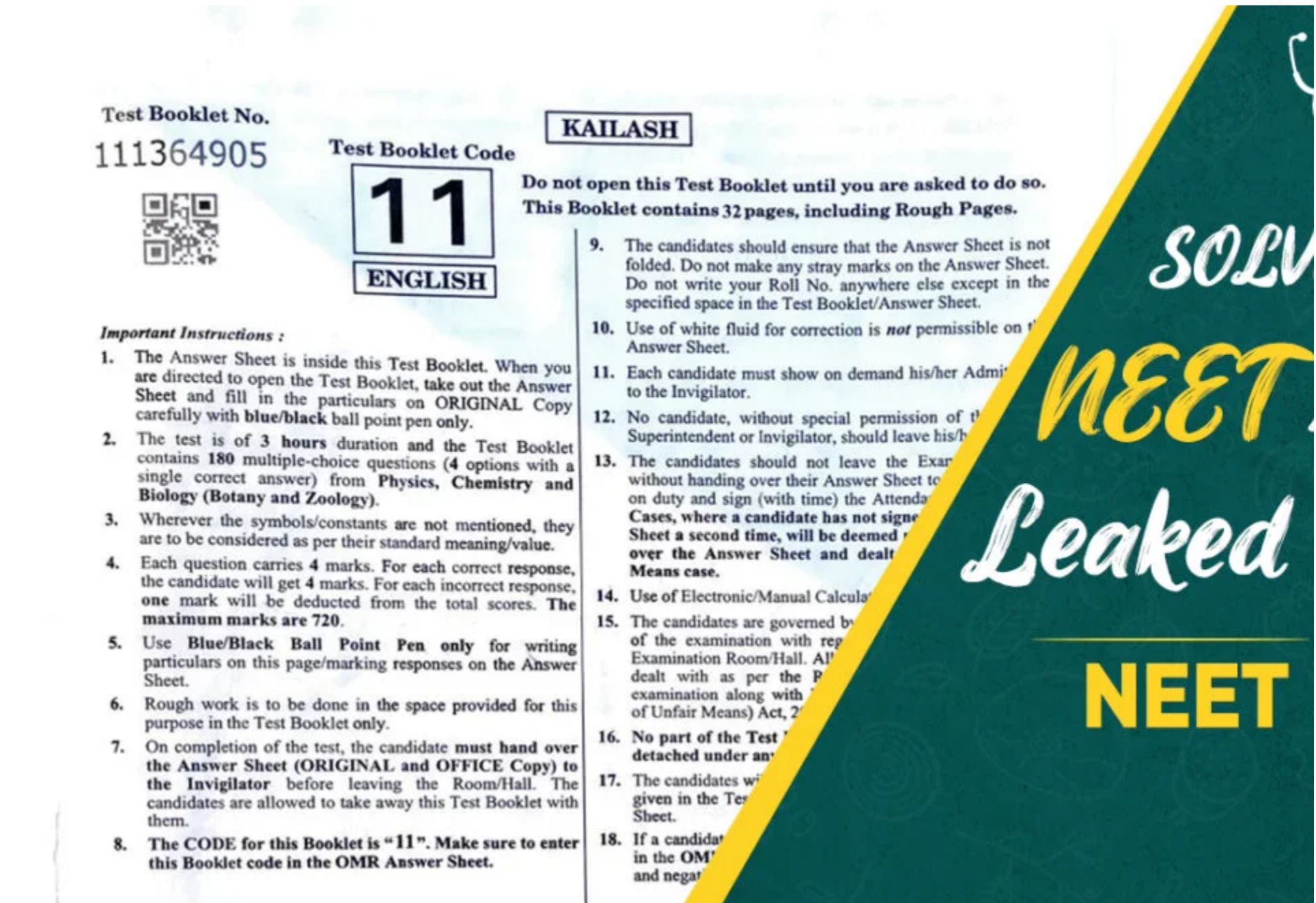


Neet 2026 Leaked Paper with Solutions PDF – Code 11

written by Nazir

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June 28, 2026



Question 1: The speed of light in vacuum is taken as unity. If light takes 6 min 40 s to reach the Earth from the Sun, the distance between th unit is: (1) 3×10^8 (2) 500 (3) 3×10^{10} (4) 400

Answer (4)

Solution:

- Time, $t = 6 \text{ min } 40 \text{ s}$
- $= 360 + 40 = 400 \text{ s}$
- Distance in new system $d = vt$
- $= 1 \times 400 = 400$

Question 2: Match List I with List II:

List I	List II
A. Young’s Modulus	I. $\frac{\Delta d}{\Delta L} (\frac{L}{d})$
B. Compressibility	II. $-\frac{1}{\Delta P} (\frac{\Delta V}{V})$

List I	List II
C. Bulk Modulus	III. $\frac{FL}{A(\Delta L)}$
D. Poisson’s Ratio	IV. $-P(\frac{V}{\Delta V})$

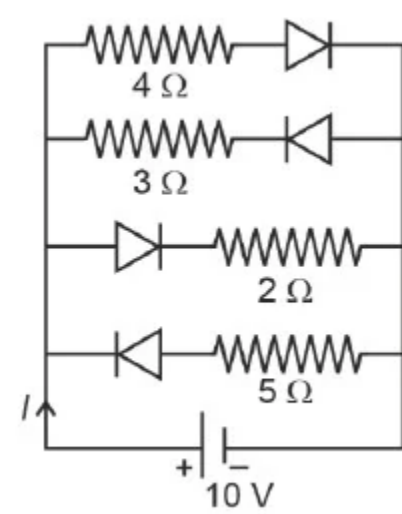
Choose the correct answer from the options given below: (1) A-IV, B-I, C-II, D-III (2) A-III, B-II, C-I, D-IV (3) A-I, B-IV, C-III, D-II (4) A-II, B-III, C-

Answer (4)

Solution:

- A. Young’s Modulus = $\frac{Stress}{Strain} = \frac{FL}{A\Delta L}$
- B. Compressibility = $\frac{1}{Bulk\ modulus}$
- C. Bulk Modulus = $-P(\frac{V}{\Delta V})$
- D. Poisson’s Ratio = $\frac{Lateral\ strain}{Longitudinal\ strain} = \frac{\Delta d/d}{\Delta L/L}$

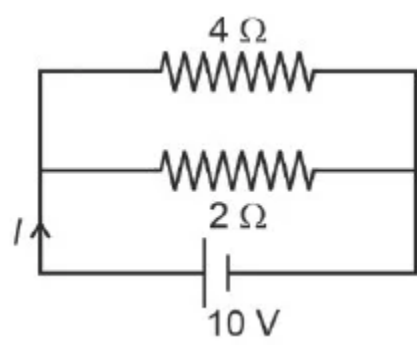
Question 3: The current I in the circuit shown below is: (All diodes are ideal and identical)



- (1) $\frac{5}{3}$ A (2) $\frac{5}{9}$ A (3) $\frac{1}{3}$ A (4) $\frac{15}{2}$ A

Answer (4)

Solution:



- For ideal diode, forward resistance = 0 and reverse biased resistance = ∞
- Circuit can be redrawn as above,
- $I = \frac{10}{2} + \frac{10}{4}$
- $= \frac{30}{4} = \frac{15}{2}$ A

Question 4: The angular speed of a flywheel is increased from 600 rpm to 1200 rpm in 10 s. The number of revolutions completed by the fly 900 (2) 600 (3) 150 (4) 300

Answer (3)

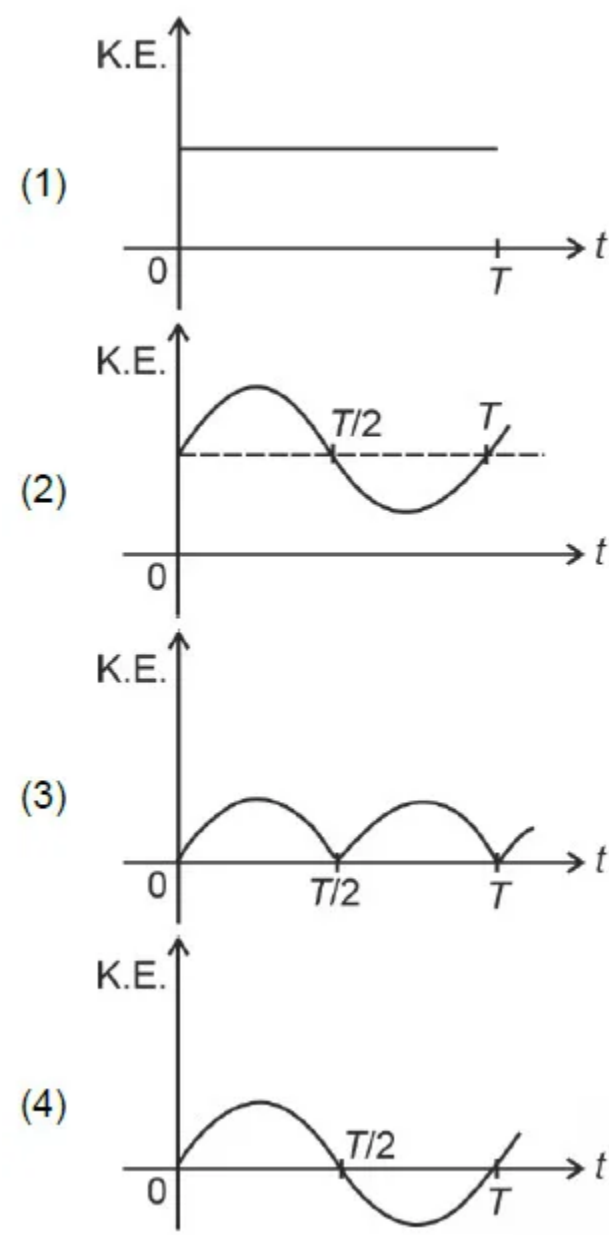
Solution:

- $\alpha = \frac{\omega_2 - \omega_1}{\Delta t} = (\frac{1200 - 600}{10}) \frac{2\pi}{60} = 2\pi \text{ rad/s}^2$
- Use equation of motion, $\omega_2^2 = \omega_1^2 + 2\alpha\theta$

- $\omega_2 = 1200 \times \frac{2\pi}{60} = 40\pi$
- $\omega_1 = 600 \times \frac{2\pi}{60} = 20\pi$
- $(40\pi)^2 = (20\pi)^2 + 2 \times 2\pi\theta$
- $1200\pi^2 = 4\pi\theta$
- $\theta = 300\pi$ radian
- Number of revolution $= \frac{\theta}{2\pi} = 150$

Question 5: For a simple pendulum, having time period T , the variation of kinetic energy (K.E.) with time (t) is represented by:

[INSERT IMAGE Q5 HERE]



Answer (3)

Solution:

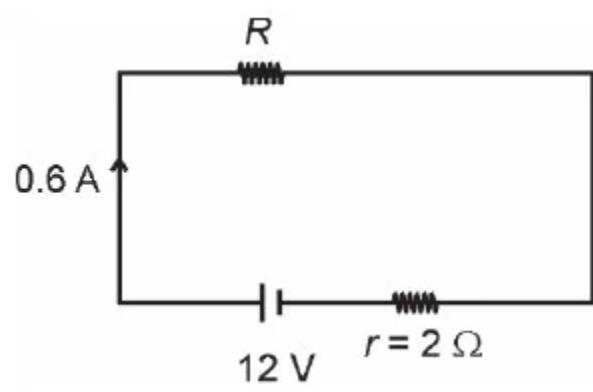
- Kinetic energy, $K = \frac{1}{2}mv^2$
- $= \frac{1}{2}mA^2\omega^2 \cos^2(\omega t + \phi)$
- $\therefore K \propto \cos^2(\omega t + \phi)$

Question 6: A resistor is connected to a battery of 12 V emf and internal resistance $2\ \Omega$. If the current in the circuit is 0.6 A, the terminal volt

(2) 1.2 V (3) 12 V (4) 10.8 V

Answer (4)

Solution:



- Circuit can be draw as above image,
- Terminal voltage of battery $V = E - ir$
- $= 12 - 0.6 \times 2 = 10.8 \text{ V}$

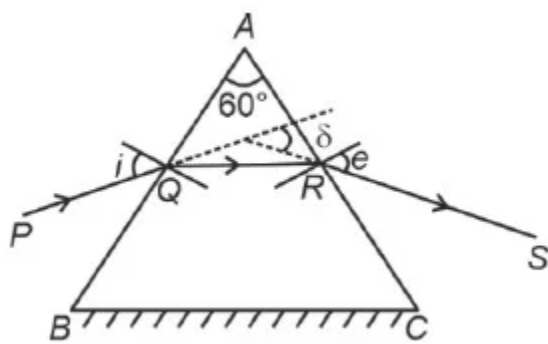
Question 7: A flask contains argon and chlorine in the ratio of 2:1 by mass. The temperature of the mixture is 27°C. The ratio of root mean square of the two gases ($\frac{V_{rms}^{Ar}}{V_{rms}^{Cl}}$) is: (Atomic mass of argon = 40.0 u and molecular mass of chlorine = 70.0 u) (1) $\frac{\sqrt{7}}{2}$ (2) $\frac{7}{4}$ (3) $\frac{7}{2}$ (4) $\frac{2}{\sqrt{7}}$

Answer (1)

Solution:

- $v_{rms} = \sqrt{\frac{3RT}{M}}$
- For same temperature, $v_{rms} \propto \frac{1}{\sqrt{M}}$
- $\frac{V_{rms}^{Ar}}{V_{rms}^{Cl}} = \sqrt{\frac{M_{Cl}}{M_{Ar}}} = \sqrt{\frac{70}{40}} = \frac{\sqrt{7}}{2}$

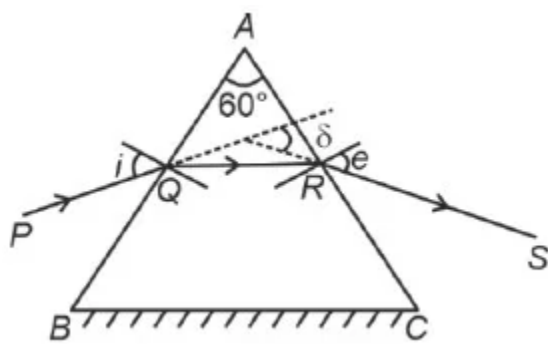
Question 8: A ray of monochromatic light is passing through an equilateral prism (ABC) as shown in the figure. The refracted ray (QR) is parallel to the base BC. The angle of incidence (i) is 50°. Then the angle of deviation (δ) is:



- (1) 45° (2) 35° (3) 40° (4) 55°

Answer (3)

Solution:



- $i = e$
- Equation of prism
- $i + e = A + \delta$
- $2i - A = \delta$
- $2(50) - 60 = \delta$
- $\delta = 40^\circ$

Question 9: Match List I with List II.

List I	List II
A. $E = h\nu$	I. de Broglie wavelength
B. Diffraction and Interference	II. Particle nature of light
C. $\lambda = h/p$	III. Wave nature of light

List I	List II
D. Compton effect	IV. Energy of photon

Choose the correct answer from the options given below. (1) A-IV, B-I, C-II, D-III (2) A-IV, B-III, C-II, D-I (3) A-I, B-IV, C-III, D-II (4) A-IV, B-III, C

Answer (4)

Solution:

- A. $E = h\nu$ is energy of photon
- B. Diffraction and interference confirm wave nature of light
- C. $\lambda = \frac{h}{p}$ is de Broglie wavelength of particle.
- D. Compton effect confirms particle nature of light.

Question 10: In the first excited state of hydrogen atom, the energy of its electron is -3.4 eV. The radial distance of the electron from the hyd approximately: (Take $1\text{ eV} = 1.6 \times 10^{-19}\text{ J}$, $e = 1.6 \times 10^{-19}\text{ C}$ and $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9\text{ N m}^2/\text{C}^2$) (1) $2.1 \times 10^{-9}\text{ m}$ (2) $2.1 \times 10^{-8}\text{ m}$ (3) $2.1 \times 10^{-10}\text{ m}$ (4) $2.1 \times 10^{-11}\text{ m}$

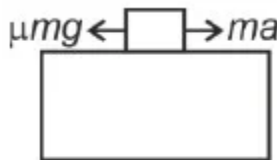
Answer (3)

Solution:

- $\frac{kQ^2}{2r} = 3.4\text{ eV}$
- $\frac{9 \times 10^9 \times (1.6 \times 10^{-19})^2}{2 \times 3.4 \times 1.6 \times 10^{-19}} = r$
- $2.1176 \times 10^{-10} = r$
- $r = 2.1 \times 10^{-10}\text{ m}$

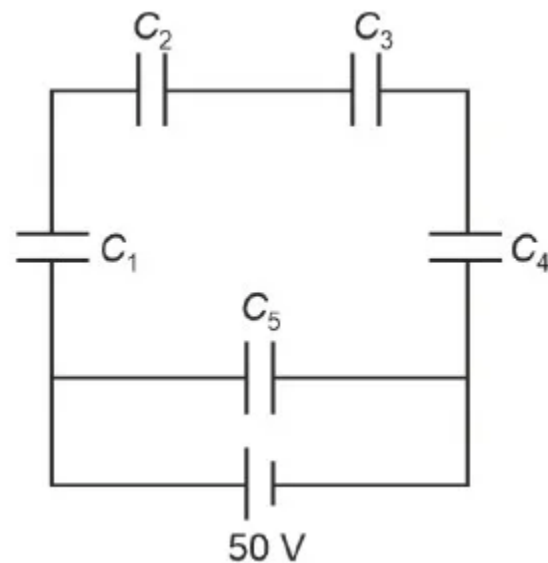
Question 11: A box of mass **15 kg** is kept on the floor of a stationary trolley. The coefficient of static friction between the box and the trolley stationary state over the trolley, the maximum acceleration with which the trolley can be moved horizontally in m s^{-2} is: ($g = 10\text{ m/s}^2$) (1) **2.1** (2) 1.2 (3) 0.12 (4) 0.21

Answer (4) Solution:



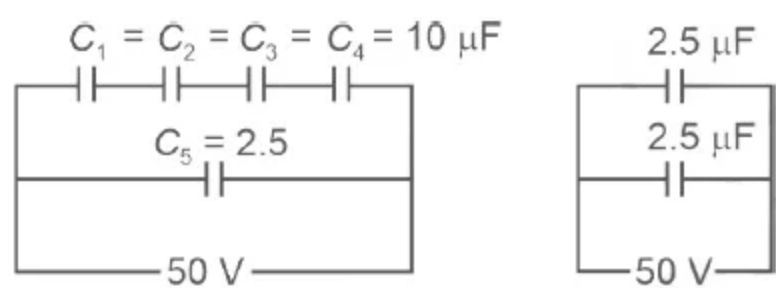
- $a = \mu g = 0.12 \times 10 = 1.2\text{ m/s}^2$

Question 12: Five capacitors of capacitances $C_1 = C_2 = C_3 = C_4 = 10\text{ }\mu\text{F}$ and $C_5 = 2.5\text{ }\mu\text{F}$ are connected as shown, along with a batte



The equivalent capacitance and the charges on each capacitor respectively are: (1) **5 μF , 125 μC on C_1 to C_4 and 25 μC on C_5** (2) 5 μF , 125 250 μC on all capacitors (4) 4 μF , 250 μC on C_1 to C_4 and 125 μC on C_5

Answer (2) Solution:



- $C_1 = C_2 = C_3 = C_4 = 10\ \mu\text{F}$
- $C_5 = 2.5\ \mu\text{F}$
- $C_{eq} = 2.5 + 2.5 = 5\ \mu\text{F}$
- $q_1 = q_2 = q_3 = q_4 = 2.5 \times 50 = 125\ \mu\text{C}$
- $q_5 = 2.5 \times 50 = 125\ \mu\text{C}$

Question 13: The amount of work done to raise a mass m' from the surface of the Earth to a height equal to the radius of the Earth R' will **mgR (4) mgR/2**

Answer (4) Solution:

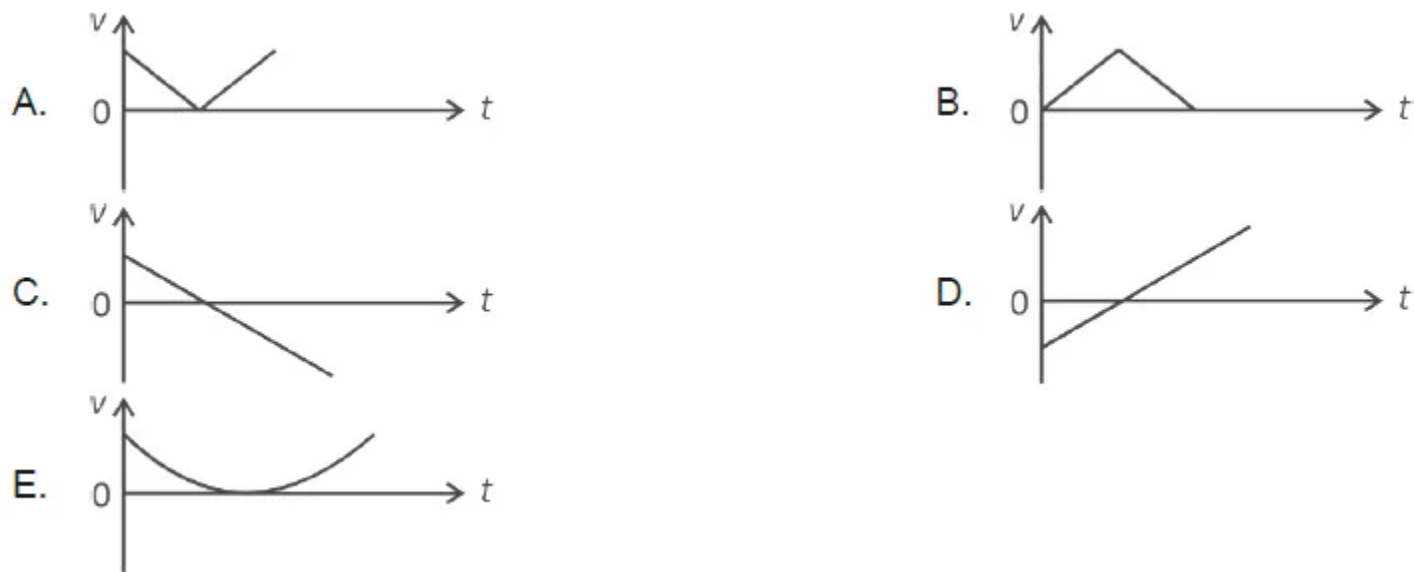
- $W.D. = U_2 - U_1$
- $= -\frac{GMm}{R+R} - \left(-\frac{GMm}{R}\right)$
- $= -\frac{GMm}{2R} + \frac{GMm}{R}$
- $= \frac{GMm}{2R} = \frac{mgR}{2}$

Question 14: Each side of a metallic cube of mass **5.580 kg** is measured to the **9.0 cm**. Keeping the significant figures in view, the density of be best expressed as $X \times 10^3\ \text{kg m}^{-3}$ where the value of X is: (1) **7.654** (2) **7.6** (3) **7.65** (4) **7.7**

Answer (4) Solution:

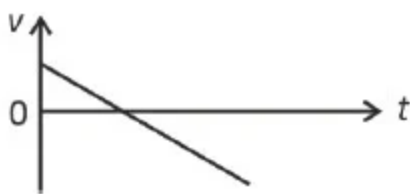
- $\text{Density} = \frac{\text{Mass}}{\text{Volume}}$
- $= \frac{5.580\ \text{kg}}{(9.0\ \text{cm})^3}$
- $= \frac{5.580}{729} \times 10^6\ \frac{\text{kg}}{\text{m}^3}$
- $= 0.007654321 \times 10^6\ \frac{\text{kg}}{\text{m}^3}$
- $= 7.654 \times 10^3\ \frac{\text{kg}}{\text{m}^3}$
- $= 7.7 \times 10^3\ \frac{\text{kg}}{\text{m}^3}$
- Hence, on comparing $X = 7.7$

Question 15: The following plots show variation of velocity (v) with time (t) of a ball thrown vertically upward, and falling back. Which of the correct?



