

PHYSICS

1. (b)

Potential energy stored in external magnetic field is given by $U = -\vec{m} \cdot \vec{B}$

$\therefore$ Angle between $\vec{m}$ and $\vec{B}$ is 90°

$$\therefore U = -mB \cos 90^\circ$$

$$= 0$$

2. (a)

In horizontal circular motion,

$$T = m\omega^2 r$$

For constant m and r , $T \propto \omega^2$

$$T' = 4 T \text{ (Given)}$$

$$\Rightarrow \omega' = 2\omega$$

$$= 20 \text{ rpm}$$

3. (d)

In metal all the charge is present on surface.

$$Q = 6\mu C$$

$$\text{Total surface area } S = 6a^2$$

$$= 6 \times (5 \times 10^{-2})^2$$

$$= 6 \times 25 \times 10^{-4}$$

$$= 150 \times 10^{-4} \text{ m}^2$$

$$\text{Surface charge density } \sigma = \frac{Q}{S}$$

$$= \frac{6 \times 10^{-6}}{150 \times 10^{-4}}$$

$$= 0.4 \times 10^{-3} \text{ Cm}^{-2}$$

4. (d)

For diamagnetic material,

$$0 \leq \mu_r < 1$$

$$\chi = \mu_r - 1$$

$$\Rightarrow -1 \leq \chi < 0$$

$$\mu_r = \frac{\mu}{\mu_0}$$

$$\Rightarrow \mu < \mu_0 (\because \mu_r < 1)$$

5. (c)

According to Bernoulli's principle,

Kinetic energy per unit volume + Potential energy per unit volume + Pressure = Constant

$$\frac{1}{2} \rho V^2 + \rho gh + P = \text{constant}$$

Apply Bernoulli's principle at point X and Y ,

$$P + K_1 + \rho g(0) = P + K_2 + \rho g(h)$$

$$K_1 = K_2 + \rho gh$$

$$K_1 > K_2$$

6. (c)

Escape velocity of object from planet is given by

$$(v_e)_p = \sqrt{\frac{2GM_p}{R_p}}$$

$$\therefore (v_e)_p \propto \sqrt{\frac{M_p}{R_p}}$$

Now, $M_p = 9M_e$ and $R_p = 16R_e$ (given)

$$\frac{(v_e)_p}{(v_e)_e} = \sqrt{\frac{M_p}{R_p} \times \frac{R_e}{M_e}} = \sqrt{\frac{9M_e}{16R_e} \times \frac{R_e}{M_e}} = \sqrt{\frac{9}{16}} = \frac{3}{4}$$

$$\Rightarrow (v_e)_p = \frac{3}{4}v$$

7. (a)

de-Broglie wavelength is given by

$$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mqV}}$$

For same potential difference

$$\lambda \propto \frac{1}{\sqrt{mq}}$$

$$\frac{\lambda_\alpha}{\lambda_e} = \sqrt{\frac{m_e q_e}{m_\alpha q_\alpha}}$$

$$\because m_\alpha \gg m_e$$

$$\lambda_e > \lambda_\alpha$$

8. (c)

Work energy theorem,

$$W_{\text{all}} = \Delta K.E \quad (W_{\text{all}} = \text{work done by all forces})$$

$$\Rightarrow K_f - K_i = \vec{F} \cdot \Delta \vec{x}$$

$$\Rightarrow K_f - 10 = (-2\hat{i} + 3\hat{j}) \cdot (3\hat{i})$$

$$K_f - 10 = -6$$

$$K_f = 4 \text{ J}$$

9. (d)

K.E. just before striking the ground

$$K_1 = mgh_1 = mg(10)$$

K.E. just after striking the ground

$$= K_1 - \frac{50}{100} K_1 = \frac{50}{100} K_1 = \frac{K_1}{2} = K_2$$

Now, $K_2 = mgh_2$

$$\Rightarrow \frac{K_1}{2} = mgh_2$$

$$\Rightarrow \frac{mg(10)}{2} = mgh_2 \Rightarrow h_2 = 5 \text{ m}$$

10. (d)

V_L leads current I by $\frac{\pi}{2}$

$$\therefore V_L = V_0 \sin\left(\omega t + \frac{\pi}{2}\right) \quad (\because I = I_0 \sin \omega t)$$

$$V_0 = I_0 X_L$$

$$\Rightarrow V_L = I_0 X_L \cos(\omega t) = I_0 \omega L \cos(\omega t)$$

11. (a)

Electrostatic energy stored $U = \frac{1}{2} CV^2$

$$= \frac{1}{2} \times 12 \times 10^{-12} \times (50)^2$$

$$= 6 \times 25 \times 10^{-10}$$

$$= 15 \times 10^{-9} \text{ J}$$

$$= 15 \text{ nJ}$$

12. (b)

current $i = nAv_d e$ (v_d = mean drift velocity)

$$= n \left(\frac{\pi D^2}{4} \right) v_d e$$

$$\therefore i \propto D^2 v_d$$

$$\frac{100}{200} = \frac{(d)^2}{\left(\frac{d}{2}\right)^2} \times \frac{v}{v'}$$

$$\Rightarrow v' = 2 \times 2^2 v = 8v$$

13. (b)

$$R = \frac{V}{I} = \frac{200}{20} = 10\Omega$$

$$\frac{\Delta R}{R} = \frac{\Delta V}{V} + \frac{\Delta I}{I} = \frac{4}{200} + \frac{0.2}{20} = \frac{4+2}{200} = \frac{6}{200}$$

$$\Rightarrow \Delta R = \frac{6}{200} \times R = \frac{6}{20} = \frac{3}{10} = 0.3\Omega$$

$$\therefore \text{Resistance} = R \pm \Delta R = (10 \pm 0.3)\Omega$$

14. (a)

In secondary circuit, $P = Vi$

$$\Rightarrow 88 = 11000i$$

$$\Rightarrow i = \frac{88}{11 \times 10^3} = 8 \times 10^{-3} \text{ A}$$

$$\Rightarrow i = 8 \text{ mA}$$

15. (d)

Position of particle, $x = at^4 + \beta t^2 + \gamma t + \delta$

$$\text{Velocity } v = \frac{dx}{dt} = 4at^3 + 2\beta t + \gamma$$

$$\text{Initial velocity} = v(t=0) = \gamma$$

$$\text{Acceleration } a = \frac{dv}{dt} = 12at^2 + 2\beta$$

$$\text{Initial acceleration} = a(t=0) = 2\beta$$

$$\therefore \frac{v(t=0)}{a(t=0)} = \frac{\gamma}{2\beta}$$

16. (d)

$$I_{XY} = I_{CM} + MR^2 = \frac{2}{5}MR^2 + MR^2 = \frac{7}{5}MR^2 = \frac{7}{5} \times 5R^2 = 7R^2 \dots (i)$$

$$I_{XY} = MK^2 = 5 \times 5^2 \dots (ii)$$

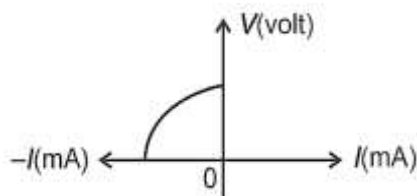
$$\therefore 5 \times 5^2 = 7 \times R^2 \text{ [rom (i) and (ii)]}$$

$$\Rightarrow R = \sqrt{\frac{5}{7}} \times 5 = \frac{5x}{\sqrt{7}} \text{ (Given)}$$

$$\therefore x = \sqrt{5}$$

17. (d)

The I-V characteristics of solar cell is



18. (c)

Time period of oscillation of magnet inside the magnetic field

$$T = 2\pi \sqrt{\frac{I}{MB}}$$

$$T = \frac{t}{n} = \frac{10}{10} = 1 \text{ s}$$

$$1 = 2\pi \sqrt{\frac{10^{-6}}{\pi^2 \times 1.0 \times 10^{-2} \times B}}$$

$$\frac{1}{4} = \frac{10^{-4}}{B} \Rightarrow B = 0.4 \text{ mT}$$

19. (b)

Capacitance of capacitor $C = \frac{A\epsilon_0}{d}$

so capacitance of capacitor is independent of charge (q) and potential (V), it depends on geometry of the capacitor and medium between plates of the capacitor.

20. (c)

Regular reflection is necessary for image formation, that is why we can see our image in a mirror but not in wall. Different colours in white light as its constituent are responsible for the variety in colour of objects.

21. (a)

$$R_0 = 10\Omega$$

After stretching its length upto 2l

$$R_1 = n^2 R_0$$

$$= 4R_0$$

$$= 40\Omega$$



$$R_{AB} = \frac{20 \times 20}{20 + 20} = 10\Omega$$

22. (b)

The spectral series which corresponds to the electronic transition from the levels $n_2 = 5, 6, \dots$ to $n_1 = 4$ is Brackett series.

23. (b)

Layer of foam create an insulation which prohibits heat transfer, and hence roofs of houses containing foam keep room cooler during summer.

24. (c)

$$\text{Potential energy} = \frac{1}{2} kx^2$$

$$\text{Kinetic energy} = \frac{1}{2} kA^2 - \frac{1}{2} kx^2$$

According to given condition

$$\frac{1}{2} kx^2 = \frac{1}{2} kA^2 - \frac{1}{2} kx^2$$

$$k2x^2 = kA^2$$

$$x^2 = \frac{A^2}{2}$$

$$x = \frac{A}{\sqrt{2}}$$

25. (d)

$$\text{Fringe width} = F \text{ ring separation } (\beta) = \frac{\lambda D}{d}$$

$$\Rightarrow \beta = \frac{600 \times 10^{-9} \times 1}{1.5 \times 10^{-3}} = \frac{6 \times 10^{-7}}{1.5 \times 10^{-3}} = 4 \times 10^{-4} \text{ m}$$

26. (b)

Water is used as a coolant in nuclear reactor because of its high specific heat capacity.

