

MedicNEET

NEET (UG) 2024 — Question Paper with Answers & Solutions

Held Sunday, 05 May 2024 · Duration 3 hours · Maximum Marks 720 · 200 Questions · Physics, Chemistry, Biology.

Important Instructions

1. The test is of 3 hours and contains 200 multiple-choice questions (four options, single correct answer) from Physics, Chemistry and Biology (Botany and Zoology).
2. Each question carries 4 marks; 1 mark is deducted for a wrong answer; unattempted get 0. Maximum marks 720.
3. This is the NEET (UG) 2024 paper, reproduced by MedicNEET with a verified answer key and step-by-step solutions for free practice.
4. Every answer is marked Answer (X) followed by Sol. — a full worked solution. All figures are redrawn in-house.

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PHYSICS (Q1 - Q50)

1. At any instant of time t , the displacement of any particle is given by $2t - 1$ (SI unit) under the influence of force of 5N. The value of instantaneous power is (in SI unit):

- (1) 5
- (2) 7
- (3) 6
- (4) 10

Answer (4)

Sol. Correct Answer (D): 10

Solution:

$$v = dx/dt = 2 \text{ m/s}; P = Fv = 5(2) = 10 \text{ W.}$$

2. If the monochromatic source in Young's double slit experiment is replaced by white light, then

- (1) There will be a central dark fringe surrounded by a few coloured fringes
- (2) There will be a central bright fringe surrounded by a few coloured fringes.
- (3) All bright fringes will be of equal width
- (4) Interference pattern will disappear.

Answer (2)

Sol. Answer: (B) There will be a central bright fringe surrounded by a few coloured fringes.

Solution: At the centre the path difference is zero for all wavelengths, giving a white central maximum. On either side, different colours have different fringe widths ($\beta \propto \lambda$), so a few coloured fringes appear before the pattern washes out.

3. A radioactive nucleus ${}_{82}^{290}\text{X}$ undergoes the following series of successive emissions: ${}_{82}^{290}\text{X} \rightarrow (\alpha) \text{Y} \rightarrow (e^+) \text{Z} \rightarrow (e^-) \text{P} \rightarrow (e^-) \text{Q}$ — i.e. it emits one α -particle, then one positron (e^+), then two β^- particles (e^-) in turn. The mass number and atomic number of the final product Q respectively are:

- (1) 286, 80
- (2) 288, 82
- (3) 286, 81
- (4) 280, 81

Answer (3)

Sol. Track the mass number A and atomic number Z through each emission. Start: $A = 290, Z = 82$. (1) α -emission (${}^4_2\text{He}$): A decreases by 4 and Z by 2 $\rightarrow A = 286, Z = 80$. (2) Positron (β^+) emission: a proton becomes a neutron, so Z decreases by 1 and A is unchanged $\rightarrow A = 286, Z = 79$. (3) β^- emission: a neutron becomes a proton, so Z increases by 1, A unchanged $\rightarrow A = 286, Z = 80$. (4) A second β^- emission: Z increases by 1 again $\rightarrow A = 286, Z = 81$. So the final product Q has mass number 286 and atomic number 81. (Net check: $A = 290 - 4 = 286; Z = 82 - 2 - 1 + 1 + 1 = 81$.)

4. Match List - I with List - II. List - I (Material) List - II (Susceptibility) (χ) A. Diamagnetic B. Ferromagnetic I. $\chi = 0$ II. $0 > \chi \geq -1$ C. Paramagnetic III. $\chi \gg 1$ D. Non-magnetic IV. $0 < \chi < \epsilon$ (a small positive number) Choose the correct answer from the options given below

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

Answer (4)

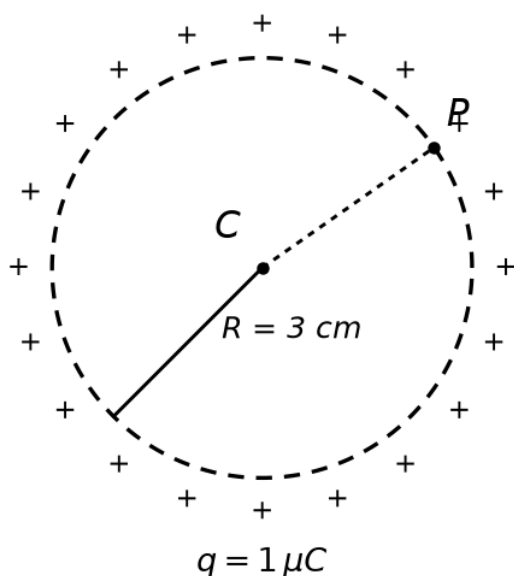
Sol. Diamagnetic: small negative, $0 > \chi \geq -1$ (II). Ferromagnetic: very large positive, $\chi \gg 1$ (III). Paramagnetic: small positive, $0 < \chi < \epsilon$ (IV). Non-magnetic: $\chi = 0$ (I). So A-II, B-III, C-IV, D-I → option (D).

5. In the following circuit, the equivalent capacitance between terminal A and terminal B is:
- (1) $1\mu F$
 - (2) $0.5\mu F$
 - (3) $4\mu F$
 - (4) $2\mu F$

Answer (4)

Sol. Balanced Wheatstone bridge: bridge capacitor carries no charge and is removed. Each arm branch = two $2\mu F$ in series = $1\mu F$; the two branches in parallel = $1 + 1 = 2\mu F$. → option (d).

6. A thin spherical shell is charged by some source. The potential difference between the two points C and P (in V) shown in the figure is (Take $1/(4\pi\epsilon_0) = 9 \times 10^9$ SI units).



- (1) 1×10^5
- (2) 0.5×10^5
- (3) Zero
- (4) 3×10^5

Answer (3)

Sol. All charge sits on the shell surface; field inside = 0, so potential is uniform throughout the interior. Both C and P are inside → $\Delta V = 0$. → option (c).

7. The output (Y) of the given logic gate is similar to the output of an/a:
- (1) NOR gate
 - (2) OR gate
 - (3) AND gate
 - (4) NAND gate

Answer (3)

Sol. Each input is inverted then fed to a NOR: $Y = (\bar{A} + \bar{B})' = A \cdot B$ (De Morgan). Hence the output is that of an AND gate.

8. An unpolarized light beam strikes a glass surface at Brewster's angle. Then
- (1) The refracted light will be completely polarised
 - (2) Both the reflected and refracted light will be completely polarised
 - (3) The reflected light will be completely polarized but the refracted light will be partially polarized
 - (4) The reflected light will be partially polarized.

Answer (3)

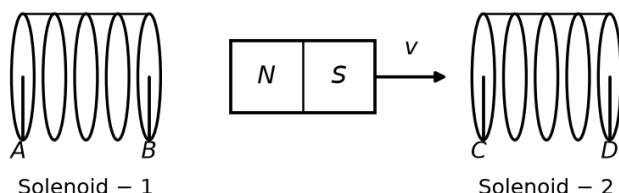
Sol. Answer: (C) The reflected light will be completely polarized but the refracted light will be partially polarized. Solution: At Brewster's angle the reflected beam is completely (plane) polarised, while the refracted beam still contains both components and is only partially polarised.

9. A tightly wound 100 turns coil of radius 10 cm carries a current of 7 A. The magnitude of the magnetic field at the centre of the coil is (Take permeability of free space as $4\pi \times 10^{-7}$ SI units):
- (1) 4.4 T
 - (2) 4.4 mT
 - (3) 44 T
 - (4) 44 mT

Answer (2)

Sol. Field at centre of an N-turn circular coil: $B = \mu_0 N I / (2a)$.
 $N = 100, I = 7 \text{ A}, a = 0.10 \text{ m}$.
 $B = (4\pi \times 10^{-7} \times 100 \times 7) / (2 \times 0.10)$
 $B = (4\pi \times 7 \times 10^{-5}) / 0.2 = 4\pi \times 3.5 \times 10^{-4} \approx 4.4 \times 10^{-3} \text{ T} = 4.4 \text{ mT}$.

10. A strong bar magnet is moving towards solenoid-2 from solenoid-1, as shown in the diagram. The direction of the induced current in solenoid-1 and that in solenoid-2, respectively, are through the directions:



- (1) BA and CD
- (2) AB and CD
- (3) BA and DC
- (4) AB and DC

Answer (4)

Sol. Apply Lenz's law: the induced current opposes the change in flux through each solenoid. The magnet (N pole facing right) moves away from solenoid-1, so its flux decreases; solenoid-1 induces current to oppose the decrease, giving the direction AB. The magnet approaches solenoid-2, so its flux increases; solenoid-2 opposes the increase by presenting a like (N) pole to the incoming N, giving the direction DC. Hence AB and DC → answer D.

11. Two bodies A and B of same mass undergo completely inelastic onedimensional collision. The body A moves with velocity v_1 while body B is at rest before collision. The velocity of the system after collision is v_2 . The ratio $v_1 : v_2$ is:
- (1) 2 : 1
 - (2) 4 : 1

- (3) 1 : 4
 (4) 1 : 2

Answer (1)

Sol. Correct Answer (A)

Solution: Momentum: $m v_1 = 2m v_2 \Rightarrow v_2 = v_1/2 \Rightarrow v_1 : v_2 = 2 : 1$.

12. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R. Assertion A: The potential (V) at any axial point, at 2m distance (r) from the centre of the p dipole of dipole moment vector P of magnitude, $4 \times 10^{-6} \text{ Cm}$, is $\pm 9 \times 10^3 \text{ V}$ (Take $\epsilon_0 = 9 \times 10^9 \text{ SI units}$) $4\pi \epsilon_0 r^2 P$ Reason R: $V = \pm \frac{1}{4\pi \epsilon_0} \frac{P}{r^2}$, where r is the distance of any axial point, situated at 2m from the $4\pi \epsilon_0 r^2$ centre of the dipole. In the light of the above statements, choose the correct answer from the options given below:

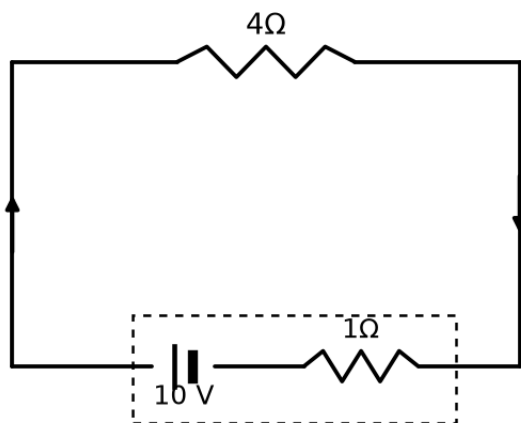
- (1) Both A and R are true and R is NOT the correct explanation of A.
 (2) A is true but R is false
 (3) A is false but R is true
 (4) Both A and R are true and R is the correct explanation of A.

Answer (2)

Sol. Reason R is true: growing ovarian follicles secrete estrogen in females, and the interstitial (Leydig) cells secrete androgens in males. Assertion A is false because FSH acts on the ovarian follicles in females but in males FSH acts on the Sertoli cells, NOT the Leydig cells; it is LH that acts on the Leydig cells. Hence A is false while R is true.

NCERT Reference: Ch 2, p.31, line 47 — "LH acts at the Leydig cells and stimulates synthesis and"

13. The terminal voltage of the battery, whose emf is 10 V and internal resistance 1Ω , when connected through an external resistance of 4Ω as shown in the figure, is:



- (1) 6 V
 (2) 8 V
 (3) 10 V
 (4) 4 V

Answer (2)

Sol. $i = 10/(4+1) = 2 \text{ A}$. $V = E - ir = 10 - 2 \times 1 = 8 \text{ V}$.

14. A particle moving with uniform speed in a circular path maintains:

- (1) Constant acceleration
 (2) Constant velocity but varying acceleration
 (3) Varying velocity and varying acceleration

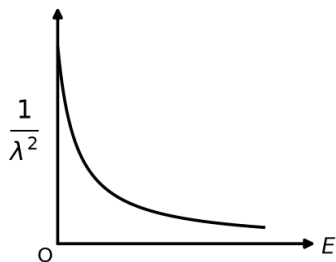
(4) Constant velocity.

Answer (3)

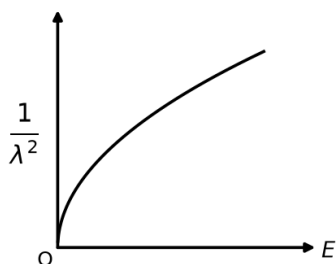
Sol. Speed is constant, but the velocity vector (direction) and the centripetal acceleration vector (direction) both vary. So velocity and acceleration are both varying.

15. The graph which shows the variation of $(1/\lambda^2)$ with its kinetic energy E is (where λ is the de Broglie wavelength of a free particle):

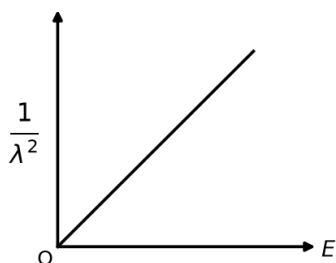
(1) $1/\lambda^2$ decreases with E (rectangular-hyperbola shape)



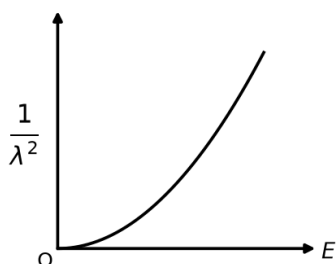
(2) $1/\lambda^2$ increases with E , concave down (\sqrt{E} shape)



(3) $1/\lambda^2$ increases linearly with E (straight line through the origin)



(4) $1/\lambda^2$ increases with E , concave up (parabola shape)

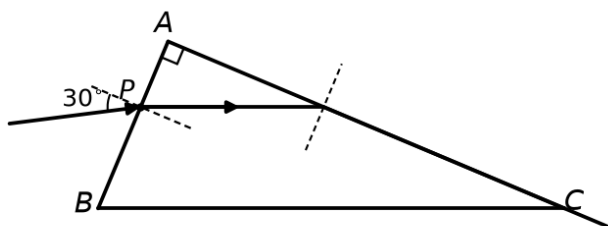


Answer (3)

Sol. $\lambda = h/p$ and $E = p^2/2m \Rightarrow p = \sqrt{2mE}$, so $(1/\lambda)^2 = p^2/h^2 = (2m/h^2) \cdot E$.

Thus $(1/\lambda)^2$ is directly proportional to E — a straight line passing through the origin.

16. A light ray enters through a right-angled prism at point P with an angle of incidence 30° as shown in the figure. It travels through the prism parallel to its base BC and emerges along the face AC. The refractive index of the prism is:



- (1) $\sqrt{5} / 2$
- (2) $\sqrt{3} / 4$
- (3) $\sqrt{3} / 2$
- (4) $\sqrt{5} / 4$

Answer (1)

Sol. At entry face: $\sin 30^\circ = \mu \sin \theta_c$ -related angle inside \Rightarrow the refracted ray inside travels parallel to base BC.

The ray then meets face AC and emerges grazing (along AC), i.e. it strikes AC at the critical angle so that the emergent ray runs along the face.

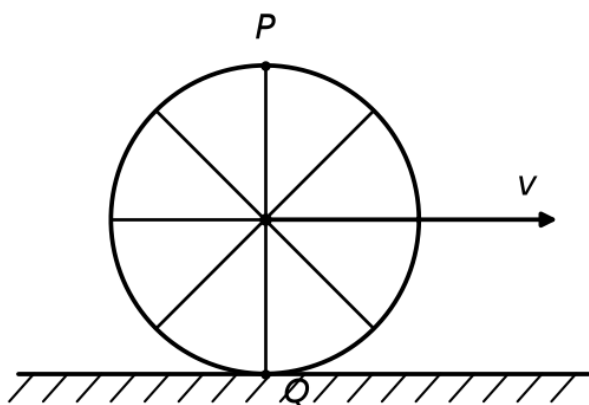
Geometry with the entry refraction and the grazing-emergence condition gives:

$$\sin 30^\circ = \mu \cos \theta_c \text{ and } \sin \theta_c = 1/\mu.$$

$$\text{So } 1/2 = \mu \cos \theta_c = \mu \cdot \sqrt{1 - 1/\mu^2} = \sqrt{\mu^2 - 1}.$$

$$\text{Squaring: } 1/4 = \mu^2 - 1 \Rightarrow \mu^2 = 5/4 \Rightarrow \mu = \sqrt{5}/2.$$

17. A wheel of a bullock cart of radius r rolls without slipping on a level road in the direction shown; the centre of the wheel moves with linear speed v . P is the topmost (highest) point of the wheel and Q is the point of the wheel in contact with the ground (the lowest point). Which one of the following is correct?



- (1) Point P moves faster than point Q
- (2) Both the points P and Q move with equal speed
- (3) Point P has zero speed
- (4) Point P moves slower than point Q

Answer (1)

Sol. For a wheel rolling without slipping, the velocity of any point = velocity of the centre (translation, v) + velocity due to rotation about the centre ($r\omega$), and the rolling condition gives $v =$

$r\omega$. Topmost point P: translation and rotation are in the same direction, so $v_P = v + r\omega = v + v = 2v$. Contact point Q (lowest point): they are opposite, so $v_Q = v - r\omega = v - v = 0$ (the contact point is instantaneously at rest). Therefore point P (speed $2v$) moves faster than point Q (speed 0).
Answer: Point P moves faster than point Q.

18. A thermodynamic system is taken through the cycle abcda. The work done by the gas along the path bc is:

- (1) 30 J
- (2) -90 J
- (3) -60 J
- (4) Zero

Answer (4)

Sol. On the P-V diagram of the cycle abcda, the path bc is a vertical segment, i.e. the volume does not change:

$$\Delta V_{(bc)} = 0.$$

The work done by a gas is $W = \int P dV$. For an isochoric (constant-volume) process,

$$W_{(bc)} = \int_{(V)}^{(V)} P dV = 0.$$

Therefore the work done along bc is zero, matching option (d).

19. In an ideal transformer, the turns ratio is (the symbols carry their usual meaning):

- (1) 2 : 1
- (2) 1 : 1
- (3) 1 : 4
- (4) 1 : 2

Answer (1)

Sol. Correct Answer (A)

Solution: Momentum: $m v_1 = 2m v_2 \Rightarrow v_2 = v_1/2 \Rightarrow v_1 : v_2 = 2 : 1$.

20. A thin flat circular disc of radius 4.5 cm is placed gently over the surface of water. If surface tension of water is 0.07 Nm^{-1} , then the excess force required to take it away from the surface is:

- (1) 198 N
- (2) 1.98 mN
- (3) 99 N
- (4) 19.8 mN

Answer (4)

Sol. The water clings along the circumference of the disc. Extra force = $T \times (\text{circumference}) =$

$$T \cdot 2\pi r$$

$$= 0.07 \times 2\pi \times 0.045 \approx 0.0198 \text{ N} = 19.8 \text{ mN}.$$

21. The maximum elongation of a steel wire of 1m length if the elastic limit of steel and its Young's modulus, respectively, are $8 \times 10^8 \text{ Nm}^{-2}$ and $2 \times 10^{11} \text{ Nm}^{-2}$, is

- (1) 0.4mm
- (2) 40 mm
- (3) 8 mm
- (4) 4 mm

Answer (4)

Sol. Correct Answer (D): 4 mm

Maximum elongation at elastic limit: $\Delta L = (\text{elastic limit} \times L)/Y = (8 \times 10^8 \times 1)/(2 \times 10^{11}) = 4 \times$

$$10^{-3} \text{ m} = 4 \text{ mm.}$$

(NEET 2024, 2024)

22. The mass of a planet is that of the earth and its diameter is half that of the 10 earth. The acceleration due to gravity on that planet is:

- (1) 9.8 ms^{-2}
- (2) 4.9 ms^{-2}
- (3) 3.92 ms^{-2}
- (4) 19.6 ms^{-2}

Answer (3)

Sol. Correct Answer (C): 3.92 m s^{-2}

Solution:

$$g' = GM'/R'^2 = G(M/10)/(R/2)^2 = (4/10) \cdot GM/R^2 = 0.4g = 0.4 \times 9.8 = 3.92 \text{ m s}^{-2}.$$

23. In a vernier calipers, (N + 1) divisions of vernier scale coincide with n divisions of main scale. If 1MSD represents 0.1mm, the vernier constant (in cm) is:

- (1) $100 (N + 1)$
- (2) $100 N$
- (3) $10 (N + 1)$
- (4) $10 N$

Answer (1)

Sol. Correct Answer (A): $1/[100(N+1)]$

$$(N+1) \text{ VSD} = N \text{ MSD} \rightarrow 1 \text{ VSD} = N/(N+1) \text{ MSD. LC} = 1 \text{ MSD} - 1 \text{ VSD} = \text{MSD}/(N+1) = 0.1 \text{ mm}/(N+1) = 0.01 \text{ cm}/(N+1) = 1/[100(N+1)] \text{ cm.}$$

24. Given below are two statements: Statement I: Atoms are electrically neutral as they contain equal number of positive and negative charges. Statement II: Atoms of each element are stable and emit their characteristic spectrum. In the light of the above statements, choose the most appropriate answer from the options given below:

- (1) Both Statement I and Statement II are incorrect.
- (2) Statement I is correct but Statement II is incorrect.
- (3) Statement I is incorrect but Statement II is correct
- (4) Both Statement I and Statement II are correct

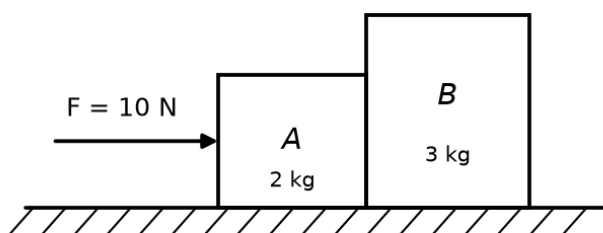
Answer (2)

Sol. NCERT states the bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced — so Statement I is correct. It also states that both bone-marrow and thymus provide micro-environments for the development and maturation of T-lymphocytes — so Statement II is correct.

Why not the others: Since both statements match the text verbatim, the options declaring either statement incorrect are wrong.

NCERT Reference: NCERT Ch7, p.138, lines 10-17: "main lymphoid organ where all"

25. A horizontal force 10 N is applied to block A as shown in the figure. The masses of blocks A and B are 2 kg and 3 kg, respectively. The blocks slide over a frictionless surface. The force exerted by block A on block B is:



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

Answer (2)

Sol. Correct Answer (B)

Solution: System acceleration $a = 10/(2+3) = 2 \text{ m/s}^2$. Contact force on B = $m_B a = 3 \times 2 = 6 \text{ N}$.

26. The quantities which have the same dimensions as those of solid angle are:

- (1) Stress and angle
- (2) Strain and arc
- (3) Angular speed and stress
- (4) strain and angle

Answer (4)

Sol. Correct Answer (D): Strain and angle

Solid angle is dimensionless; strain and plane angle are also dimensionless.