(1) C only (2) D only (3) B only (4) A and E only

Answer (1) Solution:



- During the whole journey, acceleration due to gravity is vertically downward.
- Therefore, slope of velocity vs time curve should be negative throughout the journey.
- $\therefore$ Statement (C) is correct.

Question 16: The sum of kinetic energy and potential energy of a simple pendulum bob is **0.02 joule**. The speed of the simple pendulum bob approximately: (Consider mass of the bob = **20 g**) (1) **0.2 m/s** (2) **1.41 m/s** (3) **14.1 m/s** (4) **2.0 m/s**

Answer (2) Solution:

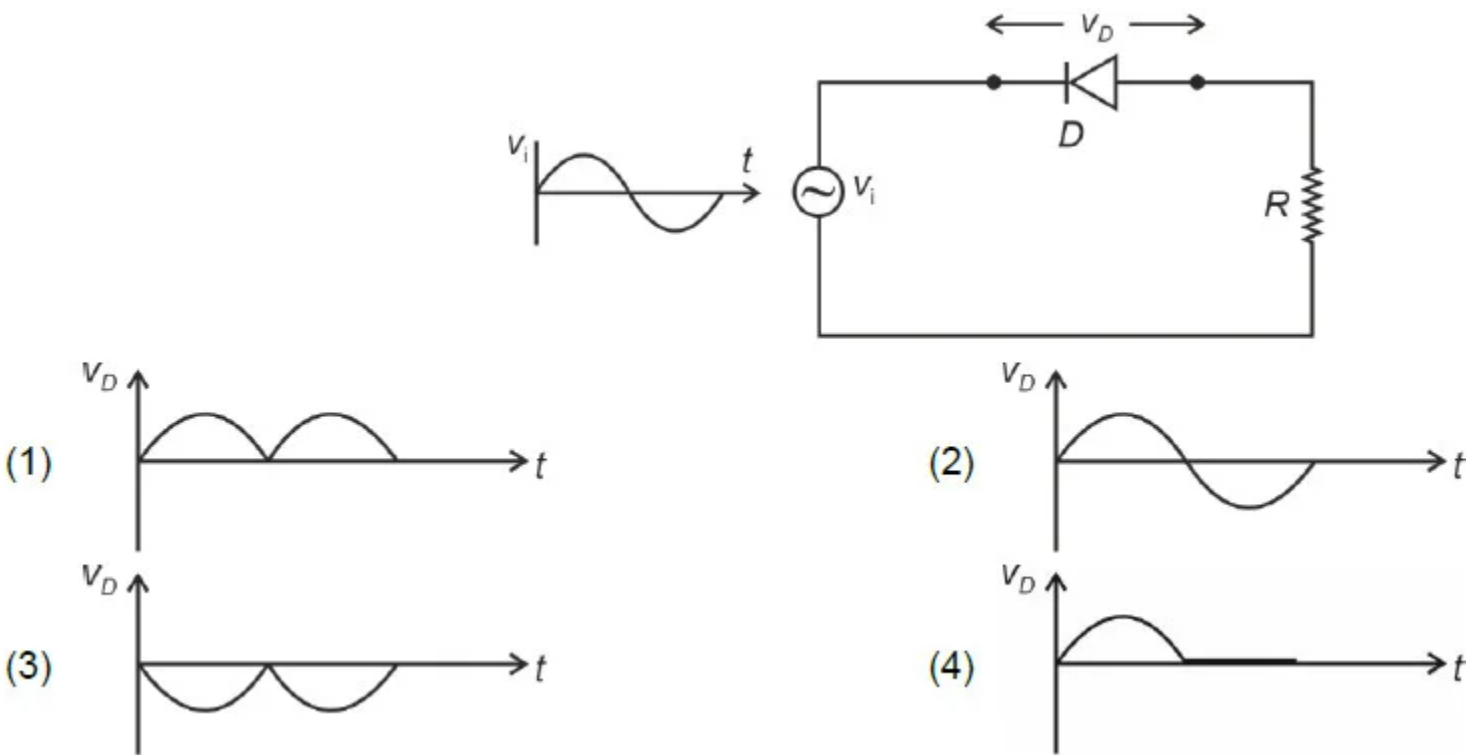
- At equilibrium position
- Total energy = K.E.
- $\frac{1}{2}mv^2 = 0.02$
- $\frac{1}{2} \times 20 \times v^2 \times 10^{-3} = 2 \times 10^{-2}$
- $v = \sqrt{2}$
- $v = 1.41 \text{ m/s}$

Question 17: In Young’s double slit experiment, using monochromatic light of wavelength λ , the intensity of light at a point on the screen wrt K units. The intensity of light at a point where the path difference is $\lambda/3$ will be: (1) **K/4** (2) **K/2** (3) **2K** (4) **K** (implied option)

Answer (1) Solution:

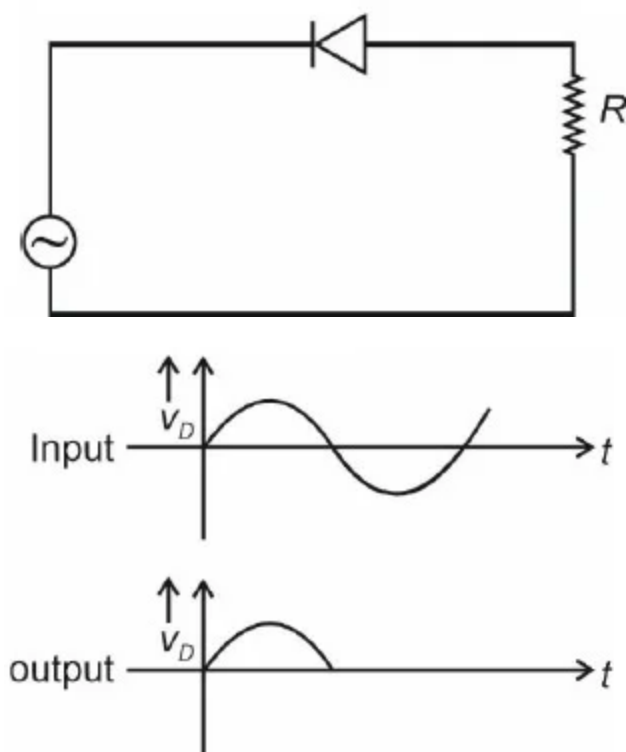
- $I = I_0 \cos^2 \frac{K\Delta x}{2}$
- $K = I_0 \cos^2(\frac{2\pi}{\lambda} \times \frac{\lambda}{2})$
- $K = I_0$
- $K_1 = I_0 \cos^2(\frac{2\pi}{\lambda} \times \frac{\lambda}{3 \times 2}) = I_0 \cos^2(\frac{\pi}{3})$
- $K_1 = \frac{I_0}{4}$
- $\frac{K}{K_1} = 4 \Rightarrow K_1 = \frac{K}{4}$

Question 18: In the circuit shown below, the voltage appearing across the diode D will be of the form:



Answer (4) Solution:

- Voltage drop will be across the diode, when it will be in reverse bias.
- In positive half cycle it will be in reverse biased.



Question 19: An ac circuit contains a resistance of **1 Ω**, a capacitor of **0.1 μF** and an inductor of **1 mH** connected in series. The resonance frequency is approximately: (1) **13.5 kHz** (2) **10.1 kHz** (3) **20.7 kHz** (4) **15.9 kHz**

Answer (4) Solution:

- Resonance frequency
- $f_0 = \frac{1}{2\pi\sqrt{LC}}$
- $= \frac{1}{2\pi\sqrt{1\times10^{-7}\times10^{-3}}}$
- $= 15.9 \text{ kHz}$

Question 20: In interference and diffraction, the light energy is redistributed. If it reduces in one region, producing a dark fringe, it increases in another region, producing a bright fringe. A. As there is no gain or loss of energy, these phenomena are consistent with the principle of conservation of energy. B. Diffraction is a characteristic exhibited only by light waves. Choose the correct answer from the options given below: (1) **A is true and B is also true** (2) **A is true, but B is false** (4) **Both A and B are false**

Answer (3) Solution:

- In interference and diffraction there is no loss of energy, the energy gets redistributed.
- Interference and diffraction both are exhibited in light as well as sound waves.

Question 21: For a travelling harmonic wave $y(x, t) = 2.0 \cos 2\pi(10t - 0.0080x + 0.35)$, where x and y are in cm and t in s. The phase difference between the motions of two points separated by a distance of **0.5 m** is:

- (1) **0.08 π rad**
- (2) **0.8 π rad**
- (3) **8 π rad**
- (4) **0.008 π rad**

Answer (2)

Solution:

- $y(x, t) = 2.0 \cos 2\pi(10t - 0.008x + 0.35)$
- Total phase $\phi = 20\pi t - 2\pi \times 8 \times 10^{-3}x + 2\pi \times 0.35$
- $\Delta\phi = k\Delta x$
- $\Delta\phi = 2\pi \times 8 \times 10^{-3}\Delta x$
- $= 2\pi \times 8 \times 10^{-3} \times (50) \text{ [Since } 0.5 \text{ m} = 50 \text{ cm]}$
- $= 8\pi \times 10^{-1} = 0.8\pi \text{ rad}$

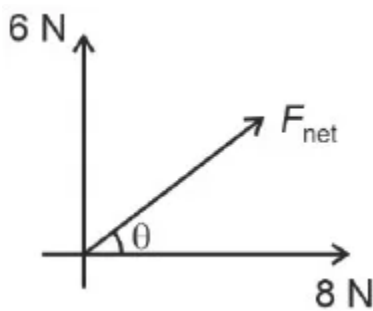
Question 22: The magnitude and direction of the acceleration produced in a body of mass **5 kg** with a net force of **8 N** is: (1) **0.4 m/s² in the direction of the force** (2) **1.6 m/s² in the direction of the force** (3) **0.4 m/s² opposite to the direction of the force** (4) **1.6 m/s² opposite to the direction of the force**

respectively:

- (1) **20 m s⁻²**; $\tan^{-1}(4/3)$ with 8 N force
- (2) **2 m s⁻²**; $\tan^{-1}(3/4)$ with 6 N force
- (3) **2 m s⁻²**; $\tan^{-1}(4/3)$ with 8 N force
- (4) **2 m s⁻²**; $\tan^{-1}(3/4)$ with 8 N force

Answer (4)

Solution:



- $F_{net} = \sqrt{6^2 + 8^2} = 10 \text{ N}$
- $a = \frac{F_{net}}{m} = \frac{10}{5} = 2 \text{ m/s}^2$
- $\tan \theta = \frac{6}{8} = \frac{3}{4}$
- $\theta = \tan^{-1}(\frac{3}{4})$ from 8 N force

Question 23: Consider two uncharged capacitors of equal capacitance **200 pF**. One of them is charged by a **100 V** supply and disconnectec connected to the uncharged capacitor. The amount of electrostatic energy lost in the process is:

- (1) **$0.5 \times 10^{-6} \text{ J}$**
- (2) **1.0 J**
- (3) **$1.0 \times 10^{-6} \text{ J}$**
- (4) **0.5 J**

Answer (1)

Solution:

- Energy loss = $\frac{1}{2} \frac{C_1 C_2}{C_1 + C_2} V^2$
- = $\frac{1}{2} (\frac{200 \times 200}{400}) \times 10^{-12} (100)^2$
- = $\frac{1}{2} \times 100 \times 10^{-12} \times 10^4$
- = $\frac{1}{2} \times 10^6 \times 10^{-12} = 0.5 \times 10^{-6} \text{ J}$

Question 24: The power of a crane, which lifts a mass of **1000 kg** to a height of **20 m** in **10 s** is: ($g = 9.8 \text{ m/s}^2$)

- (1) **19.6 W**
- (2) **39.2 W**
- (3) **19.6 kW**
- (4) **39.2 kW**

Answer (3)

Solution:

- Power = $\frac{\text{Work}}{\text{Time}}$
- = $\frac{mgh}{t}$

▪

= $\frac{10^3 \times 9.8 \times 20}{10}$

= 19600 W = 19.6 kW

Question 25: In a vernier calliper, 20 VSD coincide with 16 MSD (each division of length 1 mm). The least count of the vernier callipers is:

(1) **0.2 cm**

(2) **0.01 cm**

(3) **0.02 cm**

(4) **0.1 cm**

Answer (3)

Solution:

- Least count of vernier callipers:
- L.C. = 1 MSD – 1 VSD
- 20 VSD = 16 MSD
- 1 VSD = $\frac{16}{20}$ MSD
- L.C. = 1 MSD – $\frac{16}{20}$ MSD
- L.C. = $\frac{4}{20}$ MSD
- L.C. = $\frac{1}{5}$ mm = 0.2 mm
- L.C. = 0.02 cm

Question 26: When a ruler falls vertically, 5 different persons catch it with different reaction times. ($g = 9.8 \text{ m s}^{-2}$)

A. Person A has reaction time of **0.20 s**.

B. Person B has reaction time of **0.22 s**.

C. Person C has reaction time of **0.18 s**.

D. Person D has reaction time of **0.19 s**.

E. Person E has reaction time of **0.21 s**.

What is the correct order of the distance travelled by the ruler for each person?

(1) **B > E > A > C > D**

(2) **C > D > A > B > E**

(3) **B > E > A > D > C**

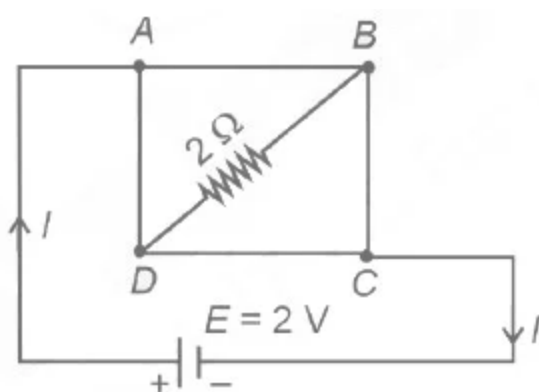
(4) **C > D > A > E > B**

Answer (3)

Solution:

- There will be a large distance for a large reaction time ($S \propto t^2$).
- Descending order of reaction time: $\Rightarrow t_B > t_E > t_A > t_D > t_C$
- Descending order of distance covered: $\Rightarrow S_B > S_E > S_A > S_D > S_C$

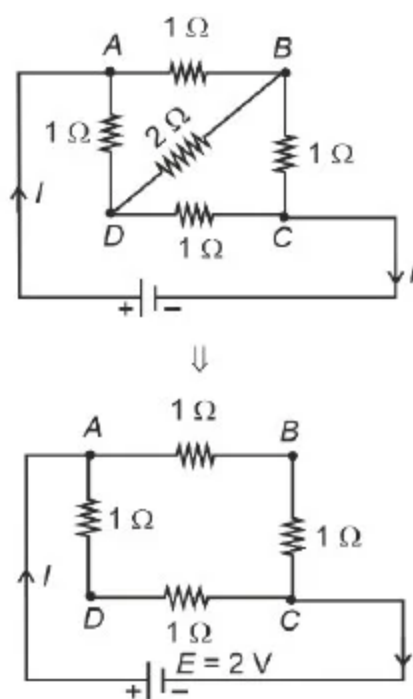
Question 27: A uniform metallic wire having resistance $4 \, \Omega$ is bent to form a square loop (ABCD) (see figure). A resistance of $2 \, \Omega$ is connect and a battery of 2 V is connected across points A and C as shown in the figure. Now the value of current (I) is:



- (1) 2 A
- (2) 8 A
- (3) 4.5 A
- (4) 4 A

Answer (1)

Solution:



- Each side will have a resistance of $1\ \Omega$ (since total is $4\ \Omega$).
- The setup forms a balanced Wheatstone bridge between points A and C.
- Therefore, no current flows through the resistance of $2\ \Omega$ between B and D.
- $[R_{\text{effective}}]_{AC} = 1\ \Omega$
- $I = \frac{E}{R_{\text{eff}}} = \frac{2}{1}$
- $I = 2\ \text{A}$

Question 28: A room heater is rated **400 W, 220 V**. If the supply voltage drops to **200 V**, what will be the power consumed (approximately)

- (1) 200 W
- (2) 400 W
- (3) 331 W
- (4) 121 W

Answer (3)

Solution:

- Rated power of heater $P_0 = \frac{V_0^2}{R}$
- Consumed power $P_c = \frac{V^2}{R}$
- $\frac{P_c}{P_0} = \frac{V^2}{V_0^2}$
- $P_c = \left[\frac{V}{V_0}\right]^2 P_0$

- $P_c = \left[\frac{200}{220}\right]^2 \times 400$
- $P_c \approx 331 \text{ W}$

Question 29: A 100-turn closely wound circular coil of radius **5 cm** has a field of $3.14 \times 10^{-3} \text{ T}$ at its centre. The current flowing through the the magnetic moment of this coil are, respectively:

(Take $\mu_0 = 4\pi \times 10^{-7} \text{ T m/A}$)

- (1) **2 A, 10 A m²**
- (2) **2.5 A, 20 A m²**
- (3) **2 A, 4 A m²**
- (4) **2.5 A, 2 A m²**

Answer (4)

Solution:

- Magnetic field of a circular loop:
- $B_0 = \frac{\mu_0 Ni}{2R}$
- $i = \frac{2RB_0}{\mu_0 N} = \frac{2 \times 5 \times 10^{-2} \times 3.14 \times 10^{-3}}{4\pi \times 10^{-7} \times 100}$
- $i = 2.5 \text{ A}$
- Magnetic moment $M = NiA$
- $= 100 \times 2.5 \times 3.14 \times (5 \times 10^{-2})^2 \text{ [where } A = \pi R^2]$
- $= 2 \text{ A m}^2$

Question 30: A rectangular wire loop of sides **8 cm** and **3 cm** with a small cut, is moving out of a region of uniform magnetic field of magnitu the plane of the loop. The emf developed across the cut, if the velocity of the loop is **2 cm s⁻¹**, in a direction normal to the shorter side of the

- (1) **$4.8 \times 10^{-4} \text{ volt}$**
- (2) **$1.2 \times 10^{-4} \text{ volt}$**
- (3) **$1.3 \times 10^{-4} \text{ volt}$**
- (4) **$1.8 \times 10^{-4} \text{ volt}$**

Answer (4)

Solution:

- The loop is moving normal to the shorter side, meaning the side cutting the magnetic flux is the shorter side ($l = 3 \text{ cm}$).
- Induced emf across the shorter side:
- $E_{\text{induced}} = Bvl \text{ [since } \vec{B} \perp \vec{v} \perp \vec{l}]$
- $= 0.3 \times 2 \times 10^{-2} \times 3 \times 10^{-2}$
- $= 1.8 \times 10^{-4} \text{ V}$

Question 31: Four statements are given (A is mass number):

- A. The volume of a nucleus is proportional to $A^{1/3}$.
- B. The volume of a nucleus is proportional to A .
- C. The difference in mass of an atom and its nucleus is called the mass defect.
- D. The difference in mass of a nucleus and its constituents is called the mass defect.

Choose the correct answer from the options given below:

- (1) A and C are true, but B and D are false
- (2) B and C are true, but A and D are false
- (3) A and D are true, but B and C are false
- (4) B and D are true, but A and C are false

Answer (4)

Solution:

- As we know, size of nucleus, $r = r_0 A^{1/3}$
- $\Rightarrow r^3 = r_0^3 \cdot A$
- $\Rightarrow V \propto A$ (Since $V = \frac{4}{3} \pi r^3$)
- So, option A $\rightarrow$ wrong and B $\rightarrow$ correct.
- The difference between the actual mass of the nucleus and its constituents is called the mass defect.
- So, option C $\rightarrow$ wrong and D $\rightarrow$ correct.

