NEET (UG) Sample Question Paper-1

ANSWERS WITH EXPLANATION

PHYSICS

 (d) Apply Newtons second law. Change in momentum is equal to Impulse.

$$\mathbf{I} = m(v_2 - v_1)$$

- 2. (b) The car may be thrown out of circular track due to lack of friction because while taking a turn frictional force acts as a centripetal force. The frictional force is reduced due to rains or oil spilled on the road.
- **3.** (b) Heat is a path function. Heat transfer depends on process. Hence heat transfer is different for different paths between same initial & final status.
- **4.** (d) If H is the height of the liquid surface then for same range $h_2 = H h_1$.



5. (a) The Earth's gravity at take off.



Equivalent spring constant of a wire is given by

$$K = \frac{YA}{l}$$

$$K_{eq} = K_1 + K_2$$
or
$$\frac{Y(2A)}{l} = \frac{Y_1A}{l} + \frac{Y_2A}{l}$$
or
$$Y = \frac{Y_1 + Y_2}{2}$$

(c) It is given that water rises to a height 'h' in a capillary tube. So, the length of the capillary tube

above the surface water is made less than 'h' then the height of water > length of capillary tube, so in such case, water will not overflow, but create constant flow using energy without any energy input. The similar force that pulls water along inside of capillary tube will hold it there when it reaches the end. Such force doesn't just pull upward, it pulls the water along the glass. At a certain height, the weight of the water column balances this pull. In that case the pull is upward since there is water below not above.

8. (c) Using Wien's law,

 $\lambda \propto \frac{1}{2}$

$$\lambda_{1\text{max}} = \lambda_0 \text{ and } \lambda_{2\text{max}} = \frac{3}{4\lambda_0}$$
$$\frac{\lambda_0}{\frac{3}{4}\lambda_0} = \frac{T_2}{T_1} \qquad \dots (i)$$

As
$$P \propto T^4$$

As

So
$$\frac{P_2}{P_1} = \left(\frac{T_2}{T_1}\right)^4$$
 ...(ii)

From equation (i) and (ii)

$$\frac{P_2}{P_1} = \left(\frac{T_2}{T_1}\right)^4 = \left(\frac{4}{3}\right)^4$$

Here, $P_2 = nP$ and $P_1 = P$

So,
$$\frac{nP}{P} = n = \left(\frac{T_2}{T_1}\right)^4 = \left(\frac{4}{3}\right)^4 = \frac{256}{81}$$

9. (a) When the lift is stationary

$$F = mg$$

49 = m × 9.8
m = 49 / 9.8 =

m = 49/9.8 = 5 kgIf a, is the downward acceleration of the lift then

$$m \times (g-a) = 5 \times (9.8-5) = 24 N$$

10. (a) Energy gained by the ice during its fall E = mgh

As,
$$\frac{mgh}{4} = mL_f$$

F =

$$h = \frac{mL_f \times 4}{mg}$$
$$= \frac{L_f \times 4}{g}$$
$$= \frac{3.4 \times 10^5 \times 4}{10}$$
$$= 136000 \text{ m}$$
$$= 136 \text{ km}$$

11. (a) The raw egg has some fluid in it and thus on spinning the egg fluid is thrown outward while the hard boiled egg is solid from inside. So,

$$I_r = I_b$$
As,
$$I_{\omega} = \text{constant}$$

$$\therefore \qquad \omega_r = \omega_b$$
or
$$\frac{\omega_r}{\omega_b} < 1$$
or
$$\frac{t_r}{t_b} > 1 \qquad \left[\because \omega = \frac{2\pi}{T} \right]$$

- 12. (a) Since, in the rocket, fuel is undergoing combustion, the gases produced in this process leave the body of the rocket with large velocity and produce upthrust to the rocket. Let us assume that the fuel is undergoing combustion at the constant rate, then rate of change of momentum of the rocket will be constant. Since, more and more fuel will be burnt the mass of rocket will go on decreasing, so it will lead to increase the velocity of the rocket more and more rapidly.
- **13.** (c) The work done by gravity is the work done, as if all the mass were concentrated at the centre of mass. The work necessary to lift the object can be thought of as the work done against gravity and is just *w* = *mgh*, where *h* is the height through which the centre of mass is raised.