27. The moment of inertia of an thin rod about an axis passing through its mid point and perpendicular to the rod is 2400 g cm^2 . The length of the 400g rod is nearly:

- (1) 17.5 cm
- (2) 20.7 cm
- (3) 72.0 cm
- (4) 8.5 cm

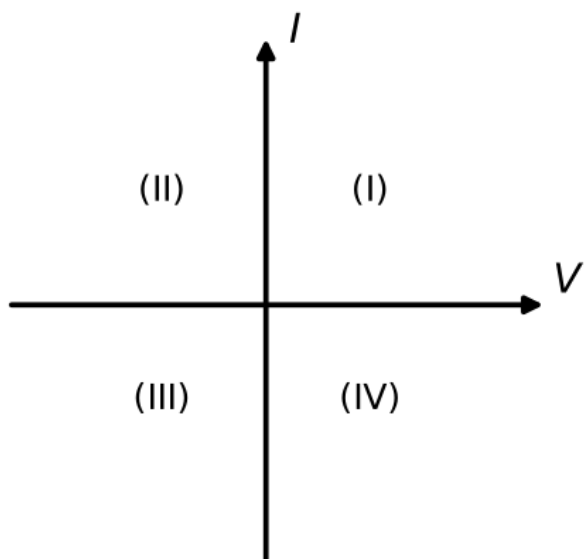
Answer (4)

Sol. Correct Answer (D): 8.5 cm

Solution:

$$I = ML^2/12 \Rightarrow L = \sqrt{(12 I/M)} = \sqrt{(12 \cdot 2400/400)} = \sqrt{72} \approx 8.49 \text{ cm} \approx 8.5 \text{ cm}.$$

28. Consider the following statements A and B and identify the correct answer: A. For a solar cell, the I-V characteristic lies in the IV quadrant of the given graph. B. In a reverse-biased pn junction diode, the current measured (in μA) is due to majority charge carriers.



- (1) A is incorrect but B is correct
- (2) Both A and B are correct
- (3) Both A and B are incorrect
- (4) A is correct but B is incorrect

Answer (4)

Sol. A solar cell's I-V characteristic lies in the fourth (IV) quadrant, so Statement A is correct. The small reverse-bias current (μA) is due to minority charge carriers, not majority, so Statement B is incorrect.

29. A wire of length 'l' and resistance 100Ω is divided into 10 equal parts. The first 5 parts are connected in series while the next 5 parts are connected in parallel. The two combinations are again connected in series. The resistance of this final combination is:

- (1) 52Ω
- (2) 55Ω
- (3) 60Ω
- (4) 26Ω

Answer (1)

Sol. Each part = 10Ω . Five in series = 50Ω ; five in parallel = $10/5 = 2\Omega$. Total = $50 + 2 = 52\Omega$.

30. If $x = 5\sin \pi t + m$ represents the motion of a particle executing simple harmonic motion, the amplitude and time period of motion, respectively, are:

- (1) 5m, 2s
- (2) 5 cm, 1s
- (3) 5m, 1s
- (4) 5cm, 2s

Answer (1)

Sol. Correct Answer (A): 5 m, 2 s

Step-by-step solution:

1. Compare with the standard form $x = A \sin(\omega t + \phi)$.
2. Amplitude $A = 5\text{ m}$.
3. Angular frequency $\omega = \pi \text{ rad/s}$, so $T = 2\pi/\omega = 2\pi/\pi = 2\text{ s}$.
4. Amplitude = 5 m, time period = 2 s.

31. If c is the velocity of light in free space, the correct statements about photon among the following are; A. The energy of a photon is $E = h\nu$ B. The velocity of a photon is c . $h\nu$ C. The momentum of a photon, $p = \frac{E}{c}$ D. In a photon-electron collision, both total energy and total momentum are conserved. E. Photon possesses positive charge. Choose the correct answer from the options given below:

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

Answer (1)

Sol. A ($E = h\nu$), B (photons travel at c), C ($p = \frac{E}{c} = \frac{h\nu}{c}$) and D (energy & momentum conserved in collisions) are all true.

E is false — photons are electrically neutral (zero charge).

So A, B, C and D only.

32. Match List I with List II: List - I (Spectral Lines of Hydrogen for transitions from) A. $n_2 = 3$ to $n_1 = 2$ B. $n_2 = 4$ to $n_1 = 2$ C. $n_2 = 5$ to $n_1 = 2$ List II (Wavelengths (nm)) I. 410.2 II. 434.1 III. 656.3 IV. 486.1 D. $n_2 = 6$ to $n_1 = 2$ Choose the correct answer from the options given below:

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

Answer (1)

Sol. All transitions end at $n_1=2$ (Balmer). Larger jumps give larger energy and shorter wavelength.

(A) $3 \rightarrow 2 = H\alpha$, longest $\lambda = 656.3$ nm (III). (B) $4 \rightarrow 2 = H\beta = 486.1$ nm (IV). (C) $5 \rightarrow 2 = H\gamma = 434.1$ nm (II). (D) $6 \rightarrow 2 = H\delta$, shortest = 410.2 nm (I). So A-III, B-IV, C-II, D-I.

33. A logic circuit provides the output Y as per the following truth table: A B Y 0 0 1 0 1 0 1 0 1 1 1 0 The expression for the output Y is:

- (1) $B + A$
- (2) B
- (3) \bar{B}
- (4) $B + \bar{A}$

Answer (2)

Sol. From the truth table, $Y = 1$ when $B = 0$ and $Y = 0$ when $B = 1$, regardless of A.

Therefore $Y = \bar{B}$.

34. In a uniform magnetic field of 0.049T, a magnetic needle performs 20 complete oscillations in 5 seconds as shown. The moment of inertia of the needle is 9.8×10^{-6} kg m². If the magnitude of the needle is $x \times 10^{-5}$ Am²; then the value of 'x' is:

- (1) $128\pi^2$
- (2) $50\pi^2$
- (3) $1280\pi^2$
- (4) $5\pi^2$

Answer (3)

Sol. Period $T = \frac{5}{20} = 0.25$ s. A dipole in a uniform field executes SHM: $T = 2\pi\sqrt{\frac{I}{mB}} \implies m = \frac{4\pi^2 I}{(B T^2)}$.

$m = \frac{4\pi^2 \times 9.8 \times 10^{-6}}{(0.049 \times 0.0625)} = \frac{4\pi^2 \times 9.8 \times 10^{-6}}{3.0625 \times 10^{-3}} = 0.0128 \pi^2 = 1280\pi^2 \times 10^{-5}$ A m².

Hence $x = 1280\pi^2$.

35. A bob is whirled in a horizontal plane by means of a string with an initial speed of ω rpm. The tension in the string is T . If speed becomes 2ω while keeping the same radius, the tension in the string becomes:

- (1) $4T$
- (2) 4
- (3) $2T$
- (4) T

Answer (1)

Sol. Correct Answer (A)

Solution: Tension provides the centripetal force: $T = m r \omega^2$. At fixed m and r , $T \propto \omega^2$. Doubling $\omega \Rightarrow T' = m r (2\omega)^2 = 4T$.

36. A metallic bar of Young's modulus, $0.5 \times 10^{11} \text{ Nm}^{-2}$ and coefficient of linear thermal expansion $10^{-5} \text{ }^\circ\text{C}^{-1}$. Length 1m and area of cross-section 10^{-3} m^2 is heated from 0°C to 100°C without expansion or bending. The compressive force developed in it is:

- (1) $50 \times 10^3 \text{ N}$
- (2) $100 \times 10^3 \text{ N}$
- (3) $2 \times 10^3 \text{ N}$
- (4) $5 \times 10^3 \text{ N}$

Answer (1)

Sol. Thermal stress on a clamped bar: $F = A \cdot Y \cdot \alpha \cdot \Delta T = 10^{-3} \times 0.5 \times 10^{11} \times 10^{-5} \times 100 = 50 \times 10^3 \text{ N}$.

37. Choose the correct circuit which can achieve the bridge balance.

- (1) [Wheatstone-bridge circuit a]
- (2) [Wheatstone-bridge circuit b]
- (3) [Wheatstone-bridge circuit c]
- (4) [Wheatstone-bridge circuit d]

Answer (4)

Sol. For balance the galvanometer must sit on one diagonal and the cell+key on the other, with the four arms (100, 10, 15, 5 Ω) on the four sides. Only option (4) has this proper diamond with G and the battery on opposite diagonals, so a null (balance) can be achieved.

38. A small telescope has an objective of focal length 140 cm and an eye piece of focal length 5.0 cm . The magnifying power of telescope for viewing a distant object is:

- (1) 28
- (2) 17
- (3) 32
- (4) 34

Answer (1)

Sol. For a telescope viewing a distant object (normal adjustment), magnifying power $M = f_o / f_e$.
 $M = 140 \text{ cm} / 5.0 \text{ cm} = 28$.

39. An iron bar of length L has magnetic moment M . It is bent at the middle of its length such that the two arms make angle 60° with each other. The magnetic moment of this new magnet is.

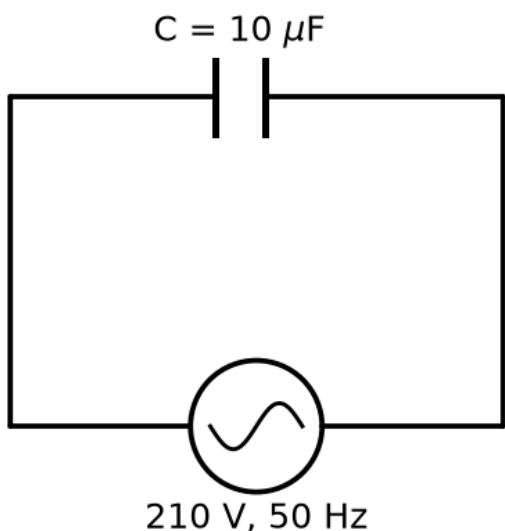
- (1) 2
- (2) $2M$

- (3) 3
- (4) M

Answer (1)

Sol. Each half has length $L/2$ and magnetic moment $M/2$ (pole strength unchanged). On bending, the two half-moment vectors are separated by 120° (the arms fold to a 60° opening). Resultant = $2 \cdot (M/2) \cdot \cos(120^\circ/2) = 2 \cdot (M/2) \cdot \cos 60^\circ = 2 \cdot (M/2) \cdot \frac{1}{2} = M/2$.

40. A $10 \mu\text{F}$ capacitor is connected to a 210 V , 50 Hz source as shown in the figure. The peak current in the circuit is nearly ($\pi = 3.14$):



- (1) 0.93 A
- (2) 1.20 A
- (3) 0.35 A
- (4) 0.58 A

Answer (1)

Sol. Capacitive reactance $X_C = 1/(\omega C) = 1/(2\pi \times 50 \times 10 \times 10^{-6}) = 1000/\pi \Omega$.
Peak current $i_0 = (\sqrt{2} \cdot V_{\text{rms}})/X_C = (\sqrt{2} \times 210)/(1000/\pi) \approx 0.93 \text{ A}$.

41. Two heaters A and B have power rating of 1kW and 2kW , respectively. Those two are first connected in series and then in parallel to a fixed power source. The ratio of power outputs for these two cases is:

- (1) 2 : 9
- (2) 1 : 2
- (3) 2 : 3
- (4) 1 : 1

Answer (1)

Sol. $R \propto 1/P$. Series $P_s = V^2/(R_1+R_2) = 2/3$ (in units of V^2). Parallel $P_p = 3$. Ratio = $(2/3)/3 = 2 : 9$.

42. If the mass of the bob in a simple pendulum is increases to thrice its original mass and its length is made half its original length, then the new time period of oscillation is x times its original time period. Then the value of x is 2

- (1) 2
- (2) 2 3
- (3) 4
- (4) 3

Answer (1)

Sol. Correct Answer (A): $\sqrt{2}$

Step-by-step solution:

1. $T = 2\pi\sqrt{L/g}$ is independent of the bob's mass, so tripling the mass has no effect.
2. With length halved, $T' = 2\pi\sqrt{(L/2)/g} = T/\sqrt{2}$.
3. Given $T' = (x/2)T$: $1/\sqrt{2} = x/2 \rightarrow x = 2/\sqrt{2} = \sqrt{2}$.
4. Value of $x = \sqrt{2}$.

43. The property which is not of an electromagnetic wave travelling in free space is that:

- (1) The energy density in electric field is equal to energy density in magnetic field
- (2) They travel with a speed equal to $\mu_0 \epsilon_0$
- (3) They originate from charges moving with uniform speed
- (4) They are transverse in nature.

Answer (3)

Sol. Answer: (C) They originate from charges moving with uniform speed. EM waves are produced only by accelerating (not uniformly moving) charges. The other three are true properties: $u_E = u_B$, speed = $1/\sqrt{\mu_0 \epsilon_0} = c$, and EM waves are transverse.

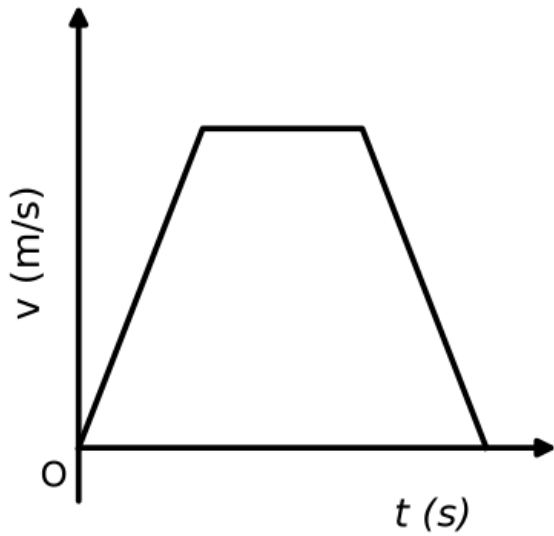
44. A sheet is placed on a horizontal surface in front of a strong magnetic pole. A force is needed to: A. hold the sheet there if it is magnetic B. hold the sheet there if it is non-magnetic. C. Move the sheet away from the pole with uniform velocity if it is conducting. D. Move the sheet away from the pole with uniform velocity if it is both, non-conducting and non-polar Choose the correct statement(s) from the options given below

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

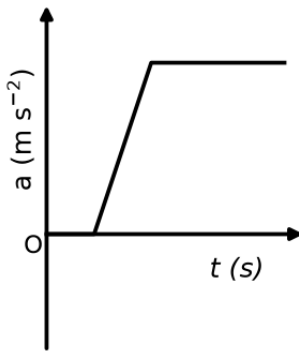
Answer (1)

Sol. A: a magnetic (ferro/para) sheet is attracted to the pole, so a force is needed to hold it (true). C: moving a CONDUCTING sheet through the non-uniform field induces eddy currents that oppose the motion (Lenz), so a force is needed to keep uniform velocity (true). B: a non-magnetic sheet feels no force, none needed (false). D: a non-conducting, non-polar sheet has no eddy currents and no magnetic response, no force needed (false). Correct: A and C only → (A).

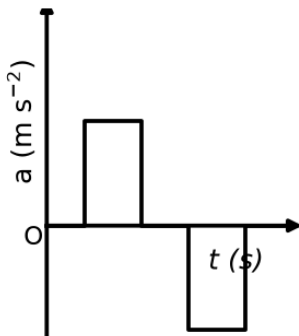
45. The velocity (v)-time (t) plot of the motion of a body is shown below. The acceleration (a)-time (t) graph that best suits this motion is:



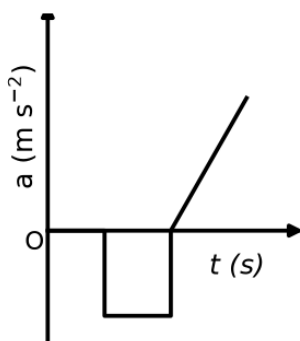
(1) a is zero, then rises linearly, then stays constant (positive)



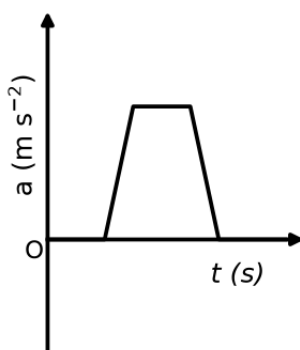
(2) a positive rectangular pulse first, then zero, then a negative rectangular pulse



(3) a is zero, then a negative rectangular pulse, then rises linearly



(4) a single trapezoidal pulse entirely above the axis



Answer (2)

Sol. $a = \text{slope of the } v\text{-}t \text{ graph}$. The $v\text{-}t$ graph rises ($a > 0$), is flat ($a = 0$), then falls ($a < 0$). The matching $a\text{-}t$ graph is a positive step, then zero, then a negative step.

46. A parallel plate capacitor is charged by connecting it to a battery through a resistor. If I is the current in the circuit, then in the gap between the plates:

- (1) Displacement current of magnitude equal to I flows in the same direction as I .
- (2) Displacement current of magnitude equal to I flows in a direction opposite to that of I .
- (3) Displacement current of magnitude greater than I flows but can be in any direction.
- (4) There is no current.

Answer (1)

Sol. Answer: (A) Displacement current of magnitude equal to I flows in the same direction as I . To maintain continuity of current, the displacement current between the plates exactly equals the conduction current I in the wires and flows in the same direction, completing the circuit.

47. A force defined by $F = \alpha t^2 + \beta t$ acts on a particle at a given time t . The factor which is dimensionless. If α and β are constants, is:

- (1) β
- (2) $\alpha\beta t \alpha\beta$
- (3) $t \beta t$
- (4) α

Answer (1)

Sol. Correct Answer (A): $\alpha/(\beta t)$

$[\alpha] = [F/t] = \text{MLT}^{-3}$, $[\beta] = [F/t^2] = \text{MLT}^{-4}$. $\alpha/(\beta t) = \text{MLT}^{-3}/(\text{MLT}^{-4} \cdot \text{T}) = \text{dimensionless}$.

48. If the plates of a parallel plate capacitor connected to a battery are moved close to each other, then A. The charge stored in it, increases. B. The energy stored in it decreases. C. Its

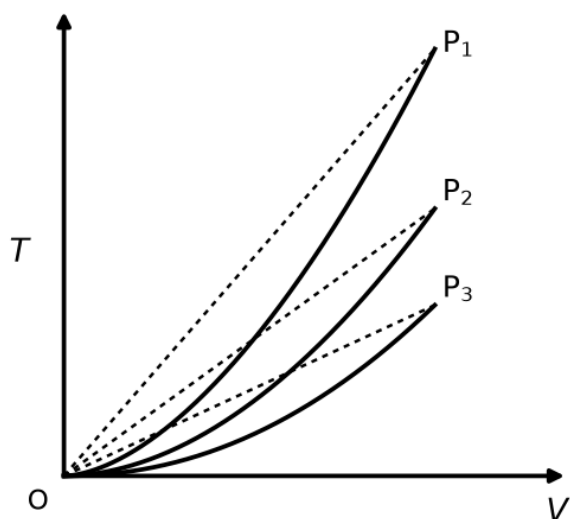
capacitance increases. D. The ratio of charge to its potential remains the same. E. The product of charge and voltage increases. Choose the most appropriate answer from the options given below:

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

Answer (1)

Sol. Battery stays connected → V constant. $d \downarrow \rightarrow C = \epsilon_0 A/d \uparrow$ (C true), $Q = CV \uparrow$ (A true), $U = \frac{1}{2} CV^2 \uparrow$ (B 'decreases' false), $QV \uparrow$ (E true), $Q/V = C$ changes (D false). Correct: A, C, E. → option (a).

49. The following graph represents the T-V curves of an ideal gas (where T is the temperature and V the volume) at three pressures P₁, P₂ and P₃, compared with those of Charles's law represented as dotted lines. Then the correct relation is:



- (1) P₁ > P₃ > P₂
- (2) P₂ > P₁ > P₃
- (3) P₁ > P₂ > P₃
- (4) P₃ > P₂ > P₁

Answer (3)

Sol. Correct Answer (C): P₁ > P₂ > P₃

Rearranging the ideal gas law $PV = nRT$ gives $T = (P/nR) V$. On a T-versus-V graph this is a straight line through the origin whose slope, P/nR , is proportional to the pressure. Therefore the steepest line corresponds to the highest pressure. Reading the graph, the line for P₁ is steepest and P₃ least steep, so P₁ > P₂ > P₃.

50. The minimum energy required to launch a satellite of mass m from the surface of earth of mass M and radius R in a circular orbit at an altitude of 2R from the surface of the earth is:

- (1) $2GmM/3R$
- (2) $GmM/2R$
- (3) $GmM/3R$
- (4) $5GmM/6R$

Answer (4)

Sol. Correct Answer (D): $5GM/6R$

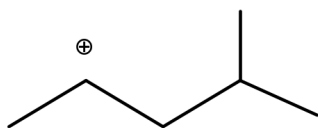
Solution:

Orbit radius $r = 3R$. $E_{\text{orbit}} = -GMm/2(3R) = -GMm/6R$. $E_{\text{surface}} = -GMm/R$. $\Delta E = -GMm/6R - (-GMm/R) = 5GMm/6R$.

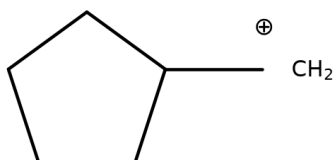
CHEMISTRY (Q51 - Q100)

51. The most stable carbocation among the following is:

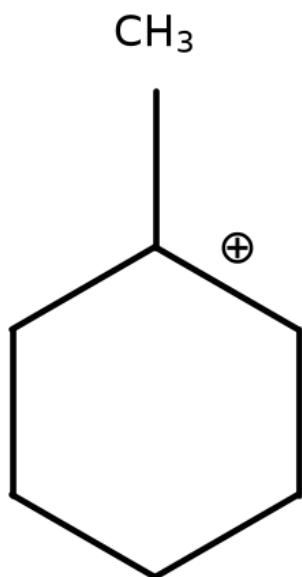
- (1) $\text{CH}_3\text{-CH}^+\text{-CH}_2\text{-CH}(\text{CH}_3)_2$ (4-methylpentan-2-yl cation, secondary)



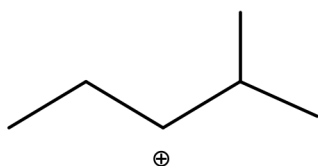
- (2) cyclopentyl- CH_2^+ (cyclopentylmethyl cation, primary)



- (3) 1-methylcyclohexyl cation (tertiary)



- (4) $\text{CH}_3\text{-CH}_2\text{-CH}^+\text{-CH}(\text{CH}_3)_2$ (2-methylpentan-3-yl cation, secondary)



Answer (3)

Sol. Carbocation stability increases with the degree of substitution and with the number of α -hydrogens available for hyperconjugation. Structure (C) is a tertiary 1-methylcyclohexyl cation: the positively charged carbon bears a methyl group and two ring CH_2 groups, giving the maximum hyperconjugation plus +I from three alkyl groups. The other three are primary or secondary cations and are far less stabilised.

52. For the reaction $2\text{A} \rightleftharpoons \text{B} + \text{C}$, $K_c = 4 \times 10^{-3}$. At a given instant the composition of the reaction mixture is $[\text{A}] = [\text{B}] = [\text{C}] = 4 \times 10^{-3}$ M. Which of the following is correct?