Question 32: An unknown nucleus has a nuclear density of $2.29 \times 10^{17} \text{ kg/m}^3$ and mass of $19.926 \times 10^{-27} \text{ kg}$. Its mass number A is approx

(Take $R_0 = 1.2 \times 10^{-15} \text{ m}$, $4\pi = 12.56$)

- (1) **12**
- (2) **20**
- (3) **16**
- (4) **19**

Answer (1)

Solution:

- Given: $\rho = 2.29 \times 10^{17} \text{ kg/m}^3$, mass $M = 19.926 \times 10^{-27} \text{ kg}$, $R_0 = 1.2 \times 10^{-15} \text{ m}$ and $R = R_0 A^{1/3}$
- Now use Volume = $\frac{\text{Mass}}{\text{Density}}$
- $\Rightarrow \frac{4}{3} \pi R^3 = \frac{M}{\rho}$
- $\Rightarrow \frac{4}{3} \pi [R_0 A^{1/3}]^3 = \frac{M}{\rho}$
- $\Rightarrow \frac{4}{3} \pi R_0^3 A = \frac{M}{\rho}$
- $\Rightarrow A = \frac{M}{\rho} \times \frac{3}{4\pi \times R_0^3} = \frac{19.926 \times 10^{-27} \times 3}{2.29 \times 10^{17} \times 12.56 \times (1.2 \times 10^{-15})^3} \approx 12$

Question 33: Savitha, a XI standard student, while conducting an experiment to determine the effective length of a simple pendulum L , notes that it takes 60 s to complete 30 oscillations as **60 s** and hence calculates the length of the simple pendulum as:

(Take $\pi^2 = 9.8$ and $g = 9.8 \text{ m/s}^2$)

- (1) **0.75 m**
- (2) **1.5 m**
- (3) **2 m**
- (4) **1 m**

Answer (4)

Solution:

- Time taken for 30 oscillations = 60 s
- Time period of simple pendulum $\Rightarrow T = \frac{\text{Time taken for 30 oscillations}}{30}$

- $\Rightarrow T = \frac{60}{30} = 2 \text{ s}$
- $T = 2\pi\sqrt{\frac{l}{g}} \Rightarrow l = \frac{gT^2}{4\pi^2} = \frac{9.8 \times 2 \times 2}{4 \times 9.8} = 1 \text{ m}$

Question 34: An electric heater supplies heat to a system at a rate of **100 W**. If the system performs work at a rate of **75 J/s**, then the rate at which the internal energy of the system increases will be:

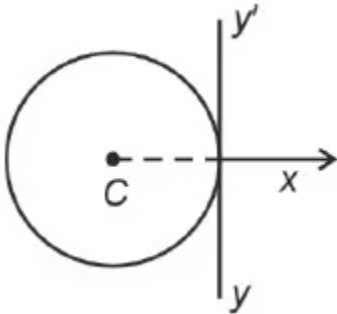
- (1) **75 W**
- (2) **100 W**
- (3) **125 W**
- (4) **25 W**

Answer (4)

Solution:

- Using the 1st law of thermodynamics for the electric heater:
- $Q = \Delta U + W$
- $\Rightarrow \frac{dQ}{dt} = \frac{d(\Delta U)}{dt} + \frac{dW}{dt}$
- $\Rightarrow 100 \text{ W} = \frac{d(\Delta U)}{dt} + 75 \text{ W}$
- $\frac{d(\Delta U)}{dt} = 25 \text{ W}$

Question 35: A thin wire of length ‘ L ’ and linear mass density ‘ m ’ is bent into a circular ring (in x-y plane) with centre ‘C’ as shown in figure. The moment of inertia of the ring about an axis yy' will be:



- (1) $\frac{3mL^3}{8\pi}$
- (2) $\frac{3mL^3}{8\pi^2}$
- (3) $\frac{3mL^2}{8\pi}$
- (4) $\frac{3mL^2}{8\pi^2}$

Answer (2)

Solution:

- Mass of thin wire = (Linear mass density) $\times$ (Length)
- $\Rightarrow M = mL$
- $L = 2\pi r$ where r = radius of circular ring = $\frac{L}{2\pi}$
- Using parallel axis theorem:
- $I_{yy'} = I_{CM} + Mr^2 = \frac{Mr^2}{2} + Mr^2 = \frac{3}{2}Mr^2$
- $\Rightarrow I_{yy'} = \frac{3}{2} \times (mL) \times \left(\frac{L}{2\pi}\right)^2 = \frac{3mL^3}{8\pi^2}$

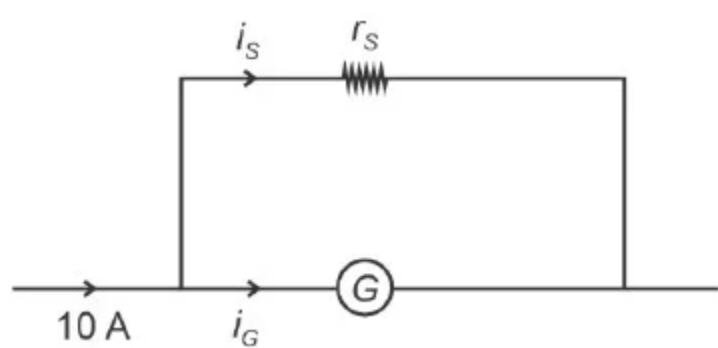
Question 36: A galvanometer of resistance **100 Ω** gives full scale deflection for a current of **1 mA**. It is converted into an ammeter of range 0 to 10 A by connecting a

- (1) **0.01 Ω**
- (2) **0.10 Ω**
- (3) **1.0 Ω**

(4) 0.001Ω

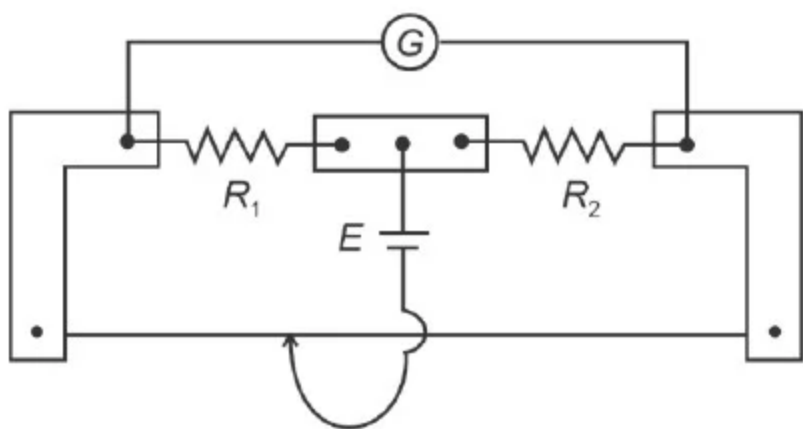
Answer (1)

Solution:



- $i_G = 1 \text{ mA} = 0.001 \text{ A}$
- $i_S = 10 - i_G \simeq 10 \text{ A}$
- Both shunt resistance and galvanometer are in parallel connection:
- $i_S r_S = i_G R_G$
- $\Rightarrow 10 \times r_S = 0.001 \times 100$
- $\Rightarrow r_S = 0.01 \Omega$

Question 37: In a metre bridge experiment (see figure), the positions of the cell, E, and galvanometer, G, are interchanged. We shall observe



- (1) Only the left-sided deflection
- (2) There will be no deflection irrespective of the position of the jockey
- (3) Only the right-sided deflection
- (4) Both right-sided and left-sided deflection and at balance point, no deflection

Answer (4)

Solution:

- Position of the null point will not change when the galvanometer (G) and the cell (E) are interchanged.
- There will be no deflection in the galvanometer only at the balance point.
- In an unbalanced meter bridge, if E and G are interchanged mutually, then the deflection in the galvanometer may be towards the left :

Question 38: The peak value of an alternating current is **5 A** and its frequency is **60 Hz**. How long will the current, starting from zero, take to

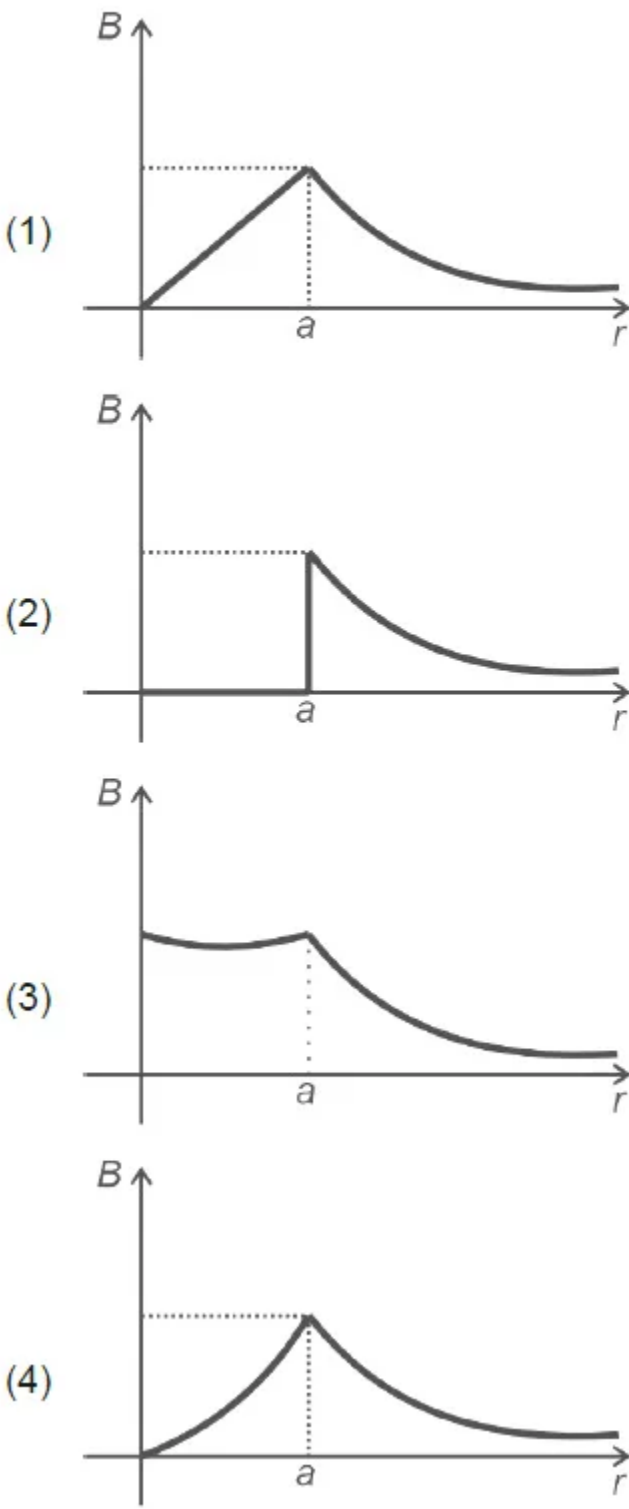
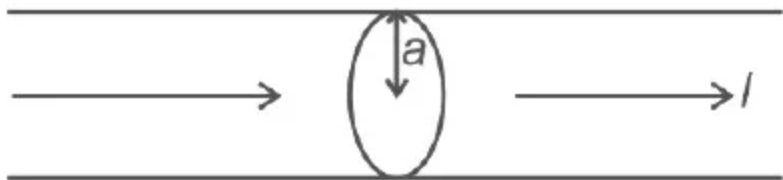
- (1) $\frac{1}{120} \text{ s}$
- (2) $\frac{1}{60} \text{ s}$
- (3) $\frac{1}{30} \text{ s}$
- (4) $\frac{1}{240} \text{ s}$

Answer (4)

Solution:

- Alternating current, $i = i_{\text{peak}} \sin(\omega t)$
- where $\omega = 2\pi f = 2\pi \times 60 = 120\pi \text{ rad/s}$
- $i = 5 \sin(120\pi t)$
- To reach the peak value, $i = 5$:
- $5 = 5 \sin(120\pi t)$
- $\Rightarrow \sin(120\pi t) = 1 = \sin(\frac{\pi}{2})$
- $120\pi t = \frac{\pi}{2}$
- $t = \frac{1}{240} \text{ s}$

Question 39: The figure given below shows a long straight solid wire of circular cross-section of radius ‘ a ’ carrying steady current I . The current is uniformly distributed across its cross-section. The plot which correctly represents the variation of magnetic field (B) with distance (r) from the axis of the conduct



Answer (1)

Solution:

- For a long straight solid wire carrying a steady current which is uniformly distributed across its cross-section, the variation of magnetic field from the axis will be:
- $B = \frac{\mu_0 I r}{2\pi a^2} \Rightarrow B \propto r$, for $r < a$
- $B = \frac{\mu_0 I}{2\pi r} \Rightarrow B \propto \frac{1}{r}$, for $r > a$
- The graph representing this relationship linearly increases to radius ‘ a ’ and then curves downwards proportional to $1/r$.

Question 40: Two statements are given below:

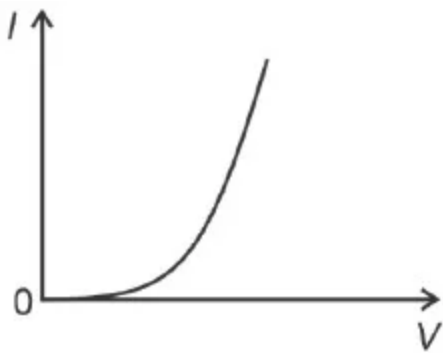
- A. When the forward bias voltage across a p-n junction diode increases above a certain threshold voltage, the diode current increases significantly.
- B. This current is called reverse saturation current.

Choose the correct answer from the options given below:

- (1) Both Statements A and B are true
- (2) Statement A is true, but Statement B is false
- (3) Both Statements A and B are false
- (4) Statement A is false, but Statement B is true

Answer (2)

Solution:



- $V - I$ characteristics of a forward-biased junction diode show that when forward bias voltage increases beyond the threshold voltage, the current increases significantly.
- This is not reverse saturation current (which occurs under reverse bias conditions). Therefore, Statement A is true and Statement B is false.

Question 41: Which of the following statements are correct?

- A. Inside a conductor, the electrostatic field is zero.
- B. Electric field at the surface of a charged conductor does not depend on its surface charge density.
- C. The interior of a charged conductor can have no excess charge in the static situation.
- D. At the surface of a charged conductor, the electrostatic field must be normal to the surface at every point.
- E. The electrostatic potential is zero everywhere inside a charged conductor.

Choose the correct answer from the options given below:

- (1) A, B and D only
- (2) A, C and E only
- (3) A, C and D only
- (4) C, D and E only

Answer (3)

Solution:

- A. Electrostatic field is zero inside a conductor. (Correct)
- B. Electric field at the surface of a charged conductor depends on surface charge density (σ). $E = \frac{\sigma}{\epsilon_0} \hat{n}$ (Incorrect)
- C. The interior of a charged conductor cannot have any excess charge in the static situation. (Correct)
- D. At the surface of a charged conductor, the electrostatic field must be normal to the surface at every point. (Correct)
- E. The electrostatic potential is constant and can be non-zero everywhere inside a charged conductor. (Incorrect)
- Thus, the correct statements are A, C, and D.

Question 42: For a metal of work function **6.6 eV**, which of the following wavelengths of incident radiation does not give rise to the photoelectric effect?

(Take Planck's constant as 6.6×10^{-34} J s)

- (1) **100 nm**
- (2) **150 nm**
- (3) **200 nm**
- (4) **50 nm**

Answer (3)

Solution:

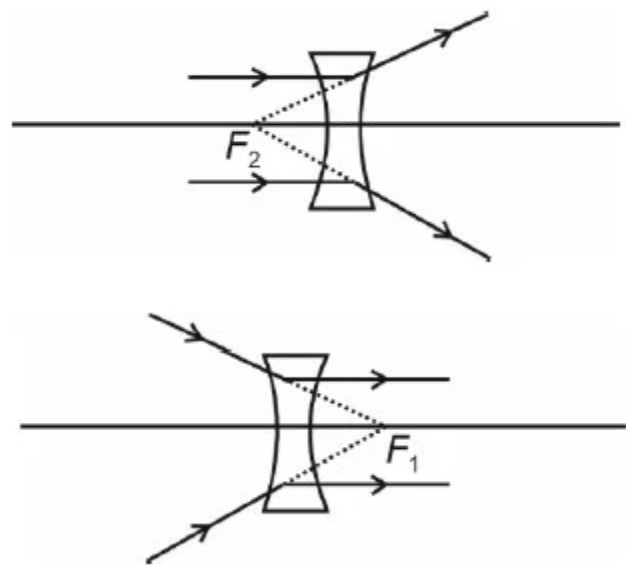
- For incident radiation having wavelength (λ), photoelectric effect doesn't occur when $\lambda > \frac{hc}{W_0}$
- $\frac{hc}{\lambda} < W_0$
- $\lambda > \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{6.6 \times 1.6 \times 10^{-19}}$
- $\lambda > \frac{3 \times 10^{-7}}{1.6}$
- $\lambda > \frac{300}{1.6} \text{ nm}$
- $\lambda > 187.5 \text{ nm}$
- $\therefore$ Option (3) 200 nm is correct.

Question 43: In a concave lens, a ray of light emanating from the object parallel to the principal axis of the lens after refraction:

- (1) **passes through 2F, which is the radius of curvature of the lens.**
- (2) **appears to diverge from the first principal focus.**
- (3) **emerges parallel to the principal axis.**
- (4) **passes through the second principal focus.**

Answer (2*)

Solution:



- Above image showing light ray diverging from F_2
- F_2 is the second principal focus. It is the virtual image position for object at infinity.
- F_1 is the first principal focus. It is the virtual object position for which image is formed at infinity.
- The best appropriate answer is option (2), although it should be second principal focus.

Question 44: A submarine is designed to withstand an absolute pressure of **100 atm**. How deep can it go below the water surface?

(Consider the density of water = 1000 kg m^{-3} , $1 \text{ atm} = 1 \times 10^5 \text{ Pa}$ and gravitational acceleration $g = 10 \text{ m/s}^2$)

- (1) **990 m**
- (2) **9900 m**

(3) **99 m**

(4) **9000 m**

Answer (1)

Solution:

- $P = P_0 + \rho gh$
- $\Rightarrow 100 \times 10^5 = 10^5 + 10^3 \times 10 \times h$
- $\Rightarrow 10^7 = 10^5 + 10^4 h$
- $\Rightarrow 10^3 = 10 + h$
- $\Rightarrow h = 1000 - 10 = 990 \text{ m}$

Question 45: Match List I with List II:

List I (Electromagnetic wave)	List II (Production)
A. Microwave	I. Electrons in atoms emit light when they move from lower energy level
B. Visible light	II. Radioactive decay of nucleus
C. Gamma rays	III. Vibration of atoms and molecules
D. Infra-red rays	IV. Klystron valve or magnetron valve

Choose the correct answer from the options given below:

- (1) **A-III, B-I, C-II, D-IV**
- (2) **A-III, B-IV, C-I, D-II**
- (3) **A-IV, B-I, C-II, D-III**
- (4) **A-IV, B-III, C-II, D-I**

Answer (3)

Solution:

- (A-IV) Microwave $\rightarrow$ Klystron valve or magnetron valve
- (B-I) Visible light $\rightarrow$ Electrons in atoms emit light when they move from a higher energy level to a lower energy level
- (C-II) Gamma rays $\rightarrow$ Radioactive decay of nucleus
- (D-III) Infra-red rays $\rightarrow$ Vibration of atoms and molecules

Question 46: Select the reagents that reduce nitriles to primary amines.

- A. (i) LiAlH_4 ; (ii) H_2O
- B. $\text{Sn} + \text{HCl}$
- C. H_2/Ni
- D. $\text{Na}(\text{Hg})/\text{C}_2\text{H}_5\text{OH}$
- E. $\text{Br}_2/\text{aq NaOH}$

Choose the correct answer from the options given below.

- (1) B, D and E only
- (2) A, C and D only
- (3) A, D and E only
- (4) A, B and C only

Answer (2)

Solution:

- $\text{R-CN} \xrightarrow{\text{Na(Hg)/C}_2\text{H}_5\text{OH}} \text{R-CH}_2\text{-NH}_2$
- $\text{R-CN} \xrightarrow{\text{(i) LiAlH}_4, \text{(ii) H}_2\text{O}} \text{R-CH}_2\text{-NH}_2$
- $\text{R-CN} \xrightarrow{\text{Sn + HCl}} \text{R-CHO}$
- $\text{R-CN} \xrightarrow{\text{H}_2/\text{Ni}} \text{R-CH}_2\text{-NH}_2$

Question 47: Match List I with List II:

List I (Transition metal/compound/complex)	List II (Catalytic Role)
A. V_2O_5	I. Preparation of ammonia from N_2/H_2 mixture
B. Fe	II. Polymerisation of alkynes
C. PdCl_2	III. Preparation of H_2SO_4 and SO_2 (Note: Typo in orig SO_3 formation)
D. Ni complex	IV. Oxidation of ethyne to ethanal

Choose the correct answer from the options given below.

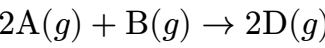
- (1) A-III, B-IV, C-I, D-II
- (2) A-IV, B-I, C-III, D-II
- (3) A-II, B-I, C-IV, D-III
- (4) A-III, B-I, C-IV, D-II

Answer (4)

Solution:

- (A) $\text{V}_2\text{O}_5 \rightarrow$ Catalyses the oxidation of SO_2 into SO_3 in the manufacture of H_2SO_4 . (III)
- (B) Fe $\rightarrow$ Act as catalysts in preparation of ammonia from N_2/H_2 mixture. (I)
- (C) $\text{PdCl}_2 \rightarrow$ Oxidation of ethyne to ethanal. (IV)
- (D) Ni complex $\rightarrow$ Polymerisation of alkynes. (II)
- $A \rightarrow III, B \rightarrow I, C \rightarrow IV, D \rightarrow II$

Question 48: Consider the following reaction:



$\Delta U^\ominus = -10 \text{ kJ mol}^{-1}$ and $\Delta S^\ominus = -44 \text{ J K}^{-1}$ at **298 K**.

Identify the correct option with $\Delta G^\ominus$ for the reaction and spontaneity of the reaction at 298 K.

(Given: $R = 8.31 \text{ J mol}^{-1}\text{K}^{-1}$)

- (1) $-1.635\text{ kJ mol}^{-1}$, **spontaneous**
- (2) $-0.63568\text{ kJ mol}^{-1}$, **spontaneous**
- (3) $+0.63568\text{ kJ mol}^{-1}$, **non-spontaneous**
- (4) $+1.635\text{ kJ mol}^{-1}$, **non-spontaneous**

Answer (3)

Solution:

- $2\text{A}(g) + \text{B}(g) \rightarrow 2\text{D}(g)$
- $\Delta U^\circ = -10\text{ kJ/mol}$
- $\Delta S^\circ = -44\text{ J/K}$
- $\Delta H^\circ = \Delta U^\circ + \Delta n_g RT$
- $\Delta H^\circ = -10 - \frac{1 \times 298 \times (8.31)}{1000} = -10 - 2.48 = -12.48\text{ kJ/mol}$
- $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$
- $= -12.48 - \frac{298 \times (-44)}{1000}$
- $= -12.48 + 13.112$
- $= +0.632\text{ kJ/mol}$
- Since ΔG° comes out to be positive, so it is non-spontaneous.

Question 49: Match List I with List II:

List I (Quantum Numbers)	List II (Orbital)
A. $n = 2, l = 1$	I. $3d$
B. $n = 4, l = 0$	II. $2p$
C. $n = 5, l = 3$	III. $4s$
D. $n = 3, l = 2$	IV. $5f$

Choose the correct answer from the options given below.

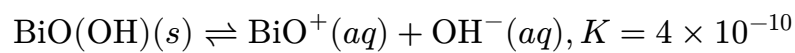
- (1) **A-IV, B-II, C-III, D-I**
- (2) **A-II, B-III, C-I, D-IV**
- (3) **A-II, B-III, C-IV, D-I**
- (4) **A-I, B-II, C-III, D-IV**

Answer (3)

Solution:

- A. $n = 2, l = 1 \rightarrow 2p$ (II)
- B. $n = 4, l = 0 \rightarrow 4s$ (III)
- C. $n = 5, l = 3 \rightarrow 5f$ (IV)
- D. $n = 3, l = 2 \rightarrow 3d$ (I)
- l represents the subshell: $l = 0$ is s , $l = 1$ is p , $l = 2$ is d , $l = 3$ is f .

Question 50: In a qualitative analysis, Bi^{3+} is detected by appearance of precipitate of $\text{BiO}(\text{OH})$ following equilibrium



(Given: $\log 2 = 0.3010$)

(1) **8.714**

(2) **4.699**

(3) **5.286**

(4) **9.301**

Answer (4)

Solution:

- $\text{BiO}(\text{OH})(s) \rightleftharpoons \text{BiO}^+(aq) + \text{OH}^-(aq)$
- $K = \frac{[\text{BiO}^+][\text{OH}^-]}{[\text{BiO}(\text{OH})(s)]}$
- $K = [\text{BiO}^+][\text{OH}^-]$ (since solid concentration is taken as 1)
- $K = s \times s = s^2$
- $s = \sqrt{K} = \sqrt{4 \times 10^{-10}} = 2 \times 10^{-5} \text{ M}$
- $[\text{OH}^-] = s = 2 \times 10^{-5} \text{ M}$
- $[\text{H}^+] = \frac{K_w}{[\text{OH}^-]} = \frac{10^{-14}}{2 \times 10^{-5}} = \frac{1}{2} \times 10^{-9} \text{ M}$
- $\text{pH} = -\log[\text{H}^+] = -\log(0.5 \times 10^{-9}) = 10 - \log 5 = 9 + \log 2 = 9.301$

Question 51: The correct statement with regard to the secondary structure of DNA/RNA is

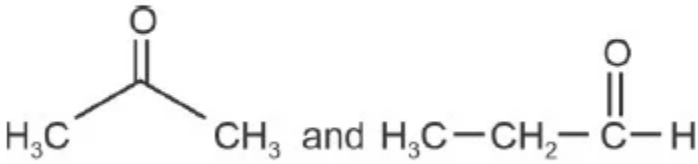
- (1) RNA possesses a single strand helix structure and contains thymine as one of the four bases
- (2) DNA possesses a double strand helix structure and contains thymine as one of the four bases
- (3) RNA possesses a double strand helix structure and contains uracil as one of the four bases
- (4) DNA possesses a single strand helix structure and contains uracil as one of the four bases

Answer (2)

Solution:

- RNA is typically single stranded but it contains uracil, not thymine.
- DNA in its secondary structure has a double strand helix consisting of two polynucleotide chains. Its four nitrogenous bases are adenine (A), guanine (G), cytosine (C) and thymine (T).

