molecule

Correct Option C

Solution: A phosphoglyceride is always made up of a saturated or an unsaturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached.

Q 15. Pigment-containing membranous extensions in some cyanobacteria are

- Option A Heterocysts
- Option B Basal bodies
- Option C Pneumatophores
- Option D Chromatophores

Correct Option D

Solution: Pigment-containing membranous extensions in some cyanobacteria are chromatophores which perform the function of photosynthesis.

Q 16. A major site for synthesis of lipids is

- Option A RER
- Option B SER
- Option C Symplast
- Option D Nucleoplasm

Correct Option B

Solution: SER – Smooth Endoplasmic Reticulum is the major site for the formation of lipids in a cell.

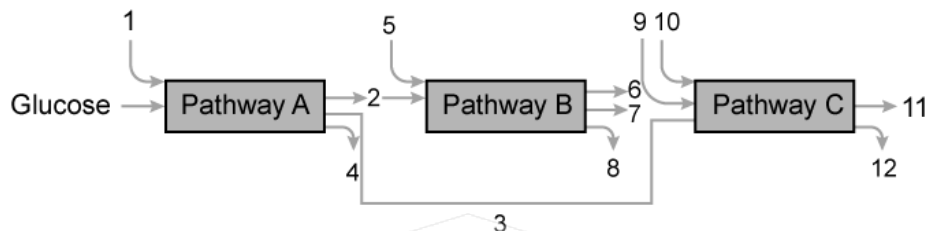
Q 17. The complex formed by a pair of synapsed homologous chromosomes is called

- Option A Equatorial plate
- Option B Kinetochore
- Option C Bivalent
- Option D Axoneme

Correct Option C

Solution: Synapsis is the process of pairing of homologous chromosomes in which each pair of synapsed homologous chromosome is termed as bivalent.

Q 18. The three boxes in this diagram represent the three major biosynthetic pathways in aerobic respiration. Arrows represent net reactants or products. Arrows numbered 4, 8 and 12 can all be



- Option A NADH
- Option B ATP
- Option C H₂O
- Option D FAD⁺ or FADH²

Correct Option B

Solution: Pathway A is glycolysis, pathway B is Krebs cycle and pathway C is oxidative phosphorylation.

Arrow 1 - ADP or NAD⁺

Arrow 2 - Pyruvate

Arrow 3 - NADH

Arrow 4 - ATP

Arrow 5 - ADP, NAD⁺ or FAD

Arrow 6 and 7 - FADH₂ and NADH (either one can be 6 or 7)

Arrow 8 - ATP or CO₂

Arrow 9 and 10 - O₂ and ADP (either one can be 9 or 10)

Arrow 11 and 12 - H₂O and ATP (either one can be 11 or 12)

Q 19. The most abundant intracellular cation is

- Option A Na⁺
- Option B Ca⁺⁺
- Option C H⁺
- Option D K⁺

Correct Option D

Solution: Na⁺ is the major extracellular cation.

Ca⁺⁺ plays an important role in signal transduction pathways.

H⁺ is found in aqueous solutions of all acids.

The most abundant intracellular cation is K⁺.

Q 20. During seed germination its stored food is mobilised by

- Option A Ethylene
- Option B Cytokinin
- Option C ABA
- Option D Gibberellin

Correct Option D

Solution: Gibberellin induces aleurone cells to secrete an enzyme to break stored food in the seed. Hence, during seed germination its stored food is mobilized by gibberellin.

Q 21. Which of the following criterion does not pertain to facilitated transport?

- Option A Requirement of special membrane proteins
- Option B High selectivity
- Option C Transport saturation
- Option D Uphill transport

Correct Option D

Solution: In facilitated diffusion special proteins help move substances across membranes without expenditure of ATP energy. Facilitated diffusion cannot cause net transport of molecules from low to high concentration as it would require input of energy. Transport rate reaches a maximum when all of the protein transporters are being used (saturation). However, uphill transport does not pertain to facilitated transport.

Q 22. The first stable product of fixation of atmospheric nitrogen leguminous plants is

- Option A NO_2^-
- Option B Ammonia
- Option C NO_3^-
- Option D Glutamate

Correct Option B

Solution: Nitrogen fixation is a process by which molecular nitrogen in the air is converted into ammonia. Hence, the first stable product of fixation of atmospheric nitrogen leguminous plants is ammonia.

Q 23. Which of the metabolites is common to respiration mediated breakdown of fats, carbohydrates and proteins?

- Option A Glucose-6-phosphate
- Option B Fructose 1, 6-bisphosphate
- Option C Pyruvic acid
- Option D Acetyl CoA

Correct Option D

Solution: Glucose and fructose are phosphorylated to give rise to glucose-6-phosphate which gets converted into pyruvic acid. Fats are broken down to fatty acid and glycerol and again fatty acids are degraded to acetyl Co-A. Proteins are first degraded by proteases to amino acids which are deaminated to pyruvic acid and further decarboxylated to acetyl Co-A. Hence, acetyl CoA is common to respiration mediated breakdown of fats, carbohydrates and proteins.

Q 24. Which of the following statements is correct?

- Option A Hard outer layer of pollen is called intine.
- Option B Sporogenous tissue is haploid.
- Option C Endothecium produces microspores.
- Option D Tapetum nourishes the developing pollen.

Correct Option D

Solution: The innermost wall layer of microsporangium is called tapetum which nourishes the developing pollen grains.

Q 25. Product of sexual reproduction generally generates

- Option A Longer viability of seeds
- Option B Prolonged dormancy
- Option C New genetic combination leading to variation
- Option D Larger biomass

Correct Option C

Solution: Sexual reproduction involves formation of male and female gametes, which fuse together resulting in offspring that are not identical to the parents or amongst themselves and thus new genetic combination occurs leading to variation.

Q 26. Meiosis takes place in

- Option A Meiocyte
- Option B Conidia
- Option C Gemmule
- Option D Megaspore

Correct Option A

Solution: In diploid organisms, specialised cells called meiocytes (gamete mother cell) undergo meiosis.

Q 27. Advantages of cleistogamy is

- Option A Higher genetic variability
- Option B More vigorous offspring
- Option C No dependence on pollinators
- Option D Vivipary

Correct Option C

Solution: The cleistogamous flowers do not open at all and produce assured seed set and hence do not depend on pollinators.