- (1) Reaction has a tendency to go in the forward direction.
- (2) Reaction has a tendency to go in the backward direction.
- (3) Reaction has gone to completion in the forward direction.

(4) Reaction is at equilibrium.

Answer (2)

Sol. Compute the reaction quotient Q_c and compare it with K_c . For $2A \rightleftharpoons B + C$, $Q_c = \frac{[B][C]}{[A]^2} = \frac{(4 \times 10^{-3})(4 \times 10^{-3})}{(4 \times 10^{-3})^2} = 1$. The given $K_c = 4 \times 10^{-3}$. Since $Q_c (= 1) > K_c (= 4 \times 10^{-3})$, there is 'too much product' relative to equilibrium, so the reaction proceeds in the reverse (backward) direction to reduce products and reach equilibrium. Answer: the reaction has a tendency to go in the backward direction.

53. 'Spin only' magnetic moment is same for which of the following ions? A. Ti^{3+} , B. Cr^{2+} C. Mn^{2+} , D. Fe^{2+} E. Sc^{3+} Chose the most appropriate answer from the options given below:

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

Answer (4)

Sol. The spin-only moment is $\mu = \sqrt{n(n+2)}$ BM, where n is the number of unpaired electrons. Ions with the same n have the same moment.

Ti^{3+} is $3d^1$ ($n=1$); Cr^{2+} is $3d^4$ ($n=4$); Mn^{2+} is $3d^5$ ($n=5$); Fe^{2+} is $3d^6$ ($n=4$); Sc^{3+} is $3d^0$ ($n=0$).

Only Cr^{2+} (B) and Fe^{2+} (D) have the same number of unpaired electrons ($n=4$), so they have the same spin-only magnetic moment.

54. The energy of an electron in the ground state ($n = 1$) for He^+ ion is $-x$ J, then that for an electron in $n = 2$ state for Be^{3+} ion in J is

- (1) $-x/9$
- (2) $-4x/9$
- (3) $-x$
- (4) $-x$

Answer (4)

Sol. $E_n \propto -(Z^2)/(n^2)$. For He^+ ($Z=2, n=1$): $(Z^2)/(n^2) = 4/1 = 4 \Rightarrow E = -x$ J. For Be^{3+} ($Z=4, n=2$): $(Z^2)/(n^2) = 16/4 = 4$, the same value, so $E = -x$ J.

55. Which reaction is NOT a redox reaction ?

- (1) $2KClO_3 + I_2 \rightarrow 2KIO_3 + Cl_2$
- (2) $H_2 + Cl_2 \rightarrow 2HCl$
- (3) $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$
- (4) $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

Answer (3)

Sol. In $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$ there is no change in the oxidation state of any element. It is a double-displacement (precipitation) reaction, hence not a redox reaction.

The others all involve oxidation-state changes: in (a) Cl goes $+5 \rightarrow 0$ and I goes $0 \rightarrow +5$; in (b) H goes $0 \rightarrow +1$ and Cl goes $0 \rightarrow -1$; in (d) Zn goes $0 \rightarrow +2$ and Cu goes $+2 \rightarrow 0$.

56. Match List-I with List-II List-I(Molecule) List-II(Number and types of bond/s between two carbon atoms) A. ethane I. one σ -bond and two π -bonds B. ethene II. two π -bonds C. carbon molecule, C_2 III. one σ -bonds D. ethyne IV. one σ -bond and one π -bonds Choose the correct answer from the options given below:

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

Answer (2)

Sol. Ethane (C-C) = 1σ (III); ethene (C=C) = $1\sigma + 1\pi$ (IV); C_2 by MOT has bond order 2 made of two π -bonds and no σ (II); ethyne (C#C) = $1\sigma + 2\pi$ (I). So A-III, B-IV, C-II, D-I.

57. Match List I with List II List I (Complex) List II (types of isomerism) A.

[Co(NH₃)₅(NO₂)]Cl₂ I. Solvate isomerism B. [Co(NH₃)₅(SO₄)]Br II. Linkage isomerism C.

[Co(NH₃)₆Cr(CN)₆] III. Ionization isomerism D. [Co(H₂O)₆]Cl₃ IV. Coordination isomerism

Choose the correct answer from the options given below

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

Answer (4)

Sol. (a) [Co(NH₃)₅(NO₂)]Cl₂: the NO₂ group is ambidentate (can bind through N as nitro -NO₂ or through O as nitrito -ONO) ⇒ linkage isomerism (ii).

(b) [Co(NH₃)₅(SO₄)]Br: the SO₄ inside and Br⁻ outside the sphere can interchange ⇒ ionization isomerism (iii).

(c) [Co(NH₃)₆][Cr(CN)₆]: both cation and anion are complex ions, so ligands can be distributed differently between the two metal centres ⇒ coordination isomerism (iv).

(d) [Co(H₂O)₆]Cl₃: water can move between the coordination sphere and the lattice ⇒ solvate (hydrate) isomerism (i).

Thus (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i), option (D).

58. The E_o value for the Mn³⁺/Mn²⁺ couple is more positive than that of Cr³⁺/Cr²⁺ or Fe³⁺/Fe²⁺ due to change of

- (1) d⁵ to d² configuration
- (2) d⁴ to d⁵ configuration
- (3) d³ to d⁵ configuration
- (4) d⁵ to d⁴ configuration

Answer (2)

Sol. The Mn³⁺/Mn²⁺ reduction is Mn³⁺ + e⁻ → Mn²⁺, which converts 3d⁴ (Mn³⁺) into 3d⁵ (Mn²⁺). The product Mn²⁺ has the exceptionally stable half-filled 3d⁵ configuration, so this reduction is strongly favoured.

This extra stability of Mn²⁺ makes Mn³⁺ easy to reduce, giving a highly positive E[°] for the Mn³⁺/Mn²⁺ couple compared with the Cr³⁺/Cr²⁺ and Fe³⁺/Fe²⁺ couples.

59. The highest number of helium atoms is in

- (1) 4 u of helium
- (2) 4 g of helium
- (3) 2.271098 L of helium at STP
- (4) 4 mol of helium

Answer (4)

Sol. A. 4 u = 1 atom (He atomic mass = 4 u).

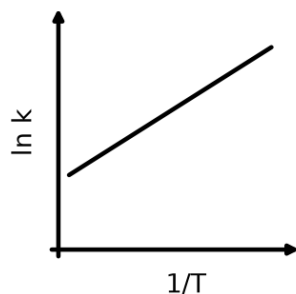
B. 4/4 = 1 mol = N_A atoms.

C. 2.271098/22.71098 = 0.1 mol = 0.1 N_A atoms (molar volume at STP = 22.71 L).

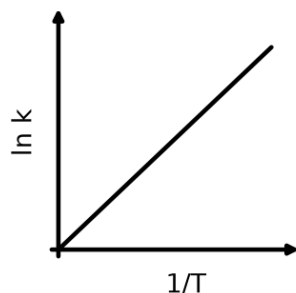
D. 4 mol = 4 N_A atoms (largest).

60. Which plot of $\ln k$ vs $1/T$ is consistent with the Arrhenius equation?

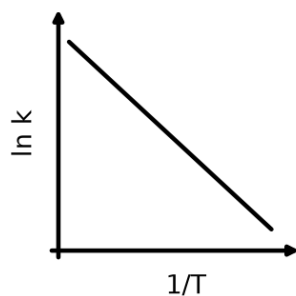
(1) straight line, positive slope, positive y-intercept



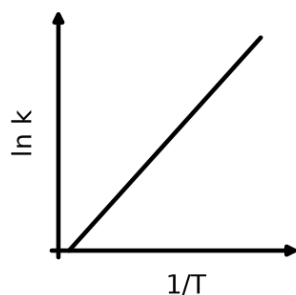
(2) straight line, positive slope, passing through the origin



(3) straight line with negative slope ($\ln k$ decreases as $1/T$ increases)



(4) straight line, positive slope, passing through the origin



Answer (3)

Sol. The Arrhenius equation is $k = A e^{(-E_a/RT)}$.

Taking the natural log: $\ln k = \ln A - E_a/R \cdot 1/T$.

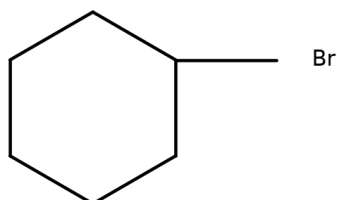
This is a straight line in $\ln k$ vs $1/T$ with intercept $\ln A$ and slope $-E_a/R$.

Since E_a and R are positive, the slope is negative, so the line falls as $1/T$ increases.

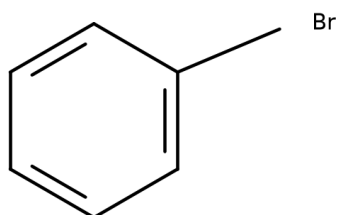
The plot showing a straight line of negative slope is consistent with the Arrhenius equation.

61. The compound that will undergo an S_N1 reaction with the fastest rate is:

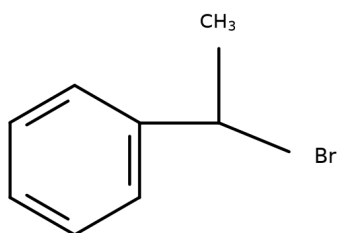
(1) bromocyclohexane (secondary alkyl halide)



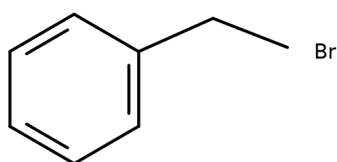
(2) bromobenzene (aryl halide)



(3) 1-bromo-1-phenylethane / (1-bromoethyl)benzene (secondary benzylic)



(4) benzyl bromide (primary benzylic)



Answer (3)

Sol. S_N1 rate is governed by the stability of the carbocation formed. $C_6H_5-CHBr-CH_3$ ionises to a benzylic (secondary) carbocation that is resonance-stabilised by the aromatic ring, making it the fastest. Bromobenzene (aryl halide) cannot form a phenyl cation, cyclohexyl bromide gives an unstabilised secondary cation, and cyclohexylmethyl bromide is a primary halide giving an unstable primary cation.

62. Match List-I with List-II List-I(Quantum Number) List-II(Information provided) A. ml I. shape of orbital B. ms II. size of orbital C. l III. orientation of orbital D. n IV. orientation of spin of electrons Choose the correct answer from the options given below

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

Answer (1)

Sol. Exophthalmic goitre (A) is a form of hyperthyroidism with enlargement of the thyroid and protrusion of the eyeballs, so A-III (hyper secretion of thyroid hormone & protruding eye balls). Acromegaly (B) results from excess growth hormone, so B-IV. Cushing's syndrome (C) is caused by excess cortisol with moon face and hyperglycemia, so C-I. Cretinism (D) is due to hypothyroidism causing stunted growth, so D-II.

NCERT Reference: Chapter 19, Page 243, Line(s) 10-12 — "Exophthalmic goitre is a form of hyperthyroidism, characterised by enlargement of the thyroid gland, protrusion of the eyeballs, increased basal metabolic rate, and weight loss, also called Graves' disease."

63. The Henry's law constant (K_H) values of three gases (A, B, C) in water are $145 \text{ m}^2 \times 10^{-5}$ and 35 kbar, respectively. The solubility of these gases in water follow the order:

- (1) $B > C > A$
- (2) $A > C > B$
- (3) $A > B > C$
- (4) $B > A > C$

Answer (1)

Sol. Henry's law states $p = K_H x$, where x is the mole fraction (solubility) of the gas. At a fixed partial pressure, solubility is inversely proportional to K_H : $x = p/K_H$.

Thus a smaller K_H means greater solubility. Ordering the K_H values: $A (145) > C (35) > B (2 \times 10^{-5})$.

The solubility order is the inverse: $B > C > A$.

64. In which of the following processes entropy increases? A. A liquid evaporates to vapour. B. Temperature of a crystalline solid lowered from 130 K to 0 K C. $2 \text{ NaHCO}_3(\text{s}) \rightarrow \text{Na}_2\text{CO}_3(\text{s}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$ D. $\text{Cl}_2(\text{g}) \rightarrow 2\text{Cl}(\text{g})$ Choose the correct answer from the options given below:

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

Answer (2)

Sol. Entropy increases when randomness or the number of gaseous moles increases.

A: liquid \rightarrow vapour increases disorder, $\Delta S > 0$.

B: cooling a crystal toward 0 K orders the lattice, $\Delta S < 0$.

C: $2\text{NaHCO}_3(\text{s}) \rightarrow \text{Na}_2\text{CO}_3(\text{s}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$ produces 2 mol of gas from a solid, $\Delta S > 0$.

D: $\text{Cl}_2(\text{g}) \rightarrow 2\text{Cl}(\text{g})$ increases the number of gaseous particles, $\Delta S > 0$.

Thus entropy increases for A, C and D.

Mapped: source lowercase answer 'b' \rightarrow option B.

65. Given below are two statements: Statement I: Aniline does not undergo Friedel-Crafts alkylation reaction. Statement II: Aniline cannot be prepared through Gabriel synthesis In the light of the above statement, choose the correct answer from the options given below:

- (1) Both statement I and statement II are false
- (2) Statement I is correct but statement II is false
- (3) Statement I is incorrect but statement II is true
- (4) Both statement I and statement II are true

Answer (4)

Sol. Statement I (TRUE): In Friedel-Crafts alkylation the Lewis acid catalyst (e.g. AlCl_3) reacts with the basic nitrogen lone pair of aniline $\text{C}_6\text{H}_5\text{NH}_2$ to form a salt ($\text{C}_6\text{H}_5\text{N}+\text{H}_2.\text{AlCl}_3$ - type complex). The resulting positively charged nitrogen strongly deactivates the ring (acts as a meta-directing -I group) and the catalyst is consumed, so aniline does not undergo Friedel-Crafts alkylation. Statement II (TRUE): Gabriel phthalimide synthesis proceeds by an $\text{S}_{\text{N}}2$ attack of potassium phthalimide on an alkyl halide. Aryl halides do not undergo nucleophilic substitution under these conditions, so aromatic primary amines like aniline cannot be prepared by Gabriel synthesis. Both statements are correct, so the answer is (D).

66. Fehling's solution 'A' is

- (1) alkaline copper sulphate
- (2) alkaline solution of sodium potassium tartrate (Rochell's salt)
- (3) aqueous sodium citrate
- (4) aqueous copper sulphate

Answer (4)

Sol. Fehling's reagent is prepared just before use by mixing two solutions: solution 'A' is aqueous copper(II) sulphate CuSO_4 , and solution 'B' is an alkaline solution of sodium potassium tartrate (Rochelle's salt). On mixing, a deep-blue cupric tartrate complex forms. Reducing sugars such as glucose reduce Cu^{2+} to red cuprous oxide Cu_2O . Hence option D is correct.

67. Activation energy of any chemical reaction can be calculated if one knows the value of

- (1) Probability of collision.
- (2) Orientation of reactant molecules during collision.
- (3) rate constant at two different temperatures.
- (4) rate constant at standard temperature.

Answer (3)

Sol. From the Arrhenius equation $k = A e^{(-E_a/RT)}$, comparing the rate constant at two different temperatures T_1 and T_2 gives the two-temperature form:

$$\log k_2/k_1 = E_a/(2.303 R)((T_2 - T_1)/(T_1 T_2))$$

Knowing the rate constants k_1 and k_2 at two different temperatures T_1 and T_2 allows the activation energy E_a to be calculated.

68. Arrange the following elements in increasing order of first ionization enthalpy: Li, Be, B, C, N Choose the answer from the options given below:

- (1) $\text{Li} < \text{B} < \text{Be} < \text{C} < \text{N}$
- (2) $\text{Li} < \text{Be} < \text{C} < \text{B} < \text{N}$
- (3) $\text{Li} < \text{Be} < \text{N} < \text{B} < \text{C}$
- (4) $\text{Li} < \text{Be} < \text{B} < \text{C} < \text{N}$

Answer (1)

Sol. First ionization enthalpy generally increases from left to right across period 2 as Z_{eff} increases, but there is an anomaly at boron. Be has a fully filled, stable $2s^2$ configuration, so it is harder to ionize than B, whose single $2p^1$ electron is removed more easily. Thus $\text{B} < \text{Be}$.

The correct increasing order is $\text{Li} < \text{B} < \text{Be} < \text{C} < \text{N}$.

69. 1 gram of sodium hydroxides was treated with 25ml of 0.75M HCl solution, the mass of sodium hydroxide left unreacted is equal to

- (1) 250 mg
- (2) Zero mg
- (3) 200 mg
- (4) 750 mg

Answer (1)

Sol. $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$

Moles HCl = $0.025 \times 0.75 = 0.01875$ mol; moles NaOH = $1/40 = 0.025$ mol.

HCl is the limiting reagent; it consumes 0.01875 mol NaOH = $0.01875 \times 40 = 0.75$ g.

NaOH left = $1 - 0.75 = 0.25$ g = 250 mg.

70. A compound with a molecular formula of C_6H_{14} has two tertiary carbons. Its IUPAC name is:

- (1) 2-methylpentane
- (2) 2,3-dimethylbutane
- (3) 2,2-dimethylbutane
- (4) n-hexane

Answer (2)

Sol. A tertiary carbon is bonded to three other carbons. In 2,3-dimethylbutane, $(\text{CH}_3)_2\text{CH}-\text{CH}(\text{CH}_3)_2$, each of the two central carbons (C-2 and C-3) is bonded to three carbons, giving exactly two tertiary carbons. 2-Methylpentane has only one tertiary carbon, 2,2-dimethylbutane has a quaternary carbon (and no two tertiary carbons), and n-hexane has none.

71. Given below are two statements: Statement I: The boiling point of three isomeric pentanes follows the order n-pentane > isopentane > neopentane Statement II: When branching increases, the molecule attains a shape of sphere. This results in smaller surface area for contact, due to which the intermolecular forces between the spherical molecules are weak, thereby lowering the boiling point. In the light of the above statements, choose the most appropriate answer from the options given below:

- (1) Both statement I and statement II are incorrect
- (2) Statement I is correct but statement II is incorrect
- (3) Statement I is incorrect but statement II is correct
- (4) Both statement I and statement II are correct

Answer (4)

Sol. NCERT states the bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced — so Statement I is correct. It also states that both bone-marrow and thymus provide micro-environments for the development and maturation of T-lymphocytes — so Statement II is correct.

Why not the others: Since both statements match the text verbatim, the options declaring either statement incorrect are wrong.

NCERT Reference: NCERT Ch7, p.138, lines 10-17: "main lymphoid organ where all"

72. In which of the following gaseous equilibria are K_p and K_c NOT equal?

- (1) $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$
- (2) $\text{CO}(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{CO}_2(\text{g}) + \text{H}_2(\text{g})$
- (3) $2\text{BrCl}(\text{g}) \rightleftharpoons \text{Br}_2(\text{g}) + \text{Cl}_2(\text{g})$
- (4) $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$

Answer (4)

Sol. K_p and K_c are related by $K_p = K_c \cdot (RT)^{\Delta n_g}$, where $\Delta n_g = (\text{moles of gaseous products}) - (\text{moles of gaseous reactants})$. $K_p = K_c$ only when $\Delta n_g = 0$. Check each: (a) $2 - (1+1) = 0$; (b) $2 - 2 = 0$; (c) $2 - 2 = 0$; (d) $\text{PCl}_5 \rightleftharpoons \text{PCl}_3 + \text{Cl}_2$ gives $(1+1) - 1 = +1 \neq 0$. Only reaction (d) has $\Delta n_g \neq 0$, so for it $K_p = K_c \cdot (RT)$ and hence $K_p \neq K_c$. Answer: $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$. (Note: option (b) is the

water-gas shift reaction; the 'CO₂ on both sides' in the raw text is an OCR error — it should read CO on the reactant side, which still gives $\Delta_{ng} = 0$.)

73. The reagents with which glucose does not react to give the corresponding test /products are A. Tollen's reagent B. Schiff's reagent C. HCN D. NH₂OH E. NaHSO₃ Choose the correct options from the given below:

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

Answer (2)

Sol. In solution, glucose exists predominantly in the cyclic hemiacetal (pyranose) form, so a truly free -CHO group is largely unavailable. The Schiff's test and NaHSO₃ addition both require a free aldehyde, hence both are negative for glucose. By contrast, Tollen's reagent (oxidation to Ag mirror), HCN (cyanohydrin) and NH₂OH (oxime formation) react via the small equilibrium amount of open-chain form. Therefore the non-reacting reagents are B and E, giving option B.

74. Match List-I with List-II List-I (Compound) List-II (Shape/geometry) A. NH₃ I. Trigonal Pyramidal B. BrF₅ II. Square Planar C. XeF₄ III. Octahedral D. SF₆ IV. Square Pyramidal Choose the correct answer from the options given below:

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

Answer (4)

Sol. By VSEPR: NH₃ (AB₃E) = trigonal pyramidal (I); BrF₅ (AB₅E) = square pyramidal (IV); XeF₄ (AB₄E₂) = square planar (II); SF₆ (AB₆) = octahedral (III). So A-I, B-IV, C-II, D-III.

75. Among Group 16 elements, which one does NOT show -2 oxidation state?

- (1) Se
- (2) Te
- (3) Po
- (4) O

Answer (3)

Sol. Electropositive (metallic) character increases down a group. Po, being the most electropositive and metallic Group-16 element, does not show the -2 oxidation state, whereas the lighter, more electronegative members (O, Se, Te) readily form the -2 state.

76. Match List I with List II List-I (Reaction) A. List-II(Reagents Condition) I. II. CrO₃ B. Anhyd. AlCl₃ III. KMnO₄/KOH, Δ C. IV. (i) O₃, (ii) Zn-H₂O D. Choose the correct answer from the options given below:

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

Answer (2)

Sol. (b)-(i): benzene undergoes Friedel-Crafts acylation with C₆H₅COCl/anhyd. AlCl₃ to give benzophenone. (d)-(iii): the side chain of ethylbenzene is oxidised by KMnO₄/KOH, Δ to benzoic acid. (c)-(ii): phenol is oxidised by CrO₃ to a carbonyl (quinone-type) product, and (a)-(iv): an alkene is cleaved by ozonolysis [(1) O₃, (2) Zn-H₂O] to carbonyl compounds. This gives option (B).

77. Arrange the following elements in increasing order of electronegativity: N, O, F, C, Si
Choose the correct answer from the options given below:

- (1) $\text{Si} < \text{C} < \text{O} < \text{N} < \text{F}$
- (2) $\text{O} < \text{F} < \text{N} < \text{C} < \text{Si}$
- (3) $\text{F} < \text{O} < \text{N} < \text{C} < \text{Si}$
- (4) $\text{Si} < \text{C} < \text{N} < \text{O} < \text{F}$

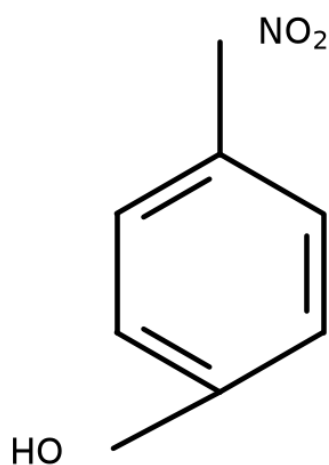
Answer (4)

Sol. Electronegativity increases with Z_{eff} and decreases with atomic size. Si lies in period 3 and is the least electronegative here. Across period 2, electronegativity rises in the order $\text{C} < \text{N} < \text{O} < \text{F}$.