Question 52: The pair of molecules that are metamers among the following is:

- (1) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ and $\text{CH}_3 - \text{CH}(\text{OH}) - \text{CH}_3$
- (2) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ and $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_3$
- (3)  and $\text{H}_3\text{C} - \text{CH}_2 - \text{C}(=\text{O}) - \text{H}$
- (4) $\text{CH}_3\text{OCH}_2\text{CH}_2\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$

Answer (4)

Solution:

- Metamerism arises due to different alkyl chains on either side of the functional group in the molecule. The pair of molecules $\text{CH}_3\text{OCH}_2\text{CH}_2\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ are metamers of each other.

Question 53: Match List I with List II:

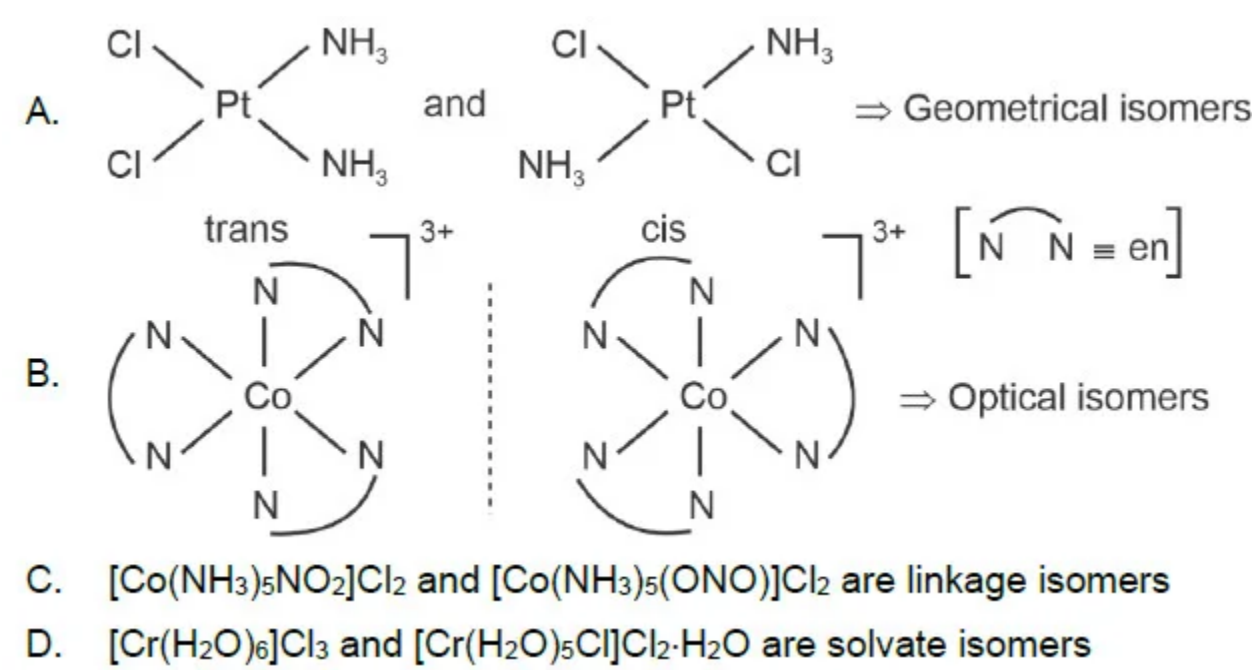
List-I (Complex)	List-II (Type of isomerism)
A. $[Pt(NH_3)_2Cl_2]$	I. Optical
B. $[Co(en)_3]^{3+}$	II. Solvate
C. $[Co(NH_3)_5NO_2]Cl_2$	III. Geometrical
D. $[Cr(H_2O)_6]Cl_3$	IV. Linkage

Choose the correct answer from the options given below:

- (1) A-III, B-I, C-II, D-IV
- (2) A-I, B-III, C-II, D-IV
- (3) A-II, B-IV, C-III, D-I
- (4) A-III, B-I, C-IV, D-II

Answer (4)

Solution:



C.

$[Co(NH_3)_5NO_2]Cl_2$

and $[Co(NH_3)_5(ONO)]Cl_2$

are linkage isomers

D.

$[Cr(H_2O)_6]Cl_3$

and $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$

are solvate isomers

Question 54: Match List I with List II:

List-I (Order of reaction)	List-II (Unit of rate constant)
A. Zero order	I. $\text{mol}^{-1} \text{ L s}^{-1}$
B. First order	II. $\text{mol}^{-2} \text{ L}^2\text{s}^{-1}$
C. Second order	III. s^{-1}
D. Third order	IV. $\text{mol L}^{-1}\text{s}^{-1}$

Choose the correct answer from the options given below :

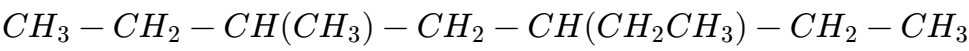
- (1) A-IV, B-II, C-I, D-III
- (2) A-IV, B-III, C-I, D-II
- (3) A-IV, B-III, C-II, D-I
- (4) A-I, B-II, C-III, D-IV

Answer (2)

Solution:

- Unit for rate constant of n^{th} order reaction = $(\text{mol L}^{-1})^{1-n} \text{s}^{-1}$
- For zero order reaction $\Rightarrow n = 0$; unit $\Rightarrow \text{mol L}^{-1} \text{s}^{-1}$
- For first order reaction $\Rightarrow n = 1$; unit $\Rightarrow \text{s}^{-1}$
- For second order reaction $\Rightarrow n = 2$; unit $\Rightarrow \text{mol}^{-1} \text{L s}^{-1}$
- For third order reaction $\Rightarrow n = 3$; unit $\Rightarrow \text{mol}^{-2} \text{L}^2 \text{s}^{-1}$
- Thus, A-IV, B-III, C-I, D-II.

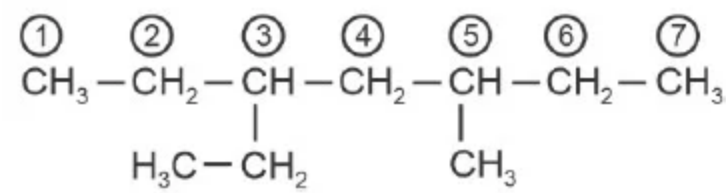
Question 55: The correct IUPAC name of the following compound is.



- (1) 3-ethyl-5-methylheptane
- (2) 2,4-diethylhexane
- (3) 3-methyl-5-ethylheptane
- (4) 3,5-diethylhexane

Answer (1)

Solution:



- IUPAC name: 3-ethyl-5-methylheptane
- Numbering of parent chain should follow lowest locant rule.
- Prefixes should be written in alphabetical order.

Question 56: A bulb is rated at 150 watt, converting 8% energy into light. If energy of one photon is 4.42×10^{-19} J, how many photons are second?

- (1) 2.71×10^{19}
- (2) 4.06×10^{19}
- (3) 27.2×10^{19}
- (4) 1.35×10^{19}

Answer (1)

Solution:

- Energy = Power $\times$ time
- = 150 watt $\times$ 1 s = 150 J
- Energy converted to light = $\frac{150 \times 8}{100} = 12$ J
- $E = nh\nu$
- Energy of one photon = 4.42×10^{-19} J
- So, n = number of photons = $\frac{E}{h\nu} = \frac{12}{4.42 \times 10^{-19}}$
- = 2.715×10^{19}

Question 57: Methane reacts with steam at 1273 K in the presence of nickel catalyst to form

(1) CO and H2O

(2) CO₂ and H₂

(3) CO and H2

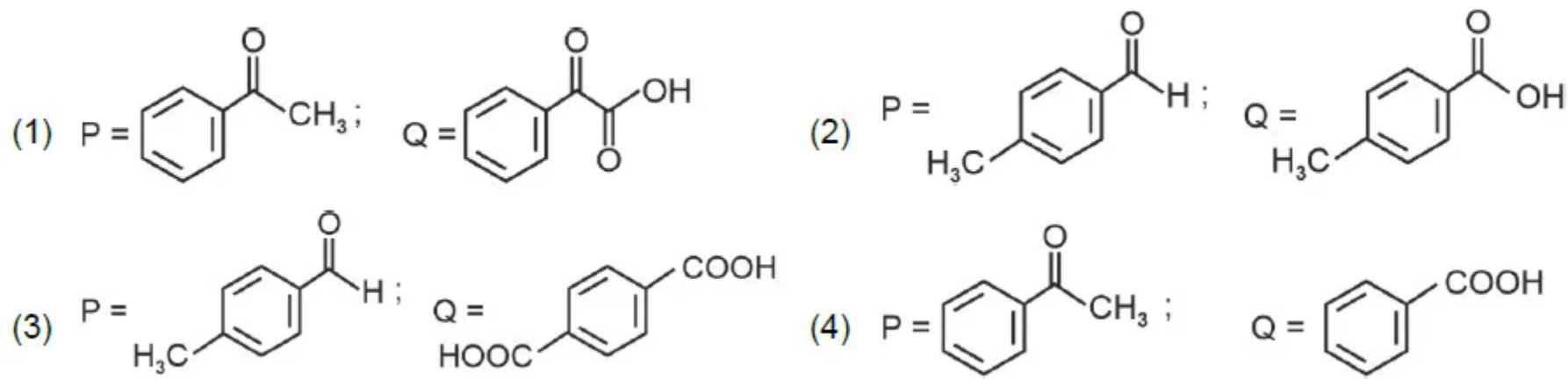
(4) CO₂ and H₂O

Answer (3)

Solution:

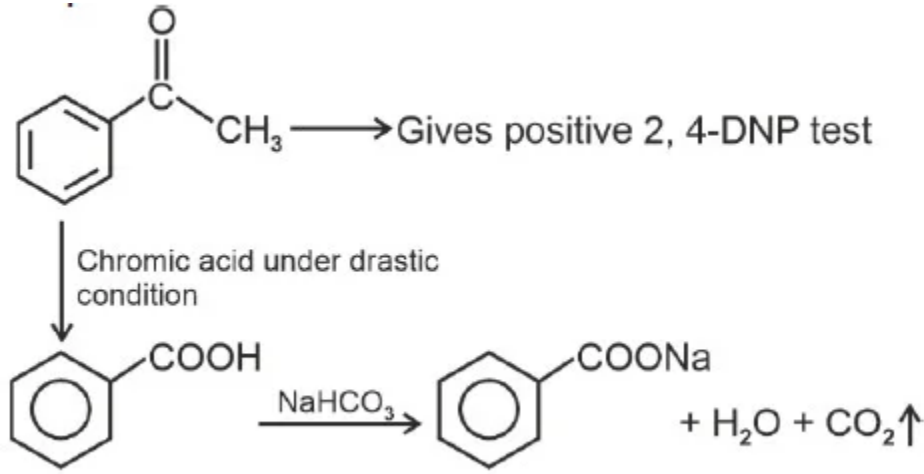
- $\text{CH}_4(g) + \text{H}_2\text{O}(g) \xrightarrow[\Delta (1273\text{K})]{\text{Ni}} \text{CO} + 3\text{H}_2$
- (Used for industrial preparation of dihydrogen gas)

Question 58: Compound $P(\text{C}_8\text{H}_8\text{O})$ gives a red orange precipitate with 2,4-DNP reagent and it does not reduce Fehling’s reagent. On dras acid, P gives an aromatic product Q that produces effervescence on treating with aq. NaHCO_3 . Compounds P and Q, respectively, are:



Answer (3 or 4)

Solution:



- Degree of unsaturation = $(8 + 1) - (\frac{8}{2}) = 9 - 4 = 5$
- In question it is mentioned that oxidation under drastic condition, therefore it must be a ketone.
- P is Acetophenone (which gives positive 2,4-DNP test).
- Acetophenone on drastic oxidation with chromic acid gives Benzoic acid (Q).
- Benzoic acid gives effervescence of CO_2 with NaHCO_3 .

Question 59: Match List I with List II:

List I	List II
A. C_2H_4	I. 3 σ bonds, 2 π bonds
B. C_2H_2	II. 3 σ bonds, one lone pair
C. CH_4	III. 4 σ bonds
D. NH_3	IV. 5 σ bonds, 1 π bond

Choose the correct answer from the options given below :

(1) A-III, B-IV, C-II, D-I

(2) A-IV, B-I, C-III, D-II

(3) A-I, B-II, C-IV, D-III

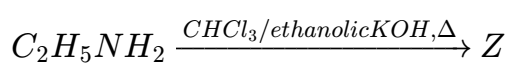
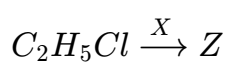
(4) A-II, B-III, C-I, D-IV

Answer (2)

Solution:

- $C_2H_4 \Rightarrow$ Number of σ bonds = 5, Number of π bond = 1 (A-IV)
- $C_2H_2 \Rightarrow H-C \equiv C-H$, Number of σ -bonds = 3, Number of π -bonds = 2 (B-I)
- $CH_4 \Rightarrow$ Number of σ -bonds = 4 (C-III)
- $NH_3 \Rightarrow$ Number of σ -bonds = 3, Number of lone pair = one (D-II)

Question 60: The following two reactions give the same foul smelling product Z.



X and Z, respectively, are:

(1) X = AgCN; Z = C_2H_5NC

(2) X = KCN; Z = C_2H_5CN

(3) X = AgCN; Z = C_2H_5CN

(4) X = KCN; Z = C_2H_5NC

Answer (1)

Solution:

- Foul smelling compound is isocyanide.
- $C_2H_5NH_2 \xrightarrow{CHCl_3/ethanolic KOH, \Delta} C_2H_5NC$ (Z)
- $C_2H_5Cl \xrightarrow{AgCN} C_2H_5NC$ (Z)
- So, X = AgCN, Z = C_2H_5NC

Question 61: The number of hydrogen atoms present in 5.4 g of urea is:

(Given: Molar mass of urea: 60 g mol⁻¹, $N_A : 6.022 \times 10^{23}$ particles mol⁻¹)

(1) 1.084×10^{23}

(2) 1.084×10^{22}

(3) 2.168×10^{22}

(4) 2.168×10^{23}

Answer (4)

Solution:

- Structure of urea: $H_2N-CO-NH_2$
- Mole of urea = $\frac{5.4}{60} = 0.09$

- Number of hydrogen atoms = $0.09 \times 4 \times 6.022 \times 10^{23}$
- = $2.1679 \times 10^{23} \approx 2.168 \times 10^{23}$

Question 62: Identify the incorrect statement from the following:

- (1) Nitrogen can form $p\pi$ - $p\pi$ multiple bonds with itself.
- (2) $P(C_2H_5)_3$ and $As(C_6H_5)_3$ form $d\pi$ - $d\pi$ bond with transition metals.
- (3) Phosphorus, arsenic and antimony show catenation property.
- (4) Nitrogen can form $d\pi$ - $p\pi$ bond with oxygen.

Answer (4)

Solution:

- Both nitrogen and oxygen do not contain d-orbitals so they cannot form $d\pi$ - $p\pi$ bond.
- Phosphorus and Arsenic can form $d\pi$ - $d\pi$ bond with transition metals since both have vacant d-orbitals by which they can interact with transition metals involve in $d\pi$ - $d\pi$ interaction.
- Phosphorous, Arsenic and Antimony show catenation property.

Question 63: Which one of the following is an ambidentate ligand?

- (1) Ethane-1,2-diamine
- (2) Ethylenediaminetetraacetate ion
- (3) Thiocyanate
- (4) Oxalate

Answer (3)

Solution:

- An ambidentate ligand is a ligand which has two different donor atoms and either of the two ligates in complex.
- (1) Ethane-1,2-diamine $\rightarrow$ didentate
- (2) Ethylenediamine tetraacetate ion $\rightarrow$ hexadentate
- (3) Thiocyanate (SCN^-) $\rightarrow$ Ambidentate ligand.
- (4) Oxalate $\rightarrow$ didentate

Question 64: The correct order of increasing metallic character of Na, Be, P, Mg and Si is

- (1) $P < Si < Be < Mg < Na$
- (2) $P < Si < Na < Mg < Be$
- (3) $P < Mg < Be < Si < Na$
- (4) $Be < Si < P < Mg < Na$

Answer (1)

Solution:

- On moving left to right in a period, metallic character decreases and on moving top to bottom in a group, metallic character increases.
- Electronegativity (On Pauling scale): Na (0.9), Mg (1.2), Be (1.5), Si (1.8), P (2.1).
- So, the correct order of increasing metallic character is: $P < Si < Be < Mg < Na$.

Question 65: Match List I with List II:

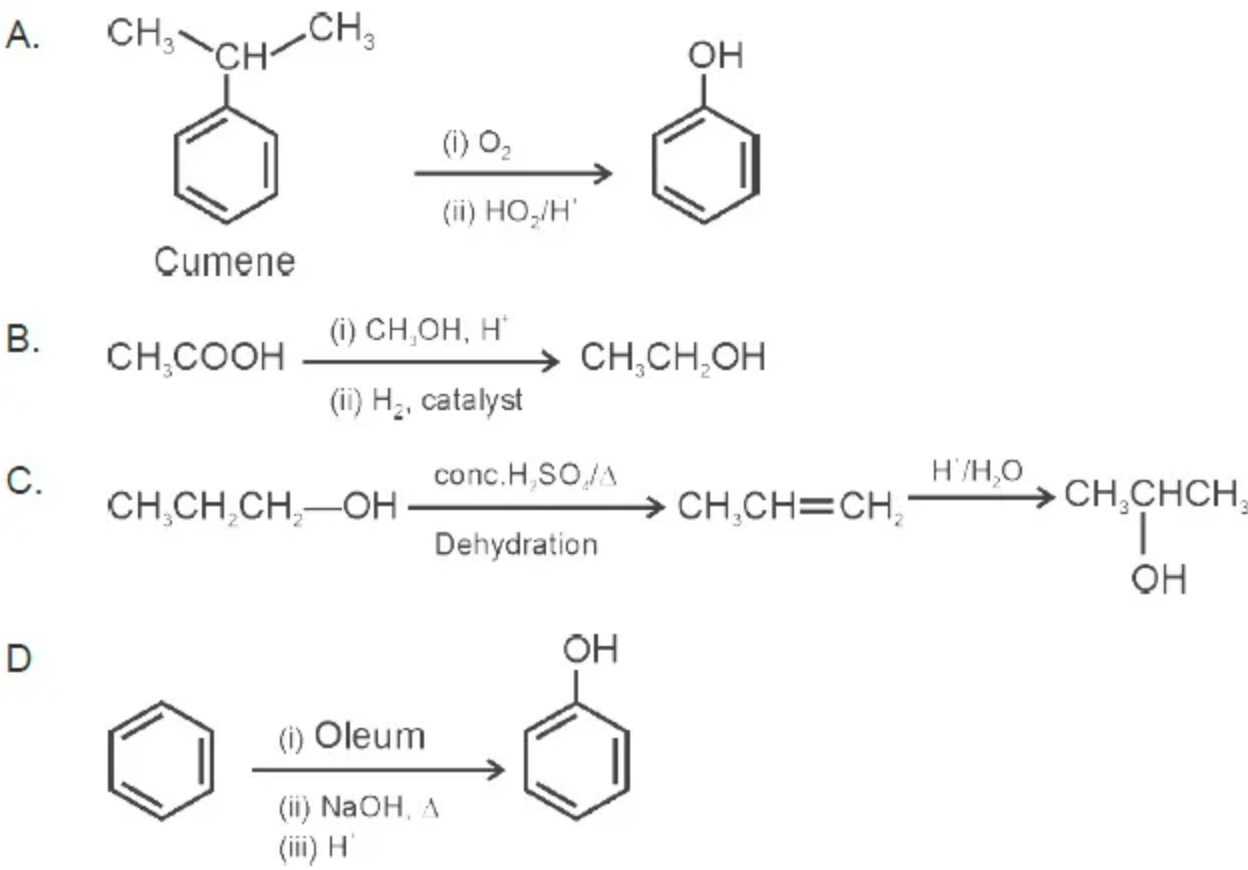
	List I		List II
A.	$\begin{array}{c} \text{H}_3\text{C}-\text{CH}-\text{CH}_3 \\ \\ \text{C}_6\text{H}_5 \end{array} \longrightarrow \text{C}_6\text{H}_5\text{OH}$	(I)	(i) Oleum; (ii) NaOH, Δ; (iii) H ⁺
B.	CH ₃ COOH → CH ₃ CH ₂ OH	(II)	(i) O ₂ ; (ii) H ₂ O/H ⁺
C.	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \longrightarrow \begin{array}{c} \text{CH}_3-\text{CH}-\text{CH}_3 \\ \\ \text{OH} \end{array}$	(III)	(i) CH ₃ OH, H ⁺ ; (ii) H ₂ , catalyst
D	$\text{C}_6\text{H}_6 \longrightarrow \text{C}_6\text{H}_5\text{OH}$	(IV)	(i) conc. H ₂ SO ₄ , Δ; (ii) H ⁺ /H ₂ O

Choose the correct answer from the options given below:

- (1) A-II, B-III, C-I, D-IV
- (2) A-II, B-III, C-IV, D-I
- (3) A-II, B-IV, C-III, D-I
- (4) A-I, B-III, C-IV, D-II

Answer (2)

Solution:



Question 66: Although +3 oxidation state is most common in lanthanoids, cerium still shows +4 oxidation state because:

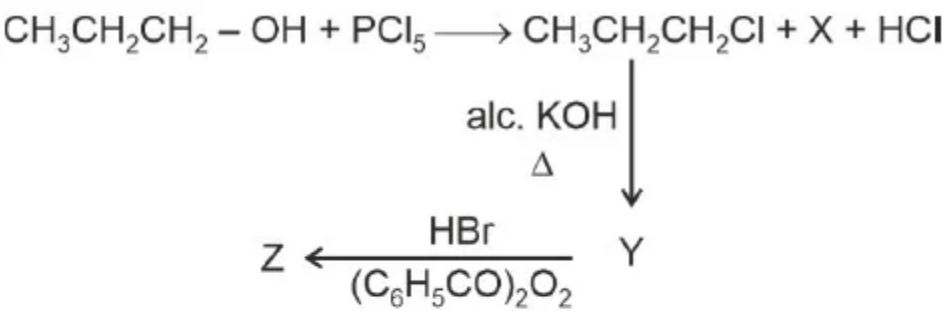
- (1) After losing one more electron, it acquires $4f^{14}$ electronic configuration.
- (2) Its nearest inert gas is Radon.
- (3) Its atomic number is 61.
- (4) After losing one more electron, it acquires $4f^0$ electronic configuration.

Answer (4)

Solution:

- Although +3 oxidation state is most common in lanthanoids, cerium still shows +4 oxidation state because after losing one more electr configuration (which is stable).