27. (b)

Least count of screw gauge

$$= \frac{\text{Pitch}}{\text{No. of divisions on circular scale}}$$

$$\Rightarrow \text{Least count} = \frac{1}{100} = 0.01 \text{ mm}$$

$$\text{Final reading} = \text{MSR} + \text{CSR} \times \text{L.C.}$$

$$= 1 \text{ mm} + (63)(0.01)\text{mm}$$

$$= 1.63 \text{ mm}$$

$$= 0.163 \text{ cm}$$

28.(a)

$$L = \mu_0 \mu_r \times n \times A \times N$$

$$L = \mu_0 \mu_r n \times A \times \frac{N}{l} \times l$$

$$L = \mu_0 \mu_r \times n^2 \times A \times I \Rightarrow L \propto n^2 I$$

$$\Rightarrow \frac{L_A}{L_B} = \frac{n_A^2}{n_B^2} \times \frac{I_A}{I_B}$$

$$\Rightarrow \frac{L_A}{L_B} = \frac{1}{4} \times 2 = \frac{1}{2}$$

29.(b)

When the output of an OR gate is applied as input to a NOT gate, then the combination acts as NOR gate.

30. (c)

For interference pattern to be observed the sources must be coherent.

Hence the superposition of waves $y = a \sin(\omega t)$ & $y = a \sin(\omega t - \phi)$ would result in interference.

31. (c)

$$(K.E.)_{\max} = \frac{hc}{\lambda} - \phi_0$$

$$\text{and } \lambda = \frac{hc}{e}$$

$$\Rightarrow (K.E.)_{\max} = \frac{hc}{\frac{hc}{e}} - \phi_0$$

$$\Rightarrow (K.E.)_{\max} = e - \phi_0 \Rightarrow (K.E.)_{\max} = e - \phi$$

32.(b)

Among the given options, γ -rays has the smallest wavelength.

33.(d)

Equilibrium state of a thermodynamic system is defined by state variables P, V and T. Work done and total heat are path variables.

34.(d)

$$h \frac{c}{\lambda_1} = \frac{-5E}{2} + 4E = \frac{3}{2}E \dots (i)$$

$$h \frac{c}{\lambda_2} = -2E + 3E = E \dots (ii)$$

$$h \frac{c}{\lambda_3} = -2E + 4E = 2E \dots (iii)$$

Comparing (ii) and (iii)

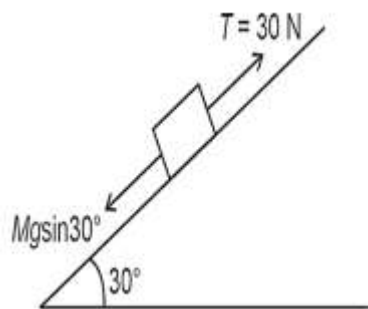
$$\frac{1}{\lambda_3} = \frac{2}{\lambda_2} \lambda_2 = 2\lambda_3$$

Comparing (i) and (ii)

$$3\lambda_1 = 2\lambda_2 \quad \lambda_1 < \lambda_2$$

35.(d)

$$T - Mg \sin 30 = Ma$$



$$30 - 5 \times 10 \times \frac{1}{2} = 5a$$

$$a = 1 \text{ m/s}^2$$

36. (c)

$$\frac{\mu_r}{E_r} = \frac{1}{4}$$

$$\frac{E}{H} = \frac{E\mu}{B} = v\mu$$

$$= \frac{1}{\sqrt{\mu\epsilon}} \mu = \sqrt{\frac{\mu}{\epsilon}} = \sqrt{\frac{\mu_0 \mu_r}{\epsilon_0 \epsilon_r}}$$

$$= \sqrt{\frac{\mu_0}{\epsilon_0}} \sqrt{\frac{\mu_r}{\epsilon_r}}$$

$$= 120\pi \left(\frac{1}{2}\right)$$

$$= \frac{60\pi}{1}$$

37. (d)

$$V = \frac{kq}{r}$$

$$= 9 \times 10^9 \times \frac{4 \times 10^{-7}}{9 \times 10^{-2}}$$

$$= 4 \times 10^4 \text{ V}$$

38. (d)

$$y = \text{csin} \frac{2\pi}{\lambda} (\text{at} - x)$$

$$y = \text{csin} \left(\frac{2\pi}{\lambda} \text{at} - \frac{2\pi}{\lambda} x \right)$$

Comparing with $y = A \sin(\omega t - kx)$

$$\omega = 2\pi f = \frac{2\pi a}{\lambda}$$

$$f = \frac{a}{\lambda}$$

39. (a)

$$Mg' = Mg \frac{R^2}{(R+h)^2}$$

$$\text{At A } Mg' = Mg \frac{R^2}{(R+2R)^2} = \frac{Mg}{9}$$

$$\text{At B } Mg' = Mg \frac{R}{\left(R+\frac{3R}{2}\right)^2} = \frac{Mg \cdot 4}{25}$$

$$\text{Change in weight} = Mg \frac{4}{25} - \frac{Mg}{9} = 49 \text{ N}$$

40. (c)

$$V = \frac{Ax^2}{\sqrt{x+B}} \quad \text{As per homogeneous rule } B = \sqrt{L}$$

$$ML^2T^{-2} = \frac{AL^2}{L^{1/2}}$$

$$A = ML^{1/2} T^{-2}$$

$$\frac{A^2}{B} = \frac{M^2 L T^{-4}}{L^{1/2}} = M^2 L^{1/2} T^{-4}$$

41. (d)

$$\vec{r} = (\hat{i} + 2\hat{j})A \cos \omega t$$

$$x = A \cos \omega t$$

$$y = 2A \cos \omega t$$

$$y = 2x$$

The path is straight line.

The motion is SHM and periodic as

$$\frac{dr}{dt} = -(\hat{i} + 2\hat{j})\omega A \sin \omega t$$

$$\frac{d^2 r}{dt^2} = -(\hat{i} + 2\hat{j})\omega^2 A \cos \omega t$$

$$\vec{a} = -\omega^2 \vec{r}$$

42. (a)

$$I_1 = \frac{l_0}{2}$$

$$I_B = (I_1) \cos^2 60^\circ$$

$$= \frac{I_0}{2} \left(\frac{1}{2}\right)^2 = \frac{I_0}{8}$$

$$I_C = I_B \cos^2 45^\circ$$

$$= \frac{I_0}{8} \times \left(\frac{1}{\sqrt{2}}\right)^2 = \frac{I_0}{16}$$

43. (a)

(A) Slow neutron can cause fission in ${}_{92}^{235}\text{U}$ than fast neutrons because fast neutrons are too quick so they scatter of atoms instead of being captured by them

(B) α -rays are Helium nuclei, is a true statement

(C) β -rays are generated when neutron is converted into proton by releasing electron or proton is converted into neutron by releasing positron.

(D) γ -rays have higher energies as compared to X-rays. So they have smaller wavelength as compared to X-rays.

44. (a)

$$\omega_1 = \frac{2\pi}{60}; x_1 = \frac{2\pi}{60} \times 60 = 2\pi$$

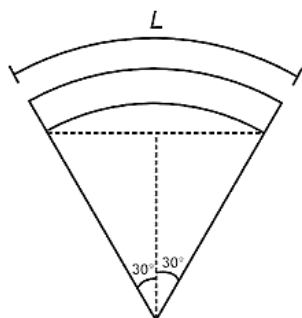
$$\omega_2 = \frac{2\pi}{3600}; x_2 = \frac{2\pi}{3600} \times 60 = \frac{2\pi}{60}$$

$$\omega_3 = \frac{2\pi}{3600 \times 12}; x_3 = \frac{2\pi}{3600 \times 12} \times 60 = \frac{2\pi}{720}$$

$$\frac{\omega_1}{x_1} = \frac{\omega_2}{x_2} = \frac{\omega_3}{x_3} = \frac{1}{60} = k$$

45. (a)

$$M = m \cdot L$$



$$R\theta = L$$

$$\frac{R\pi}{3} = L$$

$$R = \frac{3L}{\pi}$$

$$M' = m(2R)\sin 30^\circ$$

$$= m(2) \frac{3L}{\pi} \times \frac{1}{2} = \frac{3}{\pi} mL = \frac{3M}{\pi}$$

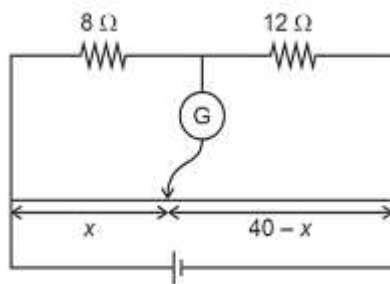
46.(d)

$$\frac{8}{x} = \frac{12}{40-x}$$

$$\frac{x}{8} = \frac{40-x}{12}$$

$$80 - 2x = 3x$$

$$16 = x$$



from B

$$= 40 - 16 = 24 \text{ cm}$$

47.(c)

A polyatomic gas has 3 translational, 3 rotational and f vibration modes

$$U = \frac{3}{2} k_B T + \frac{3}{2} k_B T + f k_B T$$

$$U = (3 + f) k_B T$$

$$C_V = (3 + f) R$$

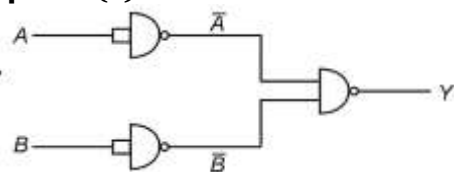
$$C_P = (4 + f) R$$

$$\frac{C_P}{C_V} = \frac{4 + f}{3 + f} = \gamma$$

$$4 + f = 3\gamma + f\gamma$$

$$4 - 3\gamma = f(\gamma - 1) \Rightarrow f = \frac{4 - 3\gamma}{\gamma - 1}$$

48. (c)



$$Y = \overline{A} \overline{B} = A + B$$

49.(b)

$$\text{Given } Q = Q_0 e^{-Rt/2L}$$

$$R = 1.5 \Omega, L = 12 \text{ mH}, \ln(2) = 0.693$$

$$Q = 0.5 Q_0, t = ?$$

$$0.5 Q_0 = Q_0 e^{-Rt/2L}$$

$$\Rightarrow \frac{1}{2} = e^{-Rt/2L}$$

Taking log on both sides

$$\ln\left(\frac{1}{2}\right) = \ln e^{-Rt/2L}$$

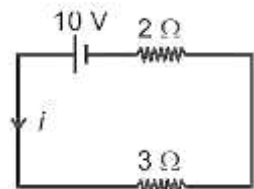
$$\Rightarrow \ln 2 = \frac{Rt}{2L}$$

$$t = \frac{2L \ln 2}{R} = \frac{2 \times 12 \times 10^{-3} \times 0.693}{1.5}$$

$$t = 11.09 \text{ ms}$$

50.(c)

At steady state, capacitor will be completely charged and will not allow current to pass through it. The simplified circuit will be :



$$i = \frac{V}{R} \Rightarrow i = \frac{10}{2+3} = 2 \text{ A}$$

CHEMISTRY

51. (b)

As the atomic number in a period increases, the effective nuclear charge also increases hence, atomic radii along the period decreases.