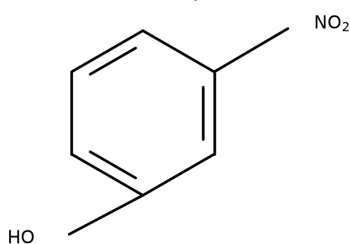
The overall increasing order is $\text{Si} < \text{C} < \text{N} < \text{O} < \text{F}$.

78. Intramolecular hydrogen bonding is present in:

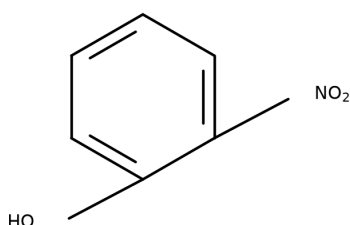
- (1) p-nitrophenol (4-nitrophenol)



- (2) m-nitrophenol (3-nitrophenol)



- (3) HF
- (4) o-nitrophenol (2-nitrophenol)



Answer (4)

Sol. Only the ortho isomer (D, o-nitrophenol) can form a 6-membered intramolecular H-bonded chelate ring between the -OH and the adjacent -NO₂. The para (A) and meta (B) isomers form intermolecular H-bonds; HF forms only intermolecular H-bonds.

79. Identify the correct reagents that would bring about the following transformation

- (1) (i) BH₃, (ii) H₂O₂/OH⁻, (iii) PCC
- (2) (i) BH₃, (ii) H₂O₂/OH⁻, (iii) alk. KMnO₄, (iv) H₃O⁺
- (3) (i) H₂O/H⁺ (ii) PCC
- (4) H₂O/H⁺

Answer (1)

Sol. Hydroboration-oxidation (BH₃ then H₂O₂/OH⁻) adds water across the terminal C=C in anti-Markovnikov fashion, giving the primary alcohol C₆H₅-CH₂-CH₂-CH₂OH. PCC then mildly oxidises this primary alcohol only as far as the aldehyde. Alkaline KMnO₄ would over-oxidise to the acid, and acid-catalysed hydration would give a Markovnikov secondary alcohol, so option (A) is correct.

80. Match List-I with List-II List-I (Conversion) List-II (No. of Faraday required) A. 1 mol of H₂O to O₂ I. 3F - 2+ B. 1 mol of MnO₄⁻ to Mn²⁺ II. 2F C. 1.5 mol of Ca from molten CaCl₂ III. 1F D. 1 mol of FeO to Fe₂O₃ IV. 5F Choose the correct answer from the options given below:
- (1) A-III, B-IV, C-I, D-II
 - (2) A-II, B-III, C-I, D-IV
 - (3) A-III, B-IV, C-II, D-I
 - (4) A-II, B-IV, C-I, D-III

Answer (4)

Sol. The number of Faradays equals the total number of electrons transferred per the stated amount.

- (A) H₂O → O₂: oxidation of water, 2H₂O → O₂ + 4H⁺ + 4e⁻; per 1 mol of H₂O, 2e⁻ are lost ⇒ 2 F → (ii).
- (B) MnO₄⁻ → Mn²⁺: Mn goes from +7 to +2, a 5e⁻ gain; 1 mol ⇒ 5 F → (iv).
- (C) Ca²⁺ + 2e⁻ → Ca: 1.5 mol Ca needs 1.5 × 2 = 3 F → (i).
- (D) FeO → Fe₂O₃: Fe goes from +2 to +3, a 1e⁻ loss; 1 mol FeO ⇒ 1 F → (iii).

Hence A-(ii), B-(iv), C-(i), D-(iii).

81. Given below are two statements: Statement I: The boiling point of hydrides of Group 16 elements follow the order H₂O > H₂Te > H₂Se > H₂S Statement II: On the basis of molecules mass, H₂O is expected to have lower boiling point than the other members of the group but due to the presence of extensive H-bonding in H₂O. It has higher boiling point. In the light of the above statements, choose the correct answer from the options given below:
- (1) Both statement I and statement II are false
 - (2) Statement I is true but statement II is false
 - (3) Statement I is false but statement II is true
 - (4) Both statement I and statement II are true.

Answer (4)

Sol. Statement I is true — most Bt toxins are insect-group specific and the toxin is coded by a gene named cry (e.g. cryIAC). Statement II is false — the inactive protoxin is converted to active toxin due to the ALKALINE pH of the insect gut, not acidic pH. Hence Statement I true, Statement II false.

NCERT Reference: Ch 10, p.179, line 45 — "once an insect ingest the inactive toxin, it is converted into an active form"; p.179, line 46 — "of toxin due to the alkaline pH of the gut which solubilise the crystals."

82. Given below are two statements: Statement 1: Both $[\text{Co}(\text{NH}_3)_6]^{3+}$ and $[\text{CoF}_6]^{3-}$ complexes are octahedral but differ in their magnetic behaviour Statement 2: $[\text{Co}(\text{NH}_3)_6]^{3+}$ is diamagnetic whereas $[\text{CoF}_6]^{3-}$ is paramagnetic In the light of above statements, choose the correct answer from the options given below:

- (1) Both Statements 1 and Statement II are false.
- (2) Statements 1 is true but Statement II is false.
- (3) Statements 1 is false but Statement II is true.
- (4) Both Statements 1 and Statement II are true.

Answer (4)

Sol. In both complexes cobalt is Co^{3+} , a d^6 ion, and both are octahedral.

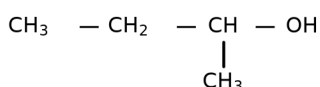
$[\text{Co}(\text{NH}_3)_6]^{3+}$: NH_3 is a strong-field ligand, so $\Delta_o >$ pairing energy and all six electrons pair up: $t_{2g}^6 e_g^0$, $n = 0$ unpaired \Rightarrow low-spin, diamagnetic.

$[\text{CoF}_6]^{3-}$: F- is a weak-field ligand, so the electrons remain unpaired as far as possible: $t_{2g}^4 e_g^2$, $n = 4$ unpaired \Rightarrow high-spin, paramagnetic.

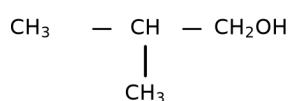
Thus both complexes are octahedral but differ in magnetic behaviour (Statement I true), and the specific assignment (Statement II) is also correct. Hence option D.

83. Which one of the following alcohols reacts instantaneously with Lucas reagent?

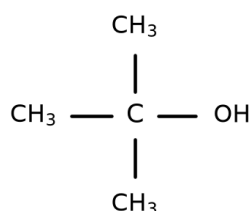
- (1) $\text{CH}_3\text{-CH}_2\text{-CH}(\text{CH}_3)\text{-OH}$ (butan-2-ol, secondary)



- (2) $(\text{CH}_3)_2\text{CH-CH}_2\text{OH}$ (2-methylpropan-1-ol, primary)



- (3) $(\text{CH}_3)_3\text{C-OH}$ (2-methylpropan-2-ol / tert-butanol, tertiary)



- (4) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{OH}$ (butan-1-ol, primary)

Answer (3)

Sol. The Lucas reagent (conc. $\text{HCl} + \text{ZnCl}_2$) reacts fastest with tertiary alcohols, because they ionise to a stable 3° carbocation and give immediate turbidity at room temperature.

Option (C) is the tertiary alcohol, so it reacts instantaneously, whereas the primary and secondary alcohols in the other options react slowly or not at all at room temperature.

84. Match List-I with List-II List-I(Process) List-II(Conditions) A. Isothermal process I. No heat exchange B. Isochoric process II. Carried out at constant temp. C. Isobaric process III. Carried out at constant volume D. Adiabatic process IV. Carried out at constant pressure Choose the correct answer from the options given below:

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

Answer (3)

Sol. Rose is a perigynous flower (II); Pea shows marginal placentation (IV); Cotton shows twisted aestivation (I); Mango is a drupe (III). This gives A-II, B-IV, C-I, D-III = option (d) = D.

NCERT Reference: Ch 5, p.64, lines 5-7 — "If one margin of the appendage overlaps that of the next one and so on as in china rose, lady's finger and cotton, it is called twisted."

85. On heating, some solid substances changes from solid to vapour state without passing through liquid state. The technique used for the purification of such substances based on the above principle is known as

- (1) Sublimation
- (2) Distillation
- (3) Chromatography
- (4) Crystallization

Answer (1)

Sol. Sublimation is the direct solid-to-vapour conversion (and re-deposition on cooling) without an intervening liquid phase. It is used to purify solids that sublime, such as camphor, naphthalene and benzoic acid, by separating them from non-volatile impurities.

86. The products A and B obtained in the following reactions, respectively are $3\text{ROH} + \text{PCl}_3 \rightarrow 3\text{RCl} + \text{A}$ and $\text{ROH} + \text{PCl}_5 \rightarrow \text{RCl} + \text{HCl} + \text{B}$

- (1) POCl_3 and H_3PO_4
- (2) H_3PO_4 and POCl_3
- (3) H_3PO_3 and POCl_3
- (4) POCl_3 and H_3PO_3

Answer (3)

Sol. With PCl_3 , three moles of alcohol convert to alkyl chloride and the phosphorus by-product is phosphorous acid: $3\text{ROH} + \text{PCl}_3 \rightarrow 3\text{RCl} + \text{H}_3\text{PO}_3$ (A = H_3PO_3). With PCl_5 , each alcohol gives the chloride plus HCl and phosphorus oxychloride: $\text{ROH} + \text{PCl}_5 \rightarrow \text{RCl} + \text{HCl} + \text{POCl}_3$ (B = POCl_3).

87. Mass in grams of copper deposited by passing 9.6487 A current through a voltmeter containing copper sulphate solution for 100 seconds is: (Given: Molar mass of Cu : 63g mol⁻¹, 1F = 96487C)

- (1) 0.315 g
- (2) 31.5g
- (3) 0.0315 g
- (4) 3.15 g

Answer (1)

Sol. At the cathode: $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$ (n = 2).

Charge passed: $Q = I t = 9.6487 \times 100 = 964.87 \text{ C}$.

Using Faraday's first law $w = (M \cdot Q)/(n \cdot F)$,

$w = (63 \times 964.87)/(2 \times 96487) = 964.87/96487 \times 63/2 = 0.01 \times 31.5 = 0.315 \text{ g}$.

88. For the equilibrium $2\text{NO}(\text{g}) \rightleftharpoons \text{N}_2(\text{g}) + \text{O}_2(\text{g})$, the equilibrium concentrations in a sealed vessel are $\text{N}_2 = 3.0 \times 10^{-3} \text{ M}$, $\text{O}_2 = 4.2 \times 10^{-3} \text{ M}$ and $\text{NO} = 2.8 \times 10^{-3} \text{ M}$. If instead 0.1 mol L⁻¹ of NO(g) is taken in a closed vessel and allowed to reach equilibrium, what is the degree of dissociation (α) of NO(g)?

- (1) 0.0889
- (2) 0.8889

- (3) 0.717
(4) 0.00889

Answer (3)

Sol. First find K_c from the given equilibrium data: $K_c = \frac{[N_2][O_2]}{[NO]^2} = \frac{(3.0 \times 10^{-3})(4.2 \times 10^{-3})}{(2.8 \times 10^{-3})^2} = \frac{(12.6 \times 10^{-6})}{(7.84 \times 10^{-6})} \approx 1.607$. Now start with 0.1 M NO. Let α be its degree of dissociation. By $2NO \rightleftharpoons N_2 + O_2$: NO reacted = 0.1α , so NO left = $0.1(1-\alpha)$; $N_2 = O_2 = (0.1\alpha)/2 = 0.05\alpha$. Then $K_c = \frac{[N_2][O_2]}{[NO]^2} = \frac{(0.05\alpha)^2}{[0.1(1-\alpha)]^2} = 0.25 \frac{\alpha^2}{(1-\alpha)^2}$. Set equal to 1.607: $\alpha^2/(1-\alpha)^2 = 1.607/0.25 = 6.43$, so $\alpha/(1-\alpha) = \sqrt{6.43} = 2.536$. Solving: $\alpha = 2.536(1-\alpha) \rightarrow 3.536\alpha = 2.536 \rightarrow \alpha = 0.717$. Therefore the degree of dissociation is 0.717.

89. Given below are two statements: Statement I : $[Co(NH_3)_6]^{3+}$ is a homoleptic complex where as $[Co(NH_3)_4Cl_2]^{+}$ is heteroleptic complex. Statement II : complex $[Co(NH_3)_6]^{3+}$ has one kind of ligands but $[Co(NH_3)_4Cl_2]^{+}$ has more than one kind of ligands. In the light of the above statements, choose the correct answer from the options given below:

- (1) Both statement I and statement II are false
(2) Statement I is true but statement II is false
(3) Statement I is false but statement II is true
(4) Both statement I and statement II are true.

Answer (4)

Sol. Statement I is true — most Bt toxins are insect-group specific and the toxin is coded by a gene named cry (e.g. cryIAC). Statement II is false — the inactive protoxin is converted to active toxin due to the ALKALINE pH of the insect gut, not acidic pH. Hence Statement I true, Statement II false.

NCERT Reference: Ch 10, p.179, line 45 — "once an insect ingest the inactive toxin, it is converted into an active form"; p.179, line 46 — "of toxin due to the alkaline pH of the gut which solubilise the crystals."

90. Identify the major product C formed in the following reaction sequence: $NaCN \text{ CH}_3 - CH_2 - CH_2 - I \rightarrow A - OH \xrightarrow{NaOH} B \rightarrow C$ Partial hydrolysis Br_2 (major)

- (1) butylamine
(2) butanamide
(3) α -bromobutanoic acid
(4) propylamine

Answer (4)

Sol. 1-Iodopropane undergoes S_N2 substitution with NaCN to give butanenitrile $CH_3CH_2CH_2CN$ (A). Partial (controlled) hydrolysis stops at the amide butanamide $CH_3CH_2CH_2CONH_2$ (B). $NaOH + Br_2$ is the Hofmann bromamide degradation, which removes one carbon and converts the amide to the primary amine with one fewer carbon: propylamine $CH_3CH_2CH_2NH_2$ (C).

91. The pair of lanthanoid ions which are diamagnetic is

- (1) Ce^{3+} and Eu^{2+}
(2) Gd^{3+} and Eu^{3+}
(3) Pm^{3+} and Sm^{3+}
(4) Ce^{4+} and Yb^{2+}

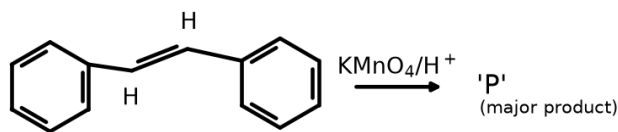
Answer (4)

Sol. A species is diamagnetic only when it has zero unpaired electrons.

Ce^{4+} has the configuration $[Xe] 4f^0$ (empty 4f), and Yb^{2+} has $[Xe] 4f^{14}$ (completely filled 4f). Both have all electrons paired, so the pair is diamagnetic.

The other ions ($Ce^{3+} 4f^1$, $Eu^{2+}/Gd^{3+} 4f^7$, $Eu^{3+} 4f^6$, $Pm^{3+} 4f^4$, $Sm^{3+} 4f^5$) all contain unpaired f-electrons and are paramagnetic.

92. For the given reaction, stilbene ($C_6H_5-CH=CH-C_6H_5$, 1,2-diphenylethene) is treated with hot acidic $KMnO_4$ ($KMnO_4/H^+$). The major product 'P' is:



- (1) Benzoic acid (C_6H_5-COOH)
- (2) 1,2-diphenylethane-1,2-diol ($C_6H_5-CH(OH)-CH(OH)-C_6H_5$)
- (3) Benzil ($C_6H_5-CO-CO-C_6H_5$)
- (4) Benzaldehyde (C_6H_5-CHO)

Answer (1)

Sol. Hot, acidic $KMnO_4$ is a strong oxidising agent that cleaves a carbon-carbon double bond completely (oxidative cleavage). A $=CH-$ (or $=CR-H$) carbon of the alkene is oxidised all the way to a $-COOH$ group. In stilbene, $C_6H_5-CH=CH-C_6H_5$, each doubly-bonded carbon bears one H and one phenyl group, so on cleavage each carbon becomes C_6H_5-COOH . The molecule therefore splits into two molecules of benzoic acid, and the product P is benzoic acid (C_6H_5-COOH). (Option (b), the diol, would form only with cold dilute alkaline $KMnO_4$ (syn-dihydroxylation, Baeyer's reagent), not with hot acidic $KMnO_4$; options (c) benzil and (d) benzaldehyde are not the products of complete acidic permanganate cleavage.)

93. A compound X contains 32% of A, 20% of B and remaining percentage of C. Then, the empirical formula of X is (Given atomic masses of A = 64; B = 40; C = 32u)

- (1) ABC_3
- (2) AB_2C_2
- (3) ABC_4
- (4) A_2BC_2

Answer (1)

Sol. Percentage of C = $100 - 32 - 20 = 48\%$.
 Moles: A = $32/64 = 0.5$; B = $20/40 = 0.5$; C = $48/32 = 1.5$.
 Dividing by the smallest (0.5): A : B : C = 1 : 1 : 3.
 Empirical formula = ABC_3 .

94. Given below are certain cations. Using the scheme of qualitative analysis, arrange them in order of increasing analytical group number (from Group 0 to Group VI): A. Al^{3+} , B. Cu^{2+} , C. Ba^{2+} , D. Co^{2+} , E. Mg^{2+} . Choose the correct order.

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

Answer (4)

Sol. Assign each cation to its group in the classical scheme of qualitative analysis (by the group reagent that precipitates it): $Cu^{2+} \rightarrow$ Group II (precipitated as sulphide by H_2S in dilute acid). $Al^{3+} \rightarrow$ Group III (precipitated as hydroxide by NH_4OH in presence of NH_4Cl). $Co^{2+} \rightarrow$ Group IV (precipitated as sulphide by H_2S in ammoniacal/basic medium). $Ba^{2+} \rightarrow$ Group V (precipitated as carbonate by $(NH_4)_2CO_3$). $Mg^{2+} \rightarrow$ Group VI (the last group). Arranging in increasing group number: $Cu^{2+}(II) < Al^{3+}(III) < Co^{2+}(IV) < Ba^{2+}(V) < Mg^{2+}(VI)$, i.e. B, A, D, C, E.

95. The work done during reversible isothermal expansion of one mole of hydrogen gas at $25^\circ C$ from pressure of 20 atmospheric to 10 atmosphere is: (Given $R = 2.0$ and $K-1 \text{ mol}^{-1}$)

- (1) -413.14 calories
- (2) 413.14 calories
- (3) 100 calories
- (4) 0 caloric

Answer (1)

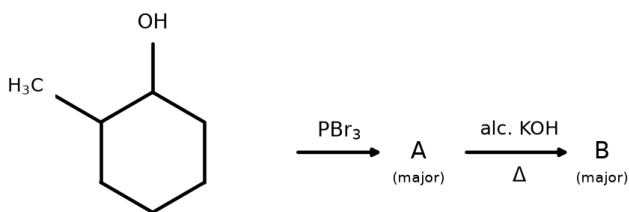
Sol. For reversible isothermal expansion, $w = -2.303 nRT \log (P_1/P_2)$. With $n = 1$, $R = 2.0 \text{ cal K}^{-1}\text{mol}^{-1}$, $T = 298 \text{ K}$, and $P_1/P_2 = 20/10 = 2$:

$$w = -2.303 \times 1 \times 2.0 \times 298 \times \log 2 = -2.303 \times 2 \times 298 \times 0.3010 \approx -413.14 \text{ cal.}$$

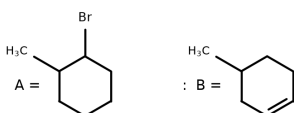
The negative sign indicates work is done by the gas on expansion.

Mapped: source lowercase answer 'a' → option A.

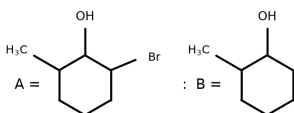
96. Major products A and B formed in the following reaction sequence are:
2-methylcyclohexan-1-ol → (PBr₃) → A (major) → (alc. KOH, Δ) → B (major).



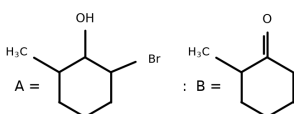
- (1) A = 1-bromo-2-methylcyclohexane; B = 3-methylcyclohexene (less-substituted alkene)



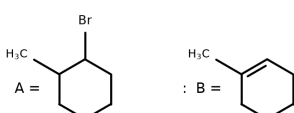
- (2) A = 2-bromo-6-methylcyclohexan-1-ol; B = 2-methylcyclohexan-1-ol



- (3) A = 2-bromo-6-methylcyclohexan-1-ol; B = 2-methylcyclohexan-1-one



- (4) A = 1-bromo-2-methylcyclohexane; B = 1-methylcyclohex-1-ene (Saytzeff, more-substituted alkene)



Answer (4)

Sol. PBr₃ replaces the -OH by -Br with retention of position, giving 1-bromo-2-methylcyclohexane (A). Alcoholic KOH causes β-elimination (dehydrohalogenation); by Saytzeff's rule the more substituted alkene is the major product. Eliminating toward the methyl-bearing carbon gives the tetrasubstituted double bond of 1-methylcyclohexene (B).

97. The rate of a reaction quadruples when the temperature changes from 27°C to 57°C. Calculate the energy of activation of the reaction. (Given $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$, $\log 4 =$

0.6021)

- (1) 380.4 kJ/mol
- (2) 3.80 kJ/mol
- (3) 3804 kJ/mol
- (4) 38.04 kJ/mol

Answer (4)

Sol. Use the two-temperature Arrhenius equation: $\log(k_2/k_1) = (E_a/2.303R) \cdot (T_2 - T_1)/(T_1 T_2)$. Here the rate quadruples, so $k_2/k_1 = 4$ and $\log 4 = 0.6021$. $T_1 = 27^\circ\text{C} = 300\text{ K}$, $T_2 = 57^\circ\text{C} = 330\text{ K}$, so $T_2 - T_1 = 30$ and $T_1 T_2 = 300 \times 330 = 99000$. Rearrange: $E_a = 2.303 \times R \times \log 4 \times (T_1 T_2)/(T_2 - T_1) = 2.303 \times 8.314 \times 0.6021 \times (99000/30) = 2.303 \times 8.314 \times 0.6021 \times 3300 \approx 38040\text{ J/mol} = 38.04\text{ kJ/mol}$. So the activation energy is 38.04 kJ/mol.

98. During the preparation of Mohr's salt solution (ferrous ammonium sulphate), which of the following acids is added to prevent hydrolysis of the Fe^{2+} ion?