Q 28. Monoecious plant of *Chara* shows occurrence of

- Option A Antheridiophore and archegoniophore on the same plant
- Option B Stamen and carpel on the same plant
- Option C Upper antheridium and lower oogonium on the same plant
- Option D Upper oogonium and lower antheridium on the same plant

Correct Option D

Solution: Monoecious or homothallic condition in *Chara* (green algae) is used to denote upper oogonium and lower antheridium on the same plant.

Q 29. Perisperm differs from endosperm in

- Option A Being a haploid tissue
- Option B Having no reserve food
- Option C Being a diploid tissue
- Option D Its formation by fusion of secondary nucleus with several sperms

Correct Option C

Solution: Perisperm is the diploid food storage tissue, which originates from the nucellus and is present in seeds whereas endosperm is the triploid food storage tissue, which originates from triple fusion and is present in the developing embryo.

Q 30. Which of the following statements is not true for two genes that show 50% recombination frequency?

- Option A The genes may be in different chromosomes.
- Option B The genes are tightly linked.
- Option C The genes show independent assortment.
- Option D If the genes are present on the same chromosome, they undergo more than one crossovers in every meiosis.

Correct Option B

Solution: The genes which remain tightly linked show very low recombination while others which are loosely linked showed higher recombination as the genes which are closely placed do not get separated and hence no crossing over occurs.

Q 31. Variation in gene frequencies within populations can occur by chance rather than by natural selection. This is referred to as

- Option A Genetic flow
- Option B Genetic drift
- Option C Random mating
- Option D Genetic load

Correct Option B

Solution: Genetic drift is the change in gene frequency which is purely a matter of chance. Hence, genetic drift is the variation in gene frequencies within populations which can occur by chance rather than by natural selection.

Q 32. If two persons with 'AB' blood group marry and have sufficiently large number of children, these children could be classified as 'A' blood group : 'AB' blood group : 'B' blood group in 1 : 2 : 1 ratio.

Modern technique of protein electrophoresis reveals presence of both 'A' and 'B' type proteins in 'AB' blood group individuals. This is an example of

- Option A Codominance
- Option B Incomplete dominance
- Option C Partial dominance
- Option D Complete dominance

Correct Option A

Solution: AB blood group is an example of codominance where allele I^A for A-type blood is codominant with its allele I^B for B-type blood. The heterozygote ($I^A I^B$) expresses the characteristics of both A and B antigens (AB – type blood).

Q 33. The process by which organism with different evolutionary history evolve similar phenotypic adaptations in response to a common environmental challenge, is called

- Option A Natural selection
- Option B Convergent evolution
- Option C Non-random evolution
- Option D Adaptive radiation

Correct Option B

Solution: The process by which organism with different evolutionary history evolve similar phenotypic adaptations in response to a common environmental challenge, is called convergent evolution.

Q 34. The tendency of population to remain in genetic equilibrium may be disturbed by

- Option A Random mating
- Option B Lack of migration
- Option C Lack of mutation
- Option D Lack of random mating

Correct Option D

Solution: According to Hardy Weinberg principle the allele frequencies in a population are stable and are constant from generation to generation, so the gene pool remains constant. Five factors are known to affect Hardy-Weinberg equilibrium - gene migration or gene flow, genetic drift, mutation, genetic recombination and natural selection. Hence, lack of random mating may disturb the tendency of population to remain in genetic equilibrium.

Q 35. Which of the following Bt crops is being grown in India by the farmers?

- Option A Maize
- Option B Cotton
- Option C Brinjal
- Option D Soybean

Correct Option B

Solution: In Bt crops, Bt toxin gene has been cloned from the bacteria and expressed in plants to provide resistance to insects without the need for insecticides. Examples are Bt cotton, Bt corn, rice, tomato, potato and soyabean.

Q 36. A good producer of citric acid is

- Option A *Aspergillus*
- Option B *Pseudomonas*
- Option C *Clostridium*
- Option D *Saccharomyces*

Correct Option A

Solution: *Aspergillus niger* (a fungus) is a producer of citric acid.

Q 37. DNA fragments generated by the restriction endonucleases in a chemical reaction can be separated by

- Option A Centrifugation
- Option B Polymerase chain reaction
- Option C Electrophoresis
- Option D Restriction mapping

Correct Option C

Solution: During DNA fingerprinting, DNA fragments generated by the restriction endonucleases in a chemical reaction can be separated by gel electrophoresis in which the set up contains agarose polymer gel.

Q 38. Which of the following is not correctly matched for the organism and its cell wall degrading enzyme?

- Option A Bacteria - Lysozyme
- Option B Plant cells - Cellulase
- Option C Algae - Methylase
- Option D Fungi - Chitinase

Correct Option C

Solution: Lysozyme destroys the cell wall of bacteria. Cellulase breaks down the cellulose in plant cell wall. Chitinase degrades the cell wall in fungi. Algae have cellulose in their cell wall which is degraded by cellulase. Hence, methylase does not degrade the cell wall of algae.

Q 39. The colonies of recombinant bacteria appear white in contrast to blue colonies of non-recombinant bacteria because of

- Option A Non-recombinant bacteria containing beta-galactosidase
- Option B Insertional inactivation of alpha-galactosidase in non-recombinant bacteria
- Option C Insertional inactivation of alpha-galactosidase in recombinant bacteria
- Option D Inactivation of glycosidase enzyme in recombinant bacteria

Correct Option C

Solution: Alpha-galactosidase is a glycoside hydrolase enzyme that hydrolyses the terminal alpha galactosyl moieties from glycolipids and glycoproteins. The colonies of recombinant bacteria appear white in contrast to blue colonies of non-recombinant bacteria because of insertional inactivation of alpha-galactosidase in recombinant bacteria.

Q 40. Which of the following are likely to be present in deep sea water?

- Option A Archaeobacteria
- Option B Eubacteria
- Option C Blue-green algae
- Option D Saprophytic fungi

Correct Option A

Solution: Archaeobacteria differ from other bacteria in having a different cell wall structure i.e. their cell membrane possesses branched chain lipids which helps them to survive in extreme conditions. Hence, they are present in deep sea water.