w = 180 (9.8) (1.7) = 3.0 kJ

$$= b \times c \times x \times \rho \times g$$
$$= b.c.x.g$$

 $(\rho = density \text{ of water} = 1)$

Mass of piece of wood
$$= a.b.c.p$$

So acceleration =
$$-bcxg/abc\rho = -gx/a\rho$$

Hence time period T =
$$2\pi \sqrt{\frac{\rho a}{g}}$$

Since Time period T = $2\pi \sqrt{\frac{\text{length}}{\text{accelaration}}}$

15. (b)

 $X^A \to 3_2 H e^4 + 3_{+1} e^0 + {}_{z-9} Y^{A-12}$

Number of protons in the final nucleus = Z - 9Number of neutrons = (A - 12) - (Z - 9) = A - Z - 3

Ratio =
$$\frac{Z-9}{A-Z-3}$$

- **16.** (c) If a magnet retains its attracting power for a long time it is said to be permanent, otherwise temporary. Permanent magnets are made of ferromagnetic substances.
- 17. (d) Statement I is false and Statement II is true.
- **18.** (b) We see output of gate 1 and gate 2



 G_1 output is $A \bullet B$

 G_2 output is $\overline{\mathbf{A}} \bullet \mathbf{B}$

The output of G_1 and G_2 serve as input of OR gate, so now output *Y* is :



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

- **19.** (b) Diffusion of charge carriers. Electrons will diffuse to P side .
- **20.** (a) As per Faraday's laws, mechanical energy gets transformed into electric energy which is done in accordance with law of conservation of energy, hence Faraday's laws are consequence of conservation of energy.
- **21.** (b) Gravitational force of attraction between planet and sun gives centripetal force,

$$GMm/r^2 = mv^2/r$$

Now velocity $v = \sqrt{GM/r}$

Time period of planet T = $2\pi r/v$ or T² = $4\pi^2 r^3/GM$

From Kepler's third law, $T^2 = Kr^3$

Using equations, we see $4\pi^2 r^3/GM = Kr^3$, so relation between G and K is GMK = $4\pi^2$

- **22.** (d) From the formula $C = K\epsilon A/d$, it is clear that the capacity of parallel plate condenser depends on the separation (distance) between the plates.
- **23.** (d) Work done is not characterized by thermodynamic state of matter. It shows only relationship between two different thermodynamic states.
- 24. (c) A weber is the unit of magnetic flux in SI system.

25. (d)
$$x = \sqrt{AB} = \sqrt{1.0 \times 2.0} = 1.414$$

Now,

2

$$\frac{\Delta x}{x} = \frac{1}{2} \cdot \left[\frac{\Delta A}{A} + \frac{\Delta B}{B} \right] = \frac{1}{2} \cdot \left[\frac{0.2}{1.0} + \frac{0.2}{2.0} \right] = \frac{0.6}{2 \times 2.0}$$

$$\Delta x = \frac{0.6x}{4.0} = 0.15 \times 1.414 = 0.2121$$

Rounding off to one significant digit, $\Delta x = 0.2$ m. Hence $\sqrt{AB} = 1.4m \pm 0.2m$

- 26. (c) If net force on the system is zero, it can be resolved into two equal and opposite forces which can be considered to form a couple.
- 27. (a) Ratio of number of nuclei

Also,

so

F

$$\frac{N_1}{N_2} = e^{-8\lambda t}/e^{-\lambda t} = e^{-7\lambda t} = 1/\epsilon$$
$$7\lambda t = 1,$$
$$t = \frac{1}{7\lambda}$$

- 28. (d) The curvature of trajectory depends on all the three.
- 29. (c) We know that the de-Broglie's wavelength

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

If v is increased, λ decreases and therefore β decreases.

30. (b) From the circuit, $\varepsilon_1 = (i_1 + i_2)R + i_1r_1$

Hence
$$\varepsilon_1 - (i_1 + i_2)\mathbf{R} - i_1r_1 = 0$$

31. (d)
$$\frac{N}{N_0} = \left(\frac{1}{2}\right)^{\frac{t}{T}} = \left(\frac{1}{2}\right)^{\frac{5T}{T}} = \frac{1}{32}$$

Percentage atom remains = $\frac{1}{32} \times 100 = 3.125\%$

μ

32. (c)
$$\lambda_{med} = \frac{\lambda_{min}}{\mu}$$

 $\mu = \frac{c}{\mu}$

[µ-refractive index]

$$\mu = \frac{c}{v} = \frac{1}{\sqrt{\mu_0 \mathbf{e}_0}} \cdot \sqrt{\mu \mathbf{e}} = \sqrt{\frac{9}{1}} = 3$$
$$\lambda_{med} = \frac{\lambda_{air}}{3}$$