Correct order of atomic radii

$$\text{Li} > \text{Be} > \text{B} > \text{C}$$

52.(c)

Let the rate equation is

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

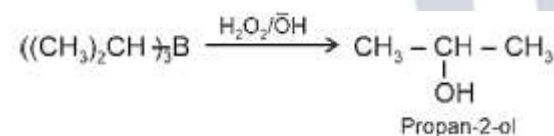
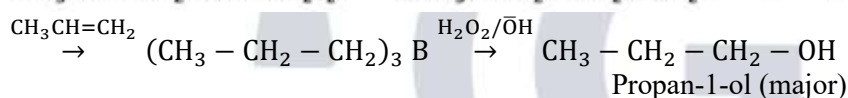
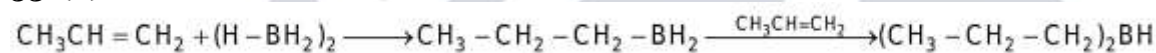
Therefore, we can write

$$2 \times 10^{-3} = k[0.1]^x[0.1]^y \dots \dots (i)$$

$$4 \times 10^{-3} = k[0.2]^x[0.1]^y \dots \dots (ii)$$

$$1.6 \times 10^{-2} = k[0.2]^x[0.2]^y \dots \dots (iii)$$

53.(b)



Statement I is incorrect but Statement II is correct.

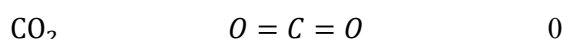
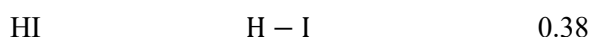
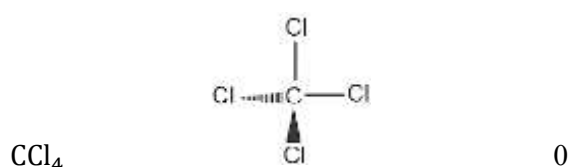
54.(c)

Baeyer's reagent is cold, dilute, aqueous solution of potassium permanganate

55.(b)

Dipole moment of a molecule depends both on shape and bond dipole.

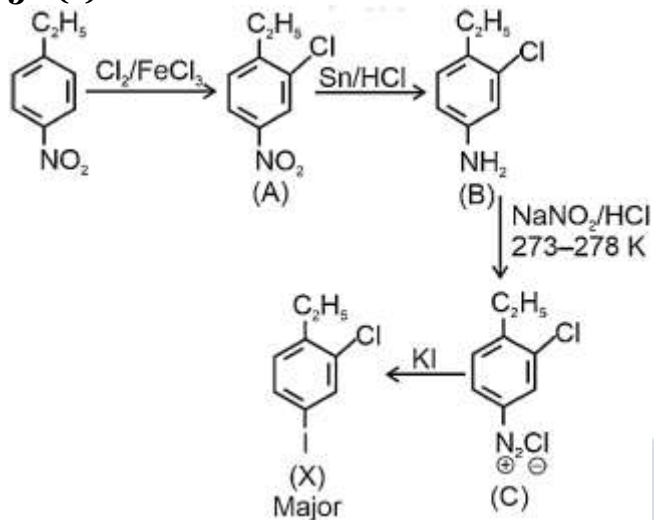
Molecule Shape μ (Debye)



BF_3


0

56.(c)



57.(c)

For weak acid and strong base titration, phenolphthalein is used as indicator. In acidic medium phenolphthalein is colourless while in alkaline medium it is pink in colour.

58.(d)

(Atom/Molecule)	(Property)
Nitrogen atom	Element with highest ionisation enthalpy in group 15
Fluorine molecule	Strongest oxidising agent
Oxygen molecule	Paramagnetic in nature
Xenon atom	Most reactive element in group 18

The correct match is A-III, B-IV, C-I, D-II

59.(b)

Corrosion slowly coats the surfaces of metallic objects with oxides or other salts of the metal. The rusting of iron, tarnishing of silver, development of green coating on copper and bronze are some

60. (d)

Magnetic moment $\mu = \sqrt{n(n+2)}BM$

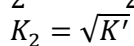
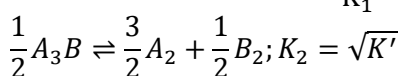
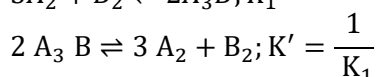
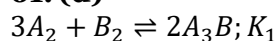
$n \Rightarrow$ Number of unpaired electrons

Ion	n	$\mu(BM)$
Zn^{2+}	0	0
Ti^{2+}	2	$\sqrt{8}$
Cr^{2+}	4	$\sqrt{24}$

Fe^{2+}	4	$\sqrt{24}$
Ti^{3+}	1	$\sqrt{3}$
Cu^{2+}	1	$\sqrt{3}$
V^{2+}	3	$\sqrt{15}$
Cu^{+}	0	0

Hence (Cr^{2+} , Fe^{2+}) and (Ti^{3+} , Cu^{2+}) are the pair of same magnetic moment.

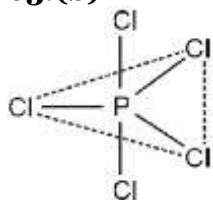
61. (d)



62. (a)

Since CHCl_3 is an organic solvent so, covalent (non-polar) compounds will be more soluble in it. As the dipole moment of solute increases, solubility in chloroform decreases. Hence increasing order of solubility. $\text{NaCl} < \text{CH}_3\text{CN} < \text{CH}_3\text{OH} < \text{Cyclohexane}$

63. (b)



It is sp^3d hybridised with axial to equatorial angle of 90° and equatorial bond angles of 120° . It has five P - Cl sigma bonds. Axial bonds are longer than equatorial bonds.

64. (c)

Since it is isothermal, $\Delta T = 0$

$$\Delta U = nC_v\Delta T = 0$$

Since expansion is taking place against vacuum

$$P_{\text{ext}} = 0$$

$$W = -P_{\text{ext}}\Delta V = 0$$

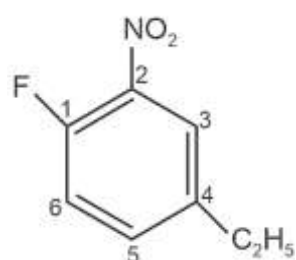
From first law of thermodynamics,

$$\Delta U = q + W$$

$$0 = q + 0$$

$$q = 0$$

65. (a)



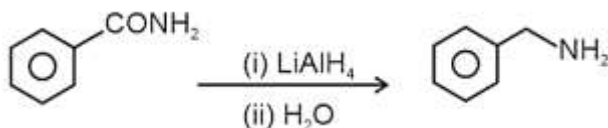
4-ethyl-1-fluoro-2-nitrobenzene

66. (a)

Most stable oxidation state of lanthanoids is +3

Ce^{4+} and Tb^{4+} will get reduced easily and will be good oxidising agents.

67. (b)

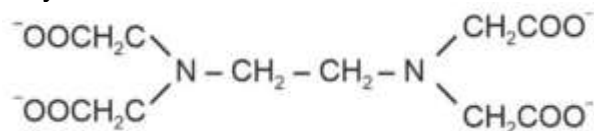


68. (b)

In lanthanoids, absorption bands are narrow because of excitation within f-level.

69. (a)

Ethylene diaminetetraacetate



It is hexadentate as it can bind through two nitrogen and four oxygen atoms to a central metal ion.

70. (a)

$$\text{Molarity, } M = \frac{w_2 \times 1000}{M_2 \times (V)}$$

w_2 = Amount of glucose

$$\text{Given molarity} = \frac{M}{20}$$

$$\frac{1}{20} = \frac{w_2 \times 1000}{180 \times 250}$$

$$w_2 = \frac{180 \times 250}{20 \times 1000}$$

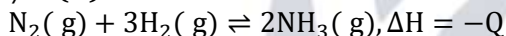
$$= 2.25 \text{ g}$$

71. (a)

The acidic strength of HX follows the order $\text{HF} < \text{HCl} < \text{HBr} < \text{HI}$

This is because bond enthalpy of hydrides of group 17 decreases down the group.

72. (d)



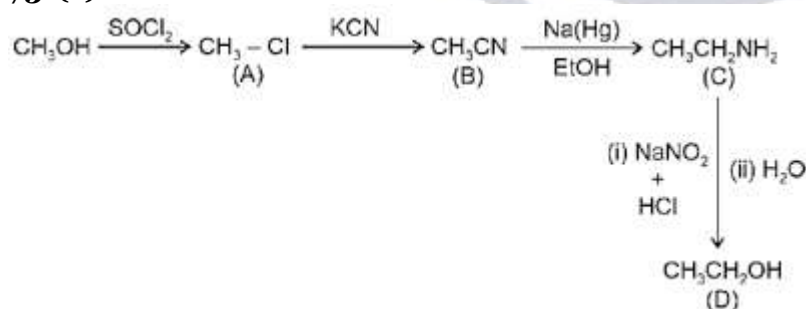
According to Le Chatelier's principle.

Exothermic reactions are favoured at low temperature.

Increase in pressure shifts the reaction in direction having lesser number of moles. Hence, the given reaction shifts forward on increasing pressure.

Increasing the concentration of reactants shifts the reaction in forward direction. So high concentration of H_2 shifts reaction in forward direction.

73. (c)



74. (c)

Sol. Element Block/group in periodic table

$\text{Ce}(Z = 58) \rightarrow$ Lanthanoid

$\text{As}(Z = 33) \rightarrow$ p-block element

$\text{Cs}(Z = 55) \rightarrow$ s-block element

$\text{Mn}(Z = 25) \rightarrow$ d-block element

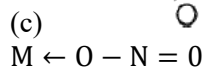
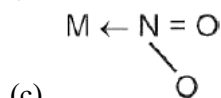
A-I, B-IV, C-II, D-III

75. (a)

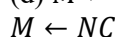
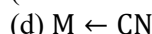
Ambidentate ligands are those ligands which have two different donor atoms and either of two donor atom is attached to the metal during complex formation.