Q 41. Natural reservoir of phosphorus is

- Option A Sea water
- Option B Animal bones
- Option C Rocks
- Option D Fossils

Correct Option C

Solution: The largest reservoir of phosphorus is in sedimentary rocks.

42. Secondary productivity is the rate of formation of new organic matter by

- Option A Producers
- Option B Parasites
- Option C Consumers
- Option D Decomposers

Correct Option C

Solution: Primary productivity depends on the producers inhabiting a particular area. However, secondary productivity is the rate of formation of new organic matter by consumers.

Q 43. Which one of the following is not used for ex situ plant conservation?

- Option A Field gene banks
- Option B Seed banks
- Option C Shifting cultivation
- Option D Botanical gardens

Correct Option C

Solution: Ex-situ conservation includes field gene banks, seed banks and botanical gardens. Shifting cultivation is not used for ex situ plant conservation.

Q 44. Kyoto protocol was endorsed at

- Option A CoP-3
- Option B CoP-5
- Option C CoP-6
- Option D CoP-4

Correct Option A

Solution: The Kyoto Protocol was adopted at the third session of the Conference of Parties to the UNFCCC, COP-3 in 1997 in Kyoto, Japan.

Q 45. Which of the following represent maximum number of species among global biodiversity?

- Option A Algae
- Option B Lichens
- Option C Fungi
- Option D Mosses and ferns

Correct Option C

Solution: Fungi represents maximum number of species among global biodiversity.

Q 46. Match the name of the animal (Column I) with one characteristic (Column II) and the phylum/class (column III) to which it belongs.

	Column I	Column II	Column III
Option A	<i>Petromyzon</i>	Ectoparasite	Cyclostomata
Option B	<i>Ichthyophis</i>	Terrestrial	Reptilia
Option C	<i>Limulus</i>	Body covered by chitinous exoskeleton	Pisces
Option D	<i>Adamsia</i>	Radially symmetrical	Porifera

Correct Option A

Solution: Petromyzon is an ectoparasite on some fishes and belongs to class Cyclostomata. Hence, option A is the correct option.

Q 47. Which of the following are correctly matched with respect to their taxonomic classification?

- Option A Flying fish, cuttlefish, silverfish, -Pisces
- Option B Centipede, millipede, spider, scorpion-Insecta
- Option C House fly, butterfly, tsetsefly, silverfish-Insecta
- Option D Spiny anteater, sea urchin, sea cucumber-Echinodermata

Correct Option C

Solution: House fly, butterfly, tsetsefly, silverfish belongs to Phylum Insecta/Arthropoda which includes insects.

Q 48. Which group of animals belong to the same phylum?

- Option A Malarial parasite, Amoeba, Mosquito
- Option B Earthworm, Pinworm, Tapeworm
- Option C Prawn, Scorpion, Locusta
- Option D Sponge, sea anemone, Starfish

Correct Option C

Solution: Prawn, Scorpion, Locusta are examples of phylum Arthropoda.

Q 49. One of representatives of Phylum Arthropoda is

- Option A Cuttlefish
- Option B Silverfish
- Option C Pufferfish
- Option D Flying fish

Correct Option B

Solution: Cuttlefish belongs to Phylum Mollusca. Silverfish belongs to Phylum Arthropoda. Pufferfish and flying fish belong to Phylum Chordata.

Q 50. The H-zone in the skeletal muscle fibres is due to

- Option A The absence of myofibrils in the central portion of A-band
- Option B The central gap between myosin filaments in the A-band
- Option C The central gap between actin filaments extending through myosin filaments in the A-band
- Option D Extension of myosin filaments in the central portion of the A-band

Correct Option C

Solution: At the centre of A-band, a comparatively less dark zone called H -zone is present. H-zone in skeletal muscle is the central gap between actin filaments extending through myosin filaments in the A-band.

Q 51. What external changes are visible 'after the last moult of a cockroach nymph?

- Option A Mandibles become harder
- Option B Anal cerci develop
- Option C Both forewings and hindwings develop
- Option D Labium develops

Correct Option C

Solution: The nymph grows by moulting about 13 times to reach the adult form. The next to last nymphal stage has wing pads but only adult cockroaches have both forewings and hindwings.

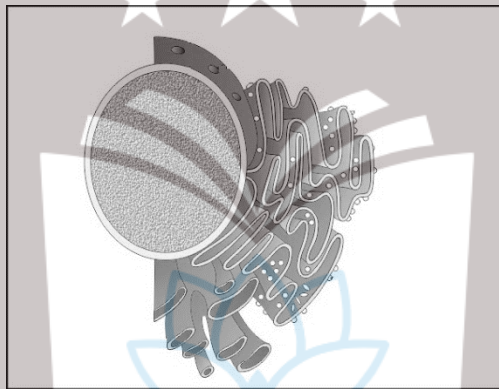
Q 52. The Golgi complex plays a major role

- Option A In trapping light and transforming it into chemical energy
- Option B In digesting proteins and carbohydrates
- Option C As energy transferring organelles
- Option D In post translational modification of proteins and glycosidation of lipids

Correct Option D

Solution: Proteins synthesised by the rough endoplasmic reticulum and lipids synthesised by the smooth endoplasmic reticulum reach the cisternae of Golgi complex where they combine with carbohydrates to form glycoproteins and glycolipids. Hence, the Golgi complex helps in post translational modification of proteins and glycosidation of lipids.

Q 53. Which one of the following organelles in the figure correctly matches with its function?



- Option A Rough endoplasmic reticulum, formation of glycoproteins
- Option B Golgi apparatus, proteins synthesis
- Option C Golgi apparatus, formation of glycolipids
- Option D Rough endoplasmic reticulum, protein synthesis

Correct Option D

Solution: The given figure shows rough endoplasmic reticulum having rough membranes as a number of ribosomes are attached on its outer surface which perform the function of protein synthesis.

Q 54. Macromolecule chitin is

- Option A Nitrogen containing polysaccharide
- Option B Phosphorus containing polysaccharide
- Option C Sulphur containing polysaccharide
- Option D Simple polysaccharide

Correct Option A

Solution: Chitin is a polysaccharide composed of a nitrogen containing glucose derivative known as N-acetyl glucosamine.