Frequency of the wave is not altered by the medium. 33. (c) Total energy lost by the capacitor is

$$(U_2 - U_1) = \frac{C_1 C_2}{2(C_1 + C_2)} (V_1 - V_2)^2$$
$$= \frac{2 \times 10^{-6} \times 10^{-6}}{2(2+1) \times 10^{-6}} [150 - 300]^2$$
$$= \frac{(150)^2 \times 10^{-6}}{3} = 7.5 \times 10^{-3} J$$

34. (c) The Stefan's law is : $E = \sigma(T^4)$ where,

$$E = \frac{Energy}{Area} \times Time$$
$$= \frac{Watt}{m^{2}}$$
Now, $\sigma = \frac{E}{T^{4}} = \frac{Watt-m^{-2}}{K^{4}}$
$$= Watt-m^{-2}K^{-4}$$

35. (b) Suppose a ball rebounds with speed
$$v_{i}$$

 $v = \sqrt{2gh} = \sqrt{2 \times 10 \times 20}$

= 20 m/s

Energy of a ball just after rebound,

1

$$\mathsf{E} = \frac{1}{2}mv^2 = 200 \; \mathrm{m}$$

As, 50% of energy loses in collision means just before collision energy is 400 m.

According to law of conservation of energy, we have

$$\frac{1}{2}mv_0^2 + mgh = 400 \text{ m}$$

$$\Rightarrow \quad \frac{1}{2}mv_0^2 + m \times 10 \times 20 = 400 \text{ m}$$

$$\Rightarrow \qquad v_0 = 20 \text{ m/s}$$
36. (a)
$$S = kt^3$$

$$a = \frac{d^2S}{dt^2} = \frac{d}{dt}(3kt^2)$$

$$= 6 kt$$

So, acceleration is increasing with time.

37. (b) Heat is a path function. Heat transfer depends on process. Hence heat transfer is different for different paths between same initial & final status.

 $a \propto x$

 $W_{net} = F.x$ $\propto a.x$ $\propto x^2$ $\Delta K \propto x^2$

_

4

6

39. (d)

$$\stackrel{\text{m/s}}{\Longrightarrow} \underset{1 \text{ m/s}}{\longleftarrow} \stackrel{\text{V}}{\longleftarrow} \underset{1 \text{ m/s}}{\overset{\text{V}}{\longleftarrow}} \underset{1 \text{ m/s}}{\overset{\text{V}}{\longleftarrow}}$$

Before collision

After collision

Let v be the velocity of ball after collision, collision is elastic

$$e = 1$$

or relative velocity of separation = relative velocity of approach

:.
$$v - 1 = 4 + 1$$

:..

v = 6 m/s (away from the wall)

40. (b) From the figure, in refraction, when CD is refracted wavefront and v_1 and v_2 are speed of light in medias, then in time t wavelet from B reaches C, wavelet from A will reach D, such that



Work =
$$(3\hat{i} + \hat{j}) \cdot (2\hat{i} + 3\hat{j} - 2\hat{k})$$

= 6 + 3 = 9 J

- **42.** (a) When a body is projected vertically upwards, at the highest point of its motion, the velocity of the body becomes zero but acceleration is not zero.
- **43.** (c) Isothermal elasticity of gas is given as $K_i = P$, it is equal to pressure.
- 44. (d) To move the body up the inclined plane, the force required = mg sin θ+ μN
 = mg sin θ+ μmg cos θ

(N is the normal force = mg $\cos \theta$)

- **45.** (c) Option (c) is correct. A minimum amount of energy equal to (TE) of the moon earth system has to be given to break (unbound) the system, the sun is exerting force on the moon but not providing any energy.
- **46.** (c) The angle between magnetic field and area vector is 90°, so the flux associated with coil is zero. Although magnetic field is changing but flux is remaining constant equal to zero, so emf induced and hence, current in the loop is equal to zero.