(a) has only one donor site through 'O'. So, it is not ambidentate.



(Ambidentate)



(Ambidentate)

76. (b)

(I) $n = 4, l = 2, m_l = -2, s = -\frac{1}{2}$; represents $4d(n + l = 6)$

(II) $n = 3, l = 2, m_l = 1, s = +\frac{1}{2}$; represents $3d(n + l = 5)$

(III) $n = 4, l = 1, m_l = 0, s = +\frac{1}{2}$; represents $4p(n + l = 5)$

(IV) $n = 3, l = 1, m_l = -1, s = +\frac{1}{2}$; represents $3p(n + l = 4)$

Order of energy depends on the $(n + l)$, greater is the $(n + l)$ value greater is the energy, if $(n + l)$ is same, then it depends on n ; if 'n' is more, energy is more.

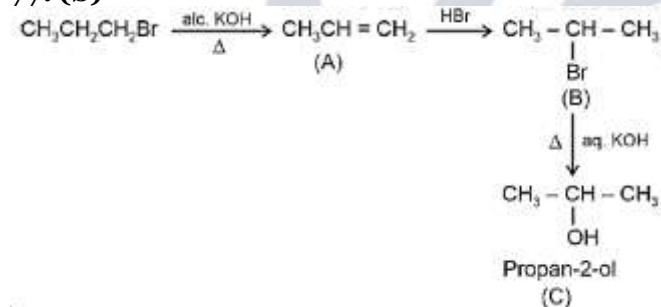
Step-1: According to $(n + l)$

Energy = (I) > (II) = (III) > (IV)

Step-2 : If $n \uparrow$, then energy increases

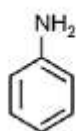
Energy = (I) > (III) > (II) > (IV)

77. (b)

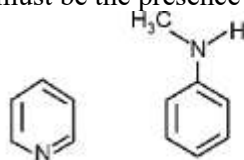


78. (a)

For positive carbylamine test, there must be the presence of primary amine



It will not show Friedal Crafts alkylation.
But gives positive carbylamine test



$(\text{C}_2\text{H}_5)_3\text{N}$

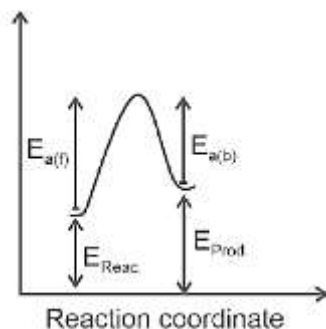
These are not primary amines
Hence, do not give carbylamine test

79. (a)

For endothermic reactions,

$\Delta H_r = \text{positive}$ (Heat is absorbed)

$\Delta H = E_{a(f)} - E_{a(b)}$



$$q_p = +ve$$

80. (a)

$$\text{Number of moles of } H_2 = \frac{1}{2} = 0.5$$

$$\text{Number of molecules of } H_2 = 0.5 N_A$$

$$(a) \text{ Number of moles of } N_2 = \frac{14}{28} = 0.5$$

$$\text{Number of molecules of } N_2 = 0.5 N_A$$

$$(b) \text{ Number of moles of } H_2O = \frac{18}{18} = 1$$

$$\text{Number of molecules of } H_2O = 1 \times N_A = N_A$$

$$(c) \text{ Number of moles of } CO = \frac{16}{28} = \frac{4}{7}$$

$$\text{Number of molecules of } CO = \frac{4}{7} N_A$$

$$(d) \text{ Number of moles of } N_2 = \frac{28}{28} = 1$$

$$\text{Number of molecules of } N_2 = 1 \times N_A = N_A$$

81. (c)

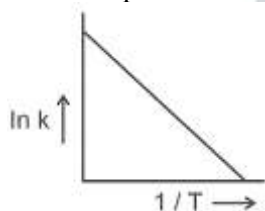
Using Arrhenius equation,

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

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

$$y = c + mx, \text{ slope } (m) = -\frac{E_a}{R}$$

$$\text{Intercept} = \ln A$$



82. (d)

If one of the substances in the mixture is water and the other, a water insoluble substance, then the mixture will boil close to but below, 373 K(100°C).

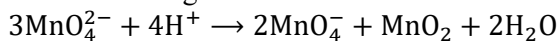
83. (b)

Glycogen is similar to amylopectin in its structure. Glycogen is also found in yeast and fungi.

So statement I is false but statement II is true.

84. (d)

In the following reaction



Oxidation state of Mn	Species
+6	MnO_4^{2-}
+7	MnO_4^-

+4

MnO₂

So +2 and +3 oxidation state is not shown by Mn

85.(c)

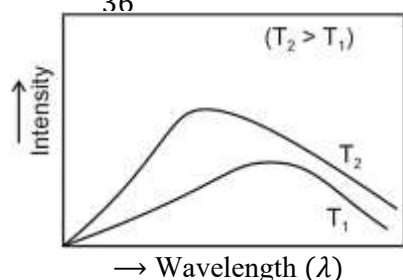
For Balmer series $n_1 = 2$

$n_2 = 3$

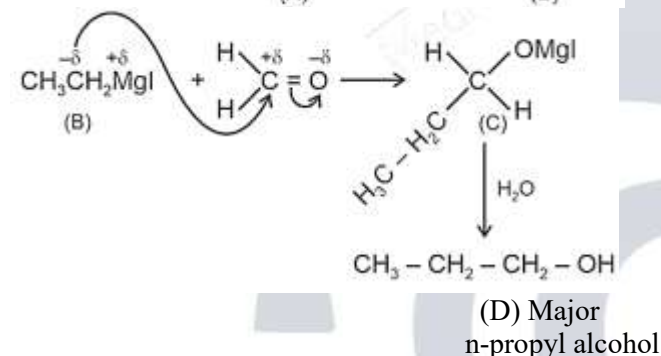
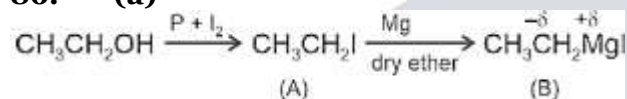
$$\bar{\nu} = \frac{1}{\lambda} = R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$$

$$\bar{\nu} = R_H \left[\frac{1}{4} - \frac{1}{9} \right]$$

$$\bar{\nu} = \frac{5R_H}{36} \text{ cm}^{-1}$$



86. (a)



87.(b)

PEt₃ and AsPh₃ as ligands can form $d\pi - p\pi$ bond with transition metals.

The N - N single bond is weaker than the single P - P bond because of high inter-electronic repulsion of the non-bonding electrons.

Nitrogen has unique ability to form $p\pi - p\pi$ multiple bonds with itself, carbon and oxygen.

Nitrogen cannot form $d\pi - p\pi$ bond as other heavier elements of its group.

88. (d)

Lake test - Al³⁺

Nessler's reagent - NH₄⁺

Potassium sulphocyanide - Fe³⁺

Brown ring test - NO₃⁻

89. (d)

Molecule	Bond enthalpy (kJ mol ⁻¹)
HCl	431.0
N ₂	946.0

H ₂	435.8
O ₂	498

90. (a)

$$\Delta_r G^\ominus = -nFE_{\text{cell}}^\ominus$$

For the given reaction, $n = 2$

$$\therefore \Delta_r G^\ominus = -2 \times 96487 \times 0.32$$

$$= -61751.68 \text{ J mol}^{-1}$$

$$= -61.751 \text{ kJ mol}^{-1}$$

91. (a)

Anion - **Observation on treatment with dil. H₂SO₄**

(A) Carbonate (CO₃²⁻) Brisk effervescence of colourless and odourless gas (CO₂)

(B) Sulphide (S²⁻) Evolution of colourless gas with rotten egg like smell (H₂ S)

(C) Sulphite (SO₃²⁻) Gas with pungent smell (SO₂)

(D) Nitrite (NO₂⁻) Brown fumes (NO₂)

Correct Match: A - II, B-III, C-IV, D-I

92. (a)

Solubility of AgCl (in 0.1 M KCl)	Solubility of AgCl (in water)
$\text{AgCl(aq)} \rightleftharpoons \text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq})_{(s+0.1)}$ s $K_{sp} = (s)(s + 0.1)$ $s \ll 0.1 \therefore (s + 0.1) \approx 0.1M$ $\therefore 10^{-10} = s \times 0.1$ $\therefore s = \frac{10^{-10}}{0.1} = 10^{-9}M$	$\text{AgCl(aq)} \rightleftharpoons \text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq})$ s s $K_{sp} = s^2$ $\therefore 10^{-10} = s^2$ $\therefore s = \sqrt{10^{-10}} = 10^{-5}M$
Hence ratio of solubilities of AgCl = $10^{-9} : 10^{-5} = 10^{-4} : 1$	

93. (b)

$$\text{Percentage of carbon} = \frac{12 \times m_2 \times 100}{44 \times m}$$

m = mass of organic compound = 0.3 g

m_2 = mass of carbon dioxide = 0.2 g

$$\therefore \%C = \frac{12 \times 0.2 \times 100}{44 \times 0.3} = 18.18\%$$

$$\text{Percentage of hydrogen} = \frac{2 \times m_1 \times 100}{18 \times m}$$

m_1 = mass of water = 0.1 g

$$\therefore \%H = \frac{2 \times 0.1 \times 100}{18 \times 0.3} = 3.70\%$$

94.(a)

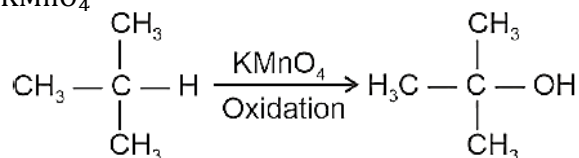
Aryl chlorides and bromides can easily be prepared by electrophilic substitution of arenes (toluene) with Cl_2 and Br_2 respectively in the presence of Lewis acid catalyst (Fe in dark).

Reaction with I_2 is reversible and requires the presence of oxidising agent.

Corresponding fluoroarene is not prepared by this method due to high reactivity of fluorine. Hence, 'X' is F.