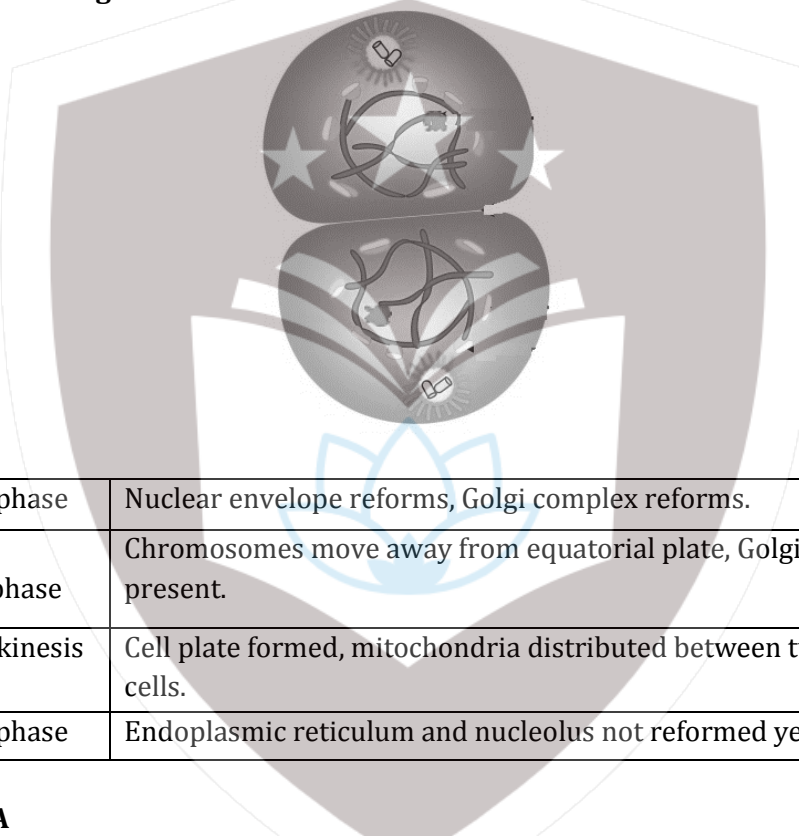
Q 55. The essential chemical components of many coenzymes are

- Option A Proteins
- Option B Nucleic acids
- Option C Carbohydrates
- Option D Vitamins

Correct Option D

Solution: The essential chemical components of many coenzymes are vitamins, e.g., coenzyme nicotinamide adenine dinucleotide (NAD) and NADP contain the vitamin niacin.

Q 56. A stage in cell division is shown in the figure. Select the answer which gives correct identification of the stage with its characteristics.



Option A	Telophase	Nuclear envelope reforms, Golgi complex reforms.
Option B	Late Anaphase	Chromosomes move away from equatorial plate, Golgi complex not present.
Option C	Cytokinesis	Cell plate formed, mitochondria distributed between two daughter cells.
Option D	Telophase	Endoplasmic reticulum and nucleolus not reformed yet.

Correct Option A

Solution: Telophase shows the following key events:

- i. Chromosomes cluster at opposite spindle poles and their identity is lost as discrete elements.
- ii. Nuclear envelope assembles around the chromosome clusters.
- iii. Nucleolus, Golgi complex and ER reform.

Hence, the given image illustrates telophase stage of cell division.

Q 57. Select the correct match of the digested products in humans given in column I with their absorption site and mechanism in column II.

	Column I	Column II
Option A	Glycine, glucose	Small intestine, active absorption
Option B	Fructose, Na ⁺	Small intestine passive absorption
Option C	Glycerol, fatty acids	Duodenum, move as chylomicrons
Option D	Cholesterol, maltose	Large intestine, active absorption

Correct Option A

Solution: Small intestine is the principal organ for absorption of nutrients where the final products of digestion such as glucose, fructose, fatty acids, glycerol and amino acids are absorbed through the mucosa into the blood stream and lymph by active transport. Hence, option A is the correct option.

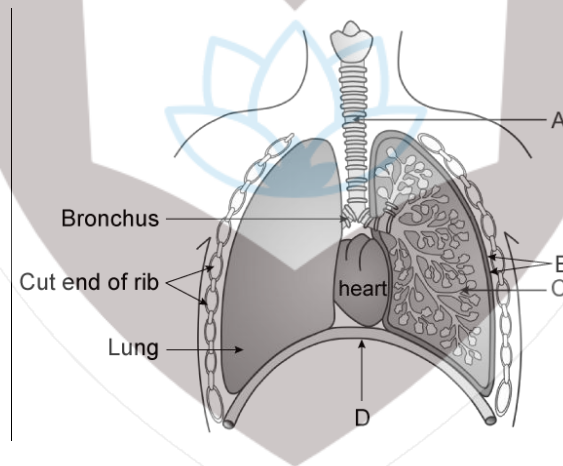
Q 58. A pregnant female delivers a baby who suffers from stunted growth, mental retardation, low intelligence quotient and abnormal skin. This is the result of

- Option A Deficiency of iodine in diet
- Option B Low secretion of growth hormone
- Option C Cancer of the thyroid gland
- Option D Over secretion of pars distalis

Correct Option A

Solution: Deficiency of iodine in our diet results in hypothyroidism and enlargement of the thyroid gland, commonly called goitre which causes defective development and maturation of the growing baby leading to stunted growth (cretinism), mental retardation, low intelligence quotient and abnormal skin.

Q 59. The figure shows a diagrammatic view of human respiratory system with labels A, B, C and D. Select the option which gives correct identification and main function and/or characteristic.