...

$$C_{p} = \frac{5}{2}R$$

$$C_{v} = C_{p} - R = \frac{5}{2}R - R = \frac{3}{2}R$$

$$\frac{C_{p}}{C_{v}} = \frac{\frac{5}{2}R}{\frac{3}{2}R} = \frac{5}{3}$$

48. (b) Loss in K.E = Gain in P.E

$$\frac{1}{2}mv^{2}\left[1+\frac{K^{2}}{R^{2}}\right] = \frac{1}{2}kx_{m}^{2}$$
Here $\frac{K^{2}}{R^{2}}$ for solid cylinder $=\frac{1}{2}$

substituting

$$3 \times 6^{2} (1 + 0.5) = 200x_{m}$$

 $x_{m} = \frac{8}{10} = 0.8m$

49. (b) For using the internal energy of sea water to operate the engine of a ship, the internal energy of the sea water has to be converted into mechanical energy. Since, whole of the internal energy cannot be converted into mechanical energy, a part has to be rejected to a colder body (skin). Since, no such body is available, the internal energy of the sea water cannot be used to operate the engine of the ship.

Note that a refrigerator is a heat engine working in the reverse direction.

$$\frac{\text{Energy}}{\text{Fission}} = 200 \text{MeV}$$
$$= 200 \times 10^6 \times 1.6 \times 10^{-19} \text{J}$$
$$\text{Fission Rate} = \frac{5 \text{MeV}}{200 \text{MeV}}$$
$$= \frac{5 \times 10^6 \text{Js}^{-1}}{200 \times 10^6 \times 1.6 \times 10^{-19} \text{J}}$$
$$= 1.56 \times 10^{17} \text{Fission/sec}$$

CHEMISTRY

51. (a) In phenols, the presence of electrons releasing group decreases the acidity whereas the presence of electron withdrawing groups increases the acidity as compared to phenol.

Among *meta* and *para* nitrophenols the latter is more acidic due to presence of NO_2 group at *para* position stabilizes the phenoxide ion to a greater extent than at meta position. Thus, order of acidic



- **52.** (c) S.I. unit of molarity will be mol/m^3 .
- **53.** (c) Azimuthal quantum number of electron present in p-orbital will be 1.
- 54. (d)



55. (b)



phenoxide



56. (c) Peptide bond is formed by the reaction of one— COOH group of one amino acid with the —NH₂ group of another amino acid.



As some double bond character is found between C—N bond, the bond length of C—N in protein should be smaller than the usual C—N bond.



58. (d) Bond order of $O_2^- = 1.5$, $O_2^{2-} = 1$; $O_2 = 2$; $O_2^+ = 2.5$

Now, bond length $\propto \frac{1}{\text{bond order}}$

Thus, the species which has maximum bond order has minimum bond length therefore, O_2^+ has minimum bond length.

59. (d)
$$NO_2^- \Rightarrow 2$$
 bond pairs + 1 lone pair
 $\Rightarrow sp^2$ hybridization
 $NH_2^- \Rightarrow 2$ bond pairs + 2 lone pairs
 $\Rightarrow sp^3$ hybridization
 $H_2O \Rightarrow 2$ bond pairs + 2 lone pairs
 $\Rightarrow sp^3$ hybridization
 $BF_3 \Rightarrow 3$ bond pairs only
 $\Rightarrow sp^2$ hybridization
60. (b) $\frac{1}{2} N_{2(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons NO_{(g)}$ (K₁) $\frac{1}{2}$

$$NO_{(g)} + \frac{1}{2}O_{2(g)} \longleftrightarrow NO_{2(g)} (K_1)^2$$

 $\frac{1}{2}N_{2(g)} + O_{2(g)} \longrightarrow NO_{2(g)}$ (K₁ K₂)^{1/2} So, for the reverse reaction which is the desired one the value of K will be reciprocal of this value. *i.e.*,

$$K = \frac{1}{(K_1 K_2)^{1/2}}$$

61. (a) For the reaction,

or

$$BrO_3^- + 5Br^- + 6H^+ \longrightarrow 3Br_2 + 3H_2O$$

Rate of appearance of bromine (Br₂) = $\frac{1}{3} \frac{d[Br_2]}{dt}$

Rate of disappearance of bromide ion Br

$$= -\frac{1}{5}\frac{d[\mathrm{Br}^{-}]}{dt}$$
$$\frac{d[\mathrm{Br}_{2}]}{dt} = -\frac{3}{5}\frac{d[\mathrm{Br}^{-}]}{dt}$$