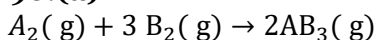
95.(b)

Generally alkanes resist oxidation but alkane with tertiary H atom(s) can be oxidised to corresponding alcohols by KMnO_4



$\therefore \text{R}_1 \Rightarrow \text{CH}_3 \text{ R}_2 \Rightarrow \text{CH}_3 \text{ R}_3 \Rightarrow \text{CH}_3$

96.(a)



$$\Delta n_{(\text{g})} = n_{(\text{P})} - n_{(\text{R})}$$

$$= 2 - 3 - 1 = -2$$

$$\Delta H = \Delta U + \Delta n_g RT$$

$$15 \times 1000 = \Delta U - 2 \times 8.314 \times 300$$

$$\Delta U = 15000 + 600 \times 8.314$$

$$= 15000 + 6 \times 831.4$$

$$= 15000 + 4988.4$$

$$\Delta U = 19988.4 \text{ J}$$

97.(c)

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

After taking ln both side

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

$$\ln K_1 = \ln A - \frac{E_a}{RT_1} \text{ at temp. } T_1 \dots \dots (i)$$

$$\ln K_2 = \ln A - \frac{E_a}{RT_2} \text{ at temp. } T_2 \dots \dots (ii)$$

(ii) - (i)

$$\ln K_2 - \ln K_1 = \frac{E_a}{R} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$$

$$\ln \frac{K_2}{K_1} = \frac{E_a}{R} \left[\frac{1}{500} - \frac{1}{700} \right]$$

$$\ln \frac{0.14}{0.04} = \frac{E_a}{R} \left[\frac{700 - 500}{500 \times 700} \right]$$

$$\ln \frac{14}{4} = \frac{E_a}{R} \left[\frac{200}{500 \times 700} \right]$$

$$\log 3.5 = \frac{E_a}{2.303 \times R} \left[\frac{1}{250 \times 7} \right]$$

$$0.5441 = \frac{E_a}{2.303 \times 8.31} \left[\frac{1}{250 \times 7} \right]$$

$$E_a = 0.5441 \times 8.31 \times 250 \times 7 \times 2.303$$

$$= 0.5441 \times 83.1 \times 25 \times 7 \times 2.303$$

$$= 18222.65$$

$$\approx 18219 \text{ J}$$

98. (d)

For isotonic solutions [osmotic pressure must be equal]

$$\pi_1 = \pi_2$$

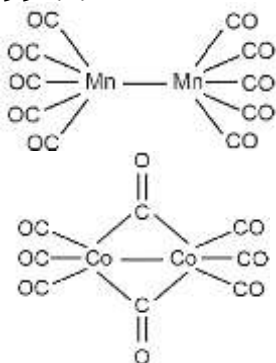
$$C_1 RT = C_2 RT$$

$$C_1 = C_2$$

$$\frac{m}{180 \times 1} = \frac{15}{60 \times 1} \text{ (m is the mass of glucose)}$$

$$m = \frac{180}{4} = 45 \text{ g}$$

99.(d)



- A. Metal-Metal linkage present.
 B. Terminal CO groups are present
 C. In $[\text{Mn}_2(\text{CO})_{10}]$ bridging CO groups are not present.
 D. Metal is in zero oxidation state.

100. (c)



Methyl group attached to a positively charged carbon atom stabilizes the carbocation due to hyperconjugation and +I effect.

BIOLOGY

101. (c)

The regions with high level of species richness, high degree of endemism and a loss of most of the species and habitat are identified as Biodiversity hotspots.

102. (a)

Sclereids are commonly found in the hard parts of the plant such as fruit walls of nuts, or they occur in soft parts, i.e., pulp of the fruits, like pear.

103. (d)

Option (d) is the correct answer because origin of replication (ori) is a sequence from where replication starts and any piece of DNA when linked to this sequence can be made to replicate, within the host cells.

Option (a) is incorrect because recognition sequence is a specific palindromic nucleotide sequence in DNA recognised by restriction endonuclease.

Options (b) and (c) are not the answers because cloning site/restriction site is the site on the vector for the use of restriction enzyme and it is similar to recognition site.

104. (b)

Polygenic inheritance refers to the inheritance of a trait governed by more than one gene.

In a polygenic trait the phenotype reflects the contribution of each allele i.e., the effect of each allele is additive.

Hence, statement I is incorrect and statement II is correct.

105. (b)

For the process of light reaction, water, light and chlorophyll are required.

CO_2 is used during the second stage of photosynthesis i.e. dark reaction.

Oxygen is a product of light reaction formed by photolysis of water.

106. (a)

Nucleus as a cell organelle was first described by Robert Brown as early as 1831.

Later the material of the nucleus stained by the basic dyes was given the name chromatin by Flemming.

Ribosomes are the granular structure first observed under the microscope as dense particle by George Palade.

Camillo Golgi first observed densely stained reticular structure near the nucleus. It consist of many disc shaped sac or cisternae.

Hence, A-II, B-IV, C-III, D-I is correct.

107. (b)

Flower colour in *Antirrhinum* is a good example of incomplete dominance.

Blood group in humans is an example of co-dominance where F_1 generation resembles both the parents.

Phenylketonuria is an example of Pleiotropy.

Skin colour in human shows polygenic inheritance.

Hence, A-II, B-I, C-IV, D-III is correct.

108. (a)

Nucellus is a mass of cell enclosed within the integument and it has abundant food reserves.

Each ovule has one or more protective layer called integuments. The ovule is a small structure attached to the placenta by means of a stalk called funicle.

109. (d)

Gymnosperm lack vessels in their xylem. In place of companion cells they have albuminous cells. They lack sieve tube but have sieve cells.

110. (b)

Botanical garden is an ex-situ conservation strategy of biodiversity. Wild-life Sanctuary, Biosphere Reserve and National Parks are in-situ conservation strategy of biodiversity.

111. (a)

Indian Government has set up organizations such as GEAC (Genetic Engineering Approval Committee), which will make decisions regarding the validity of GM research and the safety of introducing GM-organisms for public services and Biopiracy is used to refer to the use of bioresources by multinational companies and other organizations without proper authorization from the countries and people concerned without compensatory payment, thus statement I is true but statement II is false

112. (c)

Pollen grains are well-preserved as fossils because of the presence of sporopollenin, which is found in the outer layer of pollen, i.e., exine.

113. (a)

Equisetum belongs to Sphenopsida.

Adiantum belongs to Pteropsida.

114. (a)

Option (a) is correct as *Cedrus*, *Pinus* and *Sequoia* belongs to gymnosperms.

Option (b) is incorrect as *Sequoia* belongs to gymnosperms, not angiosperms.

Option (c) is incorrect as *Polysiphonia* belongs to rhodophyceae (algae) not bryophytes.

Option (d) is incorrect as *Ginkgo* belongs to gymnosperms, not pteridophytes.

115. (a)

The RNA polymerase is only capable of catalyzing the process of elongation, thus, statement I is correct.

RNA polymerase associates transiently with initiation-factor (σ) and termination-factor (ρ) to initiate and terminate the transcription. Thus, statement II is incorrect

116. (b)

Uridine is a nucleoside. Thus, option (a) is incorrect.

Adenylic acid is a nucleotide. Thus, option (b) is correct.

Guanine is a nitrogenous base. Thus, option (c) is incorrect.

Guanosine is a nucleoside. Thus, option (d) is incorrect.

117. (a)

In pea, vexillary aestivation is found.

Perigynous flowers are observed in peach.

Epiphyllous stamens are found in lily.

Epipetalous stamens are found in brinjal.

118. (c)

China rose exhibits axile placentation.

Mustard exhibits parietal placentation.

Primrose exhibits free central placentation.

Marigold exhibits basal placentation.

119. (d)

The companion cells help in maintaining the pressure gradient in the sieve tubes.

120. (c)

Mesosomes are formed by the extensions of plasma membrane into the cell. Thus, option (c) is correct. Lysosomes are membrane bound vesicular structures. Thus, option (a) is incorrect.

Several ribosomes may attach to a single mRNA and form a chain called polyribosomes. Thus, option (b) is incorrect.

121. (c)

Abscisic acid → Helps seeds to withstand desiccation

Ethylene → Promotes female flowers in cucumber

Gibberellin → Promotes bolting in beet, cabbage etc.

Cytokinin → Helps in nutrient mobilisation

Hence, the correct answer is option (c)

122. (d)

In genetically engineered human insulin, E. coli is used as host cell.

⇒ For creating GM cotton, bacteria *Bacillus thuringiensis* is used.

⇒ Gene therapy is one of the treatment for ADA deficiency.

⇒ ELISA test is based on antigen-antibody interaction.

123. (b)

ETS complex I → NADH dehydrogenase

ETS complex II → Succinate dehydrogenase

ETS complex III → Cytochrome bC complex

ETS complex IV → Cytochrome C oxidase complex

Hence the correct answer is option (b)

124. (c)

Cryopreservation technique is a type of ex-situ conservation in which gametes of threatened species can be preserved in viable and fertile conditions for long period. Hence the correct answer is option (c).

125. (a)

The entire cellular respiration do not take place in mitochondria. The process of glycolysis during respiration occur in cytoplasm of cell. Hence statement A, C, D and E are correct.

126. (c)

In eukaryotes, there are at least three RNA polymerase in the nucleus (in addition to the RNA polymerase found in the organelles). There is clear cut division of labour. RNA polymerase I transcribes rRNAs (28 S, 18 S, and 5.8 S), whereas the RNA polymerase III is responsible for transcription of tRNA, 5 SrRNA and SnRNAs. The RNA polymerase II transcribes precursor of mRNA. Hence statement I and statement II, both are correct.

127. (d)

Histones → Positively charged basic proteins

Nucleosome → DNA wrapped around histone octamer

Euchromatin → Loosely packed chromatin

Heterochromatin → Densely packed chromatin

Hence the correct answer is option (d).

128. (d)

Failure of segregation of chromatids during cell division cycle results in the gain or loss of a chromosome(s), called aneuploidy.

Failure of cytokinesis after telophase of cell division results in an increase in a whole set of chromosomes in an organism and this phenomenon is known as polyploidy.

Hence the correct answer is option (d).