- Option A A – Trachea – long tube supported by complete cartilaginous rings for conducting inspired air
- Option B B – Pleural membrane- surrounds ribs on both sides to provide cushion against rubbing
- Option C C – Alveoli – thin walled vascular bag-like structures for exchange of gases
- Option D D – Lower end of lungs – diaphragm pulls it down during inspiration

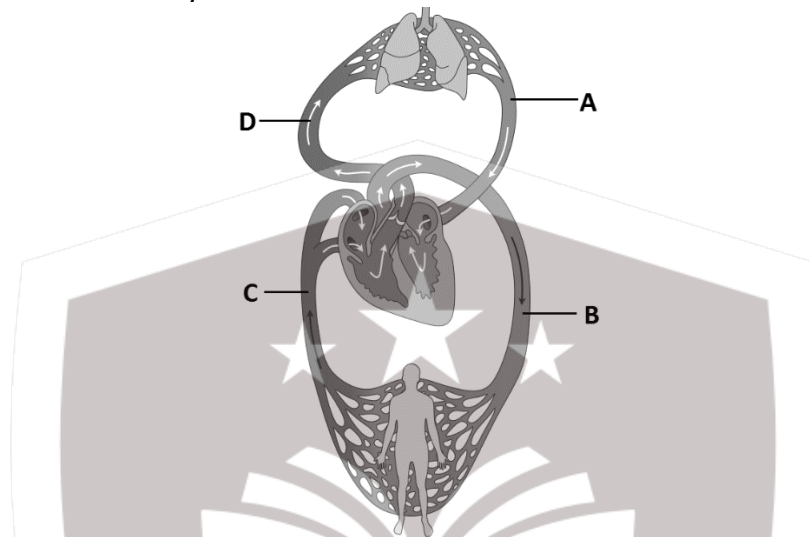
Correct Option C

Solution:

- A - The tracheae is a long tube supported by incomplete cartilaginous rings.
- B - The outer pleural membrane is in close contact with the thoracic lining whereas the inner pleural membrane is in contact with the lung surface.
- C - Each terminal bronchiole gives rise to a number of thin, irregular walled and vascularised bag-like structures called alveoli which are the primary sites for the exchange of gases.

D - The thoracic chamber is formed at the lower side by the dome-shaped diaphragm. Inspiration is initiated by the contraction of diaphragm which increases the volume of thoracic chamber in the anteroposterior axis.

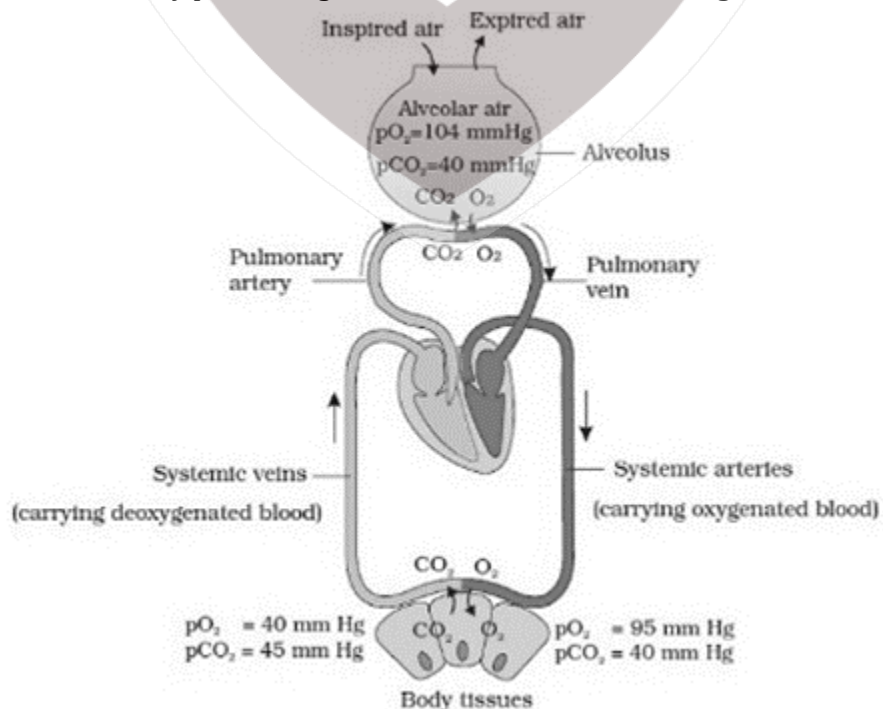
Q 60. Figure shows schematic plan of blood circulation in humans with labels A to D. Identify the label and give its function/s.



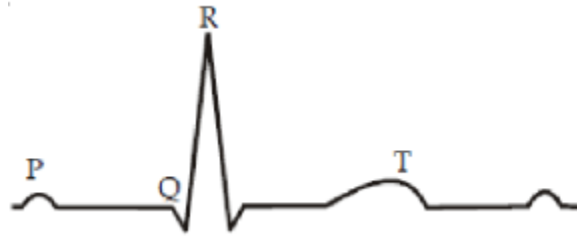
- Option A A – Pulmonary vein – takes impure blood from body parts, $PO_2 = 60$ mm Hg
- Option B B – Pulmonary artery – takes blood from heart to lungs, $PO_2 = 90$ mm Hg
- Option C C – Vena cava – takes blood from body parts to right auricle, $PCO_2 = 45$ mm Hg
- Option D D – Dorsal aorta – takes blood from heart to body parts, $PO_2 = 95$ mm Hg

Correct Option C

Solution: As the tricuspid and bicuspid valves open, blood from the pulmonary veins and vena cava flows into the left and right ventricle respectively through the left and right atria. C is vena cava which takes blood from body parts to right auricle and $PCO_2 = 45$ mm Hg.



Q 61. The diagram given here is the standard ECG of a normal person. The P-wave represents the