62. (a) Let Rate $(r) = [CH_3COCH_3]^x [Br_2]^y [H^+]^z$

where x, y and z are the order of reaction w.r.t. CH₃COCH₃, Br₂, and H⁺ respectively

$$5.7 \times 10^{-5} = (0.30)^{x} (0.05)^{y} (0.05)^{z} \dots (1)$$

$$5.7 \times 10^{-5} = (0.30)^{x} (0.10)^{y} (0.05)^{z} \dots (2)$$

$$1.2 \times 10^{-4} = (0.30)^{x} (0.10)^{y} (0.10)^{z} \dots (3)$$

$$3.1 \times 10^{-4} = (0.40)^{x} (0.05)^{y} (0.20)^{z} \dots (4)$$

From equations (1) and (2)

$$y = 0$$

From equations (2) and (3) z = 1

From equations (1) and (4) x = 1

$$x =$$

Thus, rate of reaction will be

$$= k[CH_3COCH_3]^1 [Br_2]^0 [H^+]^1$$

$$= k[CH_3COCH_3][H^+]$$

63. (a) Rate of reaction = k [A]^m [B₂]ⁿ where *m* and *n* are the orders w.r.t. A and B₂ respectively.

In following experiments

$$1.6 \times 10^{-4} = k[0.50]^m [0.50]^n \qquad \dots (1)$$

 $3.2 \times 10^{-4} = k[0.50]^m [1]^n$...(2)

 $3.2 \times 10^{-4} = k[1.00]^{m}[1]^{n}$

From equations (2) and (3), $2.2 \dots 10^{-4}$ 1.[1]m[1]n

$$\frac{3.2 \times 10^{-4}}{3.2 \times 10^{-4}} = \frac{k[1]^m[1]^n}{k[0.5]^m[1]^n} \Rightarrow 1 = 2m \Rightarrow m = 0$$

From equation (1) and (2),

$$\frac{3.2 \times 10^{-4}}{1.6 \times 10^{-4}} = \frac{[0.5]^m [1]^n}{[0.5]^m [0.5]^n} \Rightarrow 2 = 2n \Rightarrow n = 1$$

Hence, rate equation $= k[A]^0[B_2]^1 = k[B_2]$

64. (b)

Less number of unpaired electrons means less paramagnetic behaviour.

:. $[Co(H_2O)_6]^{2+}$ shows less paramagnetic behaviour.

65. (b) CFSE for octahedral complex is given by general formula as follows :

CFSE = $[-0.4 (t_{2g} \text{ electrons}) + 0.6 (e_g \text{ electrons})] \Delta_0$ For Mn⁺³ \Rightarrow 3d⁴ \rightarrow $t_{2g}^3 e_g^1$

CFSE = $[(-0.4 \times 3) + (0.6 \times 1)] \Delta_0 = -0.6\Delta_0$ For Fe³⁺, $3d^5 \rightarrow t^3_{2g}e^2_g$

CFSE =
$$[(-0.4 \times 3) + (0.6 \times 2)] = 0$$

For Co⁺², $3d^7 \rightarrow t_{2g}^5 e_g^2$

CFSE =
$$[(-0.4 \times 5) + (0.6 \times 2)] = -0.8\Delta_0$$

For Cd³⁺, $[3d^6] \rightarrow t_{2g}^4 e_g^2$

 $CFSE = [(-0.4 \times 4) + (0.6 \times 2)] = -0.4\Delta_0$

66. (d) The deactivating tendency of given groups follows the order :

$$-NO_2 > -SO_3H > -C = N > -C -OH$$

67. (a) As the hybridization of central metal in $[Co(NH_3)_6]^{3+}$ complex ion is sp^3d^2 and coordination number of Co⁺³ is 6 so, its geometry is octahedral.

68. (a) Second ionization enthalpy means removal of electron from unipositive ion. Electronic configuration of unipositive ions of Ti, V, Cr and Mn

$$Ti^{+} (21) = [Ar] 3d^{2} 4s^{1}; V^{+} (22) = [Ar] 3d^{3} 4s^{1}$$

$$Cr^{+} (23) = [Ar] 3d^{5} 4s^{0}; Mn^{+} (24) = [Ar] 3d^{5} 4s^{1}$$

Now, generally, ionization energy increases with increase in atomic number but for Cr⁺ there is extra stability due to exactly half-filled orbital thus, it has more ionization energy than Mn⁺. Thus, the correct order of ionization enthalpy is Cr > Mn > V > Ti.