129. (d)

Recombination between homologous chromosomes is completed by the end of pachytene

130. (d)

Metacentric → Middle centromere forming two equal arms chromosomes

Sub-metacentric chromosomes → Centromere is slightly away from the middle of chromosomes resulting into two unequal arms.

Acrocentric chromosomes → Centromere is situated close to its end forming one extremely short and one very long arm.

Telocentric chromosomes → Chromosome has a terminal centromere

Hence the correct answer is option (d)

131. (a)

Option (a) is the correct answer because, ligases are the enzymes that catalyse the linking together of 2 compounds, e.g., enzymes which catalyse joining of C – O, C – S, C – N, P – O etc. bonds.

⇒ Options (b), (c) and (d) are wrong as ligase catalyse the joining of P – O, C – O & C – N bonds.

132. (c)

F. Skoog observed that from the internodal segments of tobacco stems the callus proliferated only if in addition to auxins the nutrient medium was supplied with the extracts of vascular tissues, yeast extract, coconut milk or DNA. Miller et al. later identified and crystallized the cytokinesis promoting active substance that they termed kinetin.

133. (a)

Absciscic acid is antagonistic to Gibberellic acid.

Auxins induce parthenocarpy in certain fruits, such as, tomatoes.

134. (a)

DNA fragments can be visualised only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation. We cannot see pure DNA fragments in visible light and without staining.

⇒ The DNA fragments separate (resolve) according to their size through sieving effect provided by agarose gel.

⇒ DNA is a negatively charged molecule, hence it moves towards the positive electrode (anode).

135. (d)

Monocarpellary, unilocular ovary with many ovules is the characteristic feature of the members of the family Fabaceae. Sesbania and Indigofera are the members of this family. Brinjal and tobacco belong to the family Solanaceae whereas Asparagus belongs to the family Liliaceae.

136. (a)

In the lac operon the z - gene codes for β -galactosidase which is primarily responsible for the hydrolysis of lactose into its monomeric units, galactose and glucose. Glucose and galactose cannot act as the inducers of lac operon.

Rather, lactose or allolactose act as inducers of lac operon.

137. (b)

The given figure is of the false fruit, strawberry and 'x' represents the thalamus

138. (b)

In a dicotyledonous leaf, adaxial epidermis (upper surface) generally bears very less stomata and may even lack stomata. It has less number of stomata in comparison to abaxial surface.

The adaxially placed palisade parenchyma is made up of elongated cells, arranged vertically and parallel to each other.

139. (c)

glutamic acid and aspartic acid are amino acids while lecithin is a phospholipid. Palmitic acid and arachidonic acid are fatty acids.

140. (d)

According to the given pyramid of energy, if T_4 is equivalent to 1000 J, then according to the 10 percent law, which states that only 10 percent of energy is transferred to each trophic level from the lower trophic level, the value at T_1 is 10,00,000 J.

$$T_1 = 10,00,000 \text{ J}$$

$$T_2 = \frac{10}{100} \times 10,00,000 = 1,00,000 \text{ J}$$

$$T_3 = \frac{10}{100} \times 100000 = 10,000 \text{ J}$$

$$T_4 = \frac{10}{100} \times 10000 = 1000 \text{ J}$$

141. (c)

Product of light reaction are ATP, NADPH and O_2 . Of these O_2 diffuses out of the chloroplast while ATP and NADPH are used to drive the processes leading to synthesis of food, more accurately, sugars.

142. (a)

Option (a) is the correct answer because, unless we cut the vector and the source DNA with the same restriction enzyme, the recombinant vector molecule cannot be created.

In options (b), (c) and (d), restriction enzymes are different for cutting the vector DNA and source DNA, so they cannot be the answers.

143. (c)

There are certain limitation of ecological pyramids.

Such as :

It does not take into account the same species belonging to two or more trophic levels.

It assumes a simple food chain, something that almost never exists in nature.

It does not accommodate a food web.

Saprophytes are not given any place in ecological pyramids even though they play a vital role in the ecosystem

144. (a)

Option (a) is the correct answer because the activated toxin binds to the surface of midgut epithelial cells and creates pore that cause cell swelling and lysis and eventually cause death of the insect.

Bt toxin doesn't kill pest by affecting their respiratory system, nervous system and it doesn't alter the pH of body fluids. So, options (b), (c) and (d) are not the answer.

145. (c)

Euglenoids are photosynthetic in the presence of sunlight, when deprived of sunlight they behave like heterotrophs.

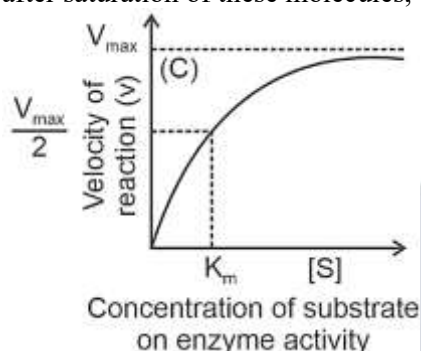
Dinoflagellates are mostly marine and photosynthetic.

Slime moulds are saprophytic protists.

Plasmodium is malarial parasite which cause malaria.

146. (a)

Option (a) is the correct answer because with the increase in substrate concentration, the velocity of enzymatic reaction rises at first. The reaction ultimately reaches maximum velocity (V_{max}) which is not exceeded by any further rise in concentration of the substrate. This is because the enzyme molecules are fewer than substrate molecules and after saturation of these molecules, there are no free enzyme molecules to bind the additional substrate molecules



Option (b) is incorrect as velocity of reaction is continuously increasing in the given graph.

In option (c) after reaching at V_{max} , velocity declines while in option (d) velocity of reaction declines from high on increasing substrate concentration. So, option (c) and (d) are incorrect.

147. (d)

(N) is the population density at time t , then its density at time $t + 1$ is

$$N_{t+1} = N_t + [(B + I) - (D + E)]$$

Population density will increase if the number of births plus the number of immigrants ($B + I$) is more than the number of deaths plus the number of emigrants ($D + E$).

148. (d)

As per the type of given progeny the genotype of the parent will be TTRr.

$$\text{Selfing} = \begin{matrix} \text{♀} \\ \text{TTRr} \end{matrix} \times \begin{matrix} \text{♂} \\ \text{TTRr} \end{matrix}$$

		$\frac{\sigma}{\phi}$	TR	Tr
F ₁ generation	TR	TTRR	TTRr	
	Tr	TTRr	TTrr	

According to the above cross progeny will be Tall round and Tall wrinkle.

149. (a)

(a) Biodiversity hotspots are regions with very high levels of species richness and high degree of endemism. Eg. Western Ghats, Sri Lanka, Indo-Burma and Himalaya

(b) In many cultures, tracts of forest were set aside, and all the trees and wildlife within were venerated and given total protection. Such sacred groves are found in Khasi and Jaintia, Hills in Meghalaya

(c) The world summit on sustainable development held in 2002 in Johannesburg, South Africa.

(d) Parthenium is an alien species

150. (c)

The calvin cycle proceeds in three stages:

(A) Carboxylation, during which CO_2 combines with ribulose-1,5-bisphosphate.

- (B) Reduction, during which carbohydrate is formed at the expense of the photochemically made ATP and NADPH.
 (C) Regeneration during which the CO_2 acceptor ribulose-1,5-bisphosphate is formed again so that the cycle continues.

ZOOLOGY

151. (d)

- (a) In predation one species is benefitted ' + ' while the other is detrimental ' - '. Pisaster is an important predator in the rocky intertidal communities of the American pacific coast.
 (b) In many species of fig trees, there is tight one-to-one relationship with the pollinator species of wasp. It means that a given fig species can be pollinated only by its 'partner' wasp species and no other species is an example of mutualism.
 (c) Plasmodium is an endoparasite in humans that causes malaria.
 (d) The Mediterranean orchid Ophrys employs 'sexual deceit' to get pollination done by a species of bee.

152. (a)

	List I Location of Joint		List II Type of Joint
A.	Joint between humerus and pectoral girdle	II.	Ball and Socket joint
B.	Knee joint	III.	Hinge joint
C.	Joint between atlas and axis	IV.	Pivot joint
D.	Joint between carpals	I.	Gliding joint

Thus, A-II, B-III, C-IV, D-I is the correct match.

153. (d)

- the correct sequence of action of toxin in Bt. cotton is
 B. Bacillus thuringiensis produces crystals with toxic insecticidal proteins.
 E. The toxin proteins exist as inactive protoxins in bacteria.
 C. The alkaline pH solubilises the crystals.
 A. The inactive toxin converted into active form due to alkaline pH of gut of insect.
 D. The activated toxin binds to the surface of midgut cells, creates pores and causes death of the insect. Hence, $B \rightarrow E \rightarrow C \rightarrow A \rightarrow D$ is the correct order.

154. (b)

	List I		List II
A.	Gene pool	IV.	Total number of genes and their alleles
B.	Genetic drift	II.	When change in gene frequency occurs by chance
C.	Gene flow	III.	When gene migration/transfer of genes into or out of population occurs multiple times.

D	Gene frequency	I.	According to Hardy Weinberg principle, gene frequency remains stable within generations.
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Hence [A – IV, B – II, C – III, D – I] is the correct match.

155. (d)

Option (a) is incorrect because artificial selection is anthropogenic, where man breeds selected plants and animals for different uses.

Option (b) is incorrect because genetic drift is change in gene frequency by chance.

Option (c) is incorrect because convergent evolution is when different structures, with different origins evolve for the same function due to same habitat and hence have similarity. Darwin's finches are the example of divergent evolution. option (d) the evolutionary phenomenon depicted in the sketch is adaptive radiation as from the original seed-eating features, many other forms of finches with altered beaks arose, enabling them to become insectivorous and vegetarian finches.

156. (d)

The correct answer is option (d) because recipient is A blood group with Rh(–ve) antigen, hence cannot receive blood from any blood group with Rh(+ve) antigen and as A blood group individuals have anti-B antibodies in plasma. So, donor could be O (Rh – ve) and A (Rh – ve) only.

Options (a), (b) and (c) are not correct answers because B^- , A^- and A^+ blood groups will lead to serve clumping reaction.

157. (d)

The correct answer is option (d) because lyases are group of enzymes that catalyze the removal of groups from substrates by mechanisms other than hydrolysis leaving double bonds.