Question 67: In the following reaction sequence, X and Z respectively are:



- (1) $\text{X} = \text{POCl}_3$; $\text{Z} = \text{CH}_3 - \underset{\text{Br}}{\text{CH}} - \text{CH}_3$
- (2) $\text{X} = \text{POCl}_3$; $\text{Z} = \text{CH}_3\text{CH}_2\text{CH}_2 - \text{Br}$
- (3) $\text{X} = \text{H}_3\text{PO}_3$; $\text{Z} = \text{CH}_3 - \underset{\text{Br}}{\text{CH}} - \text{CH}_3$
- (4) $\text{X} = \text{H}_3\text{PO}_3$; $\text{Z} = \text{CH}_3\text{CH}_2\text{CH}_2 - \text{Br}$

Answer (2)

Solution:

- $\text{CH}_3\text{CH}_2\text{CH}_2\text{-OH} \xrightarrow{\text{PCl}_5} \text{CH}_3\text{CH}_2\text{CH}_2\text{Cl} + \text{POCl}_3 \text{ (X)} + \text{HCl}$
- $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl} \xrightarrow{\text{alc. KOH, } \Delta} \text{CH}_3\text{CH=CH}_2 \text{ (Y)}$
- $\text{CH}_3\text{CH=CH}_2 \xrightarrow{\text{HBr}/(\text{C}_6\text{H}_5\text{CO})_2\text{O}_2} \text{CH}_3\text{CH}_2\text{CH}_2\text{-Br (Z)}$ (Anti-Markovnikov addition)
- So, $\text{X} = \text{POCl}_3$ and $\text{Z} = \text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$

Question 68: Match List I with List II:

List I (Complex/ion)	List II (Shape/geometry)
A. $[\text{Pt}(\text{Cl}_2)(\text{NH}_3)_2]$	I. Octahedral
B. $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$	II. Trigonal bipyramidal
C. $[\text{NiCl}_4]^{2-}$	III. Square planar
D. $[\text{Fe}(\text{CO})_5]$	IV. Tetrahedral

Choose the correct answer from the options given below:

- (1) A-III, B-IV, C-I, D-II
- (2) A-III, B-I, C-IV, D-II
- (3) A-IV, B-I, C-III, D-II
- (4) A-I, B-III, C-IV, D-II

Answer (2)

Solution:

- In $[\text{Pt}(\text{Cl}_2)(\text{NH}_3)_2]$, Pt has dsp^2 hybridisation, so shape of complex is square planar.
- In $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$, Co has d^2sp^3 hybridisation so shape of complex is octahedral.

- In $[NiCl_4]^{2-}$, Ni has sp^3 hybridisation so shape of complex ion is tetrahedral.
- In $[Fe(CO)_5]$, shape of complex is trigonal bipyramidal.

Question 69: The functional group that can be identified through phthalein dye test is:

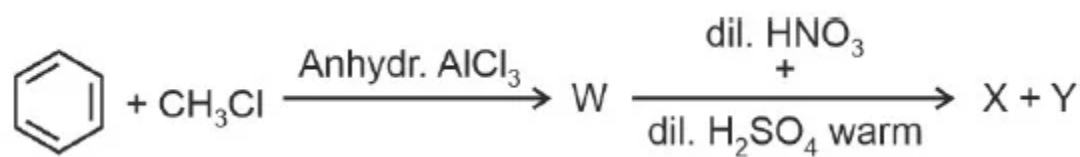
- (1) Aldehyde
- (2) Phenolic
- (3) Carboxylic acid
- (4) Alcohol

Answer (2)

Solution:

- Phthalein Dye test: Phenol on heating with phthalic anhydride in presence of concentrated sulphuric acid forms a colourless condensate phenolphthalein.
- On further reaction with NaOH it gives pink colour.
- So phenolic group is correct answer.

Question 70: Two products X and Y are formed in the following reaction sequence.



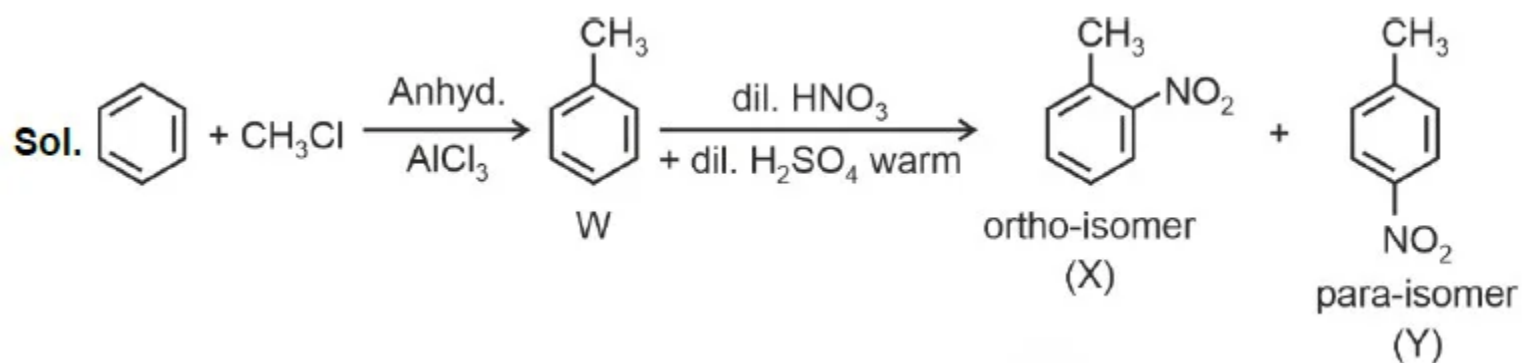
The suitable method that can be used for the separation of products X and Y is:

- (1) Fractional distillation
- (2) Sublimation
- (3) Differential extraction
- (4) Continuous extraction

Answer (1)

Solution:

- Benzene reacting with CH_3Cl and Anhyd. AlCl_3 gives Toluene (W) via Friedel-Crafts alkylation.
- Toluene upon nitration gives ortho-nitrotoluene (X) and para-nitrotoluene (Y).
- The ortho and para isomers are separated by fractional distillation under reduced pressure.
- o-isomer, (M.P. $\rightarrow -4^\circ\text{C}$, B.P. $\rightarrow 222^\circ\text{C}$)
- p-isomer, (M.P. $\rightarrow 54^\circ\text{C}$, B.P. $\rightarrow 238^\circ\text{C}$)



Question 71: Identify the correct statements:

- The molality of **2.5 g** of ethanoic acid (Molar mass: 60 g mol^{-1}) in **75 g** of benzene solution is **0.556 m**.
- The molarity of a solution containing **5 g** of NaOH (molar mass: 40 g mol^{-1}) in **450 mL** of solution is **0.278 M** at 298 K.
- Aquatic species are more comfortable in cold water.

D. The solubility of gas increases with decrease in pressure.

E. For a binary mixture of A and B, the number of moles of A and B are n_A and n_B respectively. The mole fraction of B will be $x_B = \frac{n_A}{n_A+n_B}$.

Choose the correct answer from the options given below:

(1) **A, B and C only**

(2) **A and B only**

(3) **A and C only**

(4) **A, D and E only**

Answer (1)

Solution:

- (A) Molality = $\frac{2.5}{60} \times \frac{1000}{75} = 0.556$ molal (Correct)
- (B) Molarity = $\frac{5}{40} \times \frac{1000}{450} = 0.278$ M (Correct)
- (C) Aquatic species are more comfortable in cold water (Henry's Law $K_H \propto \text{Temp} \propto \frac{1}{\text{Solubility}}$) (Correct)
- (D) According to Henry's Law, $P = K_Hx \Rightarrow P \propto \text{Solubility}$. So as P decreases, solubility decreases. (Incorrect)
- (E) Mole fraction of B, $x_B = \frac{n_B}{n_A+n_B}$. (Incorrect)

Question 72: During Lassaigne’s test, the elements present in an organic compound are converted from:

(1) **Ionic form to ionic form**

(2) **Covalent form to ionic form**

(3) **Covalent form to covalent form**

(4) **Ionic form to covalent form**

Answer (2)

Solution:

- During Lassaigne’s test, the elements present in an organic compound are converted from covalent form to ionic form.

Question 73: A solution of copper sulphate is electrolysed for **10 minutes** with a current of **1.5 amperes**. The mass of copper deposited at ca

(Given: Molar mass of Cu = **63 g mol⁻¹**, 1 F = **96487 C mol⁻¹**)

(1) **1.7018 g**

(2) **0.2938 g**

(3) **2.4036 g**

(4) **0.5876 g**

Answer (2)

Solution:

- $\text{CuSO}_4 \longrightarrow \text{Cu}^{2+} + \text{SO}_4^{2-}$
- $2e^- + \text{Cu}^{2+} \longrightarrow \text{Cu}(s)$
- $W = Zit = \frac{E \times i \times t}{96500}$
- $= \frac{63 \times 1.5 \times 10 \times 60}{2 \times 96500}$
- $= \frac{56,700}{193000} = 0.2938$ g

Question 74: At a certain temperature, T (K), during a process, **500 J** is absorbed by the system and work of **200 J** is done by the system. Th

of the system is:

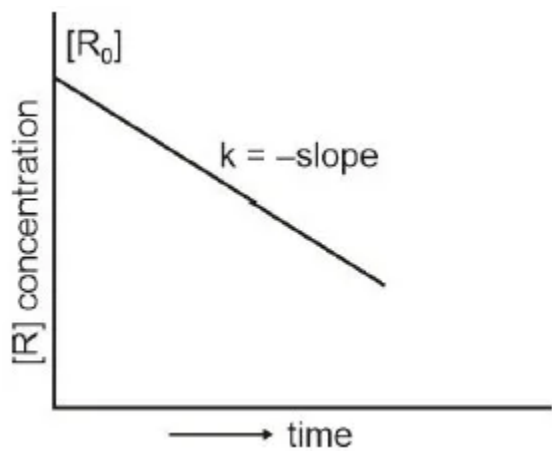
- (1) 400 J
- (2) 300 J
- (3) 700 J
- (4) 500 J

Answer (2)

Solution:

- From first law of thermodynamics: $\Delta U = q + w$
- Heat absorbed, $q = +500\text{ J}$
- Work done by system, $w = -200\text{ J}$
- $\Delta U = 500 - 200 = 300\text{ J}$

Question 75: For a certain reaction $R \rightarrow \text{Product}$, the plot of concentration $[R]$ vs time has a negative slope as shown. The order of reaction



- (1) 0
- (2) 1
- (3) 2
- (4) 2.5

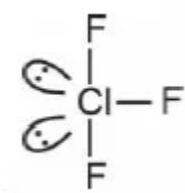
Answer (1)

Solution:

- For a zero order reaction, $[R] = [R_0] - kt$
- So, a straight line with a negative slope ($-k$) for $[R]$ vs time graph shows a zero order reaction.

Question 76: Identify the correct statement about ClF_3 from the following options:

- (1) It has T-shaped geometry with two lone pairs on Cl atom.
- (2) It has T-shaped geometry with three lone pairs on Cl atom.
- (3) It has a trigonal pyramidal geometry with two lone pairs on Cl atom.
- (4) It has a planar trigonal geometry with two lone pairs on Cl atom.



Answer (1)

Solution:

- ClF_3 has two lone pairs of electrons on Cl atom with bent T-shape structure (geometry).

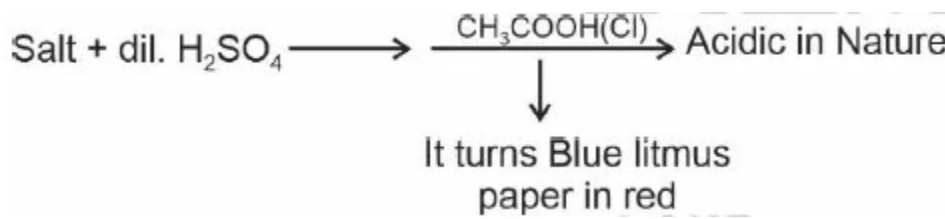
Question 77: In a test tube containing a salt, a few drops of dilute H_2SO_4 was added, which gave colourless vapours having the smell of vinegar. The salt solution turned blue litmus paper red. Identify the correct anion from the following:

- (1) Sulphide, S^{2-}
- (2) Sulphate, SO_4^{2-}
- (3) Acetate, CH_3COO^-
- (4) Carbonate, CO_3^{2-}

Answer (3)

Solution:

- Salt + dil. $\text{H}_2\text{SO}_4 \longrightarrow \text{CH}_3\text{COOH}$ (vapours with smell of vinegar).
- The vapours are acidic in nature and turn blue litmus paper red.
- So, correct answer is: Acetate, CH_3COO^-



Question 78: At 298 K, a certain buffer solution contains equal concentrations of X^- and HX , K_b for X^- is 10^{-10} . What is the pH of this buffer solution?

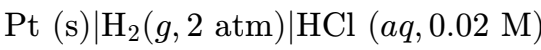
- (1) 2
- (2) 4
- (3) 6
- (4) 10

Answer (2)

Solution:

- $\text{HX} \rightleftharpoons \text{H}^+ + \text{X}^-$
- $K_a \times K_b = K_w$
- $K_a = \frac{K_w}{K_b} = \frac{10^{-14}}{10^{-10}} = 10^{-4}$
- $\text{pH} = \text{p}K_a + \log \frac{[\text{X}^-]}{[\text{HX}]}$
- Given that: $[\text{X}^-] = [\text{HX}]$
- $\text{pH} = 4 + \log(1) = 4 + 0 = 4$

Question 79: Calculate emf of the half cell given below :



$E^\circ_{\text{H}_2/\text{H}^+} = 0 \text{ V}$

(Given: $\frac{2.303RT}{F} = 0.059, \log 2 = 0.3010$)

- (1) -0.109 V
- (2) 0.035 V
- (3) -0.035 V
- (4) 0.109 V

Answer (4)

Solution:

- $\text{H}_2(g) \longrightarrow 2\text{H}^+(aq) + 2e^-$
- $E = E^\circ - \frac{2.303RT}{nF} \log \frac{[\text{H}^+]^2}{P_{\text{H}_2}}$
- $[\text{H}^+] = 0.02 \text{ M}$ (from HCl)
- $P_{\text{H}_2} = 2 \text{ atm}$
- $E = 0 - \frac{0.059}{2} \log \frac{(0.02)^2}{2}$
- $= -0.0295 \log(\frac{0.0004}{2}) = -0.0295 \log(2 \times 10^{-4})$
- $= -0.0295[\log 2 + \log 10^{-4}] = -0.0295[0.301-4] = 0.109 \text{ V}$

Question 80: The calculated ‘spin-only’ magnetic moment $\text{Ti}^{2+}(3d^2)$ is:

- (1) **5.92 BM**
- (2) **3.87 BM**
- (3) **2.84 BM**
- (4) **4.90 BM**

Answer (3)

Solution:

- Spin only magnetic moment $\mu = \sqrt{n(n+2)}$ B.M.
- n = Number of unpaired e^-
- Electronic configuration of $\text{Ti}^{2+} \Rightarrow [\text{Ar}]4s^03d^2$, so $n = 2$.
- $\mu = \sqrt{2 \times 4} = 2.84 \text{ BM}$

Question 81: Identify the incorrect statement from the following:

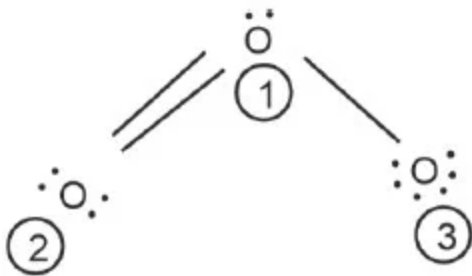
- (1) **Carbon has the ability to form $p\pi - p\pi$ multiple bond with itself.**
- (2) **ECl_3 (E = B and Al) is a monomer when E = B and a dimer when E = Al.**
- (3) **The order of catenation property of Group 14 elements is $\text{C} \gg \text{Si} > \text{Ge} \approx \text{Sn}$.**
- (4) **Oxygen exhibits only -2 oxidation state.**

Answer (4)

Solution:

- (1) C can form $p\pi - p\pi$ multiple bond with itself. It is observed when it forms $\text{C}=\text{C}$ and $\text{C} \equiv \text{C}$.
- (2) BCl_3 does not form dimer. AlCl_3 can form dimer in Al_2Cl_6 .
- (3) Catenation property of group 14 is $\text{C} \gg \text{Si} > \text{Ge} \approx \text{Sn}$.
- (4) Oxygen exhibits oxidation state of 0 in O_2 , -2 in most oxides, and -1 in peroxides. So this statement is incorrect.

Question 82: The correct formal charges on oxygen atoms numbered 2, 1 and 3 in the ozone molecule respectively are:



- (1) **-1, 0, +1**

(2) **0, +1, -1**

(3) **0, 0, 0**

(4) **+1, 0, -1**

Answer (2)

Solution:

- Let Oxygen atom 1 be the central atom (forms 1 double bond, 1 single bond, 1 lone pair). Formal charge = $6 - \frac{1}{2}(6) - 2 = +1$.
- Let Oxygen atom 2 be the double bonded atom (forms 1 double bond, 2 lone pairs). Formal charge = $6 - \frac{1}{2}(4) - 4 = 0$.
- Let Oxygen atom 3 be the single bonded atom (forms 1 single bond, 3 lone pairs). Formal charge = $6 - \frac{1}{2}(2) - 6 = -1$.
- Following the sequence of atoms numbered 2, 1, and 3, the charges are 0, +1, and -1.

Question 83: Phenolphthalein is used as an indicator for the titration of sodium hydroxide solution against a standard solution of oxalic acid observed at an alkaline pH close to the equivalence point during this titration is:

(1) **pinkish red to yellow**

(2) **yellow to pinkish red**

(3) **pink to colourless**

(4) **colourless to pink**

Answer (4)

Solution:

- Colour of Phenolphthalein before the end point = colourless.
- Colour of Phenolphthalein close to equivalence point = Pink.
- ∴ Colour change = Colourless to pink.

Question 84: When 1 dm^3 of CO_2 gas is passed over hot coke the volume of gaseous mixture after complete reaction at STP becomes 1.4 dm^3 of gaseous mixture at STP is:

(1) **0.8 dm^3 of CO, 0.8 dm^3 of CO_2**

(2) **0.8 dm^3 of CO, 0.6 dm^3 of CO_2**

(3) **0.6 dm^3 of CO, 0.8 dm^3 of CO_2**

(4) **0.6 dm^3 of CO, 0.4 dm^3 of CO_2**

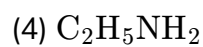
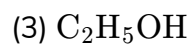
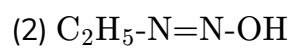
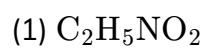
Answer (2)

Solution:

- $\text{CO}_2 + \text{C}(s) \rightarrow 2\text{CO}$
- Initial volume: $\text{CO}_2 = 1$
- At equilibrium/completion: Volume of $\text{CO}_2 = 1 - x$, Volume of $\text{CO} = 2x$
- Total volume = $1 - x + 2x = 1 + x = 1.4$
- $x = 0.4\text{ dm}^3$
- Volume of $\text{CO}_2 = 1 - 0.4 = 0.6\text{ dm}^3$
- Volume of $\text{CO} = 2 \times 0.4 = 0.8\text{ dm}^3$

Question 85: The major product Z formed in the following sequence of reactions is

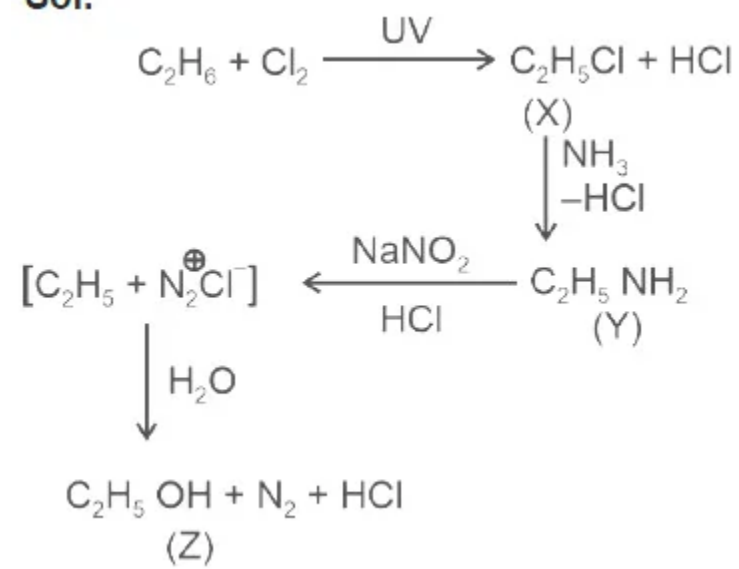




Answer (3)

Solution:

Sol.



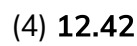
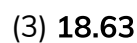
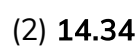
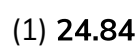
- $\text{C}_2\text{H}_6 + \text{Cl}_2 \xrightarrow{\text{UV}} \text{C}_2\text{H}_5\text{Cl} + \text{HCl}$ (X is $\text{C}_2\text{H}_5\text{Cl}$)
- $\text{C}_2\text{H}_5\text{Cl} \xrightarrow{\text{NH}_3} \text{C}_2\text{H}_5\text{NH}_2$ (Y is $\text{C}_2\text{H}_5\text{NH}_2$)
- $\text{C}_2\text{H}_5\text{NH}_2 \xrightarrow{\text{NaNO}_2/\text{HCl}} [\text{C}_2\text{H}_5\text{-N}_2^+\text{Cl}^-] \xrightarrow{\text{H}_2\text{O}} \text{C}_2\text{H}_5\text{OH} + \text{N}_2 + \text{HCl}$ (Z is $\text{C}_2\text{H}_5\text{OH}$)

Question 86: Given below is an expression for the rate constant of a first-order reaction occurring at a certain temperature, T (K).

$$\ln k = 14.34 - \frac{1.25 \times 10^4}{T}$$

The energy of activation in kcal mol^{-1} for the reaction is:

(Given: k in s^{-1} , $R = 1.987 \text{ cal mol}^{-1} \text{ K}^{-1}$)

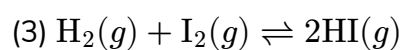
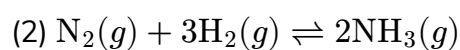
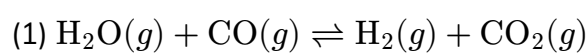


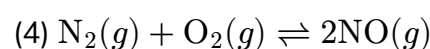
Answer (1)

Solution:

- From Arrhenius equation: $k = Ae^{\frac{-E_a}{RT}}$
- $\ln k = \ln A - \frac{E_a}{RT}$
- Comparing with the given equation: $\frac{E_a}{R} = 1.25 \times 10^4$
- $E_a = 1.25 \times 10^4 \times 1.987 = 24837.5 \text{ cal mol}^{-1} = 24.84 \text{ kcal mol}^{-1}$

Question 87: Given below are certain reactions. Identify the reaction for which $K_P \neq K_C$





Answer (2)

Solution:

- $K_P = K_C(RT)^{\Delta n_g}$
- For $K_P = K_C$, $\Delta n_g = 0$.
- For $K_P \neq K_C$, $\Delta n_g \neq 0$.
- In reaction (2), $\text{N}_2(g) + 3\text{H}_2(g) \rightleftharpoons 2\text{NH}_3(g)$, $\Delta n_g = 2 - (1 + 3) = -2 \neq 0$.

Question 88: Identify the incorrect statement from the following:

- (1) The largest and the smallest species among Mg, Mg^{2+} , Al and Al^{3+} are Al and Mg^{2+} respectively.
- (2) The IUPAC name of the element with atomic number 107 is Unnilseptium.
- (3) The similarity in behaviour of Li with Mg is referred to as 'diagonal relationship'.
- (4) The oxidation state and covalency of Al in $[\text{AlCl}(\text{H}_2\text{O})_5]^{2+}$ are 3 and 6, respectively.

Answer (1)

Solution:

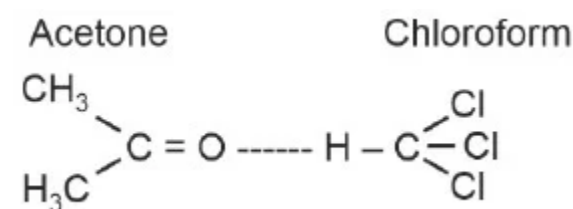
- The largest species is Mg and the smallest one is Al^{3+} among Mg, Mg^{2+} , Al and Al^{3+} . So, statement (1) is incorrect.
- Unnilseptium element has atomic number 107.
- Li and Mg are diagonally related and have similar properties.
- The oxidation state and covalency of Al in $[\text{AlCl}(\text{H}_2\text{O})_5]^{2+}$ are +3 and 6 respectively.