- (1) Concentrated sulphuric acid
- (2) Dilute nitric acid
- (3) Dilute sulphuric acid
- (4) Dilute hydrochloric acid

Answer (3)

Sol. Fe^{2+} undergoes cationic hydrolysis in water, giving a turbid/acidic solution and $\text{Fe}(\text{OH})_2$ -type species. Adding acid suppresses this hydrolysis (common-ion/Le Chatelier effect). The acid must (i) be dilute, (ii) not oxidise Fe^{2+} to Fe^{3+} , and (iii) not introduce a foreign anion. Concentrated H_2SO_4 and dilute HNO_3 are oxidising (they would convert $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+}$), and HCl introduces the foreign chloride ion. Dilute sulphuric acid supplies the same SO_4^{2-} ion already present in Mohr's salt and is non-oxidising, so it is used to prevent the hydrolysis of Fe^{2+} . Answer: dilute sulphuric acid.

99. The plot of osmotic pressure (Π) vs concentration (mol L^{-1}) for a solution gives a straight line with slope $25.73\text{ L bar mol}^{-1}$. The temperature at which the osmotic pressure measurement is done is: (Use $R = 0.083\text{ L bar mol}^{-1}\text{K}^{-1}$)

- (1) 310°C
- (2) 25.73°C
- (3) 12.05°C
- (4) 37°C

Answer (4)

Sol. The osmotic pressure equation is $\pi = C R T$. Plotting π against concentration C gives a straight line whose slope is $R T$.

So $R T = 25.73\text{ L bar mol}^{-1}$.

$T = 25.73/0.083 = 310\text{ K}$.

Converting to Celsius: $T = 310 - 273 = 37^\circ\text{C}$. (The distractor 310°C is the Kelvin value mislabelled as $^\circ\text{C}$.)

100. Identify the correct answer.

- (1) BF_3 has non-zero dipole moment
- (2) Dipole moment of NF_3 is greater than that of NH_3
- (3) Three canonical forms can be drawn for CO_3^{2-} ion.
- (4) Three resonance structures can be drawn for ozone.

Answer (3)

Sol. BF_3 is trigonal planar and symmetric, so $\mu = 0$ (A wrong). In NH_3 the lone-pair moment and bond moments add (higher μ) while in NF_3 they oppose, so $\mu(\text{NH}_3) > \mu(\text{NF}_3)$ (B wrong). CO_3^{2-} has three equivalent canonical resonance forms (C correct). Ozone has two main resonance structures, not three (D wrong).

BIOLOGY (Q101 - Q200)

101. A transcription unit in DNA is defined primarily by the three regions in DNA and these are with respect to upstream and down stream end.

- (1) Structural gene, Transposons, Operator gene
- (2) Inductor, Repressor, Structural gene
- (3) Promotor, Structural gene, Terminator
- (4) Repressor, Operator gene, Structural gene

Answer (3)

Sol. Answer: (C) Promotor, Structural gene, Terminator. A transcription unit is defined by three regions: the promoter (5'/upstream), the structural gene, and the terminator (3'/downstream). NCERT Ch 5, p.91, lines 040-044: "A transcription unit in DNA is defined primarily by the three regions in the DNA: (i) A Promoter (ii) The Structural gene (iii) A Terminator."

102. Identify the set of correct statements: A. The flowers of Vallisneria are colorful and produce nectar. B. The flowers of waterlily are not pollinated by water. C. In most of water pollinated species, the pollen grains are protected from wetting. D. Pollen grains of some hydrophytes are long and ribbon like. E. In sumo hydrophytes, the pollen grains are carried passively inside water. 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) C, D and E only

Answer (3)

Sol. Answer: C. Evaluating each statement against NCERT: A is FALSE — wind and water pollinated flowers (Vallisneria is water-pollinated) are not very colourful and do not produce nectar. B is TRUE — in water hyacinth and water lily flowers emerge above the water and are pollinated by insects or wind, not water. C is TRUE — in most water-pollinated species pollen is protected from wetting by a mucilaginous covering. D is TRUE — in seagrasses pollen grains are long and ribbon-like. E is TRUE — such pollen is carried passively inside the water. Hence B, C, D and E are correct = option (c). NCERT: Ch 1, p.13, lines 40-47 — "Pollen grains in many such species are long, ribbon like and they are carried passively inside the water; some of them reach the stigma and achieve pollination. In most of the water-pollinated species, pollen grains are protected from wetting by a mucilaginous covering. Both wind and water pollinated flowers are not very colourful and do not produce nectar."

103. Lecithin, a small molecular weight organic compound found in living tissues, is an example of

- (1) Phospholipids
- (2) Glycerides
- (3) Carbohydrates
- (4) Amino acids

Answer (1)

Sol. Lecithin is a small molecular weight lipid containing a phosphorylated organic compound, which NCERT defines as a phospholipid found in cell membranes. It is neither a simple glyceride, a carbohydrate nor an amino acid; it is explicitly named as the example of a phospholipid.

NCERT Reference: Ch 9, p.106, line ~27 — "Some lipids have phosphorous and a phosphorylated organic compound in them. These are phospholipids... Lecithin is one example."

104. These are regarded as major causes of biodiversity loss: A. Over exploitation B. Co-extinction C. Mutation D. Habitat loss and fragmentation E. Migration Choose the correct option:

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

Answer (3)

Sol. The major causes of biodiversity loss (the Evil Quartet) are habitat loss and fragmentation, over-exploitation, alien species invasions and co-extinctions. Of the listed items, A (Over exploitation), B (Co-extinction) and D (Habitat loss and fragmentation) are genuine causes, while C (Mutation) and E (Migration) are not, so only option (c) is correct.

NCERT: NCERT Class XII Biology, Ch 13 Biodiversity and Conservation, p.223, lines 22-23:

"Co-extinctions: When a species becomes extinct, the plant and animal species associated with it in an obligatory way also become extinct."

105. Match List I with List II. List I List II A. Clostridium butylicum I. Ethanol B. Saccharomyces cerevisiae II. Streptokinase C. Trichoderma polysporum III. Butyric acid D. Streptococcus sp. IV. Cyclosporin-A Choose the correct answer from the options given below.

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

Answer (2)

Sol. The correct microbe-to-product pairings are: Clostridium butylicum produces butyric acid (III), Saccharomyces cerevisiae produces ethanol (I), Trichoderma polysporum produces cyclosporin-A (IV), and Streptococcus sp. produces streptokinase (II). This matches option (B).

NCERT Reference: Ch 8, p.153, line 13 — "aceti (a bacterium) of acetic acid; Clostridium butylicum (a bacterium) of"

106. Match list I with list II. List I List II A. Rhizopus I. Mushroom B. Ustilago II. Smut fungus C. Puccinia III. Bread mould D. Agaricus IV. Rust fungus Choose the correct answer from the options given below.

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

Answer (4)

Sol. Rhizopus is the bread mould (III), Ustilago is the smut fungus (II), Puccinia is the rust fungus (IV), and Agaricus is the mushroom (I) — giving A-III, B-II, C-IV, D-I. Rhizopus is a phycmycete while Ustilago, Puccinia and Agaricus are basidiomycetes.

NCERT Reference: NCERT Class XI, Biological Classification, p.18, lines 21-23 — "Agaricus (mushroom) (Figure 2.5c), Ustilago (smut) and Puccinia (rust fungus)"

107. The lactose present in the growth medium of bacteria is transported to the cell by the action of:

- (1) Acetylase
- (2) Permease

- (3) Polymerase
- (4) Beta-galactosidase

Answer (2)

Sol. Answer: (B) Permease. In the lac operon, the y gene codes for permease, which increases cell permeability to beta-galactosides; lactose in the medium is transported into the cell through the action of permease. NCERT Ch 5, p.101, lines 005-007: "if lactose is provided in the growth medium of the bacteria, the lactose is transported into the cells through the action of permease."

108. List of endangered species was released by

- (1) WWF
- (2) FOAM
- (3) IUCN
- (4) GEAC

Answer (3)

Sol. The list documenting extinct and threatened species is the IUCN Red List; NCERT states the IUCN Red List (2004) documents the extinction of 784 species in the last 500 years. WWF, FOAM and GEAC do not release this list, so (a), (b) and (d) are wrong (GEAC, the Genetic Engineering Appraisal Committee, deals with GMOs).

NCERT: NCERT Class XII Biology, Ch 13 Biodiversity and Conservation, p.221, lines 39-41: "The IUCN Red List (2004) documents the extinction of 784 species (including 338 vertebrates, 359 invertebrates and 87 plants) in the last 500 years."

109. How many molecules of ATP and NADPH are required for every molecule of CO₂ fixed in the Calvin cycle

- (1) 2 molecules of ATP and 2 molecules of NADPH
- (2) 3 molecules of ATP and 3 molecules of NADPH
- (3) 3 molecules of ATP and 2 molecules of NADPH
- (4) 2 molecules of ATP and 3 molecules of NADPH

Answer (3)

Sol. The stem asks per molecule of CO₂ fixed. NCERT states that for every CO₂ molecule entering the Calvin cycle, 3 molecules of ATP and 2 of NADPH are required (2 ATP + 2 NADPH in reduction, plus 1 ATP in regeneration). Hence the answer is 3 ATP and 2 NADPH.

NCERT: Class 11 Ch 11, p.145 [145:003]: "Hence for every CO₂ molecule entering the Calvin cycle, 3 molecules"

110. The equation of Verhulst-Pearl logistic growth is $\frac{dN}{dt} = rN \left(\frac{K - N}{K} \right)$. From this equation, K indicates.

- (1) Biotic potential
- (2) Carrying capacity
- (3) Population density
- (4) Intrinsic rate of natural increase

Answer (2)

Sol. NCERT: Ch 11, p.196, lines 4-6 — "N = Population density at time t
r = Intrinsic rate of natural increase
K = Carrying capacity"

111. Bulliform cells are responsible for

- (1) Protecting the plant from salt stress.
- (2) Increased photosynthesis in monocots.

- (3) Providing large spaces for storage of sugars.
- (4) Inward curling of leaves in monocots.

Answer (4)

Sol. Bulliform cells are large, empty, colourless adaxial epidermal cells found along the veins in grasses (monocots). When turgid (full of water) they keep the leaf surface exposed; when flaccid under water stress they lose turgor and cause the leaf to curl inwards, which reduces the exposed surface area and minimises transpirational water loss.

NCERT Reference: NCERT Class XI, Ch 6 Anatomy of Flowering Plants, p.77, line ~22: "When they are flaccid due to water stress, they make the leaves curl inwards to minimise water loss."

112. Which one of the following is not a criterion for classification of fungi?

- (1) Mode of nutrition
- (2) Mode of spore formation
- (3) Fruiting body
- (4) Morphology of mycelium

Answer (1)

Sol. NCERT states that morphology of the mycelium, mode of spore formation and fruiting bodies form the basis for dividing the Kingdom Fungi into classes. Mode of nutrition is not among these criteria, so (A) is the answer.

NCERT Reference: NCERT Class XI, Biological Classification, p.17, lines 24-26 — "morphology of the mycelium, mode of spore formation and fruiting bodies form the basis"

113. Tropical regions show the greatest level of species richness. Consider the following reasons: A. Tropical latitudes have remained relatively undisturbed for millions of years, so more evolutionary time was available for species diversification. B. Tropical environments are more seasonal. C. More solar energy is available in the tropics. D. Constant environments promote niche specialisation. E. Tropical environments are constant and predictable. Choose the correct combination of reasons.

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

Answer (4)

Sol. According to NCERT, the higher species richness of the tropics is explained by: (A) tropical latitudes have been relatively undisturbed over long geological time, giving more time for speciation; (C) more solar energy is available, supporting higher productivity and indirectly greater diversity; (D) constant (less fluctuating) environments promote niche specialisation and hence more species; and (E) tropical environments are relatively constant and predictable. Statement B is false — the tropics are LESS seasonal, not more; it is temperate regions that are highly seasonal. Therefore the correct reasons are A, C, D and E only.

114. Which of the following is an example of actinomorphic flower?

- (1) Cassia
- (2) Pisum
- (3) Sesbania
- (4) Datura

Answer (4)

Sol. An actinomorphic flower can be divided into two equal radial halves by any radial plane through the centre; NCERT examples are mustard, datura and chilli. Among the options Datura is

actinomorphic, while Cassia, Pisum and Sesbania are zygomorphic legumes. Answer = Datura (D).

NCERT Reference: Ch 5, p.62, lines 19-21 — "it is said to be actinomorphic, e.g., mustard, datura, chilli."

115. Identify the type of flowers based on the position of calyx, corolla and androecium with respect to the ovary from the given figures (a) and (b)

- (1) (a) Hypogynous; (b) Epigynous
- (2) (a) Perigynous; (b) Epigynous
- (3) (a) Perigynous; (b) Perigynous
- (4) (a) Epigynous; (b)

Answer (3)

Sol. Flowers are classified by the position of calyx, corolla and androecium relative to the ovary. In figure (a) the other parts arise on the rim of the thalamus at about the same level as the gynoecium, with a half-inferior ovary = perigynous; in figure (b) the gynoecium occupies the highest position with the other parts below it (superior ovary) = hypogynous. So (a) Perigynous; (b) Hypogynous = option C.

NCERT Reference: Ch 5, p.63, lines 5-11 — "In the hypogynous flower the gynoecium occupies the highest position while the other parts are situated below it. The ovary in such flowers is said to be superior ... it is called perigynous. The ovary here is said to be half inferior, e.g., plum, rose, peach."

116. Match list I with list II. List I List II A. Nucleolus I. Site of formation of glycolipid B. Centriole II. Organisation like the cartwheel C. Leucoplasts III. Site for active ribosomal RNA synthesis D. Golgi apparatus IV. For storing nutrients Choose the correct answer from the options given below.

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

Answer (4)

Sol. Nucleolus (A) is the site of active ribosomal RNA synthesis (III); each centriole (B) has an organisation like the cartwheel (II); leucoplasts (C) are colourless plastids that store nutrients (IV); and the Golgi apparatus (D) is the site of formation of glycolipids (I). This matches option (d).

NCERT Reference: Ch 8, p.100, lines 42-43: "It is a site for active ribosomal RNA synthesis"; p.99, line 26: "each has an organisation like the cartwheel"; p.96, lines 21-22: "Golgi apparatus is the important site of formation of glycoproteins and glycolipids."

117. What is the rate ore piece or DNA carrying only gene of interest which is transferred into an alien organism? A. The piece of DNA would be able to multiply itself independently in the progeny cells of the organism. B. It may get integrated into the genome of the recipient. C. It may multiply and be inherited along with the host DNA. D. The alien piece of DNA is not an integral part of chromosome. E. It shows ability to replicate. Choose the correct answer from the options given below:

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

Answer (2)

Sol. The statements NOT true are C and D. Restriction endonucleases cut DNA a little away from the centre of the palindromic site (not exactly at the centre), so C is false; removing nucleotides only from the ends of DNA is the property of exonucleases, not restriction (endo)nucleases, so D is false. Statements A (molecular scissors), B (restrict bacteriophage growth in *E. coli*) and E (recognise palindromic sequences) are all true. The given key 'D' corresponds to option (4). NCERT Reference: Ch 9, p.167, line(s) 8 — "Restriction enzymes cut the strand of DNA a little away from the centre"

118. Hind II always cuts DNA molecules at a particular point called its recognition sequence, which consists of:

- (1) 6 bp
- (2) 4 bp
- (3) 10 bp
- (4) 8 bp

Answer (1)

Sol. Hind II was the first restriction endonuclease to be characterised. It recognises and cuts DNA at a specific palindromic sequence that is 6 base pairs long (a specific sequence of six base pairs). Hence its recognition sequence consists of 6 bp.

119. The cofactor of the enzyme carboxypeptidase is

- (1) Niacin
- (2) Flavin
- (3) Haem
- (4) Zinc

Answer (4)

Sol. A number of enzymes require metal ions as cofactors that form coordination bonds at the active site; NCERT gives zinc as the cofactor for the proteolytic enzyme carboxypeptidase. Niacin and flavin are vitamin-derived coenzyme components and haem is the prosthetic group of catalase/peroxidase, so only zinc fits.

NCERT Reference: Ch 9, p.118, line ~19 — "zinc is a cofactor for the proteolytic enzyme carboxypeptidase."

120. Which of the following are required for the dark reaction of photosynthesis? A. Light B. Chlorophyll C. CO₂ D. ATP E. NADPH Choose the correct answer from the options given below:

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

Answer (2)

Sol. The dark (biosynthetic) reaction does not directly require light or chlorophyll; it depends on CO₂ plus the ATP and NADPH made in the light reaction. So of the listed items, CO₂ (C), ATP (D) and NADPH (E) are needed, while light (A) and chlorophyll (B) are not directly required. Hence the correct set is C, D and E only.

NCERT: Class 11 Ch 11, p.142 [142:026]: "This process does not directly depend on the presence of light but is dependent on the products of the light reaction, i.e., ATP and NADPH, besides CO₂ and H₂O."

121. The type of conservation in which the threatened species are taken out from their natural habitat and placed in special setting when they can be protected and given special care is called

- (1) Biodiversity conservation
- (2) Semi-conservative method
- (3) Sustainable development
- (4) in-situ conservation

Answer (1)

Sol. The stem describes ex-situ conservation, in which threatened species are taken out of their natural habitat and placed in a special setting where they can be protected and given special care (zoos, botanical gardens, safari parks). However, the option set offers no 'ex-situ conservation' choice; option (d) is in-situ (the opposite), so by elimination the printed key (a) Biodiversity conservation is treated as the answer. Caution: the option set is ambiguous/internally inconsistent because the correct concept (ex-situ) is absent, so this question should be flagged as a probable misprint.

NCERT: NCERT Class XII Biology, Ch 13 Biodiversity and Conservation, p.225, lines 16-18: "Ex situ Conservation- In this approach, threatened animals and plants are taken out from their natural habitat and placed in special setting where they can be protected and given special care."

122. Match list I with list II. List I List II A. Two or more alternative forms of a gene I. Back cross B. Cross of F1 progeny with homozygous II. Ploidy recessive parent C. Cross of F1 progeny with any of the III. Allele parents D. Number of chromosome sets in plant. IV. Test cross Choose the correct answer from the options given below.

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

Answer (2)

Sol. Two or more alternative forms of a gene are alleles (A-III). A cross of the F1 progeny with the homozygous recessive parent is a test cross used to determine genotype (B-IV). A cross of F1 progeny with any of the parents is a back cross (C-I). The number of chromosome sets in a plant is its ploidy (D-II). This matching corresponds to option (b).

NCERT Reference: NCERT Class XII, Ch 4, p.58, lines 33-36: "In a typical test cross an organism (pea plants here) showing a dominant phenotype (and whose genotype is to be determined) is crossed with the recessive parent instead of self-crossing."

123. Formation of interfascicular cambium from fully developed parenchyma cells is an example for

- (1) Redifferentiation
- (2) Dedifferentiation
- (3) Maturation
- (4) Differentiation

Answer (2)

Sol. Living differentiated (mature) cells that have lost the capacity to divide can, under certain conditions, regain their meristematic (dividing) ability; this phenomenon is called dedifferentiation. The formation of the interfascicular cambium and cork cambium from fully developed parenchyma cells during secondary growth is a classic example. (Differentiation is the maturation of meristematic cells into permanent cells; redifferentiation is when dedifferentiated cells again lose their dividing capacity and mature.)

NCERT Reference: NCERT (Class XI, Anatomy of Flowering Plants – Secondary Growth / Differentiation, Dedifferentiation and Redifferentiation subsection, pre-2023 rationalisation text): living differentiated cells that have lost the capacity to divide can regain it under certain conditions – termed dedifferentiation – e.g. formation of interfascicular cambium and cork cambium from fully differentiated parenchyma cells.

124. Spindle fibres attach to kinetochores of chromosomes during
- (1) Metaphase
 - (2) Anaphase
 - (3) Telophase
 - (4) Prophase

Answer (1)

Sol. Answer: Metaphase

Solution: At metaphase the kinetochores, small disc-shaped structures on the surface of the centromeres, serve as the sites where spindle fibres attach to the chromosomes, aligning them at the metaphase plate. Spindle fibres are not yet attached in prophase, while in anaphase the chromatids have already separated and in telophase the spindle disassembles; hence metaphase is correct.

NCERT Reference: Ch 10, p.123, lines 29-30 — "Spindle fibres attach to kinetochores of"

125. In a plant, black seed color (BB/bb) is dominant, over white seed color (bb). In order to find out the genotype of the black seed plant, which of the following genotype will you cross it?
- (1) bb
 - (2) Bb
 - (3) BB/Bb
 - (4) BB

Answer (1)

Sol. A black-seeded plant showing the dominant phenotype could be either homozygous (BB) or heterozygous (Bb). To determine its genotype, it must be crossed with the homozygous recessive (white, bb) parent in a test cross; the offspring ratio then reveals the unknown genotype. Hence the correct cross is with bb.

NCERT Reference: NCERT Class XII, Ch 4, p.58, lines 31-36: "to determine the genotype of a tall plant at F₂, Mendel crossed the tall plant from F₂ with a dwarf plant. This he called a test cross. In a typical test cross an organism ... showing a dominant phenotype ... is crossed with the recessive parent"

126. A pink flowered Snapdragon plant was crossed with a red flowered Snapdragon plant. What type of phenotype/s is/are expected in the progeny ? (1) (2) (3).
- (1) Red flowered as well as pink flowered plants
 - (2) Only pink flowered plants
 - (3) Red, Pink as well as white flowered plants
 - (4) Only red flowered plants

Answer (1)

Sol. In snapdragon, flower colour shows incomplete dominance where RR is red, Rr is pink and rr is white. A pink plant (Rr) crossed with a red plant (RR) gives offspring 1/2 RR (red) and 1/2 Rr

(pink). No white (rr) is possible since no parent contributes an r-r combination, so the progeny are red and pink.

NCERT Reference: NCERT Class XII, Ch 4, p.60, lines 10-15: "the F1 (Rr) was pink (Figure 4.6). When the F1 was self-pollinated the F2 resulted in the following ratio 1 (RR) Red: 2 (Rr) Pink: 1 (rr) White."

127. Inhibition of Succinic dehydrogenase enzyme by malonate is a classical example of
- (1) Feedback inhibition
 - (2) Competitive inhibition
 - (3) Enzyme activation
 - (4) Cofactor inhibition

Answer (2)

Sol. Malonate closely resembles the substrate succinate in molecular structure and competes with it for the substrate-binding site of succinic dehydrogenase; this is the textbook example of competitive inhibition, not feedback inhibition, activation or cofactor inhibition.

NCERT Reference: Ch 9, p.117, line ~10 — "inhibition of succinic dehydrogenase by malonate which closely resembles the substrate succinate in structure."