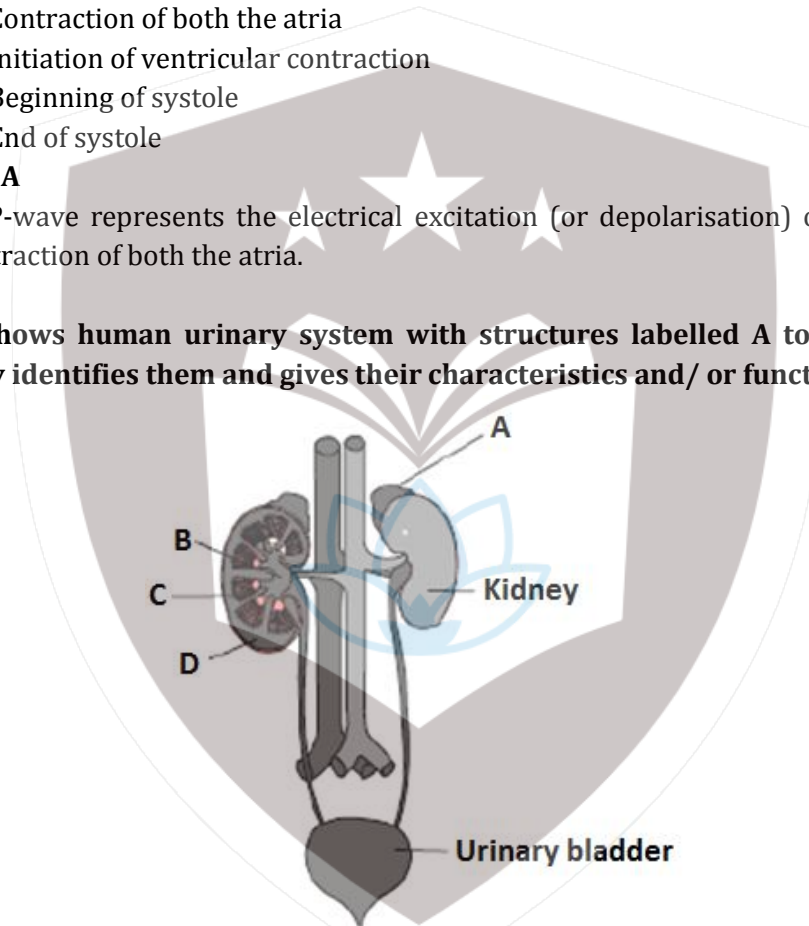


- Option A Contraction of both the atria
- Option B Initiation of ventricular contraction
- Option C Beginning of systole
- Option D End of systole

Correct Option A

Solution: The P-wave represents the electrical excitation (or depolarisation) of the atria, which leads to the contraction of both the atria.

Q 62. Figure shows human urinary system with structures labelled A to D. Select option which correctly identifies them and gives their characteristics and/ or functions.



- Option A A - Adrenal gland - located at the anterior part of the kidney, secretes catecholamines which stimulate glycogen breakdown
- Option B B - Pelvis - broad funnel shaped space inner to hilum, directly connected to the loops of Henle
- Option C C - Medulla - inner zone of kidney and contains complete nephrons
- Option D D - Cortex - outer part of kidney and does not contain any part of nephrons

Correct Option A

Solution: Adrenal gland is located at the anterior part of each kidney. The adrenal medulla secretes two hormones called adrenaline or epinephrine and nor-adrenaline or nor-epinephrine which are commonly called catecholamines which stimulate glycogen breakdown resulting in an increased concentration of glucose in blood.

Q 63. Select the correct statement with respect to locomotion in humans.

- Option A A decreased level of progesterone causes osteoporosis in old people.
- Option B Accumulation of uric acid crystals in joints causes their inflammation.
- Option C The vertebral column has 10 thoracic vertebrae.
- Option D The joint between adjacent vertebrae is a fibrous joint.

Correct Option B

Solution: Inflammation of joints due to accumulation of uric acid crystals is called gout.

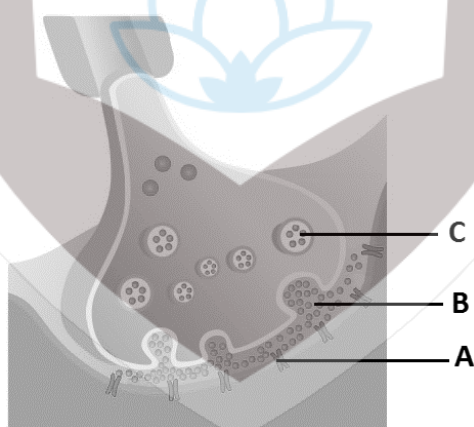
Q 64. The characteristic and an example of a synovial joint human is

	Characteristics	Examples
Option A	Fluid cartilage between two bones, limited movements	Knee joint
Option B	Fluid filled between two joints, provides cushion	Skull bones
Option C	Fluid filled synovial cavity between two bones	Joint between atlas and axis
Option D	Lymph filled between two bones, limited movement	Gliding joint between carpals

Correct Option C

Solution: Synovial joints are characterised by the presence of a fluid filled synovial cavity between the articulating surfaces of two bones. Pivot joint is present between atlas and axis.

Q 65. A diagram showing axon terminal and synapse is given. Identify correctly at least two of A-D.



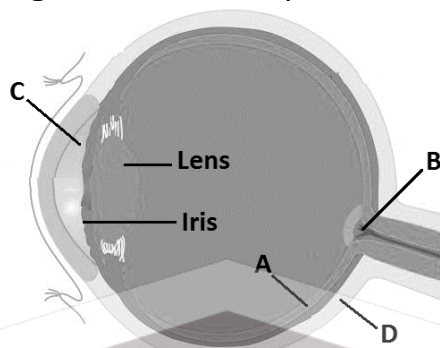
- Option A A – Receptor, C – Synaptic vesicles
- Option B B – Synaptic connection, D – K⁺
- Option C A – Neurotransmitter, B – Synaptic cleft
- Option D C – Neurotransmitter, D – Ca⁺⁺

Correct Option A

Solution: When an impulse arrives at the axon terminal, it stimulates the movement of the synaptic vesicles towards the membrane where they fuse with the plasma membrane and release their neurotransmitters in the synaptic cleft and bind to their specific receptors, present on the post-synaptic membrane.

Hence, A – Receptor and C- Synaptic vesicles.

Q 66. Parts A, B, C and D of the human eye are shown in the diagram. Select the option which gives correct identification along with its functions/ characteristics.



- Option A A - Retina – contains photo receptors rods and cones.
- Option B B - Blind spot – has only a few rods and cones.
- Option C C - Aqueous chamber- reflects the light which does not pass through the lens.
- Option D D - Choroid – its anterior part forms ciliary body.

Correct Option A

Solution: Retina contains two types of photoreceptor cells, rods and cones which contain the light-sensitive proteins called photopigments.

Q 67. Which of the following statements is correct in relation to the endocrine system?

- Option A Adenohypophysis is under direct neural regulation of the hypothalamus.
- Option B Organs in the body like gastrointestinal tract, heart, kidney and liver do not produce any hormones.
- Option C Non-nutrient chemicals produced by the body in trace amounts that act as intercellular messengers are known as hormones.
- Option D Releasing and inhibitory hormones are produced by the pituitary gland.