Question 89: Mixture of chloroform and acetone forms a solution with negative deviation from Raoult's law due to:

- (1) Increase in escaping tendency of molecules of each component.
- (2) Formation of hydrogen bonding between acetone and chloroform.
- (3) Stronger intermolecular forces between chloroform molecules than those between chloroform and acetone molecules.
- (4) Repulsive forces.

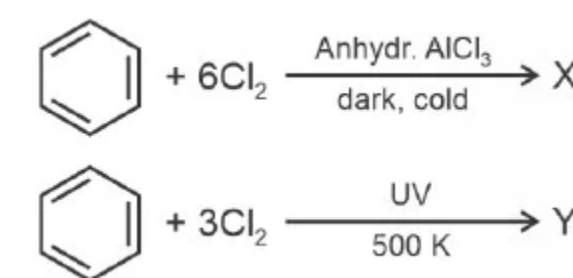
Answer (2)

Solution:



- Acetone and chloroform show negative deviation from Raoult's law due to stronger H-bonding between acetone and chloroform mixture.
- Hence, escaping tendency decreases, vapour pressure decreases, and boiling point increases.

Question 90: The number of chlorine atoms present in the organic products X and Y of the following reactions, respectively, are:



- (1) 3 and 3

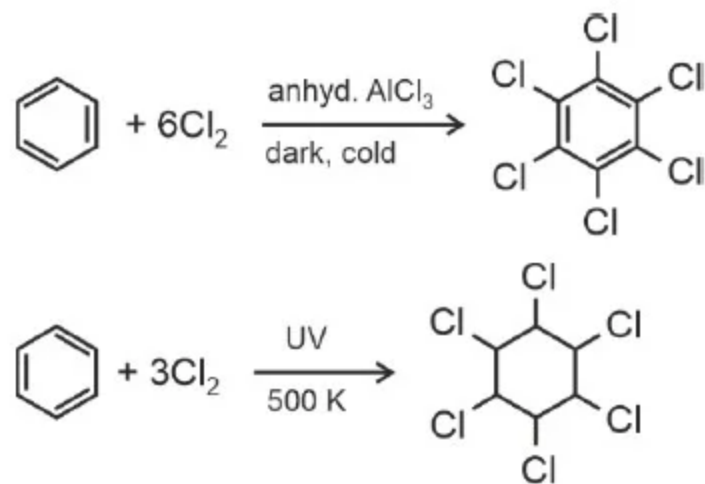
(2) 6 and 3

(3) 6 and 6

(4) 3 and 6

Answer (3)

Solution:



- Benzene + 6Cl₂ $\xrightarrow{\text{Anhyd. AlCl}_3, \text{ dark, cold}}$ Hexachlorobenzene (X, C₆Cl₆) – contains 6 chlorine atoms.
- Benzene + 3Cl₂ $\xrightarrow{\text{UV, 500 K}}$ BHC or Gammexane (Y, C₆H₆Cl₆) – contains 6 chlorine atoms.
- Therefore, the number of chlorine atoms in X and Y are 6 and 6.

Question 91: In angiosperms, root hairs arise from which one of the following regions of the root?

(1) The root cap zone

(2) The region of meristematic activity

(3) The region of elongation

(4) The region of maturation

Answer (4)

Solution:

- From the region of maturation, some epidermal cells form very fine and delicate, thread like structures called root hairs.

Question 92: In which one of the following, the ovules are not enclosed by an ovary wall and remain exposed?

(1) *Funaria*

(2) *Pinus*

(3) *Selaginella*

(4) *Wolffia*

Answer (2)

Solution:

- The gymnosperms are plants in which the ovules are not enclosed by any ovary wall and remain exposed, both before and after fertilisation.
- *Pinus* is a gymnosperm.
- *Funaria* is a moss.
- *Selaginella* is a pteridophyte.

Question 93: In the lac operon, the z gene codes for

(1) permease

(2) transacetylase

(3) **beta-galactosidase**

(4) **the repressor of lac operon**

Answer (3)

Solution:

- In lac operon,
- i gene codes for – regulator protein
- z gene codes for – beta-galactosidase
- y gene codes for – Permease
- a gene codes for – transacetylase

Question 94: Exploring molecular, genetic and species-level diversity for products of economic importance is called

(1) **Biofortification**

(2) **Bioremediation**

(3) **Bioprospecting**

(4) **Biomagnification**

Answer (3)

Solution:

- Exploring molecular, genetic and species – level diversity for products of economic importance is called as bioprospecting.

Question 95: Match List I with List II:

List I	List II
A. Genetically modified organism	I. <i>Agrobacterium tumefaciens</i>
B. Thermostable DNA polymerase	II. Bt cotton
C. Ti plasmid	III. <i>Thermus aquaticus</i>
D. pBR322	IV. <i>Escherichia coli</i>

Choose the correct answer from the options given below:

(1) **A-II, B-III, C-I, D-IV**

(2) **A-II, B-I, C-IV, D-III**

(3) **A-I, B-IV, C-III, D-II**

(4) **A-I, B-II, C-IV, D-III**

Answer (1)

Solution:

- Genetically modified organism – Bt cotton
- Thermostable DNA polymerase – *Thermus aquaticus*.
- Ti plasmid – *Agrobacterium tumefaciens*
- pBR322 – *Escherichia coli*

Question 96: Match List I with List II:

List I	List II
A. Productivity	I. Gross primary productivity minus respiration losses
B. Net primary productivity	II. Rate of formation of new organic matter by consur
C. Gross primary productivity	III. Rate of biomass production
D. Secondary productivity	IV. Rate of production of organic matter during photc

Choose the correct answer from the options given below:

- (1) A-III, B-I, C-IV, D-II
- (2) A-I, B-II, C-III, D-IV
- (3) A-I, B-III, C-IV, D-II
- (4) A-III, B-I, C-II, D-IV

Answer (1)

Solution:

- Productivity is the rate of biomass production.
- Net primary productivity is the Gross primary productivity (GPP) minus respiration losses (R).
- Gross primary productivity is the rate of production of organic matter during photosynthesis.
- Secondary productivity is the rate of formation of new organic matter by consumers.

Question 97: Since the origin and diversification of life on Earth, there have been five episodes of mass extinction of species. How is the sixth progress, different from the previous episodes?

- (1) The present net species extinction rate is zero.
- (2) The current species extinction rate is nearly 10 times faster than in previous episodes.
- (3) The present species extinction rates are 100 to 1000 times faster than in the pre-human times.
- (4) The current species extinction rates are far lower than those in previous episodes.

Answer (3)

Solution:

- The current, sixth episode of mass extinction is estimated to be 100 to 1000 times faster than the ones in the pre-human times and out of these, the current has the faster rates.

Question 98: Alpha-helix is found in which level of protein structure?

- (1) Secondary structure
- (2) Tertiary structure
- (3) Primary structure
- (4) Quaternary structure

Answer (1)

Solution:

- Alpha-helix is shown by secondary structure of protein as it has right handed helices.
- Primary structure is linear and tertiary structure is a hollow ball-like structure.

- Quaternary structures are formed by more than one polypeptide chains.

Question 99: The main function of bulliform cells in grasses is

- (1) to make the leaf impermeable to fungal spores.
- (2) to transport water.
- (3) to perform photosynthesis.
- (4) to minimize water loss during water stress.

Answer (4)

Solution:

- Bulliform cells are large empty colourless cells that lose water and become flaccid in water scarce condition. Hence they curl the leaf in by reducing the exposed surface area.

Question 100: Identify the correct sequence of steps in each cycle of Polymerase Chain Reaction:

- (1) Extension → Annealing → Denaturation
- (2) Annealing → Denaturation → Extension
- (3) Denaturation → Extension → Annealing
- (4) Denaturation → Annealing → Extension

Answer (4)

Solution:

- The correct sequence of steps in PCR is
- Denaturation → Annealing → Extension

Question 101: Match List I with List II:

List-I (Phase of cell cycle)	List-II (Activity)
A. G_1 phase	I. Actual cell division occurs
B. S phase	II. Cell is metabolically active and continuously grows DNA
C. G_2 phase	III. Synthesis of DNA occurs and the amount of DNA
D. M phase	IV. Proteins are synthesized while cell growth continu

Choose the correct answer from the options given below:

- (1) A-IV, B-I, C-II, D-III
- (2) A-I, B-II, C-III, D-IV
- (3) A-III, B-IV, C-I, D-II
- (4) A-II, B-III, C-IV, D-I

Answer (4)

Solution:

- During G_1 phase the cell is metabolically active and continuously grows but does not replicate its DNA.
- S-phase marks the phase during which DNA synthesis or replication takes place and amount of DNA per cell doubles.
- During the G_2 phase, proteins are synthesised in preparation for mitosis while cell growth continues.
- During M phase the actual cell division takes place.

Question 102: Which of the following statements are correct?

- A. The Amazon rainforest being cut and cleared for cultivation of soyabeans is an example of habitat loss.
- B. Steller's sea cow and passenger pigeon became extinct due to over-exploitation by humans.
- C. The Nile perch introduced into Lake Victoria in East Africa helped in population growth of cichlid fish in the lake.
- D. Water hyacinth is an invasive species.
- E. When a species becomes extinct, the plant and animal species associated with it are not affected.

Choose the correct answer from the options given below:

(1) A, B and E only

(2) A, B and D only

(3) C, D and E only

(4) B, C and D only

Answer (2)

Solution:

- The Nile Perch introduced into Lake Victoria in East Africa led eventually to extinction of an ecologically unique assemblage of more than 200 species of cichlid fish in the lake. (Statement C is incorrect)
- When a species become extinct, the plant and animal species associated with it in an obligatory way also become extinct. (Statement E is incorrect)
- Statements, A, B and D are correct.

Question 103: Which of the following statements are correct with reference to a transcription unit?

- A. A transcription unit in DNA is defined primarily by three regions: promoter, structural gene and terminator.
- B. The promoter is said to be located towards the 5'-end of the structural gene.
- C. The promoter is a DNA sequence that provides binding site for RNA polymerase.
- D. The promoter defines the template and coding strands.
- E. The terminator is located towards the 3'-end of the coding strand and it defines the end of the process of transcription.

Choose the correct answer from the options given below:

(1) A, B, C and D only

(2) A, C, D and E only

(3) B, C, D and E only

(4) A, B, C, D and E

Answer (4)

Solution:

- The promoter and terminator flank the structural gene in a transcription unit.
- The promoter is said to be located towards 5'-end of the structural gene.
- It is a DNA sequence that provides binding site for RNA polymerase and it is the presence of promoter in a transcription unit that also defines the start of the process of transcription.

coding strands.

- The terminator is located towards 3'-end of the coding strand and it usually defines the end of transcription.

Question 104: Which one of the following statements is not true about the universal rules of binomial nomenclature?

- (1) **Biological names are generally in Latin**
- (2) **Both the words in a biological name, when handwritten, are separately underlined or printed in italics**
- (3) **The specific epithet in the biological name starts with a small letter**
- (4) **The first word in the biological name represents the specific epithet, while the second component denotes the genus**

Answer (4)

Solution:

- According to universal rules of nomenclature, the first word denoting the genus starts with a capital letter while the second component and starts with a small letter.

Question 105: Match List I with List II:

List-I (Process)	List-II (Location) (Note: Heading says location but it is process)
A. Decomposition	I. Accumulation of dark coloured amorphous colloidal substance
B. Detritus	II. Release of inorganic nutrients by the activity of microorganisms
C. Mineralisation	III. Breaking down of complex organic matter into inorganic substances
D. Humification	IV. Dead remains of plants and animals including fecal matter

Choose the correct answer from the options given below:

- (1) **A-IV, B-III, C-I, D-II**
- (2) **A-III, B-IV, C-II, D-I**
- (3) **A-I, B-II, C-III, D-IV**
- (4) **A-III, B-II, C-I, D-IV**

Answer (2)

Solution:

- Decomposition is the process of breaking down of complex organic matter into inorganic substance.
- Detritus includes dead remains of plants and animals including fecal matter and acts as the raw material for decomposition.
- Degradation of humus by activity of microbes leading to release of inorganic nutrients is called Mineralisation.
- Accumulation of the dark coloured amorphous substance called humus, is called humification.

Question 106: Which one of the following is the site for active ribosomal RNA synthesis?

- (1) **Centrosome**
- (2) **Chromatin**
- (3) **Nucleolus**
- (4) **Kinetochore**

Answer (3)

Solution:

- Nucleolus is the site for active ribosomal RNA synthesis.

Question 107: $2(C_{51}H_{98}O_6) + 145\ O_2 \rightarrow 102\ CO_2 + 98\ H_2O + \text{energy}$

The Respiratory Quotient (RQ) of a biomolecule used for respiration, as per the above equation would be :

- (1) **Between 0.5 and 0.95**
- (2) **Less than 0.5**
- (3) **1.0**
- (4) **Between 1.25 and 2**

Answer (1)

Solution:

- R.Q = Volume of CO_2 evolved / Volume of O_2 consumed
- As per the given equation, $2(C_{51}H_{98}O_6) + 145\ O_2 \rightarrow 102\ CO_2 + 98\ H_2O + \text{Energy}$
- Hence the RQ can be calculated as, $R.Q = \frac{102}{145} \approx 0.7$
- This value lies between 0.5 and 0.95.

Question 108: Match List I with List II:

List-I	List-II
A. Incomplete dominance	I. Human skin colour
B. Co-dominance	II. Inheritance of flower colour in <i>Antirrhinum</i> sp.
C. Pleiotropy	III. Phenylketonuria in humans
D. Polygenic inheritance	IV. ABO blood groups

Choose the correct answer from the options given below:

- (1) **A-II, B-IV, C-III, D-I**
- (2) **A-I, B-III, C-II, D-IV**
- (3) **A-I, B-IV, C-III, D-II**
- (4) **A-II, B-I, C-III, D-IV**

Answer (1)

Solution:

- Inheritance of flower colour in snapdragon (*Antirrhinum* sp.) is an example of incomplete dominance.
- ABO blood groups exhibit codominance in case of individuals having AB blood group ($I^A I^B$).
- Phenylketonuria in humans is an example of pleiotropy since the gene responsible for it leads to multiple phenotypic effects.
- Human skin colour is controlled by three pairs of non allelic genes, hence it is an example of polygenic inheritance.

Question 109: Arrange the following steps of DNA fingerprinting in a correct sequence.

- A. Isolation of DNA and its digestion by restriction endonucleases.
- B. Hybridisation using a labelled VNTR probe.

C. Transferring of separated DNA fragments to synthetic membranes.

D. Detection of hybridised DNA fragments by autoradiography.

E. Separation of DNA fragments by electrophoresis.

Choose the correct answer from the options given below:

(1) A, B, D, C, E

(2) A, D, B, E, C

(3) A, E, C, B, D

(4) A, E, B, C, D

Answer (3)

Solution:

- The following is the correct sequence of steps of DNA fingerprinting.
- A. Isolation of DNA and its digestion by restriction endonuclease.
- E. DNA fragments are separated based on their size by the technique of gel electrophoresis.
- C. The separated DNA fragments are transferred to synthetic membranes made of nylon or nitrocellulose.
- B. Probes made complementary to the VNTR locus are allowed to hybridise with the DNA fragments.
- D. Finally, the hybridised DNA fragments are detected under X-rays in a technique called autoradiography.

Question 110: Which of the following statements are correct with reference to packaging of DNA helix?

A. Histones are organized to form a unit of eight molecules called histone octamer.

B. Histones are negatively charged basic proteins.

C. Histones are rich in the basic amino acid residues – lysine and arginine.

D. The positively charged DNA is wrapped around the histone octamer to form nucleosome.

E. The packaging of chromatin at higher levels requires an additional set of proteins called non-histone chromosomal proteins.

Choose the correct answer from the options given below :

(1) A, C and E only

(2) B, D and E only

(3) C, D and E only

(4) A, B and D only

Answer (1)

Solution:

- Eight Histones are combined to form a histone octamer.
- Histones are positively charged basic proteins that are rich in basic amino acids (lysine and arginine).
- The negatively charged DNA is wrapped around the histone octamer to form nucleosome.
- The packaging of chromatin at higher levels require NHC (non histone chromosomal) proteins.

Question 111: Find the incorrect statement(s) about photosynthesis from the following:

A. The water splitting complex is associated with PS I.

B. C_4 plants use the C_3 pathway of CO_2 fixation as the main biosynthetic pathway.

C. In C_4 plants, photorespiration does not occur.

- D. C_3 plants exhibit ‘Kranz’ anatomy.
- E. ATP synthesis in chloroplast occurs through chemiosmosis.

Choose the answer from the options given below:

- (1) B and C only
- (2) B only
- (3) B and E only
- (4) A and D only

Answer (4)

Solution:

- The water splitting complex is associated with PS-II (Statement A is incorrect).
- C_3 pathway is the main biosynthetic pathway for CO_2 fixation in both C_3 and C_4 plants.
- C_3 plants do not exhibit ‘Kranz’ anatomy (Statement D is incorrect).
- ATP synthesis in chloroplast (Photophosphorylation) occurs by chemiosmosis.
- Therefore, the incorrect statements are A and D.

Question 112: Arrange the following steps of somatic hybridisation in a correct sequence.

- A. Digestion of cell walls.
- B. Isolation of naked protoplasts.
- C. Fusion of protoplasts to get hybrid protoplast.
- D. Isolation of single cells from two different varieties of plants.
- E. Growing of hybrid protoplast to form a new plant.

Choose the correct answer from the options given below:

- (1) D, A, B, C, E
- (2) E, B, A, D, C
- (3) D, B, A, E, C
- (4) E, A, B, C, D

Answer (1)

Solution:

- Scientists have isolated single cell protoplasts from two different varieties of plants (D).
- After digesting their cell walls (A), they have been able to isolate naked protoplasts surrounded by plasma membrane (B).
- These can be fused to get a hybrid protoplast (C).
- This can be further grown to form a new plant (E).
- So the correct sequence for the formation of somatic hybrids is D, A, B, C, E.

Question 113: Match List-I with List-II:

List-I	List-II
A. Conjunctive tissue	I. Specialised cells in the vicinity of guard cells
B. Casparian strips	II. Endodermal cells rich in starch

List-I	List-II
C. Subsidiary cells	III. Tissue between xylem and phloem
D. Starch sheath	IV. Endodermal cells with suberin deposition

Choose the correct answer from the options given below :

- (1) A-IV, B-III, C-I, D-II
- (2) A-III, B-IV, C-II, D-I
- (3) A-III, B-IV, C-I, D-II
- (4) A-IV, B-III, C-II, D-I

Answer (3)

Solution:

- (A) Conjunctive tissue is the tissue between xylem and phloem (III).
- (B) Casparian strips are found in endodermal cells, they are suberin depositions in the cell wall (IV).
- (C) Subsidiary cells are specialised cells in the vicinity of guard cells (I).
- (D) Starch sheath is another name for endodermal cells rich in starch (II).

Question 114: Which one of the following is not a characteristic of plant cells in the phase of elongation?

- (1) New cell wall deposition
- (2) Cell enlargement
- (3) Increased vacuolation
- (4) Large conspicuous nuclei

Answer (4)

Solution:

- Phase of elongation is characterised by new cell wall deposition, increased vacuolation and enlargement of cell.
- Presence of large conspicuous nuclei is a feature of cells in the meristematic phase.

Question 115: Match List-I with List-II

List-I (Growth Regulator)	List-II (Function/Effect)
A. 2,4-D	I. Brewing industry
B. GA_3	II. Stimulation of stomatal closure
C. Kinetin	III. Herbicide
D. ABA	IV. Nutrient mobilisation

Choose the correct answer from the options given below:

- (1) A-III, B-I, C-IV, D-II
- (2) A-IV, B-III, C-II, D-I
- (3) A-I, B-IV, C-III, D-II

(4) A-I, B-II, C-IV, D-III

Answer (1)

Solution:

- A. 2,4-D (Auxin) is used as a Herbicide (III).
- B. GA_3 (Gibberellic Acid) is used in the Brewing industry (I).
- C. Kinetin (Cytokinin) is responsible for Nutrient mobilisation (IV).
- D. ABA (Absciscic Acid) stimulates stomatal closure (II).

Question 116: The enzyme required for carboxylation in the Calvin cycle is

- (1) Hexokinase
- (2) PEP carboxylase
- (3) RuBP carboxylase – oxygenase
- (4) Carboxypeptidase

Answer (3)

Solution:

- RuBisCO (RuBP carboxylase – oxygenase) is the enzyme required for carboxylation in the Calvin cycle.

Question 117: How many ATP and NADPH molecules are required to make one molecule of glucose through the Calvin pathway?

- (1) 18 ATP and 12 NADPH
- (2) 12 ATP and 18 NADPH
- (3) 24 ATP and 18 NADPH
- (4) 6 ATP and 12 NADPH

Answer (1)

Solution:

- Each turn of Calvin pathway utilizes 3 ATP and 2 $NADPH$ molecules for the fixation of 1 CO_2 molecule.
- So for 1 Glucose molecule, 6 turns are required.
- Hence, $6 \times 3 = 18$ ATP and $6 \times 2 = 12$ NADPH are required for glucose synthesis.

Question 118: Which of the following floral formula is the correct floral formula of Solanaceae family?

- (1) $\oplus \underline{+} K_{(5)} C_{(5)} A_5 \underline{G}_{(2)}$
- (2) $\oplus \underline{+} K_{(5)} \overline{C_{(5)} A_5} \underline{G}_{(2)}$
- (3) $\oplus \underline{+} K_5 C_5 A_5 \underline{G}_{(2)}$
- (4) $\oplus \underline{+} K_5 \overline{C_{(5)} A_5} \underline{G}_{(2)}$

Answer (2)

Solution:

- $\oplus \underline{+} K_{(5)} \overline{C_{(5)} A_5} \underline{G}_{(2)}$ is the floral formula for Solanaceae.
- It shows actinomorphic ($\oplus$), bisexual ($\underline{+}$), pentamerous flower with epipetalous condition.
- Generally in Solanaceae, calyx (K) and Corolla (C) show fusion in sepals and petals respectively. Hence the floral formula must exhibit c gamopetalous condition.

Question 119: Which of the following is an in situ conservation method?

- (1) **Sacred Groves**
- (2) **Wildlife Safari Parks**
- (3) **Botanical Gardens**
- (4) **Seed Banks**

Answer (1)

Solution:

- In-situ conservation is exemplified by sacred groves, national parks, and biosphere reserves.
- Wildlife Safari parks, Botanical gardens, and seed banks are examples of ex-situ conservation.

Question 120: Which of the following statements are not true regarding restriction endonucleases?

- A. They are called molecular scissors.
- B. These are the enzymes responsible for restricting the growth of bacteriophages in E. coli.
- C. They cut the DNA only at the centre of the palindromic sites.
- D. They remove nucleotides only from the ends of DNA fragments.
- E. They recognise specific palindromic base-pair sequences.

Choose the answer from the options given below:

- (1) **A and B only**
- (2) **A and E only**
- (3) **D and E only**
- (4) **C and D only**

Answer (4)

Solution:

- Statements C and D are incorrect.
- Restriction endonucleases usually cut the DNA slightly away from the centre of palindrome sites.
- They cannot remove nucleotides from the ends of the DNA fragment; that is the function of restriction exonucleases.

Question 121: In racemose inflorescence,

- (1) **The main axis terminates in a flower**
- (2) **Flowers are solitary**
- (3) **The growth is limited**
- (4) **Flowers are borne in an acropetal succession**

Answer (4)

Solution:

- In a racemose type of inflorescence, the main axis continues to grow and the flowers are borne laterally in an acropetal succession.
- On the contrary, in a cymose type of inflorescence, the main axis terminates into a flower and hence, is limited in growth.