Option (a) is incorrect because transferases are enzymes catalyzing a transfer of a group G (other than hydrogen) between a pair of substrate S and S'.

Option (b) is incorrect because oxidoreductases are enzymes which catalyse oxidation-reduction between two substrates S and S'.

Option (c) is incorrect because dehydrogenases are also known as oxidoreductases.

158. (a)

Zygotene is the second stage of prophase I during this stage synaptonemal complex formation occur. In pachytene the four chromatids of each bivalent chromosomes becomes distinct and clearly appears as tetrad and in this stage crossing over occurs.

Diplotene is recognised by the dissolution of the synaptonemal complex and the tendency of the recombined homologous chromosomes of the bivalents to separate from each other except at the sites of crossovers. These X-shaped are called chiasmata. Diakinesis is marked by terminalisation of chiasmata.

159. (a)

	List-I		List-II
A.	Primary structure of protein	III.	Polypeptide chain with positional information of amino acids
B.	Secondary structure of protein	IV.	Alpha helix and β sheet structure

C.	Tertiary structure of protein	II.	Hollow woolen ball like structure with hydrogen and disulphide bonds
D.	Quaternary structure of protein	I.	Assembly of more than one polypeptides, seen in adult human hemoglobin

Hence, A-III, B-IV, C-II, D-I is the correct match.

160. (c)

Epinephrine is an emergency hormone, also known as adrenaline and is secreted from adrenal medulla.

Thyroxine is secreted from thyroid gland and plays an important role in regulation of basal metabolic rate.

Oxytocin is a peptide hormone synthesized by hypothalamus and released by posterior pituitary. It causes smooth muscle contraction.

Glucagon is secreted from α -cells of pancreas, acts mainly on hepatocytes and stimulates glycogenolysis resulting in an increased blood sugar level or hyperglycemia.

161. (b)

The correct answer is option (b), because tight junctions help to stop substances from leaking across a tissue.

Options (a), (c) and (d) are incorrect because

Adhering junctions perform cementing to keep neighboring cells together.

Gap junctions facilitate the cells to communicate with each other by connecting the cytoplasm of adjoining cells for rapid transfer of ions, small molecules and sometimes big molecules.

162. (a)

The correct answer is option (a), because the restriction sites for restriction endonucleases Bam HI and Sal I are present within the tet^R gene in the pBR322 cloning vector.

Options (b), (c) and (d) are incorrect because the restriction sites of Pst I and Pvu I are present within the amp^R gene in the PBR 322 cloning vector.

163. (c)

Carcharodon is a cartilaginous fish which belongs to the class Chondrichthyes.

Myxine is a jawless vertebrate that belongs to the class Cyclostomata.

Clarias is a bony fish which belongs to the class Osteichthyes.

Ichthyophis is a limbless animal which belongs to the class Amphibia.

Hence the correct matches are

A. Chondrichthyes - Carcharodon

B. Cyclostomata - Myxine

C. Osteichthyes - Clarias

D. Amphibia - Ichthyophis

164. (c)

28 days menstrual cycle of a human female, rapid secretion of LH leading to its maximum level during the mid-cycle (14th day) called LH surge induces the rupture of Graafian follicle and thereby the release of ovum (ovulation). Hence, both (A) and (R) are correct and (R) is the correct explanation of (A).

165. (a)

Lemur is a placental mammal, shows convergent evolution with spotted cuscus which is an Australian marsupial.

Bobcat is a placental mammal, shows convergent evolution with Tasmanian tiger cat which is an Australian marsupial.

Anteater is a placental mammal, shows convergent evolution with Numbat which is an Australian marsupial.

Flying squirrel is a placental mammal, shows convergent evolution flying Phalanger which is Australian marsupial.

166. (d)

- (a) During G_1 phase the cell is metabolically active and continuously grows but does not replicate its DNA.
 (b) S or synthesis phase marks the period during which DNA synthesis or replication takes place.
 (c) During the G_2 phase, proteins are synthesized in preparation for mitosis while cell growth continues.
 (d) Cells that do not divide further exit G_1 phase to enter an inactive stage called quiescent stage (G_0) of the cell cycle. Cells in this stage remain metabolically active but no longer proliferate unless called on to do so.

167. (b)

- (a) In some shallow south American lakes, visiting flamingoes and resident fishes compete for their common food i.e., their is interspecific competition.
 (b) The Abingdon tortoise in Galapagos Islands become extinct within a decade after goats were introduced on the island, apparently due to the greater browsing efficiency of the goats this is an example of interference competition.
 (c) The larger and competitively superior barnacle *Balanus* dominates the intertidal areas and excludes the smaller barnacle *Chthamalus* from that zone.
 (d) If two species compete for the same resource, they could avoid competition by choosing for example related species of warblers living on the same tree were able to avoid competition and coexist due to behavioral difference in their foraging activities

168. (a)

Streptokinase is produced by *Streptococcus* and is used as a clot buster for removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack.
 Cyclosporin A, that is used as an immuno-suppressive agent in organ-transplant patients, it is produced by the fungus *Trichoderma polysporum*
 Statins produced by *Monascus purpureus* have been commercialized as blood-cholesterol lowering agent.
 Citric acid is produced by *Aspergillus niger*

169. (b)

F_1 particles or oxysomes are found on the inner face of the inner membrane of mitochondria.
 Chromatin fibres condenses to form chromosomes.
 Chromatin is essentially composed of DNA and basic histone proteins.
 Core of cilia is known as axoneme.
 In golgi complex cisternae are sac like structure.
 A-IV, B-I, C-II, D-III

170. (d)

Multiload 375 is a copper releasing IUD which suppresses sperm motility and fertilizing capacity of sperms.
 Lippes loop is a non-medicated intra uterine device.
 Vaults are barrier type of contraceptives which prevent physical meeting of ovum and sperms.
 LNG-20 is a hormone releasing IUD that makes the uterus unsuitable for implantation and the cervix hostile to the sperms.

Hence the correct matches are

- A. Copper releasing IUD - Multiload 375
 B. Non-medicated IUD - Lippes loop
 C. Contraceptive barrier - Vaults
 D. Hormone releasing IUD - LNG-20

171. (c)

statement I and statement II are correct.
 Antibiotics are chemicals produced by microorganisms.
 Antibiotics have the capacity to inhibit the growth and eventually destroy bacterial and other microorganisms in low concentration. Thus, statement I is correct.
 Antibodies are immunoglobulins produced in the body in response to any attack from pathogens. Antibodies facilitate killing of microbes by various mechanisms and provide immunity to the body. Thus, statement II is also correct.

172. (c)

The correct answer is Option (c) as the correct route of milk ejection via mammary glands in human is: Mammary alveolus → Mammary tubule → Mammary duct → Mammary ampulla → Lactiferous duct In the question, the given structures are represented as:-

C → E → A → D → B (given in option 3)

The other option i.e., (a), (b) and (d) are incorrect as they represent the wrong pathway.

173. (d)

The correct answer is option (d) as

EcoRI does not cut the DNA with blunt ends. Instead, it cuts the DNA with sticky / cohesive / staggered ends on each strand.

EcoRI is a restriction endonuclease that recognises a specific palindromic sequence and cuts at a specific site within the DNA, known as the restriction site. It is not an exonuclease as exonucleases remove nucleotides from the free ends of the DNA.

The recognition sequence for EcoRI is $5' - G^{\downarrow} - A - A - T - T - C - 3'$
 $3' - C - T - T - A - A^{\uparrow} - G - 5'$ and it cuts the DNA between bases G and

A only when the sequence GAATTC is present in the DNA.

Therefore, 'A' and 'E' represent incorrect features about EcoRI, whereas 'B', 'C' and 'D' are correct features of EcoRI.

The other options, i.e., (a), (b) and (c) are incorrect as they represent incorrect combinations of features w.r.t. EcoRI.

174. (d)

The correct answer is option (d) as

A. Collateral gland - Present in female cockroaches It is a pair of gland that secrete the hard egg case or ootheca

B. Mushroom gland - Absent in female cockroaches Present in males in the 6th to 7th abdominal segments

C. Spermatheca - Present in female cockroaches in the 6th abdominal segment

D. Anal style - Absent in female cockroaches Present in males and project backwardly from 9th sternum

E. Phallic gland - Absent in female cockroaches Present in males as a large club shaped gland located below the ejaculatory duct and reaches anteriorly up to the 5th abdominal segment.

Thus, only structures represented by 'A' and 'C' are present in female cockroaches.

Whereas, structures indicated by 'B', 'D' and 'E' are present in males.

Options (a) and (b) are incorrect as these structures are present in males.

Option (c) is incorrect as it represents only a single structure which is present in female cockroaches.

175. (a)

The correct answer is option (a) as:

A. Malignant tumors - Exhibit the property of metastasis

B. MALT - Mucosa Associated Lymphoid Tissue

C. NACO - National AIDS Control Organisation

D. α -Interferons - Biological response modifiers given to cancer patients that activate their immune system and help in destroying the tumor.

Thus, correct match is, A-III, B-IV, C-II, D-I and therefore the correct answer is option (a).

The other options i.e., (b), (c) and (d) are incorrect as they represent mismatches

176. (c)

The correct answer is option (c) as Anopheles (Arthropods), Limax (Mollusc) and Limulus (Arthropods) have an open circulatory system.

Option (a) is incorrect as Nereis (Annelid) has a closed circulatory system.

Option (b) is incorrect as Hirudinaria (Annelid) has a closed circulatory system.

Option (d) is incorrect as Pheretima (Annelid) has a closed circulatory system.

Arthropods (Palaemon, Bombyx, Musca) have an open circulatory system.

Hemichordates (Balanoglossus) have an open circulatory system.

177. (b)

The correct answer is option (b) as blood does not contain fibre secreting cells called as fibroblasts. Whereas, cartilage, bone, adipose tissue and areolar tissue contain cells that secrete fibres of collagen or elastin or structural protein.

The other options (a), (c) and (d) are incorrect as they mention blood which lacks fibroblasts.

178. (d)

The correct answer is option (d) as it represents an incorrect match because Platyhelminthes are triploblastic organisms; not diploblastic.

Option (a) represents the correct match as annelids and arthropods exhibit bilateral symmetry.