128. Given below are two statements: Statement I: Bt toxins are insect group specific and coded by a gene cry 1Ac. Statement II: Bt toxin exists as inactive protoxin in *B. thuringiensis*. However, after ingestion by the insect the inactive protoxin gets converted into active form due to acidic pH of the insect gut. In the light of the above statements, choose the correct answer from the options given below:

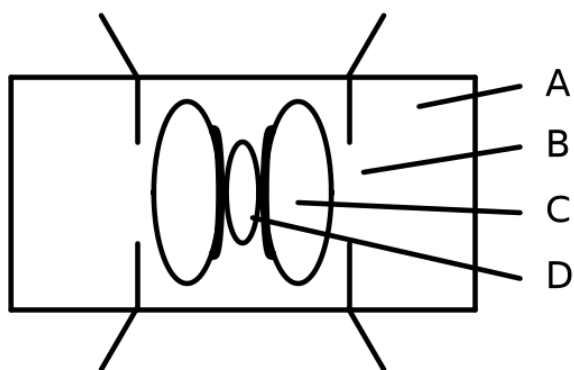
- (1) Both Statement I and Statement II are false
- (2) Statement I is true but Statement II is false
- (3) Statement I is false but Statement II is true
- (4) Both Statement I and Statement II are true

Answer (2)

Sol. Statement I is true — most Bt toxins are insect-group specific and the toxin is coded by a gene named cry (e.g. cryIAc). Statement II is false — the inactive protoxin is converted to active toxin due to the ALKALINE pH of the insect gut, not acidic pH. Hence Statement I true, Statement II false.

NCERT Reference: Ch 10, p.179, line 45 — "once an insect ingest the inactive toxin, it is converted into an active form"; p.179, line 46 — "of toxin due to the alkaline pH of the gut which solubilise the crystals."

129. In the given figure of a stoma, which labelled component has thin outer walls and highly thickened inner walls?



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

Answer (4)

Sol. In a dicot seed the embryonal axis bears the radicle at one end and the plumule at the other; the radicle is the part that develops into the root on germination. In the labelled figure the radicle is marked C, and option (b) = C is correct (answer B).

NCERT Reference: Ch 5, p.66, lines 26-28 — "At the two ends of the embryonal axis are present the radicle and the plumule"

130. Which one of the following can be explained on the basis of Mendal’s law of Dominance? A. Out of one pair of factors one is dominant and the other is recessive. B. Alleles do not show any expression and both the character appear as such in F2 generation. C. Factors occur in pairs in normal diploid plants. D. The discrete unit controlling a particular character is called factor. E. The expression of only one of the parental characters is found in a monohybrid cross. Choose the comet aver from the options given below:

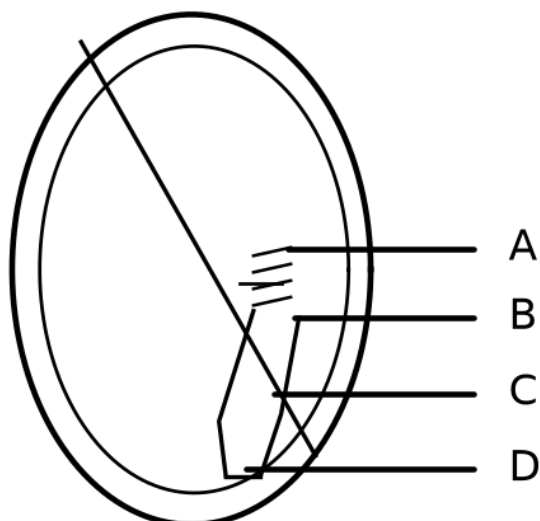
- (1) A, C, D and E only
- (2) B, C, and D only
- (3) A, B, C, D and E
- (4) A, B and C only

Answer (1)

Sol. The Law of Dominance states that characters are controlled by discrete units called factors which occur in pairs, and in a dissimilar pair one factor dominates the other; it explains the expression of only one parental character in a monohybrid F1 (statements A, C, D, E). Statement B is false because alleles DO show expression and both characters are recovered in F2 (this describes the Law of Segregation, not Dominance). Hence A, C, D and E only are correct.

NCERT Reference: NCERT Class XII, Ch 4, p.59, lines 9-19: "4.2.1 Law of Dominance (i) Characters are controlled by discrete units called factors. (ii) Factors occur in pairs. (iii) In a dissimilar pair of factors one member of the pair dominates (dominant) the other (recessive). The law of dominance is used to explain the expression of only one of the parental characters in a monohybrid cross"

131. Identify the part of the seed in the given figure which is destined to form the root when the seed germinates.



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

Answer (2)

Sol. Answer: B. The part of the embryo destined to form the root on germination is the radicle (root tip). In a typical dicot embryo the cylindrical portion below the level of the cotyledons is the hypocotyl, which terminates at its lower end in the radicle or root tip, covered by a root cap. The labelled part identified as the radicle in the figure corresponds to option B. NCERT: Ch 1, p.19, lines 39-42 — "The cylindrical portion below the level of cotyledons is hypocotyl that terminates at its lower end in the radicle or root tip. The root tip is covered with a root cap."

132. Auxin is used by gardeners to prepare weed-free lawns. But no damage is caused to grass as auxin

- (1) promotes abscission of mature leaves only
- (2) does not affect mature monocotyledon plants
- (3) can help in cell division in grasses, to produce growth
- (4) promotes apical dominance

Answer (2)

Sol. The auxin herbicide 2,4-D kills dicotyledonous weeds but does not affect mature monocotyledonous plants, so spraying it on a lawn (grasses are monocots) removes weeds without harming the grass. It does not act by promoting abscission, by aiding cell division in grasses, or via apical dominance in this context.

NCERT: Ch 13, p.176, line ~5: "widely used to kill dicotyledonous weeds, does not affect mature monocotyledonous plants".

133. Given below are two statements. Statement 1: Chromosomes become gradually visible under light microscope during leptotene stage. Statement 2: The beginning of diplotene stage is recognized by dissolution of synaptonemal complex. In the light of the above statements, choose the correct answer from the options given below.

- (1) Both Statement I and Statement II are false
- (2) Statement I is true but Statement II is false
- (3) Statement I is false but Statement II is true

(4) Both Statement I and Statement II are true

Answer (4)

Sol. Statement I is true — most Bt toxins are insect-group specific and the toxin is coded by a gene named cry (e.g. cryIAc). Statement II is false — the inactive protoxin is converted to active toxin due to the ALKALINE pH of the insect gut, not acidic pH. Hence Statement I true, Statement II false.

NCERT Reference: Ch 10, p.179, line 45 — "once an insect ingest the inactive toxin, it is converted into an active form"; p.179, line 46 — "of toxin due to the alkaline pH of the gut which solubilise the crystals."

134. The capacity to generate a whole plant from any cell of the plant is called

- (1) Micropropagation
- (2) Differentiation
- (3) Somatic hybridization
- (4) Totipotency

Answer (4)

Sol. The ability of any plant cell to regenerate a whole plant is totipotency, a hallmark of plant cells underlying tissue culture. Micropropagation and somatic hybridization are tissue-culture techniques (not the inherent capacity itself), and differentiation is the maturation of cells into specialised types.

NCERT: Ch 13, p.172, line ~24: "parenchyma cells that are made to divide under controlled laboratory conditions during plant tissue culture".

135. Given below are two statements. Statement 1: Parenchyma is living but collenchyma is dead tissue Statement 2: Gymnosperms lack xylem vessels but presence of xylem vessels is the characteristic of angiosperms. In the light of the above statements, choose the correct answer from the options given below.

- (1) Both Statement I and Statement II are false
- (2) Statement I is true but Statement II is false
- (3) Statement I is false but Statement II is true
- (4) Both Statement I and Statement II are true

Answer (3)

Sol. Statement I is true — most Bt toxins are insect-group specific and the toxin is coded by a gene named cry (e.g. cryIAc). Statement II is false — the inactive protoxin is converted to active toxin due to the ALKALINE pH of the insect gut, not acidic pH. Hence Statement I true, Statement II false.

NCERT Reference: Ch 10, p.179, line 45 — "once an insect ingest the inactive toxin, it is converted into an active form"; p.179, line 46 — "of toxin due to the alkaline pH of the gut which solubilise the crystals."

136. Spraying sugarcane crop with which of the following plant growth regulators, increases the length of stem, thus, increasing the yield?

- (1) Gibberellin
- (2) Cytokinin
- (3) Abscisic acid
- (4) Auxin

Answer (1)

Sol. Gibberellins increase the length of the axis; spraying sugarcane with gibberellins increases stem length and raises yield by up to 20 tonnes per acre. Cytokinin (cell division), abscisic acid (growth inhibitor) and auxin (rooting, apical dominance) do not produce this stem-elongation yield

effect in sugarcane.

NCERT: Ch 13, p.176, line ~39: "sugarcane crop with gibberellins increases the length of the stem, thus increasing the yield".

137. Given below are two statements. Statement 1: in C₃ plants, some O₂ binds to RuBisCO, hence CO₂ fixation is decreased. Statement 2: In C₄ plants, mesophyll cells show very little photorespiration while bundle sheath cells do not show photorespiration. In the light of the above statements, choose the correct answer from the options given below.

- (1) Both Statement I and Statement II are false
- (2) Statement I is true but Statement II is false
- (3) Statement I is false but Statement II is true
- (4) Both Statement I and Statement II are true

Answer (2)

Sol. Statement I is true — most Bt toxins are insect-group specific and the toxin is coded by a gene named cry (e.g. cryI_{Ac}). Statement II is false — the inactive protoxin is converted to active toxin due to the ALKALINE pH of the insect gut, not acidic pH. Hence Statement I true, Statement II false.

NCERT Reference: Ch 10, p.179, line 45 — "once an insect ingest the inactive toxin, it is converted into an active form"; p.179, line 46 — "of toxin due to the alkaline pH of the gut which solubilise the crystals."

138. Match list I with list II. List I List II A. GLUT-4 I. Hormone B. Insulin II. Enzyme C. Trypsin III. Intercellular ground substance D. Collagen IV. Enables glucose transport into cells Choose the correct answer from the options given below.

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

Answer (4)

Sol. Answer: (A) A-III, B-IV, C-I, D-II. Griffith discovered transformation (III); Jacob & Monod elucidated the lac operon (IV); Khorana's chemical method helped decipher the genetic code (I); Meselson & Stahl proved semi-conservative replication (II). NCERT Ch 5, p.85, lines 005-008 (Griffith transforming principle); p.100, lines 027-029: "The elucidation of the lac operon was also a result of a close association between a geneticist, Francois Jacob and a biochemist, Jacques Monod"; p.95, lines 046-047 (Khorana's method for genetic code); p.89, lines 004-005 (Meselson and Stahl's semiconservative experiment).

139. Read the following statements and choose the set of correct statements: In the members of Phacophyceae, A. Asexual reproduction occurs usually by biflagellate zoospores. B. Sexual reproduction is in oogamous method only. C. Stored food is in the form of carbohydrates which is either mannitol or laminarin. D. The major pigments found are chlorophyll a, c and carotenoids and xanthophyll. E. Vegetative cells have a cellulosic wall, usually covered on the outside by gelatinous coating of algin. Choose the correct answer from the options given below:

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

Answer (2)

Sol. For Phaeophyceae (brown algae): asexual reproduction is by biflagellate zoospores (A correct); stored food is mannitol or laminarin (C correct); pigments are chlorophyll a, c, carotenoids and xanthophylls (D correct); and vegetative cells have a cellulosic wall covered by a gelatinous coating of algin (E correct). Statement B is the WRONG one — sexual reproduction in brown algae may be isogamous, anisogamous OR oogamous, not oogamous only — so the correct set excludes B, giving A, C, D, E.

NCERT Reference: Class XI Biology, Plant Kingdom, p.27, lines 9-12 — "Asexual reproduction in most brown algae is by biflagellate zoospores... Sexual reproduction may be isogamous, anisogamous or oogamous."

140. Which of the following statements is correct regarding the process of replication in E.coli ?

- (1) The DNA dependent RNA polymerase catalyses polymerization in one direction, that is 5' → 3'.
- (2) The DNA dependent DNA polymerase catalyses polymerization in 5' → 3' as well as 3' → 5' direction.
- (3) The DNA dependent DNA polymerase catalyses polymerization in 5' → 3' direction.
- (4) The DNA dependent DNA polymerase catalyses polymerization in one direction that is 3' → 5'.

Answer (3)

Sol. Answer: (C) The DNA dependent DNA polymerase catalyses polymerization in 5' → 3' direction. DNA-dependent DNA polymerases catalyse polymerisation only in one direction, 5' → 3'; this single-direction constraint is why one strand is synthesised continuously and the other discontinuously. NCERT Ch 5, p.90, lines 034-035: "The DNA-dependent DNA polymerases catalyse polymerisation only in one direction, that is 5' → 3'."

141. Identify the step in the tricarboxylic acid (Krebs) cycle which does NOT involve oxidation of the substrate.

- (1) Succinic acid → Malic acid
- (2) Succinyl-CoA → Succinic acid
- (3) Isocitrate → α-ketoglutaric acid
- (4) Malic acid → Oxaloacetic acid

Answer (2)

Sol. An oxidation step in the TCA cycle removes hydrogen/electrons and reduces a coenzyme (NAD⁺ → NADH or FAD → FADH₂). Check the options: Isocitrate → α-ketoglutarate is an oxidative decarboxylation (produces NADH) — oxidation. Malate → Oxaloacetate is catalysed by malate dehydrogenase (produces NADH) — oxidation. Succinate → Malate proceeds via succinate → fumarate (succinate dehydrogenase, produces FADH₂) — oxidation. Succinyl-CoA → Succinate, however, is a substrate-level phosphorylation: the energy of the thioester bond is used to make GTP/ATP, with no coenzyme reduced and no oxidation of the substrate. Hence the non-oxidative step is Succinyl-CoA → Succinic acid.

142. Match List I with List II. List I List II A. Robert May I. Species-Area relationship B. Alexander von Humboldt II. Long term ecosystem experiment using out door plots C. Paul Ehrlich III. Global species diversity at about 7 million D. David Tilman IV. Rivet popper hypothesis Choose the correct answer from the options given below.

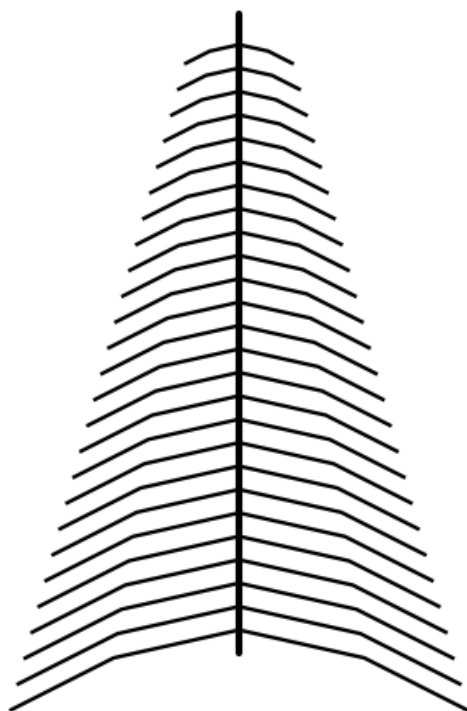
- (1) A-III, B-I, C-IV, D-II
- (2) A-I, B-III, C-II, D-IV
- (3) A-III, B-IV, C-II, D-I
- (4) A-II, B-III, C-I, D-IV

Answer (1)

Sol. Robert May placed the global species diversity estimate at about 7 million (A-III); Alexander von Humboldt described the species-area relationship (B-I); Paul Ehrlich proposed the rivet popper hypothesis (C-IV); and David Tilman conducted long-term ecosystem experiments using outdoor plots (D-II). Only option (a) matches all four correctly.

NCERT: NCERT Class XII Biology, Ch 13 Biodiversity and Conservation, p.221, lines 7-9: "David Tilman's long-term ecosystem experiments using outdoor plots provide some tentative answers."

143. Identify the correct description of the given figure (a feathery/plumose inflorescence).



- (1) Water pollinated flowers showing stamens with mucilaginous covering.
- (2) Cleistogamous flowers showing endogamy.
- (3) Compact inflorescence showing complete autogamy.
- (4) Wind pollinated plant inflorescence showing flowers with well-exposed stamens.

Answer (4)

Sol. Answer: D. The figure shows a wind-pollinated plant inflorescence with well-exposed stamens. Wind-pollinated flowers possess well-exposed stamens so the light, non-sticky pollen is easily dispersed into wind currents, and they typically have numerous flowers packed into a compact inflorescence. This matches option (d); options describing mucilaginous water-pollination, cleistogamy/endogamy or complete autogamy do not fit. NCERT: Ch 1, p.13, lines 6-15 — "Wind pollination also requires that the pollen grains are light and non-sticky so that they can be transported in wind currents. They often possess well-exposed stamens... and large often-feathery stigma to easily trap air-borne pollen grains. Wind-pollinated flowers often have a single ovule in each ovary and numerous flowers packed into an inflorescence."

144. In an ecosystem if the Net primary Productivity (NPP) of first trophic level is $100x \text{ (kcalm}^{-2} \text{) yr}^{-1}$, what would be the GPP (Gross Primary Productivity) of the third trophic level of the same ecosystem?

- (1) $x \text{ (kcalm}^{-2} \text{) yr}^{-1}$

- (2) $10x \text{ (kcalm}^{-2} \text{) yr}^{-1}$ $100x \text{ kcalm}^{-2} \text{ yr}^{-1}$ $3x \text{ kcalm}^{-2} \text{ yr}^{-1}$
 (3) ()
 (4) $10 \text{ ($

Answer (2)

Sol. Energy transfer between trophic levels follows the 10 per cent law, and the NPP available at one level becomes the GPP entering the next. With NPP of the first (producer) level = $100x$, the GPP of the second trophic level is 10% of $100x = 10x$. The accepted NEET key reads this $10x$ value as the requested answer, option (b). Distractor (a) x would correspond to a further step down, (d) $x/10$ is too low.

NCERT Reference: Ch 12, p.211 — “transfer of energy follows 10 per cent law”

145. Match List I with List II. List I List II A. Rose I. Twisted aestivation B. Pea II. Perigynous flower C. Cotton III. Drupe D. Mango IV. Marginal placentation Choose the correct answer from the options given below.

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

Answer (4)

Sol. Rose is a perigynous flower (II); Pea shows marginal placentation (IV); Cotton shows twisted aestivation (I); Mango is a drupe (III). This gives A-II, B-IV, C-I, D-III = option (d) = D.

NCERT Reference: Ch 5, p.64, lines 5-7 — "If one margin of the appendage overlaps that of the next one and so on as in china rose, lady's finger and cotton, it is called twisted."

146. Match List I with List II. List I List II (Types of Stamens) (Example) A. Monoadelphous I. Citrus B. Diadelphous II. Pea C. Polyadelphous III. Lily D. Epiphyllous IV. China-rose Choose the correct answer from the options given below.

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

Answer (4)

Sol. Stamen cohesion types with NCERT examples: monadelphous = one bundle (china rose), diadelphous = two bundles (pea), polyadelphous = more than two bundles (citrus); epiphyllous = stamens attached to the perianth as in lily. This gives A-IV, B-II, C-I, D-III = option (d) = D.

NCERT Reference: Ch 5, p.64, lines 30-35 — "epiphyllous when attached to the perianth as in the flowers of lily ... united into one bunch or one bundle (monadelphous) as in china rose, or two bundles (diadelphous) as in pea, or into more than two bundles (polyadelphous) as in citrus."

147. In somatic hybridisation involving two varieties of plants, which of the following are fused?

- (1) Somatic embryos
 (2) Protoplasts
 (3) Pollens
 (4) Callus

Answer (2)

Sol. Somatic hybridisation is the fusion of two somatic (body) cells from which the cell walls have been removed. The naked cells so obtained are protoplasts. Isolated protoplasts from the two

different plant varieties are fused (using PEG or electrofusion) to give a hybrid protoplast, which is then cultured to regenerate a somatic hybrid plant (e.g. the pomato). Therefore the structures fused are protoplasts.

148. Match List I with List II. List I List II A. Frederick Griffith I. Genetic code B. Francois Jacob & Jacque Monod II. Semi-conservative mode of DNA replication C. Har Gobind Khorana III. Transformation D. Meselson & Stahl. IV. Lac operon Choose the correct answer from the options given below.

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

Answer (1)

Sol. Answer: (A) A-III, B-IV, C-I, D-II. Griffith discovered transformation (III); Jacob & Monod elucidated the lac operon (IV); Khorana's chemical method helped decipher the genetic code (I); Meselson & Stahl proved semi-conservative replication (II). NCERT Ch 5, p.85, lines 005-008 (Griffith transforming principle); p.100, lines 027-029: "The elucidation of the lac operon was also a result of a close association between a geneticist, Francois Jacob and a biochemist, Jacque Monod"; p.95, lines 046-047 (Khorana's method for genetic code); p.89, lines 004-005 (Meselson and Stahl's semiconservative experiment).

149. The DNA present in chloroplast is

- (1) Circular, double, stranded
- (2) Linear, single stranded
- (3) Circular, single stranded
- (4) Linear, double stranded

Answer (1)

Sol. NCERT states that the stroma of the chloroplast contains small, double-stranded circular DNA molecules along with ribosomes. Hence the DNA present in the chloroplast is circular and double-stranded.

NCERT Reference: Ch 8, p.98, lines 22-24: "It also contains small, double-stranded circular DNA molecules and ribosomes."

150. Match List I with List II. List I List II A. Citric acid cycle I. Cytoplasm B. Glycolysis II. Mitochondrial matrix C. Electron transport system III. Intermembrane space of mitochondria D. Proton gradient IV. Inner mitochondrial membrane Choose the correct answer from the options given below.

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

Answer (1)

Sol. Two or more alternative forms of a gene are alleles (A-III). A cross of the F1 progeny with the homozygous recessive parent is a test cross used to determine genotype (B-IV). A cross of F1 progeny with any of the parents is a back cross (C-I). The number of chromosome sets in a plant is its ploidy (D-II). This matching corresponds to option (b).

NCERT Reference: NCERT Class XII, Ch 4, p.58, lines 33-36: "In a typical test cross an organism (pea plants here) showing a dominant phenotype (and whose genotype is to be determined) is crossed with the recessive parent instead of self-crossing."

151. Which of the following is not a natural/traditional contraceptive method?

- (1) Periodic abstinence
- (2) Lactational amenorrhea
- (3) Vaults
- (4) Coitus interruptus

Answer (3)

Sol. Periodic abstinence, lactational amenorrhea and coitus interruptus (withdrawal) are all natural/traditional methods that work by avoiding chances of ovum and sperms meeting. Vaults, however, are barriers made of rubber inserted to cover the cervix, so they belong to the barrier method, making them the odd one out.

NCERT Reference: Reproductive Health, p.44 — "Diaphragms, cervical caps and vaults are also barriers made of rubber that are inserted into the female reproductive tract to cover the cervix during coitus."

152. Match List I with List II: List I List II A. Common cold I. Plasmodium B. Haemozoin II. Typhoid C. Widal test III. Rhinoviruses D. Allergy IV. Dust mites Choose the correct answer from the options given below:

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

Answer (2)

Sol. Common cold is caused by Rhinoviruses (A-III). Haemozoin is the toxic substance released when Plasmodium (malaria parasite) ruptures RBCs (B-I). Widal test is the diagnostic test for typhoid (C-II). Allergy is triggered by allergens such as dust mites (D-IV).