Question 122: Arrange the following in the correct developmental sequence related to microsporogenesis:

- A. Microspore tetrads

B. Sporogenous tissue

C. Pollen grains

D. Pollen mother cells

Choose the correct answer from the options given below:

(1) **D, A, C, B**

(2) **B, D, A, C**

(3) **B, D, C, A**

(4) **A, D, C, B**

Answer (2)

Solution:

- The process of formation of microspores from a pollen mother cell (PMC) through meiosis is called microsporogenesis.
- The correct developmental sequence related to microsporogenesis will be:
- Sporogenous tissue (B) → Pollen mother cell (D) → Microspore tetrads (A) → Pollen grains (C).

Question 123: Identify the correct statements about biomolecules.

A. Lipids are generally water soluble.

B. Proteins are polypeptides.

C. Polysaccharides are long chains of sugars.

D. Adenine and guanine are substituted pyrimidines.

E. Almost all enzymes are proteins.

Choose the correct answer from the options given below:

(1) **B, D and E only**

(2) **B, C and E only**

(3) **A, B and C only**

(4) **C, D and E only**

Answer (2)

Solution:

- Statements B, C and E are correct.
- Statements A and D are not true. Lipids are not water soluble. Adenine and guanine are substituted purines (not pyrimidines).

Question 124: Which of the following statements are true with reference to the sex-determination in honeybees?

A. An offspring formed from the union of a sperm and an egg, develops as a female (queen or worker).

B. An unfertilized egg develops as a male by parthenogenesis.

C. A male has half the number of chromosomes than that of a female.

D. Males produce sperms by meiosis.

E. Honeybees have a haplodiploid sex-determination system.

Choose the correct answer from the options given below:

(1) **A, B, C and E only**

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(2) **B, C, D and E only**

(3) **A, B, C and D only**

(4) **A, B, D and E only**

Answer (1)

Solution:

- In case of honeybees, males have half the number of chromosomes than that of females. The females are diploid (32 chromosomes) and males are haploid (16 chromosomes).
- This is called a haplodiploid sex-determination system.
- Statement D is incorrect because the males (being haploid) produce sperms by mitosis, not meiosis. Statements A, B, C, and E are correct.

Question 125: Heterophyllous development in response to environment is an example of which of the following phenomena?

(1) **Redifferentiation**

(2) **Elasticity**

(3) **Dedifferentiation**

(4) **Plasticity**

Answer (4)

Solution:

- Plants follow different pathways in response to environment or phases of life to form different kinds of structures.
- This ability is called plasticity (e.g., heterophyly in cotton, coriander and larkspur).

Question 126: Which of the following statements are correct regarding amino acids?

A. They are substituted methanes.

B. Serine is an aromatic amino acid.

C. Valine is a neutral amino acid.

D. Lysine is an acidic amino acid.

Choose the correct answer from the options given below:

(1) **C and D only**

(2) **B and C only**

(3) **A and C only**

(4) **A and B only**

Answer (3)

Solution:

- Statements A and C are correct. Amino acids are substituted methanes, and valine is a neutral amino acid.
- Statements B and D are incorrect. Serine is a hydroxyl (alcoholic) amino acid (not aromatic), and lysine is a basic amino acid (not acidic).

Question 127: “The Evil Quartet” of biodiversity loss includes which of the following?

(1) **Over-exploitation; Alien species invasions; Air pollution; Co-extinctions**

(2) **Habitat loss and fragmentation; Air pollution; Water pollution; Co-extinctions**

(3) **Habitat loss and fragmentation; over-exploitation; Alien species invasions; Co-extinctions**

(4) **Over-exploitation; Alien species invasions; Soil pollution; Co-extinctions**

Answer (3)

Solution:

- ‘The Evil Quartet’ is the sobriquet used to describe the four major causes of biodiversity loss which includes: Habitat loss and fragment species invasions, and Co-extinctions.

Question 128: Match List-I with List-II:

List-I (Process)	List-II (Location)
A. Glycolysis	I. Inner mitochondrial membrane
B. ETS	II. Mitochondrial matrix
C. Accumulation of protons	III. Cytoplasm
D. Krebs’ cycle	IV. Intermembrane space

Choose the correct answer from the options given below:

- (1) **A-IV, B-II, C-I, D-III**
- (2) **A-II, B-III, C-IV, D-I**
- (3) **A-III, B-I, C-IV, D-II**
- (4) **A-I, B-IV, C-III, D-II**

Answer (3)

Solution:

- The site of glycolysis is the cytoplasm (III) in all living organisms.
- Electron transport system (ETS) is localized in the inner mitochondrial membrane (I).
- Accumulation of protons occurs in the intermembrane space (IV).
- Krebs’ Cycle takes place in the mitochondrial matrix (II).

Question 129: Which one of the following is a triploid cell?

- (1) **Synergid**
- (2) **Central cell**
- (3) **Zygote**
- (4) **Primary endosperm cell**

Answer (4)

Solution:

- Synergid is haploid (n). Zygote is diploid (2n).
- The central cell initially contains two polar nuclei which fuse just before fertilization to form a secondary nucleus (2n).
- Primary endosperm cell (PEC), formed by triple fusion (male gamete with secondary nucleus), is triploid (3n).

Question 130: Which one of the following types of pollination brings genetically different types of pollen grains to the stigma?

- (1) **Autogamy**
- (2) **Xenogamy**

(3) Geitonogamy

(4) Cleistogamy

Answer (2)

Solution:

- Transfer of pollen grains from the anther to the stigma of a different plant is known as Xenogamy.
- This is the only type of pollination which brings genetically different types of pollen grains to the stigma.

Question 131: Match List I with List II:

List I (Placentation)	List II (Example)
A. Marginal	I. Mustard
B. Axile	II. Pea
C. Parietal	III. Marigold
D. Basal	IV. Lemon

Choose the correct answer from the options given below:

- (1) A-II, B-IV, C-I, D-III
- (2) A-I, B-III, C-II, D-IV
- (3) A-III, B-I, C-IV, D-II
- (4) A-IV, B-II, C-I, D-III

Answer (1)

Solution:

- Marginal placentation is found in pea (A-II).
- Axile placentation is found in lemon (B-IV).
- Parietal placentation is found in mustard (C-I).
- Basal placentation is found in marigold (D-III).

Question 132: The main criteria used for Five Kingdom Classification proposed By R.H. Whittaker (1969) included :

- A. Cell structure
- B. Body organization
- C. Presence of flagellum
- D. Reproduction
- E. Phylogenetic relationships

Choose the correct answer from the options given below :

- (1) A, B, C, D and E
- (2) B, C and D only
- (3) A, B, D and E only
- (4) A, B and E only

Answer (3)

Solution:

- The main criteria for five kingdom classification used by R.H. Whittaker includes cell structure, body organization, mode of nutrition, re relationships.
- Presence of flagellum is not one of the main criteria. Therefore, A, B, D, and E only is correct.

Question 133: Match List I with List II:

List I	List II
A. Trypsin	I. Intercellular ground substance
B. Morphine	II. Lectin
C. Concanavalin A	III. Enzyme
D. Collagen	IV. Alkaloid

Choose the correct answer from the options given below:

- (1) A-III, B-IV, C-II, D-I
- (2) A-I, B-II, C-III, D-IV
- (3) A-IV, B-III, C-II, D-I
- (4) A-III, B-II, C-IV, D-I

Answer (1)

Solution:

- Trypsin is a proteolytic enzyme (A-III).
- Morphine is a secondary metabolite that belongs to the category of alkaloid (B-IV).
- Concanavalin A is a lectin (C-II).
- Collagen acts as an intercellular ground substance (D-I).

Question 134: Which of the following statements are correct with respect to DNA separation, isolation and visualization?

- A. The cutting of DNA is done by molecular scissors.
- B. The DNA fragments separate according to their size in an agarose gel, upon electrophoresis.
- C. The separated DNA fragments can be seen without staining when exposed to UV light.
- D. The separated DNA fragments, when stained with ethidium bromide, can be seen in visible light.

Choose the correct answer from the options given below:

- (1) B and D only
- (2) A and B only
- (3) B and C only
- (4) A and D only

Answer (2)

Solution:

- The cutting of DNA is possible by the use of restriction enzymes (molecular scissors) that res Privacy & Cookies Policy ⚡ (Statement A

- These fragments of DNA can be separated by a technique known as gel electrophoresis. The DNA fragments separate (resolve) according to the sieving effect provided by the agarose gel (Statement B is correct).
- The separated DNA fragments can be visualised only after staining the DNA with a compound known as ethidium bromide followed by UV light (Statements C and D are incorrect).

Question 135: Which one of the following disorders is caused by the substitution of Glutamic acid (Glu) by Valine (Val) at the sixth position of the beta globin chain of the haemoglobin molecule?

- (1) **Thalassemia**
- (2) **Sickle-cell anaemia**
- (3) **Phenylketonuria**
- (4) **Haemophilia**

Answer (2)

Solution:

- Sickle cell anaemia is an autosome-linked recessive trait that can be transmitted from parents to offspring when both partners are carriers.
- The defect is caused by the substitution of Glutamic acid (Glu) by Valine (Val) at the sixth position of the beta globin chain of the haemoglobin molecule.

Question 136: Match List I with List II:

List I	List II
A. Cortisol	I. Stimulates the formation of alveoli in mammary glands
B. Aldosterone	II. Produces anti-inflammatory reactions
C. Cholecystokinin	III. Stimulates reabsorption of Na^{+} and water from renal tubules
D. Progesterone	IV. Stimulates secretion of pancreatic enzymes and bile juice

Choose the correct answer from the options given below:

- (1) **A-III, B-II, C-IV, D-I**
- (2) **A-IV, B-II, C-I, D-III**
- (3) **A-II, B-III, C-IV, D-I**
- (4) **A-II, B-III, C-I, D-IV**

Answer (3)

Solution:

- Cortisol produces anti-inflammatory reactions and suppresses the immune response (A-II).
- Aldosterone acts mainly at the renal tubules and stimulates the reabsorption of Na^{+} and water and excretion of K^{+} and phosphate in urine (B-III).
- Cholecystokinin (CCK) acts on both pancreas and gall bladder and stimulates the secretion of pancreatic enzymes and bile juice, respectively (C-IV).
- Progesterone acts on the mammary glands and stimulates the formation of alveoli (D-I).

Question 137: Arrange the following events occurring in Renin-Angiotensin mechanism in the correct order:

- A. Increase in blood pressure and Glomerular filtration rate
- B. Reabsorption of Na^{+} and water from distal parts of tubule due to Aldosterone
- C. Fall in Glomerular filtration rate

D. Vasoconstriction by Angiotensin II and release of Aldosterone.

E. Renin converts Angiotensinogen into Angiotensin I, followed by Angiotensin II.

Choose the correct answer from the options given below:

(1) A, C, E, B, D

(2) C, A, B, D, E

(3) A, D, B, E, C

(4) C, E, D, B, A

Answer (4)

Solution:

- A fall in glomerular blood flow/GFR (C) can activate the JG cells to release renin which converts angiotensinogen in blood to angiotensin II (E).
- Angiotensin II, being a powerful vasoconstrictor, increases the glomerular blood pressure and activates the adrenal cortex to release aldosterone (B).
- Aldosterone causes reabsorption of Na^+ and H_2O from the distal parts of the tubule (B).
- This leads to an increase in blood pressure and GFR (A).
- Correct order: C, E, D, B, A.

Question 138: In humans, respiration occurs in the following steps. Arrange these steps in the correct order.

A. Diffusion of O_2 and CO_2 between blood and tissues

B. Diffusion of O_2 and CO_2 across alveolar membrane

C. Pulmonary ventilation by which atmospheric air is drawn in and CO_2 rich alveolar air is released out

D. Cellular respiration

E. Transport of gases by the blood

Choose the correct answer from the options given below:

(1) A, B, C, D, E

(2) E, A, C, D, B

(3) C, B, E, A, D

(4) C, A, B, E, D

Answer (3)

Solution:

- Respiration involves the following steps:
 1. Breathing or pulmonary ventilation by which atmospheric air is drawn in and CO_2 rich alveolar air is released out (C).
 2. Diffusion of gases across alveolar membrane (B).
 3. Transport of gases by the blood (E).
 4. Diffusion of O_2 and CO_2 between blood and tissues (A).
 5. Utilisation of O_2 by the cells for catabolic reactions and resultant release of CO_2 (Cellular respiration) (D).
- Correct order: C, B, E, A, D.

Question 139: The following are the stages of life cycle of Plasmodium. Arrange the stages in the proper order.

A. The parasites reproduce asexually in RBCs, bursting the cells.

B. The parasites reproduce asexually in liver cells, bursting the cells and releasing into blood.

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- C. Gametocytes develop in RBCs.
- D. Sporozoites reach the liver through the blood.
- E. Female mosquito injects sporozoites into humans during bite.

Choose the correct answer from the options given below.

- (1) E, D, B, A, C
- (2) A, B, C, D, E
- (3) C, A, B, D, E
- (4) E, C, D, B, A

Answer (1)

Solution:

- Plasmodium enters the human body as sporozoites through the bite of an infected female *Anopheles* mosquito (E).
- Sporozoites reach the liver through the blood (D).
- The parasites initially multiply asexually within the liver cells and release into blood (B) and then attack the RBCs resulting in their rupture.
- Sexual stages (gametocytes) develop in red blood cells (C).
- Correct order: E, D, B, A, C.

Question 140: Insertion of a foreign DNA at BamHI site in an E.coli cloning vector pBR322 results in the loss of antibiotic resistance towards:

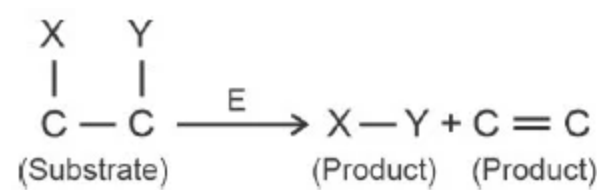
- (1) Ampicillin and tetracycline
- (2) Ampicillin
- (3) Tetracycline
- (4) Gentamycin

Answer (3)

Solution:

- If one ligates a foreign DNA at the BamHI site of the tetracycline resistance gene in the vector pBR322, the recombinant plasmid will lose its ability to confer resistance to tetracycline due to insertion of foreign DNA.

Question 141: The following reaction depicts the activity of a particular class of enzymes :



Identify the enzymes class 'E' from the following options :

- (1) Transferases
- (2) Isomerases
- (3) Lyases
- (4) Ligases

Answer (3)

Solution:

- Lyases are the enzymes that catalyse removal of groups from substrates by mechanisms other than hydrolysis leaving double bonds.
- Transferases catalyse a transfer of a group between a pair of substrates.

- Isomerases catalyse inter-conversion of optical, geometric or positional isomers.
- Ligases catalyse the linking together of 2 compounds.

Question 142: The specific receptors for neurotransmitters in a synapse are present on _____.

- (1) Schwann cell
- (2) Pre-synaptic membrane
- (3) Myelin sheath
- (4) Post-synaptic membrane

Answer (4)

Solution:

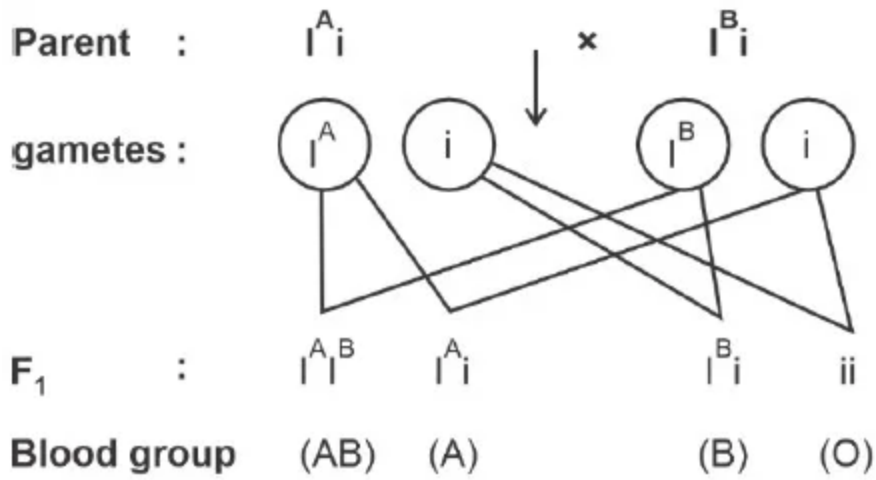
- The specific receptors for neurotransmitters in a synapse are present on the post-synaptic membrane.

Question 143: What is the probability of having children with ‘O’ blood group, where both mother and father are heterozygous for ‘A’ and ‘E

- (1) 25%
- (2) 0%
- (3) 75%
- (4) 50%

Answer (1)

Solution:



∴ Out of four children, one is with blood group ‘O’.

∴ The probability of having children with ‘O’ blood group will be 25%

- Parent: $I^A i$ (Heterozygous A) $\times$ $I^B i$ (Heterozygous B)
- Gametes: $(I^A), (i) \times (I^B), (i)$
- F₁ generation genotypes: $I^A I^B$ (AB blood group), $I^A i$ (A blood group), $I^B i$ (B blood group), ii (O blood group).
- Out of four children, one is with blood group ‘O’. The probability of having children with ‘O’ blood group will be $\frac{1}{4}$ or 25%.

Question 144: Match List-I with List-II.

List-I (Respiratory Volume)	List-II (Capacity in mL)
A. ERV (Expiratory Reserve Volume)	I. 2500-3000 mL
B. RV (Residual Volume)	II. 500 mL
C. IRV (Inspiratory Reserve Volume)	III. 1000-1100 mL
D. TV (Tidal Volume)	IV. 1100-1200 mL

Choose the correct answer from the options given below:

(1) **A-III, B-IV, C-I, D-II**

(2) **A-III, B-I, C-IV, D-II**

(3) **A-I, B-III, C-II, D-IV**

(4) **A-I, B-II, C-III, D-IV**

Answer (1)

Solution:

- ERV (Expiratory Reserve Volume) = 1000-1100 mL (A-III)
- RV (Residual Volume) = 1100-1200 mL (B-IV)
- IRV (Inspiratory Reserve Volume) = 2500-3000 mL (C-I)
- TV (Tidal Volume) = 500 mL (D-II)

Question 145: Which of the following is not an example of convergent evolution?

(1) **Flippers of penguins and dolphins**

(2) **Eyes of octopuses and mammals**

(3) **Fore limbs of whales and bats**

(4) **Wings of butterflies and birds**

Answer (3)

Solution:

- Fore limbs of whales and bats are examples of divergent evolution that show homology. All the other options show analogous structural evolution.

Question 146: Male frogs can be distinguished from female frogs due to the presence of

A. Bulging eyes

B. Vocal sacs

C. Webbed digits in feet

D. Copulatory pad on first digit of fore limbs

E. Olive green-coloured skin with dark irregular spots

Choose the correct answer from the options given below

(1) **B and C only**

(2) **C and E only**

(3) **A and B only**

(4) **B and D only**

Answer (4)

Solution:

- Male frogs can be distinguished from female frogs due to the presence of vocal sacs and a copulatory pad on the first digit of forelimbs
- Bulging eyes, webbed digits in feet, and olive green-coloured skin with dark irregular spots are common in both male and female frogs

Question 147: A group of researchers procured some fish like animals and upon investigation the following characters were observed:

- A. Endoskeleton was made of cartilage.
- B. Ectoparasitic; as they were found attached on fish skin with their circular sucking mouth.
- C. Paired fins and scales were absent, but 7 pairs of gill slits were present.

Which of the following species of animals did they consider to fit best with these characters?

- (1) **Scoliodon** sp.
- (2) **Petromyzon** sp.
- (3) **Exocoetus** sp.
- (4) **Branchiostoma** sp.

Answer (2)

Solution:

- Petromyzon sp. (lampreys) have a cartilaginous endoskeleton. They have a circular sucking mouth and are ectoparasites on some fishes. They lack scales and paired fins. They have 6-15 pairs of gill slits (7 pairs falls in this range).
- Scoliodon and Exocoetus are not parasites.

Question 148: Match List I with List II with respect to chronology of evolution of life forms

List-I	List-II
A. About 65 mya	(I) Jawless fish probably evolved
B. About 500 mya	(II) The dinosaurs suddenly disappeared from the earth
C. About 350 mya	(III) Seaweeds and few plants probably existed
D. About 320 mya	(IV) Invertebrates were formed and became active

Choose the correct answer from the options given below:

- (1) **A(III), B(IV), C(I), D(II)**
- (2) **A(I), B(II), C(III), D(IV)**
- (3) **A(II), B(IV), C(III), D(I)**
- (4) **A(II), B(IV), C(I), D(III)**

Answer (4)

Solution:

- About 65 mya – The dinosaurs suddenly disappeared from the earth (A-II).
- About 500 mya – Invertebrates were formed and became active (B-IV).
- About 350 mya – Jawless fish probably evolved (C-I).
- About 320 mya – Seaweeds and few plants probably existed (D-III).

Question 149: Match List I and List II

List-I	List-II
A. Progestasert	(I) Barrier made of rubber used by females
B. Multiload 375	(II) Oral contraceptive

List-I	List-II
C. Diaphragm	(III) Hormone releasing IUD
D. Saheli	(IV) Copper releasing IUD

Choose the correct answer from the options given below:

- (1) A(III), B(IV), C(I), D(II)
- (2) A(IV), B(II), C(I), D(III)
- (3) A(IV), B(III), C(I), D(II)
- (4) A(III), B(IV), C(II), D(I)

Answer (1)

Solution:

- Progestasert – Hormone releasing IUD (A-III).
- Multiload 375 – Copper releasing IUD (B-IV).
- Diaphragm – Barrier made of rubber used by females (C-I).
- Saheli – Oral contraceptive (D-II).

Question 150: The WBC count of a person’s blood sample is 8000/cu mm. How many eosinophils and lymphocytes would be in the same bl

- (1) 300-500/cu mm and 1200-1500/cu mm respectively
- (2) 160-240/cu mm and 1600-2000/cu mm respectively
- (3) 300-500/cu mm and 500-700/cu mm respectively
- (4) 100-120/cu mm and 160-200/cu mm respectively

Answer (2)

Solution:

- Eosinophils constitute 2-3% of total WBCs. Hence, their value is approximately 2 to 3% of 8000/cu mm = 160-240/cu mm.
- Lymphocytes constitute 20-25% of total WBCs. Hence, their value is approximately 20 to 25% of 8000/cu mm = 1600-2000/cu mm.

Question 151: Match List I with List II:

List I (Drug)	List II (Effect)
A. Nicotine	I. Causes sense of euphoria and increased energy
B. Morphine	II. Stimulates adrenal gland to release catecholamine
C. Heroin	III. Effective sedative and painkiller
D. Cocaine	IV. A depressant; slows down body function

Choose the correct answer from the options given below:

- (1) A-III, B-II, C-IV, D-I
- (2) A-II, B-III, C-I, D-IV
- (3) A-II, B-III, C-IV, D-I

(4) **A-III, B-II, C-I, D-IV**

Answer (3)

Solution:

- Nicotine is present in tobacco and it activates adrenal medulla to release catecholamines into blood circulation, so (A) → II
- Morphine acts as an effective sedative and painkiller. It is an opioid, so (B) → III
- Heroin acts as a depressant and slows down body function, so (C) → IV
- Cocaine acts as a stimulant and causes a sense of euphoria and increased energy, so (D) → I
- Thus, (A) → II, (B) → III, (C) → IV, (D) → I

Question 152: The human protein named α -1-antitrypsin, obtained from transgenic animals, is used for the treatment of

(1) **Emphysema**

(2) **Alzheimer's disease**

(3) **Rheumatoid arthritis**

(4) **Cystic fibrosis**

Answer (1)

Solution:

- The human protein named α -1-antitrypsin, obtained from transgenic animals, is used for the treatment of emphysema.
- Transgenic models exist for the study of other diseases, such as Alzheimer's disease, rheumatoid arthritis and cystic fibrosis.