Option (b) represents the correct match as sponges are acoelomates.

Option (c) represents the correct match as coelenterates and ctenophores exhibit radial symmetry.

Hence, option (a), (b) and (c) cannot be the answer.

179. (c)

Option (c) is the answer of this question because correct match is A-III, B-I, C-IV, D-II.

Option (a), (b) and (d) are incorrect because they are not correctly matched.

Residual volume - Volume of air remaining in lungs after forcible expiration.

Vital capacity - Maximum volume of air that can be breathed in after forced expiration.

Expiratory Capacity - Total volume of air expired after normal inspiration.

Tidal volume - Volume of air inspired or expired during normal respiration.

180. (a)

The correct answer is option (1) because:

Latimeria is a living fossil, it is a bony fish, so (A) matches with (IV).

Echidna is the connecting link between the reptiles and the mammals, so (B) matches with (III).

Vestigial organs are remnants of organs which were complete and functional in the ancestral forms. The vermiform appendix of man is a vestigial organ. So, (C) matches with (II).

Atavism is a trait of distant ancestors that reappears in the modern day, e.g., elongated canine teeth in humans. So, (D) matches with (I).

Options (b), (c) and (d) are incorrect as (A), (B), (C) and (D) have incorrect matches in them.

181. (a)

The correct answer is option (a) because

The myelinated nerve fibres are enveloped with Schwann cells, which form a myelin sheath around the axon. So, (A) matches with (III)

Synaptic knob possess synaptic vesicles containing chemicals called neurotransmitters. So, (B) matches with (I)

Bipolar neurons have one axon and one dendrite, found in the retina of eye. So, (C) matches with (IV)

Multipolar neurons have one axon and two or more dendrites, found in the cerebral cortex. So, (D) matches with (II)

Option (b), (c) and (d) are incorrect as they have mismatches for (A), (B), (C) and (D)

182. (d)

The correct answer is option (d) because,

Diuresis is prevented by vasopressin or anti-diuretic hormone from neurohypophysis or posterior pituitary. When there is excessive loss of fluid from the body the secretion of, ADH facilitates water reabsorption from latter part of renal tubules.

Option (a) is incorrect because renin from JG cells convert angiotensinogen in blood to angiotensin I and further to angiotensin II; which is a powerful vasoconstrictor and increases the glomerular blood pressure and thereby GFR.

Option (b) is incorrect because ANF causes vasodilation and thereby decrease GFR.

Option (c) is incorrect because aldosterone is released from adrenal cortex and causes reabsorption of Na^+ and water from distal parts of renal tubules.

183. (b)

The correct answer is option (b) -B and D only because except for hepatitis -B, genital herpes and HIV infections, other sexually transmitted diseases are completely curable, if detected early and treated properly.

Genital warts, syphilis and trichomoniasis are completely curable STDs upon proper detection and treatment.

Option (a) is incorrect as it includes genital warts

Option (c) is incorrect as it includes genital warts and syphilis.

Option (d) is incorrect as it includes trichomoniasis.

Genital warts, genital herpes and hepatitis -B are viral STDs, syphilis is a bacterial and trichomoniasis is a protozoan STD.

184. (b)

The correct answer is option (b) as the correct order (from old to recent) of periods in Paleozoic era is Silurian, Devonian, Carboniferous, Permian

Option (a) is incorrect because Permian, is mentioned before (carboniferous).

Option (c) is incorrect because it is mentioned that Permian is the oldest period of Paleozoic era.

Option (d) is incorrect because it is mentioned that Devonian is the recent period of Paleozoic era

185. (d)

The correct answer is option (d) because LUB is the first heart sound and it is produced by closing of AV valves; (tricuspid valve in between right atrium and right ventricle) and (bicuspid /mitral valve in between left atrium and left ventricle), during ventricular systole.

Option (a) is incorrect as closure of the semilunar valves produce the second heart sound called 'DUB'.

Option (b) is incorrect because opening of valves are not responsible for production of heart sounds 'LUB' and 'DUB'.

Option (c) is incorrect because opening of semilunar valves does not produce only heart sounds.

186. (a)

The correct answer is option (a) because

Mons pubis is a cushion of fatty tissue covered by skin and pubic hair. So (A) matches with (II).

Clitoris is a tiny finger like structure which lies at the upper junction of the two labia minora above the urethral opening. So, (B) matches with (III)

Hymen is a membrane which partially covers the opening of vagina., So (C) matches with (IV)

Labia majora are fleshy folds of tissue which extends down from the mons pubis and surround the vaginal opening. So, (D) matches with (I)

Other options (b), (c) and (d) are incorrect as they represent mismatches for (A), (B), (C) and (D)

187. (d)

Failure of segregation of chromatids during cell division-cycle results in the gain or loss of chromosome called aneuploidy.

Aneuploidy occurs due to addition or deletion.

Hence only (B) and (C) are correct

188. (a)

The correct answer is option (a) because Statement I is correct which states that RNA interference takes place in all eukaryotic organisms as method of cellular defense and Statement II is incorrect which states that RNAi involved the silencing of a specific mRNA due to a complementary ssRNA molecule that binds and prevents translation of mRNA. In statement II, it should be complementary dsRNA molecule that is involved in silencing of a specific mRNA.

Options (b), (c) and (d) are incorrect as they represent wrong answer.

189. (c)

The correct answer is option (c), (C) and (E) only as both are wrong statements.

Atrial natriuretic factor, a peptide hormone is secreted from the atria of the heart not by the seminiferous tubules of the testes.

Gastrin acts on the gastric glands not on the intestinal wall and stimulates the secretion of hydrochloric acid and pepsinogen.

Rest statements (A), (B) and (D) are correct statements.

Option (a), (b) and (d) are incorrect because they have either one or two correct statements.

190. (a)

The correct answer is option (a) as the correct sequence of steps involved in the process of PCR are :

(C) Denaturation

(A) Annealing

(D) Treatment with Taq polymerase and deoxynucleotides

(E) Extension

(B) Amplification (~ 1 billion times).

That is $C \rightarrow A \rightarrow D \rightarrow E \rightarrow B$

Option (b), (c) and (d) are incorrect as they represent incorrect sequence.

191. (c)

mammals have the ability to produce a concentrated urine. The Henle's loop and vasa recta play a significant role in this. The flow of filtrate in the two limbs of Henle's loop as well as flow of blood through the two limbs of vasa recta are in a counter current pattern. The proximity between the Henle's loop and vasa recta, as well as the counter current in them help in maintaining the increasing osmolarity towards the inner medullary interstitium, i.e., from 300 mos mol L^{-1} in the cortex to about 1200mOsmol L^{-1} in the inner medulla. So, counter current mechanism of loop of Henle of juxtamedullary nephron participates in concentration of urine.

192. (d)

The Golgi cisternae are concentrically arranged near the nucleus with distinct convex cis or the forming face and concave trans or the maturing face.

A number of proteins synthesised by ribosomes on the endoplasmic reticulum are modified in the cisternae of the Golgi apparatus before they are released from its trans face.

Hence the correct answer is option (d).

193. (a)

Parturition is induced by a complex neuroendocrine mechanism. The signals for parturition originate from the fully developed foetus and the placenta that induce mild uterine contractions called foetal ejection reflex.

Placenta acts as an endocrine tissue and produces several hormones like hCG, hPL estrogens, progesterones, etc.

The milk produced during the initial few days of lactation is called colostrum that contains several antibodies absolutely necessary to develop resistance for the new-born babies.

Fimbriae helps in collection of the ovum after ovulation.

194. (a)

Phylum Chordata is divided into three subphyla: Urochordata, Cephalochordata and Vertebrata. The members of subphylum Vertebrata possess notochord during the embryonic period. The notochord is replaced by a cartilaginous or bony vertebral column in the adult. Thus, all vertebrates are chordates but all chordates are not vertebrates.

195. (d)

The child blood group is (A^+) that means he must have received (i) allele from the father i.e. the father genotype is ($I^B i$)

While mother can have $I^A I^A$ or $I^A i$ genotype.

So, the possible genotypes of all three i.e. mother, father and child respectively would be either

(B) $I^A I^A | I^B i | I^A i$

(E) $I^A i | I^B i | I^A i$

196. (a)

The given graph represents the population growth curve where 'a' represents exponential growth when responses are not limiting the growth which forms a J-shaped curve and 'b' represents logistic growth when responses are limiting the growth which forms an S-shaped curve.

197. (a)

Muscle contraction is initiated by a signal sent by the CNS via a motor neuron. A neural signal reaching the neuromuscular junction releases a neurotransmitter (acetylcholine) which generates an action potential in the sarcolemma. This spreads through the muscle fibre and causes the release of Ca^{2+} into the sarcoplasm. Increase in Ca^{2+} level leads to the binding of calcium with a subunit of troponin on actin filaments and thereby remove the masking of active sites for myosin. Utilising the energy from ATP hydrolysis, the myosin head now binds to the exposed active sites on actin to form a cross bridge.

198. (d)

The simple squamous epithelium is involved in functions like forming a diffusion boundary and is found in the walls of blood vessels.

The main function of ciliated epithelium is to move particles in a specific direction over the epithelium and is present in the inner surface of fallopian tubes.

Goblet cells of the alimentary canal are examples of unicellular glands which consist of isolated glandular cells.

Compound epithelium is made of more than one layer of cells and is found in the inner lining of pancreatic ducts.

199. (c)

The B-lymphocytes produce an army of proteins in response to pathogens into our blood to fight with them. These proteins are called antibodies.

Interferons belong to the cytokine barrier of innate immunity, which protect non-infected cells from further viral infection.

T-lymphocytes mediate cell mediated immunity.

Colostrum provides natural passive immunity to the infant.

200. (c)

Nearly 20 – 25 percent of CO_2 is transported by RBCs whereas 70 percent of it is carried as bicarbonate. About 7 percent of CO_2 is carried in a dissolved state through plasma. The binding of CO_2 with haemoglobin is related to the partial pressure of CO_2 . pO_2 is a major factor which could affect this binding. When pCO_2 is high and pO_2 is low as in the tissues, more binding of CO_2 occurs. Percentage of a gas transported depends upon its partial pressure. If partial pressure decreases, the transportation of gases also decreases with hemoglobin. So, Reason is the correct explanation of Assertion.