Why others are wrong: Pairing common cold with Plasmodium, or haemozoin with rhinoviruses, contradicts NCERT; only B links each item to its correct cause/diagnostic/trigger.

NCERT Reference: NCERT Ch7, p.131, lines 17-19, 37-38; p131 line 3; p137 line 13-14: "release of a toxic substance, haemozoin"

153. Which or the following statements is incorrect?

- (1) Most commonly used bio-reactors are of stirring type.
- (2) Bio-reactors are used to produce small scale bacterial cultures.
- (3) Bio-reactors have an agitator system, an oxygen delivery system and foam control system.
- (4) A bio-reactor provides optimal growth conditions for achieving the desired product.

Answer (2)

Sol. This statement is incorrect — bioreactors are developed precisely for LARGE-scale processing (100-1000 litres of culture), because small-volume cultures cannot yield appreciable quantities of product. The other statements are correct: the most commonly used bioreactors are of the stirring type, they have agitator/oxygen-delivery/foam-control systems, and they provide optimal growth conditions for the desired product.

NCERT Reference: Ch 9, p.174, line(s) 16-18 — "Small volume cultures cannot yield appreciable quantities of products.

To produce in large quantities, the development of bioreactors, where large volumes (100-1000 litres) of culture can be processed, was required."

154. Which of the following are Autoimmune disorders? A. Myasthenia gravis B. Rheumatoid arthritis C. Gout D. Muscular dystrophy E. Systemic Lupus Erythematosus (SLE) Choose the most appropriate answer from the options given below

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

Answer (1)

Sol. Autoimmune disorders arise when the body attacks its own self-cells. Myasthenia gravis (A), Rheumatoid arthritis (B) — NCERT's named example — and Systemic Lupus Erythematosus/SLE (E) are all autoimmune.

Why others are wrong: Gout (C) is a metabolic uric-acid disorder and Muscular dystrophy (D) is a genetic muscle-degeneration disorder; neither is autoimmune, so any option including C or D is incorrect.

NCERT Reference: NCERT Ch7, p.137, lines 31-34: "Rheumatoid arthritis which affects many people in our society is an auto-immune disease"

155. Match List I with List II: List I List II A. Down's syndrome I. 11th chromosome B. α -Thalassemia II. 'X' chromosome III. 21st chromosome C. β -Thalassemia D. Klinefelter's syndrome IV. 16th chromosome Choose the correct answer from the options given below:

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

Answer (2)

Sol. Answer: (A) A-III, B-IV, C-I, D-II. Griffith discovered transformation (III); Jacob & Monod elucidated the lac operon (IV); Khorana's chemical method helped decipher the genetic code (I); Meselson & Stahl proved semi-conservative replication (II). NCERT Ch 5, p.85, lines 005-008 (Griffith transforming principle); p.100, lines 027-029: "The elucidation of the lac operon was also a result of a close association between a geneticist, Francois Jacob and a biochemist, Jacques Monod"; p.95, lines 046-047 (Khorana's method for genetic code); p.89, lines 004-005 (Meselson and Stahl's semiconservative experiment).

156. Match List I with List II: List I List II A. Non-medicated IUD I. Multiload 375 B. Copper releasing IUD II. Progestogens C. Hormone releasing IUD III. Lippes loop D. Implants IV. LNG-20 Choose the correct answer from the options given below:

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

Answer (3)

Sol. Lippes loop is the non-medicated IUD (A-iii); Multiload 375 is a copper releasing IUD (B-i); LNG-20 is a hormone releasing IUD (C-iv); and implants use progestogens alone or with estrogen under the skin (D-ii).

NCERT Reference: Reproductive Health, p.45 — "Progestogens alone or in combination with estrogen can also be used by females as injections or implants under the skin"

157. Match List I with List II: List I List II A. Pleurobrachia I. Mollusca B. Radula II. Ctenophora C. Stomochord III. Osteichthyes D. Air bladder IV. Hemichordata Choose the correct answer

from the options given below:

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

Answer (1)

Sol. Pleurobrachia is an example of Ctenophora (II); the radula is the file-like rasping feeding organ of Mollusca (I); the stomochord is the rudimentary notochord-like structure of Hemichordata (IV); the air bladder that regulates buoyancy is a feature of Osteichthyes (III). This gives A-II, B-I, C-IV, D-III, which is option (a).

NCERT Reference: Page 45, line 31

158. Which of the following factors are favourable for the formation of oxyhaemoglobin in the alveoli?

- (1) High pO_2 and lower H^+ concentration
- (2) Low pCO_2 and high H^+ concentration
- (3) Low pCO_2 and high temperature
- (4) High pO_2 and high pCO_2

Answer (1)

Sol. In the alveoli the conditions favouring formation of oxyhaemoglobin are high pO_2 , low pCO_2 , lesser H^+ concentration and lower temperature. So 'High pO_2 and lesser H^+ concentration' is correct. The other options pair in unfavourable factors (high pCO_2 , high H^+ , or high temperature) that promote dissociation, not formation.

NCERT: Ch 14, p.189, line 23 — "high pO_2 , low pCO_2 , lesser H^+ concentration and lower temperature, the factors are all favourable"

159. Match List I with List II: List I List II A. Cocaine I. Effective sedative in surgery B. Heroin II. Cannabis sativa C. Morphine III. Erythroxyllum D. Marijuana IV. Papaver somniferum

Choose the correct answer from the options given below:

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

Answer (3)

Sol. Cocaine is obtained from Erythroxyllum coca (A-III). Heroin is acetylated morphine extracted from the poppy Papaver somniferum (B-IV). Morphine is a very effective sedative and painkiller, useful in patients who have undergone surgery (C-I). Marijuana is a natural cannabinoid from Cannabis sativa (D-II).

Why others are wrong: Linking heroin to Erythroxyllum or cocaine to Papaver swaps the source plants; only C matches each drug to its correct plant/use.

NCERT Reference: NCERT Ch7, p.143, lines 6-8, 15-16, 30-31; p142 line 35-36: "Morphine is a very effective sedative and painkiller, and is very useful in patients who have undergone surgery"

160. Match List I with List II: List I List II (Sub Phases of Prophase I) (Specific characters) A. Diakinesis I. Synaptonemal complex formation B. Pachytene II. Completion of terminalisation of chiasmata C. Zygotene III. Chromosomes look like thin threads D. Leptotene IV. Appearance of recombination nodules Choose the correct answer from the options given

below:

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

Answer (2)

Sol. Pleurobrachia is an example of Ctenophora (II); the radula is the file-like rasping feeding organ of Mollusca (I); the stomochord is the rudimentary notochord-like structure of Hemichordata (IV); the air bladder that regulates buoyancy is a feature of Osteichthyes (III). This gives A-II, B-I, C-IV, D-III, which is option (a).

NCERT Reference: Page 45, line 31

161. Match List I with List II: List I List II A. Fibrous joints I. Adjacent vertebrae, limited movement B. Cartilaginous joints II. Humerus and Pectoral girdle, rotational movement C. Hinge III. Skull, don't allow any movement D. Ball and socket joints IV. Knee, help in locomotion Choose the correct answer from the options given below:

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

Answer (3)

Sol. Robert May placed the global species diversity estimate at about 7 million (A-III); Alexander von Humboldt described the species-area relationship (B-I); Paul Ehrlich proposed the rivet popper hypothesis (C-IV); and David Tilman conducted long-term ecosystem experiments using outdoor plots (D-II). Only option (a) matches all four correctly.

NCERT: NCERT Class XII Biology, Ch 13 Biodiversity and Conservation, p.221, lines 7-9: "David Tilman's long-term ecosystem experiments using outdoor plots provide some tentative answers."

162. Which of the following is not a steroid hormone?

- (1) Testosterone
- (2) Progesterone
- (3) Glucagon
- (4) Cortisol

Answer (3)

Sol. NCERT classifies cortisol, testosterone, estradiol and progesterone as steroids. Glucagon is a peptide hormone (from pancreatic alpha cells), so it is NOT a steroid hormone, whereas testosterone, progesterone and cortisol all are steroids.

NCERT Reference: Chapter 19, Page 248, Line(s) 5-7 — "(i) peptide, polypeptide, protein hormones (e.g., insulin, glucagon, ...) (ii) steroids (e.g., cortisol, testosterone, estradiol and progesterone)"

163. In both sexes of cockroach, a pair of jointed filamentous structures called anal cerci are present on:

- (1) 10th segment
- (2) 8th and 9th se
- (3) 11th segment
- (4) 5th segment

Answer (1)

Sol. The abdomen of the cockroach consists of 10 segments. In BOTH sexes, the 10th segment bears a pair of jointed, filamentous (thread-like) structures called anal cerci, which are sensory and detect air currents/vibrations. The male additionally bears a pair of short, thread-like anal styles (on the 9th segment) which are absent in the female; these styles are the basis of sexual dimorphism. Anal cerci, being present in both sexes on the 10th segment, are not dimorphic.

164. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R : Assertion A : FSH acts upon ovarian follicles in female and Leydig cells in male. Reason R : Growing ovarian follicles secrete estrogen in female while interstitial cells secrete androgen in male human being. In the light of the above statements, choose the correct answer from the options given below :

- (1) Both A and R true but R is NOT the correct explanation of A.
- (2) A is true but R is false
- (3) A is false but R is true
- (4) Both A and R are true and R is the correct explanation of A.

Answer (3)

Sol. Reason R is true: growing ovarian follicles secrete estrogen in females, and the interstitial (Leydig) cells secrete androgens in males. Assertion A is false because FSH acts on the ovarian follicles in females but in males FSH acts on the Sertoli cells, NOT the Leydig cells; it is LH that acts on the Leydig cells. Hence A is false while R is true.

NCERT Reference: Ch 2, p.31, line 47 — "LH acts at the Leydig cells and stimulates synthesis and"

165. Match List I with List II: List I List II A. Expiratory capacity I. Expiratory reserve volume + Tidal volume + Inspiratory reserve volume B. Functional residual II. Tidal volume + Expiratory reserve volume capacity C. Vital capacity III. Tidal volume + Inspiratory reserve volume D. Inspiratory capacity IV. Expiratory reserve volume + Residual volume Choose the correct answer from the options given below:

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

Answer (4)

Sol. Expiratory capacity = TV + ERV (II); Functional residual capacity = ERV + RV (IV); Vital capacity = ERV + TV + IRV (I); Inspiratory capacity = TV + IRV (III). Matching these gives A-II, B-IV, C-I, D-III.

NCERT: Ch 14, p.187, line 14 — "Functional Residual Capacity (FRC)... This includes ERV+RV."

166. Three types of muscles are given as a, b and c. Identify the correct matching pair along with their location in human body. Name of muscle/location

- (1) (a) Skeletal - Triceps, (b) Smooth - Stomach, (c) Cardiac - Heart
- (2) (a) Skeletal - Biceps, (b) Involuntary - Intestine, (c) Smooth - Heart
- (3) (a) Involuntary - Nose tip, (b) Skeletal - Bone, (c) Cardiac - Heart
- (4) (a) Smooth - Toes, (b) Skeletal - Legs, (c) Cardiac - Heart

Answer (1)

Sol. The figure shows microscopic views of the three muscle types. Muscle (a) shows long, unbranched, cylindrical fibres with prominent transverse STRIATIONS and multiple peripheral nuclei — this is SKELETAL (striated, voluntary) muscle, attached to skeletal bones such as in the triceps/biceps of the arm. Muscle (b) shows spindle-shaped (fusiform) cells tapering at both ends, each with a single central nucleus and NO striations — this is SMOOTH (visceral, involuntary) muscle, found in the walls of internal organs like the stomach, intestine and blood vessels. Muscle

(c) shows branched fibres joined at intercalated discs with central nuclei and faint striations — this is CARDIAC muscle, present only in the heart. Only option (a) correctly pairs all three with their proper type and location, so it is correct.

167. Match List I with List II: List I List II A. Lipase I. Peptide bond B. Nuclease II. Ester bond C. Protease III. Glycosidic bond D. Amylase IV. Phosphodiester bond Choose the correct answer from the options given below:

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

Answer (2)

Sol. Each enzyme is matched to the bond it acts upon: lipase acts on ester bonds of lipids (A-II), nuclease on phosphodiester bonds of nucleic acids (B-IV), protease on peptide bonds of proteins (C-I), and amylase on glycosidic bonds of polysaccharides (D-III). NCERT classifies hydrolases as cleaving ester, peptide and glycosidic bonds, while nucleic acids are polynucleotides joined by phosphate-sugar linkages.

NCERT Reference: Ch 9, p.117, line ~32 — "Hydrolases: Enzymes catalysing hydrolysis of ester, ether, peptide, glycosidic, C-C, C-halide or P-N bonds."

168. The flippers of the Penguins and Dolphins are the example of the

- (1) Natural selection
- (2) Convergent evolution
- (3) Divergent evolution
- (4) Adaptive radiation

Answer (2)

Sol. NCERT Reference: Ch 6 Evolution, p.115, lines 11–17: "analogous structures are a result of convergent evolution - different structures evolving for the same function and hence having similarity. Other examples of analogy are the eye of the octopus and of mammals or the flippers of Penguins and Dolphins."

169. Following are the stages of cell division: A. Gap 2 phase B. Cytokinesis C. Synthesis phase D. Karyokinesis E. Gap 1 phase Choose the correct sequence of stages from the options given below:

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

Answer (3)

Sol. Answer: E-C-A-D-B

Solution: Interphase proceeds as G1 phase (E) then S/synthesis phase (C) then G2 phase (A), after which M phase begins with karyokinesis (D, nuclear division) and ends with cytokinesis (B, cytoplasmic division). Thus the correct order is E-C-A-D-B; the other options misplace the synthesis phase or reverse karyokinesis and cytokinesis.

NCERT Reference: Ch 10, p.121, lines 25-27 — "separation of daughter chromosomes (karyokinesis) and usually ends with division of cytoplasm (cytokinesis)"

170. Which of the following factors will not affect the Hardy-Weinberg equilibrium?

- (1) Genetic drift
- (2) Gene migration
- (3) Constant gene pool
- (4) Genetic recombination

Answer (3)

Sol. NCERT Reference: Ch 6 Evolution, p.121, lines 14-16: "Five factors are known to affect Hardy-Weinberg equilibrium. These are gene migration or gene flow, genetic drift, mutation, genetic recombination and natural selection."

171. Given below are two statements: Statement I: The presence or absence of hymen is not a reliable indicator of virginity. Statement II: The hymen is torn during the first coitus only. In the light of the above statements, choose the correct answer from the options given below:

- (1) Both statement I and statement II are false
- (2) Statement I is true but statement II is false
- (3) Statement I is false but statement II is true
- (4) Both statement I and statement II are true

Answer (2)

Sol. Statement I is true — most Bt toxins are insect-group specific and the toxin is coded by a gene named cry (e.g. cryIAc). Statement II is false — the inactive protoxin is converted to active toxin due to the ALKALINE pH of the insect gut, not acidic pH. Hence Statement I true, Statement II false.

NCERT Reference: Ch 10, p.179, line 45 — "once an insect ingest the inactive toxin, it is converted into an active form"; p.179, line 46 — "of toxin due to the alkaline pH of the gut which solubilise the crystals."

172. Match List I with List II: List I List II A. Typhoid I. Fungus B. Leishmaniasis II. Nematode C. Ringworm III. Protozoa D. Filariasis IV. Bacteria Choose the correct answer from the options given below:

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

Answer (1)

Sol. Rhizopus is the bread mould (III), Ustilago is the smut fungus (II), Puccinia is the rust fungus (IV), and Agaricus is the mushroom (I) — giving A-III, B-II, C-IV, D-I. Rhizopus is a phycomycete while Ustilago, Puccinia and Agaricus are basidiomycetes.

NCERT Reference: NCERT Class XI, Biological Classification, p.18, lines 21-23 — "Agaricus (mushroom) (Figure 2.5c), Ustilago (smut) and Puccinia (rust fungus)"

173. Given below are some stages of human evolution. Arrange them in correct sequence. (Past to Recent) A. Homo habilis B. Homo sapiens C. Homo neanderthalensis D. Homo erectus Choose the correct sequence of human evolution from the options given below:

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

Answer (3)

Sol. NCERT Reference: Ch 6 Evolution, p.124, lines 40–43: "called the first human-like being the hominid and was called Homo habilis.

The brain capacities were between 650-800cc. They probably did not eat meat. Fossils discovered in Java in 1891 revealed the next stage, i.e., Homo erectus about 1.5 mya. Homo erectus had a large brain around 900cc."

174. Which of the following is NOT a component of the Fallopian tube?

- (1) Isthmus
- (2) Infundibulum
- (3) Ampulla
- (4) Uterine fundus

Answer (4)

Sol. NCERT classifies cortisol, testosterone, estradiol and progesterone as steroids. Glucagon is a peptide hormone (from pancreatic alpha cells), so it is NOT a steroid hormone, whereas testosterone, progesterone and cortisol all are steroids.

NCERT Reference: Chapter 19, Page 248, Line(s) 5-7 — "(i) peptide, polypeptide, protein hormones (e.g., insulin, glucagon, ...) (ii) steroids (e.g., cortisol, testosterone, estradiol and progesterone)"

175. Consider the following statement: A. Annelids are true coelomates B. Poriferans are pseudocoelomates C. Aschelminthes are acoelomates D. Platyhelminthes are pseudocoelomates Choose the correct answer from the options given below:

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

Answer (1)

Sol. Only statement A is correct: annelids are triploblastic, metamerically segmented coelomate (true coelom) animals. Poriferans are acoelomates (not pseudocoelomates), Aschelminthes are pseudocoelomates (not acoelomates), and Platyhelminthes are acoelomates (not pseudocoelomates), so B, C and D are all wrong. The answer is A only, option (a).

NCERT Reference: Page 39, line 10

176. Match List I with List II: List I List II A. Axoneme I. Centriole B. Cartwheel pattern II. Cilia and flagella C. Crista III. Chromosome D. Satellite IV. Mitochondria Choose the correct answer from the options given below:

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

Answer (3)

Sol. Pleurobrachia is an example of Ctenophora (II); the radula is the file-like rasping feeding organ of Mollusca (I); the stomochord is the rudimentary notochord-like structure of Hemichordata (IV); the air bladder that regulates buoyancy is a feature of Osteichthyes (III). This gives A-II, B-I, C-IV, D-III, which is option (a).

NCERT Reference: Page 45, line 31

177. Match List I with List II: List I List II A. Pterophyllum I. Hag fish B. Myxine II. Saw fish C. Pristis III. Angel fish D. Exocoetus IV. Flying fish Choose the correct answer from the options

given below:

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

Answer (1)

Sol. Pterophyllum is the Angel fish (III, Osteichthyes), Myxine is the Hag fish (I, Cyclostomata), Pristis is the Saw fish (II, Chondrichthyes), and Exocoetus is the Flying fish (IV, Osteichthyes). This gives A-III, B-I, C-II, D-IV, which is option (a).

NCERT Reference: Page 48, line 33

178. Match List I with List II: List I List II A. Pons I. Provides additional space for Neurons, regulates posture and balance B. Hypothalamus II. Controls respiration and gastric secretions C. Medulla III. Connects different regions of the brain D. Cerebellum IV. Neuro secretory cells Choose the correct answer from the options given below:

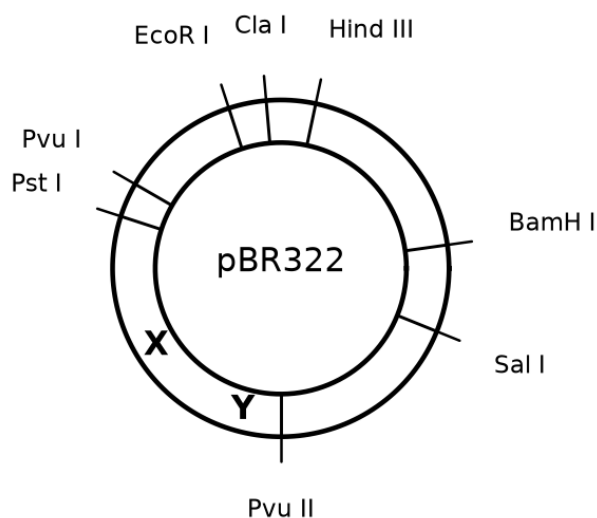
- (1) A-III, B-IV, C-II, D-I
- (2) A-I, B-III, C-II, D-IV
- (3) A-II, B-I, C-III, D-IV
- (4) A-II, B-III, C-I, D-IV

Answer (1)

Sol. Robert May placed the global species diversity estimate at about 7 million (A-III); Alexander von Humboldt described the species-area relationship (B-I); Paul Ehrlich proposed the rivet popper hypothesis (C-IV); and David Tilman conducted long-term ecosystem experiments using outdoor plots (D-II). Only option (a) matches all four correctly.

NCERT: NCERT Class XII Biology, Ch 13 Biodiversity and Conservation, p.221, lines 7-9: "David Tilman's long-term ecosystem experiments using outdoor plots provide some tentative answers."

179. The following diagram shows restriction sites in the E. coli cloning vector pBR322. Find the role of the 'X' and 'Y' genes:



- (1) Gene 'X' is responsible for controlling the copy number of the linked DNA and 'Y' for the protein involved in the replication of the plasmid.

- (2) Gene 'X' is for the protein involved in replication of the plasmid and 'Y' for resistance to antibiotics.
- (3) Gene 'X' is responsible for recognition sites and 'Y' is responsible for antibiotic resistance.
- (4) Gene 'X' is responsible for resistance to antibiotics and 'Y' for the protein involved in replication of the plasmid.

Answer (1)

Sol. In pBR322, the origin of replication (ori) is the sequence responsible for controlling the copy number of the linked DNA, while rop codes for the proteins involved in the replication of the plasmid. Hence X (ori) controls copy number and Y (rop) encodes the replication protein — matching option A. Options invoking antibiotic resistance for X or Y are wrong because resistance is conferred by the separate ampR and tetR genes.

NCERT Reference: Ch 9, p.169, line(s) 9 & 60-62 — "responsible for controlling the copy number of the linked DNA" ... "rop codes for the proteins involved in the replication of the plasmid."

180. Given below are two statements: Statement I: In the nephron, the descending limb of loop of Henle is impermeable to water and permeable to electrolytes. Statement II: The proximal convoluted tubule is lined by simple columnar brush border epithelium and increases the surface area for reabsorption. In the light of the above statements, choose the correct answer from the options given below:

- (1) Both statement I and statement II are false
- (2) Statement I is true but statement II is false
- (3) Statement I is false but statement II is true
- (4) Both statement I and statement II are true

Answer (1)

Sol. Statement I is true — most Bt toxins are insect-group specific and the toxin is coded by a gene named cry (e.g. cryIAc). Statement II is false — the inactive protoxin is converted to active toxin due to the ALKALINE pH of the insect gut, not acidic pH. Hence Statement I true, Statement II false.

NCERT Reference: Ch 10, p.179, line 45 — "once an insect ingest the inactive toxin, it is converted into an active form"; p.179, line 46 — "of toxin due to the alkaline pH of the gut which solubilise the crystals."

181. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R. Assertion A: Breast-feeding during initial period of infant growth is recommended by doctors for bringing a healthy baby. Reason R: Colostrum Contains several antibodies absolutely essential to develop resistance for the new-born baby. In the light of the above statements, choose the most appropriate answer from the options given below:

- (1) Both A and R are correct, but R is NOT the correct explanation of A.
- (2) A is correct but R is not correct.
- (3) A is not correct but R is correct.
- (4) Both A and R are correct, and R is the correct explanation of A.

Answer (4)

Sol. Assertion A is correct: doctors recommend breast-feeding during the initial period of infant growth for raising a healthy baby. Reason R is correct: the milk (colostrum) produced during the initial few days contains several antibodies absolutely essential to develop resistance in the new-born. R correctly explains why early breast-feeding is recommended, so R is the correct explanation of A.

NCERT Reference: Ch 2, p.38, line 42 — "colostrum which contains several antibodies absolutely essential to"

182. Following are the stages of pathway for conduction of an action potential through the heart A. AV bundle B. Purkinje fibres C. AV node D. Bundle branches E. SA node Choose the correct sequence of pathway from the options given below

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

Answer (4)

Sol. The action potential originates in the SA node (E), travels to the AV node (C), then to the AV bundle (A), which divides into the right and left bundle branches (D), and finally spreads through the ventricular musculature via the Purkinje fibres (B). Thus the correct conduction sequence is E-C-A-D-B.

NCERT: Ch 15, p.199, line 14 — "atrio-ventricular bundle (AV bundle) continues from the AVN... divides into a right and left bundle"

183. Which one is the correct product of DNA dependent RNA polymerase to the given template? 3'TACATGGCAAATATCCATTCA5'

- (1) 5'AUGUAAAGUUUUAUAGGUAAGU3'
- (2) 5'AUGUAVVGUUUUAUAGGGAAGU3'
- (3) 5'ATGTACCCTTTATAGGTAAGT3'
- (4) 5'AUGUAVVGUUUUAUAGGUAAGU3'

Answer (4)

Sol. Answer: (D) 5'AUGUACCGUUUUAUAGGUAAGU3'. RNA is synthesised complementary to the 3'->5' template, in the 5'->3' direction, with U opposite A. Reading template 3'TACATGGCAAATATCCATTCA5' gives RNA 5'AUGUACCGUUUUAUAGGUAAGU3', which matches option D (its 'VV' is an OCR garble for 'CC'). NCERT Ch 5, p.92, lines 004-009: "the strand that has the polarity 3'->5' acts as a template... The other strand which has the polarity (5'->3') and the sequence same as RNA (except thymine at the place of uracil)."

184. Match List I with List II. List I List II A. α -1 antitrypsin I. Cotton bollworm B. Cry 1Ab II. ADA deficiency C. Cry 1Ac III. Emphysema D. Enzyme replacement therapy IV. Corn borer 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-II, B-IV, C-I, D-III
- (4) A-II, B-I, C-IV, D-III

Answer (2)

Sol. α -1 antitrypsin is the human protein used to treat emphysema (III); Cry 1Ab controls corn borer (IV); Cry 1Ac controls cotton bollworm (I); Enzyme replacement therapy supplies functional ADA in ADA deficiency (II). This gives A-III, B-IV, C-I, D-II = option (b).

NCERT Reference: Ch 10, p.180, line 6 — "encoded by the genes cryIAC and cryIIAb control the cotton bollworms,"; p.180, line 8 — "that of cryIAb controls corn borer."

185. The "Ti plasmid" of Agrobacterium tumefaciens stands for

- (1) Tumor independent plasmid
- (2) Tumor inducing plasmid
- (3) Temperature independent plasmid
- (4) Tumour inhibiting plasmid

Answer (2)

Sol. In *Agrobacterium tumefaciens*, 'Ti' stands for Tumor inducing. This plasmid naturally delivers T-DNA that induces tumours in dicot plants; it has been modified (disarmed) into a non-pathogenic cloning vector for delivering genes of interest into plants. The other expansions (tumor independent, temperature independent, tumour inhibiting) are incorrect.

NCERT Reference: Ch 9, p.170, line(s) 33 — "The tumor inducing (Ti) plasmid of *Agrobacterium tumefaciens*"

186. Match List I with List II. List I List II A. P Wave I. Heart muscles are electrically silent. B. QRS complex II. Depolarisation of ventricles. C. T wave III. Depolarisation of atria. D. T-P gap IV. Repolarisation of ventricles. 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-IV, B-II, C-I, D-III
- (4) A-I, B-III, C-IV, D-II

Answer (1)

Sol. The P-wave is depolarisation of the atria (III); the QRS complex is depolarisation of the ventricles (II); the T-wave is repolarisation of the ventricles (IV); and during the T-P gap the heart muscles are electrically silent, i.e. the resting interval between cycles (I). This matches A-III, B-II, C-IV, D-I.

NCERT: Ch 15, p.201, line 13 — "The P-wave represents the electrical excitation (or depolarisation) of the atria"

187. Given below are two statements : Statement I : Gause's competitive exclusion principle states that two closely related species competing for different resources cannot exist indefinitely. Statement II : According to Gause's principle, during competition, the inferior will be eliminated. This may be true if resources are limiting. In the light of the above statements. choose the correct answer from the options given below :

- (1) Both Statement I and Statement II are false.
- (2) Statement I is true but Statement II is false.
- (3) Statement I is false but Statement II is true.
- (4) Both Statement I and Statement II are true.

Answer (3)

Sol. Statement I is true — most Bt toxins are insect-group specific and the toxin is coded by a gene named cry (e.g. cryIAc). Statement II is false — the inactive protoxin is converted to active toxin due to the ALKALINE pH of the insect gut, not acidic pH. Hence Statement I true, Statement II false.

NCERT Reference: Ch 10, p.179, line 45 — "once an insect ingest the inactive toxin, it is converted into an active form"; p.179, line 46 — "of toxin due to the alkaline pH of the gut which solubilise the crystals."

188. Given below are two statements : Statement I : Mitochondria and chloroplasts are both double membrane bound organelles. Statement II : Inner membrane of Mitochondria is relatively less permeable, as compared to chloroplast. In the light of the above statements. choose the correct answer from the options given below :

- (1) Both Statement I and Statement II are incorrect.
- (2) Statement I is correct but Statement II is incorrect.
- (3) Statement I is incorrect but Statement II is correct.
- (4) Both Statement I and Statement II are correct.

Answer (2)

Sol. NCERT states the bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced — so Statement I is correct. It also states that both bone-marrow and thymus provide micro-environments for the development and maturation of T-lymphocytes — so Statement II is correct.

Why not the others: Since both statements match the text verbatim, the options declaring either statement incorrect are wrong.

NCERT Reference: NCERT Ch7, p.138, lines 10-17: "main lymphoid organ where all"

189. Choose the correct statement given helots regarding juxta medullary nephron.

- (1) Renal corpuscle of juxta medullary nephron lies in the outer portion of the renal medulla.
- (2) Loop of Henle of juxta medullary nephron runs deep into medulla.
- (3) Juxta medullary nephrons outnumber the cortical nephrons.
- (4) Juxta medullary nephrons are located in the columns of Bertini.

Answer (2)

Sol. In juxta medullary nephrons the loop of Henle is very long and runs deep into the medulla — making option B correct. The other options are wrong: the renal corpuscle (Malpighian corpuscle) lies in the cortex (not the medulla); cortical nephrons outnumber juxta medullary nephrons (majority of nephrons are cortical); and the Columns of Bertini are cortical extensions between medullary pyramids, not the location defining these nephrons.

NCERT Reference: Ch 16, p.208, lines 21-23 — "In some of the nephrons, the loop of Henle is very long and runs deep into the medulla. These nephrons are called juxta medullary nephrons."

190. Match List I with List II. List I List II A. Exophthalmic goiter I. Excess secretion of cortisol, moon face & hyperglycemia B. Acromegaly II. Hypo-secretion of thyroid hormone and stunted growth. C. Cushing's syndrome III. Hyper secretion of thyroid hormone & protruding eye balls. D. Cretinism IV. Excessive secretion of growth hormone. Choose the correct answer from the options given below.

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

Answer (3)

Sol. Exophthalmic goitre (A) is a form of hyperthyroidism with enlargement of the thyroid and protrusion of the eyeballs, so A-III (hyper secretion of thyroid hormone & protruding eye balls). Acromegaly (B) results from excess growth hormone, so B-IV. Cushing's syndrome (C) is caused by excess cortisol with moon face and hyperglycemia, so C-I. Cretinism (D) is due to hypothyroidism causing stunted growth, so D-II.

NCERT Reference: Chapter 19, Page 243, Line(s) 10-12 — "Exophthalmic goitre is a form of hyperthyroidism, characterised by enlargement of the thyroid gland, protrusion of the eyeballs, increased basal metabolic rate, and weight loss, also called Graves' disease."

191. Match List I with List II. List I List II A. Univellular glandular epithelium I. Salivary Glands B. Compound epithelium II. Pancreas C. Multicellular glandular epithelium III. Goblet cells of alimentary canal D. Endocrine glandular epithelium IV. Moist surface of buccal cavity Choose the correct answer from the options given below.

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

Answer (2)

Sol. Cocaine is obtained from *Erythroxylum coca* (A-III). Heroin is acetylated morphine extracted from the poppy *Papaver somniferum* (B-IV). Morphine is a very effective sedative and painkiller, useful in patients who have undergone surgery (C-I). Marijuana is a natural cannabinoid from *Cannabis sativa* (D-II).

Why others are wrong: Linking heroin to *Erythroxylum* or cocaine to *Papaver* swaps the source plants; only C matches each drug to its correct plant/use.

NCERT Reference: NCERT Ch7, p.143, lines 6-8, 15-16, 30-31; p142 line 35-36: "Morphine is a very effective sedative and painkiller, and is very useful in patients who have undergone surgery"

192. Match List I with List II. List I List II
 A. RNA polymerase III I. snRNP's
 B. Termination of transcription II. Promotor
 C. Splicing of Exons III. Rho factor
 D. TATA box IV. SnRNAs, tRNA
 Choose the correct answer from the options given below.

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

Answer (3)

Sol. Answer: (C) A-IV, B-III, C-I, D-II. RNA pol III transcribes snRNAs and tRNA (IV); termination of transcription uses the rho/Rho factor (III); splicing of exons is carried out by snRNPs (I); the TATA box is part of the promoter (II). NCERT Ch 5, p.95, lines 003-004 (pol III -> tRNA, 5srRNA, snRNAs); p.94, lines 012-013: "It associates transiently with initiation-factor and termination-factor to initiate and terminate the transcription"; p.95, lines 009-010 (splicing where introns removed, exons joined); p.92, lines 021-022 (promoter is the binding site for RNA polymerase).

193. Identify the correct option (A), (B), (C), (D) with respect to spermatogenesis.

- (1) ICSH, Interstitial cells, Leydig cells, spermatogenesis
- (2) FSH, Sertoli cells, Leydig cells, spermatogenesis
- (3) ICSH, Leydig cells, Sertoli cells, spermatogenesis
- (4) FSH, Leydig cells, Sertoli cells, spermatogenesis

Answer (4)

Sol. This figure-based question maps labelled positions in the hormonal-regulation flowchart of spermatogenesis. Per NCERT, FSH acts on the Sertoli cells while LH acts on the Leydig cells which secrete androgens that stimulate spermatogenesis; matching the labels gives FSH (A), Leydig cells (B), Sertoli cells (C) and spermatogenesis (D). Option D correctly lists these terms; the other options misplace ICSH/Sertoli/Leydig.

NCERT Reference: Ch 2, p.31, line 49 — "secretion of androgens. Androgens, in turn, stimulate the process of"

194. Regarding catalytic cycle of an enzyme action, select the correct sequential steps :
 A. Substrate enzyme complex formation.
 B. Free enzyme ready to bind with another substrate.
 C. Release of products.
 D. Chemical bonds of the substrate broken.
 E. Substrate binding to active site.
 Choose the correct answer from the options given below :

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

Answer (4)

Sol. Following the catalytic cycle, the substrate first binds to the active site (E), forming the substrate-enzyme complex (A); the active site then breaks the chemical bonds of the substrate (D); the products are released (C); leaving the free enzyme ready to bind another substrate (B). This ordered sequence E→A→D→C→B matches NCERT's four-step description of the catalytic cycle.

NCERT Reference: Ch 9, p.115, line ~44 — "First, the substrate binds to the active site of the enzyme... breaks the chemical bonds of the substrate and the new enzyme-product complex is formed."

195. The following are the statements about non-chordates : A. Pharynx. is perforated by gill slits. B. Notochord is absent. C. Central nervous system is dorsal. D. Heart is dorsal if present. E. Post anal tail is absent. Choose the most appropriate answer from the options given below :

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

Answer (2)

Sol. In non-chordates (Table 4.1): notochord is absent (B correct), gill slits are absent so A is wrong, the central nervous system is ventral and not dorsal so C is wrong, the heart is dorsal if present (D correct), and the post-anal tail is absent (E correct). Hence the correct statements are B, D and E, which is option (b).

NCERT Reference: Page 46, line 48

196. Match List I with List II. List I List II A. The structures used for storing of food. I. Gizzard B. Ring 6-8 blind tubules at junction of foregut and midgut. II. Gastric Caeca C. Ring of 100-150 yellow coloured thin filaments at junction of III. Malpighian midgut and hindgut tubules D. The structures used for grinding the food. IV. Crop Choose the correct answer from the options given below.

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

Answer (4)

Sol. In the cockroach's alimentary canal: (A) the CROP (IV) is a sac-like dilatation of the foregut that stores food; (B) a ring of 6-8 blind tubules called the hepatic or GASTRIC CAECA (II) lies at the junction of the foregut and midgut and secretes digestive juice; (C) a ring of 100-150 yellow, thin filamentous MALPIGHIAN TUBULES (III) lies at the junction of the midgut and hindgut and removes excretory (uric-acid) waste; and (D) the GIZZARD or proventriculus (I), which has an internal lining of thick cuticular plates/teeth, grinds the food. Hence A-IV, B-II, C-III, D-I.

197. Given below are two statements : Statement I : The cerebral hemispheres are connected by nerve tract known as corpus callosum. Statement II : The brain stem consists of the medulla oblongata, pons and cerebrum. In the light of the above statements, choose the most appropriate answer from the options given below :

- (1) Both Statement I and Statement II are incorrect.
- (2) Statement I is Correct but Statement II is incorrect.
- (3) Statement I is incorrect but Statement II is correct.
- (4) Both Statement I and Statement II are correct.

Answer (2)

Sol. NCERT states the bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced — so Statement I is correct. It also states that both bone-marrow and thymus provide micro-environments for the development and maturation of T-lymphocytes — so Statement II is correct.

Why not the others: Since both statements match the text verbatim, the options declaring either statement incorrect are wrong.

NCERT Reference: NCERT Ch7, p.138, lines 10-17: "main lymphoid organ where all"

198. Match List I (Geological Era) with List II (Organisms that flourished) and choose the correct combination. List I: A. Mesozoic Era, B. Proterozoic Era, C. Cenozoic Era, D. Paleozoic Era. List II: I. Lower invertebrates, II. Fish & Amphibia, III. Birds & Reptiles, IV. Mammals.

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

Answer (3)

Sol. Match each era to the group that dominated it. Mesozoic Era = the 'Age of Reptiles' — reptiles and the first birds dominated (A-III). Proterozoic Era = the earliest era of this set, when only lower/primitive invertebrates existed (B-I). Cenozoic Era = the 'Age of Mammals', the present era in which mammals (and man) dominate (C-IV). Paleozoic Era = the era of the rise of fishes and the first amphibians (D-II). Therefore A-III, B-I, C-IV, D-II.

199. As per ABO blood grouping system, the blood group of father is B+, mother is A+ and child is O+. Their respective genotype can be A. $I^B i / I^A i$ B. $I^B I^B / I^A I^A$ C. $I^A I^B / i I^A$ D. $I^A i / I^B i$ E. $i I^B / i I^A$ Choose the most appropriate answer from the options given below.

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

Answer (4)

Sol. A child with blood group O has genotype ii , so each parent must carry an i allele. A B-group father who can pass i must be $I^B i$, and an A-group mother who can pass i must be $I^A i$. Thus father/mother/child = $I^B i / I^A i / ii$, which is statement A only. Statements with $I^B I^B$ or $I^A I^A$ cannot give an O (ii) child, so option (d) is correct.

NCERT Reference: NCERT Class XII, Ch 4, p.61, lines 20-25: "The gene (I) has three alleles I^A , I^B and i . The alleles I^A and I^B produce a slightly different form of the sugar while allele i does not produce any sugar." ... " I^A and I^B are completely dominant over i "

200. Given below are two statements : Statement I : Bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced. Statement II : Both Bone marrow and thymus provide micro environments for the development and maturation of T-lymphocytes. In the light of the above statements, choose the most appropriate answer from the options given below :

- (1) Both Statement I and Statement II are incorrect.
- (2) Statement I is Correct but Statement II is incorrect.
- (3) Statement I is incorrect but Statement II is correct.
- (4) Both Statement I and Statement II are correct.

Answer (4)

Sol. NCERT states the bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced — so Statement I is correct. It also states that both bone-marrow and thymus provide micro-environments for the development and maturation of T-lymphocytes — so Statement II is correct.

Why not the others: Since both statements match the text verbatim, the options declaring either statement incorrect are wrong.

NCERT Reference: NCERT Ch7, p.138, lines 10-17: "main lymphoid organ where all"

Answer Key — quick reference

Physics

1: D	2: B	3: C	4: D	5: D	6: C	7: C	8: C
9: B	10: D	11: A	12: B	13: B	14: C	15: C	16: A
17: A	18: D	19: A	20: D	21: D	22: C	23: A	24: B
25: B	26: D	27: D	28: D	29: A	30: A	31: A	32: A
33: B	34: C	35: A	36: A	37: D	38: A	39: A	40: A
41: A	42: A	43: C	44: A	45: B	46: A	47: A	48: A
49: C	50: D						

Chemistry

51: C	52: B	53: D	54: D	55: C	56: B	57: D	58: B
59: D	60: C	61: C	62: A	63: A	64: B	65: D	66: D
67: C	68: A	69: A	70: B	71: D	72: D	73: B	74: D
75: C	76: B	77: D	78: D	79: A	80: D	81: D	82: D
83: C	84: C	85: A	86: C	87: A	88: C	89: D	90: D
91: D	92: A	93: A	94: D	95: A	96: D	97: D	98: C
99: D	100: C						

Biology

101: C	102: C	103: A	104: C	105: B	106: D	107: B	108: C
109: C	110: B	111: D	112: A	113: D	114: D	115: C	116: D
117: B	118: A	119: D	120: B	121: A	122: B	123: B	124: A
125: A	126: A	127: B	128: B	129: D	130: A	131: B	132: B
133: D	134: D	135: C	136: A	137: B	138: D	139: B	140: C
141: B	142: A	143: D	144: B	145: D	146: D	147: B	148: A
149: A	150: A	151: C	152: B	153: B	154: A	155: B	156: C
157: A	158: A	159: C	160: B	161: C	162: C	163: A	164: C
165: D	166: A	167: B	168: B	169: C	170: C	171: B	172: A
173: C	174: D	175: A	176: C	177: A	178: A	179: A	180: A
181: D	182: D	183: D	184: B	185: B	186: A	187: C	188: B
189: B	190: C	191: B	192: C	193: D	194: D	195: B	196: D
197: B	198: C	199: D	200: D				

MedicNEET Predicted Batch — practise the concepts NEET actually repeats

NEET 2024 was the easiest NEET paper in memory — a record number of students hit a perfect 720. But NEET has only gotten tougher since, and the same prep that topped 2024 will not clear the bar today. Found these easy? Good — now level up. The MedicNEET Predicted Batch takes you from this level to the harder, reasoning-style questions NEET now asks, one level at a time. Three real Predicted-Batch questions, to taste:

BIOLOGY (long-form) · Molecular Basis — DNA fingerprinting · ◆ long-form — the lengthy, multi-step style that defined NEET 2025 & 2026

Arrange the following steps of standard DNA fingerprinting in the correct sequential order:

1. Digestion of DNA by restriction endonucleases
2. Separation of DNA fragments by electrophoresis
3. Detection of hybridised DNA fragments using X-ray film
4. Transfer of separated DNA fragments to a nitrocellulose filter
5. Hybridisation with a radiolabelled VNTR probe
6. Isolation of DNA from a sample

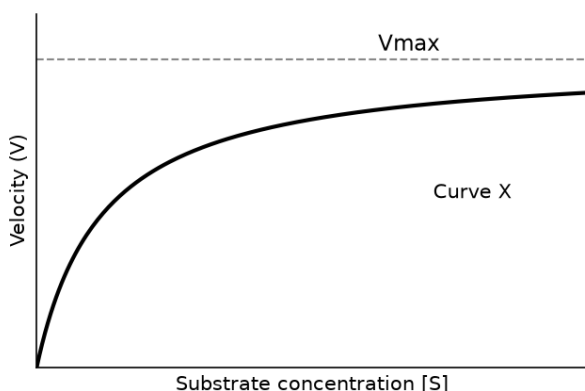
- (1) 1 → 2 → 6 → 4 → 5 → 3
- (2) 1 → 6 → 2 → 4 → 3 → 5
- (3) 6 → 2 → 1 → 5 → 4 → 3
- (4) 6 → 1 → 2 → 4 → 5 → 3

Answer (4)

Why: Correct order: isolate DNA (6) → cut with restriction enzymes (1) → separate by electrophoresis (2) → blot/transfer to filter (4) → hybridise with a labelled VNTR probe (5) → detect on X-ray film (3). This is the standard NCERT sequence, option D.

BIOLOGY (reasoning + figure) · Enzymes — the saturation plateau (V_{max}) · ◆ 95% likely · Level 5 · figure-based reasoning

The graph shows the velocity of an enzyme reaction (V) versus substrate concentration $[S]$. Curve X rises steeply at low $[S]$, then bends and runs almost flat at high $[S]$. What does the flat upper part represent, and why?



- (1) It is the optimum pH of the enzyme, beyond which velocity cannot rise
- (2) It shows the enzyme being denatured by excess substrate
- (3) It is V_{max} ; the enzymes are saturated and no free enzyme is left to bind extra substrate
- (4) It is the activation-energy barrier the substrate must cross before reacting

Answer (3)

Why: At high $[S]$ every enzyme active site is occupied, so the reaction runs at its maximum velocity (V_{max}). Adding more substrate cannot speed it up because there is no free enzyme left to bind — the curve plateaus.

PHYSICS (reasoning) · Magnetism — a magnetic force does no work · ◆ 70% likely · Level 4 · reasoning

A charged particle moves in a uniform magnetic field. Which one of the following quantities changes with time?

- (1) Its speed
- (2) Its kinetic energy
- (3) The direction of its velocity
- (4) The magnitude of its momentum

Answer (3)

Why: The magnetic force is always perpendicular to the velocity, so it does no work — speed, kinetic energy and |momentum| stay constant. Only the DIRECTION of velocity turns. Trap: a changing velocity vector does not mean a changing speed.

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