Question 153: Select the set of fishes which belong to the class Osteichthyes:

(1) **Devil fish, Cuttlefish and Hagfish**

(2) **Saw fish, Fighting fish and Dog fish**

(3) **Starfish, Hagfish and Cuttlefish**

(4) **Flying fish, Angel fish and Fighting fish**

Answer (4)

Solution:

- Flying fish (*Exocoetus*) is a marine bony fish. Angel fish (*Pterophyllum*) and fighting fish (*Betta*) are aquarium bony fishes.
- Option (1) is incorrect as Devil fish (*Octopus*) and cuttlefish (*Sepia*) are molluscs, and Hag fish (*Myxine*) is a cyclostome.
- Option (2) is incorrect as Saw fish (*Pristis*) and dog fish are cartilaginous fishes.
- Option (3) is incorrect as Star fish (*Asterias*) is an echinoderm.

Question 154: Select the incorrect statements from the following

A. Digestive system in Platyhelminthes is incomplete.

B. Bilateral symmetry is a characteristic feature of adult Echinoderms.

C. Pseudocoelom is possessed by Aschelminthes.

D. Notochord is persistent throughout life in the class Chondrichthyes.

E. Members of class Reptilia maintain a constant body temperature.

Choose the answer from the options given below:

(1) **A and C only**

(2) **B and E only**

(3) **C and D only**

(4) **B and D only**

Answer (2)

Solution:

- (A) Correct → Platyhelminthes have an incomplete digestive system.
- (B) Incorrect → Bilateral symmetry is a characteristic feature of *larvae* of echinoderms. In adult echinoderms, radial symmetry is seen.
- (C) Correct → Aschelminthes are characterised by the presence of pseudocoelom.
- (D) Correct → Notochord is persistent throughout life in the Chondrichthyes.
- (E) Incorrect → Reptiles are cold-blooded organisms and thus, they cannot maintain a constant body temperature. Warm-blooded org mammals can maintain a constant body temperature.
- Thus, the incorrect statements are indicated by (B) and (E) only.

Question 155: Non-membrane bound cell organelles found in both prokaryotic and eukaryotic cells are

(1) **Ribosomes**

(2) **Lysosomes**

(3) **Centrosomes**

(4) **Mitochondria**

Answer (1)

Solution:

- Ribosome is a non-membrane bound cell organelle, found in both prokaryotic and eukaryotic cells.

Question 156: Which of the following equations depicts Verhulst-Pearl logistic population growth?

(1) $\frac{dN}{dt} = rN\left(\frac{K+N}{K}\right)$

(2) $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$

(3) $\frac{dN}{dt} = rN\left(\frac{K-N}{N}\right)$

(4) $\frac{dN}{dt} = rN\left(\frac{K}{K-N}\right)$

Answer (2)

Solution:

- Verhulst-Pearl logistic population growth is depicted by the equation: $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$
- Where K = Carrying capacity, r = Intrinsic rate of natural increase, N = Population density at time 't'.

Question 157: Select the incorrect statement with reference to Rh grouping.

A. Erythroblastosis foetalis is a condition observed having foetus with Rh^{-ve} blood and mother with Rh^{+ve} blood.

B. Rh antigen is observed on RBCs in the majority of human beings.

C. Before blood transfusion, Rh group should also be matched.

D. Rh incompatibility is observed when a pregnant mother is Rh^{-ve} and the foetus is Rh^{+ve} .

E. Erythroblastosis foetalis can be avoided by administering anti-Rh antibodies to the mother immediately after the delivery of the second child.

Choose the answer from the options given below

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- (1) C and D only
- (2) A and B only
- (3) A and E only
- (4) B and C only

Answer (3)

Solution:

- (A) Incorrect → A special case of Rh incompatibility has been observed between the Rh^{-ve} blood of a pregnant mother with Rh^{+ve} blood.
- (B) Correct → Rh antigen is observed on the surface of RBCs of majority (nearly 80 percent) of humans.
- (C) Correct → Before blood transfusion, Rh group should also be matched to avoid severe problems of destruction of RBCs.
- (D) Correct → Rh incompatibility (Erythroblastosis foetalis) is observed when a pregnant mother is Rh^{-ve} and the foetus is Rh^{+ve} .
- (E) Incorrect → Erythroblastosis foetalis can be avoided by administering anti-Rh antibodies to the mother immediately after the delivery.
- Thus, the incorrect statements are (A) and (E).

Question 158: Match List I with List II:

List I (Bioactive molecules)	List II (Importance)
A. Streptokinase	I. Immunosuppressive agent
B. Statins	II. Removal of clots from the blood vessels
C. Lipases	III. Blood cholesterol-lowering agent
D. Cyclosporin A	IV. Detergent formulations

Choose the correct answer from the options given below:

- (1) A-II, B-III, C-I, D-IV
- (2) A-IV, B-III, C-II, D-I
- (3) A-III, B-II, C-IV, D-I
- (4) A-II, B-III, C-IV, D-I

Answer (4)

Solution:

- Streptokinase → Used as ‘clot buster’ for removing clots from the blood vessels (II).
- Statins → Blood cholesterol lowering agent, produced by *Monascus purpureus* (III).
- Lipases → Used in detergent formulation (IV).
- Cyclosporin A → Used as immunosuppressive agent in organ transplant patients and produced by *Trichoderma polysporum* (I).

Question 159: Match List I with List II:

List I	List II
A. Molluscs	I. Pulmonary respiration only
B. Reptiles	II. Branchial respiration

List I	List II
C. Adult amphibians	III. Cellular respiration
D. Amoeba	IV. Pulmonary and cutaneous respiration

Choose the correct answer from the options given below:

- (1) A-II, B-I, C-IV, D-III
- (2) A-I, B-II, C-IV, D-III
- (3) A-II, B-I, C-III, D-IV
- (4) A-III, B-II, C-I, D-IV

Answer (1)

Solution:

- (A) Molluscs → (II) Perform branchial respiration by using feather-like gills
- (B) Reptiles → (I) Perform pulmonary respiration only via lungs
- (C) Adult amphibians → (IV) Perform pulmonary and cutaneous respiration via lungs and moist skin, respectively
- (D) Amoeba → (III) Performs cellular respiration to generate ATP for survival

Question 160: The sixth mutant codon of beta globin gene causing polymerization of Haemoglobin and change in RBC shape is

- (1) GUG
- (2) AUG
- (3) GAG
- (4) CAG

Answer (1)

Solution:

- Sickle cell anaemia is an autosomal recessive disorder which is caused by the substitution of Glutamic acid by Valine, at the sixth posit the haemoglobin molecule.
- The substitution of amino acid in the globin protein results due to the single base substitution from GAG to GUG.
- Hence, GUG is responsible for the change in the shape of RBC.

Question 161: Choose the correct statements regarding muscle contraction.

- A. A motor neuron carries a signal sent by the Central Nervous System (CNS) to the sarcolemma of the muscle fibre.
- B. The neural signal generates an action potential which causes the release of Ca^{++} into sarcoplasm.
- C. Increase in Ca^{++} inactivates the actin for breaking cross bridges.
- D. Actin binds to the myosin head to form a cross bridge.
- E. Shortening of sarcomere takes place, by pulling actin filaments towards the centre of 'A' band.

Choose the correct answer from the options given below :

- (1) C and D only
- (2) A and B only
- (3) C and E only

(4) **A, B, D and E only**

Answer (4)

Solution:

- Statements A, B, D and E are correct while statement C is incorrect.
- A neural signal reaching the neuromuscular junction releases a neurotransmitter (Acetylcholine) which generates an action potential in the muscle fibre and causes the release of Ca^{++} into the sarcoplasm.
- This Ca^{++} binds to the subunit of troponin on actin filaments and thereby removes the masking of active site for myosin on actin and (inactivates) the formation of a cross bridge.

Question 162: Which of the following statements are correct with reference to human endoskeleton?

- A. Human skull is monocondylic.
- B. The joint between any two adjacent vertebrae is a cartilaginous joint.
- C. In human beings, the number of cervical vertebrae is seven.
- D. All ribs except the last 2 pairs are bicephalic.
- E. The occipital bone of skull is articulated with atlas vertebra.

Choose the correct answer from the options given below:

- (1) **B and E only**
- (2) **B, C and E only**
- (3) **C, D and E only**
- (4) **A, B and D only**

Answer (2)

Solution:

- (A) Incorrect: Human skull is dicondylic. The skull region articulates with the superior region of the vertebral column (Atlas) with the help of two condyles.
- (B) Correct: The joint present between the adjacent vertebrae of the vertebral column is a cartilaginous joint.
- (C) Correct: There are 7 cervical vertebrae in human beings.
- (D) Incorrect: All ribs of humans are bicephalic, i.e., they have two articulation surfaces on their dorsal end.
- (E) Correct: The occipital bone of the skull articulates with the atlas vertebra via occipital condyles, forming the atlanto-occipital joint.

Question 163: Spermatogonia undergo a series of cell divisions to produce sperms. Select the correct statements from the following:

- A. Spermatogonia always undergo meiotic cell division.
- B. Primary spermatocytes divide mitotically to produce secondary spermatocytes.
- C. Secondary spermatocytes, through their second meiotic division, produce haploid spermatids.
- D. Spermatids produce spermatozoa through mitosis.
- E. Spermatids transform into spermatozoa by spermiogenesis.

Choose the correct answer from the options given below:

- (1) **A and E only**
- (2) **C and E only**
- (3) **A, C and E only**
- (4) **B, C and D only**

Answer (2)**Solution:**

- (A) Incorrect: Spermatogonia undergo mitotic differentiation.
- (B) Incorrect: Primary spermatocytes undergo 1st meiotic division to form secondary spermatocytes.
- (C) Correct: Secondary spermatocytes undergo 2nd meiotic division to form the haploid spermatids.
- (D) Incorrect: Spermatids form spermatozoa through a differentiation process called spermiogenesis (not mitosis).
- (E) Correct: Spermatids produce spermatozoa via spermiogenesis.

Question 164: The JGA (Juxta Glomerular Apparatus) is a special sensitive region formed by cellular modifications in _____ related to the s

- (1) **Distal convoluted tubule and efferent renal arteriole**
- (2) **Proximal convoluted tubule and efferent renal arteriole**
- (3) **Proximal convoluted tubule and afferent renal arteriole**
- (4) **Distal convoluted tubule and afferent renal arteriole**

Answer (4)**Solution:**

- JGA is a special sensitive region formed by cellular modifications in the distal convoluted tubule and the afferent arteriole at the locatio

Question 165: Which one of the following is an appropriate example of sexual deceit?

- (1) **Female wasp and fig**
- (2) **Ophrys and bumblebee**
- (3) **Sea anemone and clown fish**
- (4) **Cuckoo and crow**

Answer (2)**Solution:**

- Ophrys (orchid) and bumblebee show sexual deceit.
- Female wasp and fig show mutualism.
- Sea anemone and clown fish show commensalism.
- Cuckoo and crow show brood parasitism.

Question 166: Choose the correct statements regarding frog's anatomy:

- A. Hepatic portal system is the special venous connection between liver and intestine.
- B. There are twelve pairs of cranial nerves arising from the brain.
- C. The ureters and oviducts open separately into the cloaca in female frogs.
- D. Hind-brain consists of cerebellum, medulla oblongata and optic lobes.
- E. Sinus venosus joins the right atrium of heart.

Choose the correct answer from the options given below:

- (1) **A, B and C only**
- (2) **B and D only**
- (3) **B and C only**
- (4) **A, C and E only**

Answer (4)

Solution:

- A. Correct → In frogs, the special venous connection between liver and intestine is called the hepatic portal system.
- B. Incorrect → There are ten pairs of cranial nerves arising from the brain of a frog.
- C. Correct → In female frogs, the ureters and oviduct open separately in the cloaca.
- D. Incorrect → In frogs, the midbrain consists of the optic lobes. The hindbrain consists of cerebellum and medulla oblongata.
- E. Correct → In frogs, a triangular structure called sinus venosus joins the right atrium.

Question 167: Match List I with List II related to embryonic development at various months of pregnancy:

List-I	List-II
A. The foetus movement starts and hair appears on the head	(I) 24 weeks of pregnancy
B. The foetus develops limbs and digits	(II) 20 weeks of pregnancy
C. The foetus develops external genital organs	(III) 8 weeks of pregnancy
D. The foetus body is covered with fine hair; eyelids separate and eyelashes are formed	(IV) 12 weeks of pregnancy

Choose the correct answer from the options given below:

- (1) A-IV, B-II, C-III, D-I
- (2) A-II, B-III, C-IV, D-I
- (3) A-III, B-II, C-IV, D-I
- (4) A-II, B-IV, C-III, D-I

Answer (2)

Solution:

- By the end of the second month of pregnancy (8 weeks), the foetus develops limbs and digits (B-III).
- By the end of 12 weeks (first trimester) of pregnancy, most of the major organ systems are formed, including the external genital organ
- During the fifth month (20 weeks) of pregnancy, the first movements of the foetus and appearance of hair on the head are observed (A
- By the end of about 24 weeks (end of second trimester) of pregnancy, the body is covered with fine hair, eye lids separate and eyelash

Question 168: In a population of a grasshopper species, the chromosome number of some members is 23 and some other members posses and 24 chromosome-bearing members in this species are

- (1) females and males, respectively
- (2) all males
- (3) males and females, respectively
- (4) all females

Answer (3)

Solution:

- In grasshoppers, sex determination is XX-XO type. Males have only one X-chromosome besides the autosomes (XO), whereas females chromosomes, besides autosomes (XX).
- Therefore, the individual with 23 chromosomes is a male grasshopper and the one with 24 chromosomes is a female grasshopper.

Question 169: In which animal do haploid cells divide mitotically to produce gametes?

- (1) Male honeybees
- (2) Male earthworms
- (3) Male frogs
- (4) Male grasshoppers

Answer (1)

Solution:

- The male honeybee is haploid and females are diploid.
- The gamete formation in female honey bees is by meiosis, whereas male honeybees form gametes by mitosis. Thus, haploid cells undergo mitosis in male honeybees.

Question 170: Arrange the following cell layers/structures around the female gamete, from outer to inner side:

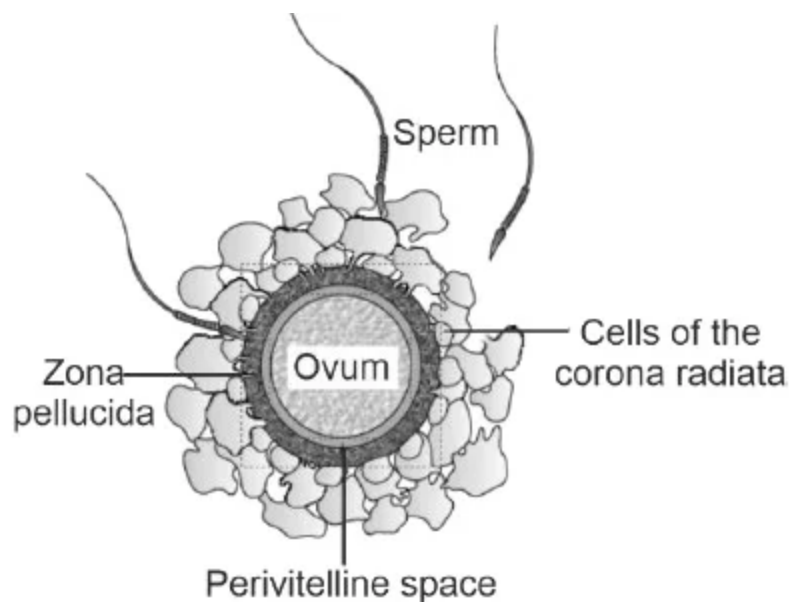
- A. Zona pellucida
- B. Perivitelline space
- C. Corona radiata
- D. Plasma membrane of ovum

Choose the correct answer from the options given below:

- (1) D, B, A, C
- (2) C, A, D, B
- (3) C, A, B, D
- (4) A, C, B, D

Answer (3)

Solution:



- The cell layers/structures around the female gamete from outer to inner side are: Corona radiata → Zona pellucida → Perivitelline space → Plasma membrane of ovum.
- So the correct answer is C, A, B, D.

Question 171: What is the reason behind production of large holes in 'Swiss Cheese'?

- (1) The production of large amount of CO_2 by *Propionibacterium sharmanii*
- (2) The production of large amount of CO_2 by *Clostridium butylicum*
- (3) The production of large amount of CO_2 and H_2 by lactic acid bacteria called *Lactobacillus*

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(4) The production of large amount of CO_2 and H_2 by *Trichoderma polysporum*

Answer (1)

Solution:

- The large holes in Swiss cheese are due to the production of a large amount of CO_2 by the bacterium *Propionibacterium sharmanii*.

Question 172: The toxin proteins isolated from *Bacillus thuringiensis*, coded by which of the following genes would control cotton bollworm:

(1) *cryIAc* and *cryIAb*

(2) *cryIAc* and *cryIIAb*

(3) *cryIIAb* and *cryIAc*

(4) *cryIAc* and *cryIIIAb*

Answer (1)

Solution:

- The proteins encoded by the genes *cryIAc* and *cryIIAb* control the cotton bollworms, and that of *cryIAb* controls corn borer.
- So, the correct answer is *cryIAc* for cotton bollworms and *cryIAb* for corn borer.

Question 173: Ecological pyramids represent the relationship between the organisms at different trophic levels and they are generally inverted

(1) Pyramid of number in grassland

(2) Pyramid of energy in pond ecosystem

(3) Pyramid of biomass in grassland

(4) Pyramid of biomass in sea

Answer (4)

Solution:

- Pyramid of biomass in the sea is generally inverted because the biomass of fishes far exceeds that of phytoplankton.
- Pyramid of number and biomass in grasslands are upright. Pyramid of energy is always upright.

Question 174: Choose the correct statement regarding GIFT to overcome infertility.

(1) Ova collected from a female donor are transferred to the uterus of an infertile female.

(2) Early embryos with up to 8 blastomeres are transferred to the uterus of an infertile female.

(3) Early embryos with up to 8 blastomeres are transferred into the fallopian tube of an infertile female.

(4) It is the transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce ovum but can provide a suitable environment for fertilization and development.

Answer (4)

Solution:

- GIFT (Gamete Intra Fallopian Transfer) facilitates the transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce ovum but can provide a suitable environment for fertilization and further development.

Question 175: Choose the correct statements regarding cell organelles and their inclusions.

A. The endomembrane system includes Golgi complex, endoplasmic reticulum and mitochondria.

B. Rough endoplasmic reticulum bears ribosomes on its surface.

C. Both mitochondria and plastids have circular DNA.

- D. A network of microtubules, microfilaments and intermediate filaments present in the cytoplasm is called cytoskeleton.
- E. Mitochondrion is a single membrane-bound structure.

Choose the correct answer from the options given below:

- (1) **A and B only**
- (2) **A, B and C only**
- (3) **C, D and E only**
- (4) **B, C and D only**

Answer (4)

Solution:

- The endomembrane system does not include mitochondria (Statement A is incorrect).
- Mitochondria is a double membrane-bound cell organelle (Statement E is incorrect).
- Statements B, C, and D are correct.

Question 176: Select the correct statements regarding cell membrane in eukaryotic cell.

- A. Membrane of human RBCs has approximately 52% protein.
- B. Major phospholipids are arranged in a bilayer.
- C. Extensions of the plasma membrane into the cell form mesosomes.
- D. Tails towards the inner part of lipids are hydrophobic and thus protected from aqueous medium.
- E. Glycocalyx is present on the outer surface of the plasma membrane.

Choose the correct answer from the options given below:

- (1) **C, D and E only**
- (2) **B, C and E only**
- (3) **A, B and D only**
- (4) **A, C and E only**

Answer (3)

Solution:

- In prokaryotes, extensions of the plasma membrane into the cell form mesosomes. Eukaryotes lack such a structure (Statement C is incorrect).
- Glycocalyx is present on the outer surface of the plasma membrane in prokaryotes. Eukaryotes do not have a glycocalyx (Statement E is incorrect).
- Statements A, B, and D are correct.

Question 177: Match List I with List II related to muscular/skeletal system:

List I	List II
A. Tetany	(I) Inflammation of joints
B. Arthritis	(II) Autoimmune disorder affecting neuromuscular junction
C. Myasthenia gravis	(III) Wild contraction in muscle due to low Ca^{++} in blood
D. Muscular dystrophy	(IV) Progressive degeneration of skeletal muscle

Choose the correct answer from the options given below:

(1) A-III, B-I, C-II, D-IV

(2) A-I, B-II, C-III, D-IV

(3) A-IV, B-III, C-II, D-I

(4) A-III, B-II, C-I, D-IV

Answer (1)

Solution:

- Tetany is rapid spasms (wild contractions) in muscle due to low Ca^{++} in body fluids (A-III).
- Arthritis is an inflammation of joints (B-I).
- Myasthenia gravis is an autoimmune disorder affecting the neuromuscular junction leading to fatigue, weakening and paralysis of skeletal muscles (C-II).
- Muscular dystrophy is the progressive degeneration of skeletal muscle mostly due to genetic disorder (D-IV).

Question 178: Evolution of human appears parallel to the progressive development of brain and language skills. As such, the evolution of in sequence of their appearance is:

(1) Ramapithecus → Homo habilis → Homo erectus → Neanderthal → Homo sapiens

(2) Homo sapiens → Ramapithecus → Homo habilis → Neanderthal → Homo erectus

(3) Homo habilis → Homo erectus → Ramapithecus → Neanderthal → Homo sapiens

(4) Neanderthal → Ramapithecus → Homo habilis → Homo erectus → Homo sapiens

Answer (1)

Solution:

- The correct chronological order in which human evolution took place is: Ramapithecus → Australopithecines → Homo habilis → Homo erectus → Homo sapiens.

Question 179: The flightless bird with forelimbs modified as paddle-like structures suited for swimming is known as:

(1) Struthio

(2) Neophron

(3) Aptenodytes

(4) Psittacula

Answer (3)

Solution:

- Neophron is a vulture and Psittacula is a parrot. Both perform flight.
- Struthio is an ostrich and Aptenodytes is a penguin. Both are flightless birds.
- In penguins, forelimbs are modified into flippers (paddle-like structures) and are used for swimming. In ostriches, forelimbs are small and are used for running, not for swimming.

Question 180: Choose the correct statements regarding population interactions between two species.

A. In both parasitism and commensalism, only one species benefits and the other species is harmed.

B. Both species benefit in mutualism.

C. Both species benefit in commensalism.

D. In parasitism, only one species benefits and the other species is harmed.

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E. In amensalism, one species is harmed and the other is unaffected.

Choose the correct answer from the options given below:

- (1) B and E only
- (2) A and B only
- (3) B, D and E only
- (4) A and D only

Answer (3)

Solution:

- In mutualism, both species benefit (B is correct).
- In parasitism, one species is benefitted and the other is harmed (D is correct).
- In amensalism, one species is harmed and the other remains unaffected (E is correct).
- In commensalism, one species gets benefitted and the other remains unaffected (Statements A and C are incorrect).

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