Correct Option C

Solution: Hormones are non-nutrient chemicals which act as intercellular messengers and are produced in trace amounts.

Q 68. Select the answer which correctly matches the endocrine gland with the hormone it secretes and its function / deficiency symptom.

	Endocrine Gland	Hormone	Function/Deficiency Symptoms
Option A	Anterior pituitary	Oxytocin	Stimulates uterus contraction during child birth
Option B	Posterior pituitary	Growth Hormone (GH)	Oversecretion stimulates abnormal growth
Option C	Thyroid gland	Thyroxine	Lack of iodine in diet results in goitre
Option D	Corpus luteum	Testosterone	Stimulates spermatogenesis

Correct Option C

Solution:

Anterior pituitary produces growth hormone (GH).

Posterior pituitary stores and releases two hormones called oxytocin and vasopressin.

Corpus luteum secretes mainly progesterone.

Thyroid gland secretes thyroxine. Iodine is essential for the normal rate of hormone synthesis in the thyroid. Deficiency of iodine in our diet results in hypothyroidism and enlargement of the thyroid gland, commonly called goitre.

Q 69. What is the correct sequence of sperm formation?

- Option A Spermatid, Spermatocyte, Spermatogonia, Spermatozoa
- Option B Spermatogonia, Spermatocyte, Spermatozoa, Spermatid
- Option C Spermatogonia, Spermatozoa, Spermatocyte, Spermatid
- Option D Spermatogonia, Spermatocyte, Spermatid, Spermatozoa

Correct Option D

Solution: During the multiplicative phase of spermatogenesis, the sperm mother cells divide repeatedly by mitotic divisions to form spermatogonia. In the growth phase, the spermatogonia grow in size due to accumulation of nutritive material to form primary spermatocyte. In maturation phase, the primary spermatocytes undergo two maturation divisions and become spermatids which are later transformed into flagellated sperms/spermatozoa.

Q 70. Menstrual flow occurs due to lack of

- Option A Progesterone
- Option B FSH
- Option C Oxytocin
- Option D Vasopressin

Correct Option A

Solution: If fertilisation fails to occur, then the corpus luteum of the ovary degenerates and the secretion of progesterone and estrogen is inhibited, leading to fresh start of the menstrual cycle. Hence, menstrual flow occurs due to lack of progesterone hormone.

Q 71. Which one of the following is not the function of placenta? It

- Option A Facilities supply of oxygen and nutrients to the embryo
- Option B Secretes estrogen
- Option C Facilities the removal of carbon dioxide and waste material from the embryo
- Option D Secretes oxytocin during parturition

Correct Option D

Solution: Placenta performs the following functions:

- i. Facilities supply of oxygen and nutrients to the embryo
- ii. Secretes estrogen
- iii. Facilities removal of carbon dioxide and waste material from the embryo

However, placenta does not secrete oxytocin during parturition.

Q 72. One of the legal methods of birth control is

- Option A Abortion by taking an appropriate medicine
- Option B By abstaining from coitus from day 10 to 17 of the menstrual cycle
- Option C By having coitus at the time of day break
- Option D By a premature ejaculation during coitus

Correct Option B

Solution: Periodic abstinence is one such method in which the couples avoid or abstain from coitus from day 10 to 17 of the menstrual cycle when ovulation could be expected. This is one of the legal methods of birth control.

Q 73. Which of the following cannot be detected in a developing foetus by amniocentesis?

- Option A Klinefelter's syndrome
- Option B Sex of the foetus
- Option C Down's syndrome
- Option D Jaundice

Correct Option D

Solution: Amniocentesis is a foetal sex determination test based on the chromosomal pattern in the amniotic fluid surrounding the developing embryo that helps in detecting the genetic abnormalities in the developing foetus. Hence, it can be used to detect Klinefelter's syndrome, sex of the foetus and Down's syndrome but cannot be used to detect jaundice in the developing foetus.

Q 74. Artificial insemination means

- Option A Transfer of sperms of a healthy donor to a test tube containing ova
- Option B Transfer of sperms of husband to a test tube containing ova
- Option C Artificial introduction of sperms of a healthy donor into the vagina
- Option D Introduction of sperms of a healthy donor directly into the ovary

Correct Option C

Solution: Artificial insemination is the technique of artificial introduction of the semen collected either from the husband or a healthy donor into the vagina or the uterus of the female.

Q 75. Which Mendelian idea is depicted by a cross in which the F₁ generation resembles both the parents?

- Option A Incomplete dominance
- Option B Law of dominance
- Option C Inheritance of one gene
- Option D Co-dominance

Correct Option D

Solution: In co-dominance, both the alleles of a pair are fully expressed in a heterozygote and the genes and traits are said to be codominant. Hence, F₁ generation resembles both the parents.

Q 76. The incorrect statement with regards to haemophilia is

- Option A It is a sex-linked disease.
- Option B It is a recessive disease.
- Option C It is a dominant disease.
- Option D A single protein involved in the clotting of blood is affected.

Correct Option C

Solution: Haemophilia is a sex-linked recessive disease in which a single protein is affected which is a part of the cascade of proteins involved in clotting of blood.

Q 77. If both parents are carriers for thalassemia which is an autosomal recessive disorder, what are the chances of pregnancy resulting in an affected child?

- Option A No chance
- Option B 50 %
- Option C 25 %
- Option D 100 %

Correct Option C

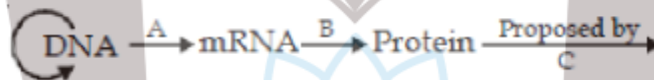
Solution: The genotype of husband for thalassemia is $X^T X$ and the genotype for carrier women is $X^T X$.

Parents....	Husband	×	Wife
Genes....	$X^T Y$	×	$X^T X$
Gametes.....	X^T, Y	×	X^T, X

	X^T	Y
X^T	$X^T X^T$	$X^T Y$
X	XX^T	XY

Hence, the probability of an affected child will be 25%.

Q 78. The diagram shows an important concept in the genetic implication of DNA. Fill in the blanks A to C.



- Option A A - Transcription, B - Transcription, C - James Watson
- Option B A - Translation, B - Transcription, C - Erwin Chargaff
- Option C A - Transcription, B - Translation, C - Francis Crick
- Option D A - Translation, B - Extension, C - Rosalind Franklin

Correct Option C

Solution: Francis Crick proposed the central dogma in molecular biology, which states that the genetic information flows from DNA → RNA → Protein.

Q 79. Which enzyme/s will be produced in a cell in which there is a non-sense mutation in the lac Y gene?

- Option A β - galactosidase
- Option B Lactose permease
- Option C Transacetylase
- Option D Lactose permease and transacetylase

Correct Option A

Solution: A non-sense mutation in the lac Y gene will produce non-functional permease and a stop codon will be introduced in the sequence after lac Z gene. Since only β -galactosidase enzyme is produced and permease and transacetylase enzymes are not produced, lactose is not transported into the cell. Hence, β - galactosidase will be produced in a cell in which there is a non-sense mutation in the lac Y gene.

Q 80. According to Darwin, the organic evolution is due to

- Option A Intraspecific competition
- Option B Intraspecific competition
- Option C Competition within closely related species.
- Option D Reduced feeding efficiency in one species due to the presence of interfering species.

Correct Option B

Solution: According to Darwin, organic evolution is due to intraspecific competition which is an interaction in which members of the same species compete for limited resources.

Q 81. The eye of octopus and eye of cat show different patterns of structure, yet they perform similar function. This is an example of

- Option A Homologous organs that have evolved due to convergent evolution.
- Option B Homologous organs that have evolved due to divergent evolution.
- Option C Analogous organs that have evolved due to convergent evolution.
- Option D Analogous organs that have evolved due to divergent evolution.

Correct Option C

Solution: Analogous organs are organs which perform the same function but differ in their origin and structure. The eye of octopus and eye of cat show different patterns of structure, yet they perform similar function. Hence, they are analogous organs that have evolved due to convergent evolution.

Q 82. Infection of *Ascaris* usually occurs by

- Option A Drinking water containing eggs of *Ascaris*
- Option B Eating imperfectly cooked pork
- Option C Tse-tse fly
- Option D Mosquito bite

Correct Option A

Solution: Infection of *Ascaris* usually occurs by drinking contaminated water, vegetables and fruits, containing eggs of *Ascaris*.

Q 83. The cell-mediated immunity inside the human body is carried out by

- Option A T- lymphocytes
- Option B B-lymphocytes
- Option C Thrombocytes
- Option D Erythrocytes

Correct Option A

Solution: The cell-mediated immunity inside the human body is carried out by highly specialised cells called T- lymphocytes which recognizes 'non-self' and 'self' cells.

Q 84. In plant breeding programmes, the entire collection (of plants/seeds) having all the diverse alleles for all genes in a given crop is called

- Option A Selection of superior recombinants
- Option B Cross-hybridisation among the selected parents
- Option C Evaluation and selection of parents.
- Option D Germplasm collection

Correct Option D

Solution: Collection and preservation of all different wild varieties, species and relatives of the cultivated species is a pre-requisite for effective exploitation of natural genes available in the populations. In plant breeding programmes, the entire collection (of plants/seeds) having all the diverse alleles for all genes in a given crop is called germplasm collection.

Q 85. During sewage treatment, biogas is produced which includes

- Option A Methane, hydrogen sulphide, carbon dioxide
- Option B Methane, oxygen, hydrogen sulphide
- Option C Hydrogen sulphide, methane, sulphur dioxide
- Option D Hydrogen sulphide, nitrogen, methane

Correct Option A

Solution: Biogas is a mixture of gases predominantly methane, small amounts of hydrogen sulphide and carbon dioxide produced during decay of biomass in the absence of oxygen.

Q 86. A biologist studied the population of rats in a barn. He found that the average natality was 250, average mortality 240, immigration 20 and emigration 30. The net increase in population is

- Option A 10
- Option B 15
- Option C 05
- Option D Zero

Correct Option D

Solution: The density of a population in a given habitat during a given period, fluctuates due to changes in four basic processes, two of which (natality and immigration) contribute to an increase in population density and two (mortality and emigration) contribute to a decrease.

If the average natality was 250, average mortality 240, immigration 20 and emigration 30,

Average increase in population density = Natality + Immigration = $250 + 20 = 270$.

Average decrease in population density = Mortality + Emigration = $240 + 30 = 270$.

Hence, the net increase in population is zero.

Q 87. Which one of the following processes during decomposition is correctly described?

- Option A Fragmentation – carried out by organisms such as earthworms.
- Option B Humification - leads to an accumulation of a dark coloured substance humus which undergoes microbial action at a very fast rate.
- Option C Catabolism - last step in the decomposition under fully anaerobic condition.
- Option D Leaching - water soluble inorganic nutrients rise to the top layers of soil.

Correct Option A

Solution:

Fragmentation is carried out by organisms called detritivores such as earthworms.

Humification leads to an accumulation of a dark coloured amorphous substance called humus which is highly resistant to microbial action and undergoes decomposition at an extremely slow rate.

Bacterial and fungal enzymes degrade detritus into simpler inorganic substances by the process called catabolism.

By the process of leaching, water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.

Q 88. A sedentary sea anemone gets attached to the shell lining of hermit crab. The association is

- Option A Ecto-parasitism
- Option B Symbiosis
- Option C Commensalism
- Option D Amensalism

Correct Option B

Solution: A sedentary sea anemone getting attached to the shell lining of the hermit crab is an example of symbiosis in which the sea anemone grows on the back of the crab providing camouflage and protection and in turn, the sea anemone gets transported for reaching new food sources.

Q 89. Global warming can be controlled by

- Option A Reducing deforestation, cutting down the use of fossil fuel.
- Option B Reducing reforestation, increasing the use of fossil fuel.
- Option C Increasing deforestation, slowing down the growth of human population.
- Option D Increasing deforestation, reducing efficiency of energy usage.

Correct Option A

Solution: The measures to control global warming include cutting down the use of fossil fuels, improving efficiency of energy usage, reducing deforestation, planting trees and slowing down the growth of human population.

Q 90. The Air Prevention and Control of Pollution Act came into force in

- Option A 1975
- Option B 1981
- Option C 1985
- Option D 1990

Correct Option B

Solution: In India, the Air Prevention and Control of Pollution Act came into force in 1981, but was amended in 1987 to include noise as an air pollutant.