69. (a) The relation between standard Gibbs free energy and E°_{cell} is $\Delta G^{\circ} = -nFE^{\circ}_{cell}$

For the cell reaction

70. (c

 Δ

are as follows :

...(3)

$$2Ag^{+} + Cu \longrightarrow Cu^{+2} + 2Ag$$

$$\Delta E^{\circ}_{cell} = 0.46 \text{ V}$$

$$\Delta G^{\circ} = -nF E^{\circ}_{cell}$$

$$\Delta G^{\circ} = -2 \times 96500 \times 0.46 = -88780 \text{ J}$$

$$\Delta G^{\circ} = -89.0 \text{ kJ}$$
(c)
$$\Delta G^{\circ}_{f(H_2O)} = -237.2 \text{ kJ.mol}^{-1}$$

$$\Delta G^{\circ}_{f(CO_2)} = -394.4 \text{ kJ.mol}^{-1}$$
AG^{\circ}_{f(cO_2)} = -394.4 \text{ kJ.mol}^{-1}
In pentane oxygen fuel cell, following reaction takes place,

$$C_5H_{12} + 10H_2O \longrightarrow 5CO_2 + 32H^{+} + 32e^{-}$$

$$\frac{8O_2 + 32H^{+} + 32e^{-} \longrightarrow 16H_2O}{C_5H_{12} + 8O_2 \longrightarrow 5CO_2 + 6H_2O; E^{\circ} = ?}$$

$$\Delta G^{\circ}_{reaction} = \sum \Delta G^{\circ}_{products} - \sum \Delta G^{\circ}_{reactants}$$

$$\Delta G^{\circ}_{reaction} = (5 \times \Delta G^{\circ}_{f(CO_2)} + 6 \times \Delta G^{\circ}_{f(H_2O)})$$

$$-(\Delta G^{\circ}_{f(Pentane)} + 8 \times \Delta G^{\circ}_{f(O_2)})$$

$$= 5 \times (-394.4) + 6 \times (-237.2)$$

$$-(-8.2 + 8 \times 0)$$

$$= -3387 \text{ kJ.mol}^{-1}$$

$$= -3387 \times 10^3 \text{ J.mol}^{-1}$$

$$\Delta G^{\circ}_{reaction} = -nFE^{\circ}_{cell}$$

$$E_{cell}^{o} = \frac{-3387 \times 10^{3}}{-32 \times 96500} = 1.0968 V$$

71. (b) In S_N^2 reaction, primary is more reactive than secondary and tertiary alkyl halides.

Thus, order of S_N² is :

$$CH_3 - X > R - CH_2 - X > R_2 CH - X > R_3 C - X$$

 S_N^2 reaction is favoured by small groups on the carbon atoms attached to halogen.

72. (d) Only the terminal alkynes react with ammoniacal silver nitrate. Therefore, this reaction can be used to distinguish between 1-alkynes and others such as alkane, alkenes and non-terminal alkynes.

$$CH_3$$
— CH_2 — C \equiv $CH + 2[Ag(NH_3)_2]NO_3$
— \rightarrow CH_3CH_2C \equiv CAg
White ppt.

CU

73. (d)

$${}^{7}_{CH_{3}}$$
 $-{}^{6}_{CH_{2}}$ $-{}^{5}_{CH_{2}}$ $-{}^{4}_{CH_{2}}$ $-{}^{3}_{CH_{2}}$ $-{}^{2}_{CH_{2}}$ ${}^{2}_{CH_{2}}$ ${}^{1}_{CH_{2}}$ $-{}^{2}_{CH_{2}}$ ${}^{2}_{CH_{3}}$ ${}^{1}_{CH_{2}}$ $-{}^{2}_{CH_{2}}$ ${}^{2}_{CH_{3}}$ ${}^{1}_{CH_{2}}$ $-{}^{2}_{CH_{3}}$ ${}^{1}_{CH_{3}}$ ${}^{2}_{CH_{3}}$ $-{}^{2}_{CH_{3}}$ ${}^{1}_{CH_{3}}$ $-{}^{2}_{CH_{3}}$ $-{}^{2}_{CH_{3$

Correct IUPAC name \rightarrow 4-ethyl 3–methyl heptane.

- 74. (d) $\operatorname{Fe}_3O_4: 3x + 4(-2) = 0 \Longrightarrow x = 8/3$
- **75.** (b) Electron gain enthalpy of halogens are greater than the chalcogens. So, oxygen and sulphur have lower electron gain enthalpy than fluorine and chlorine. Also, oxygen and fluorine due to their small size has lower electron gain enthalpy than their next homologue. Thus, the correct order is : O < S < F < CI.
- **76.** (d) As the size of the alkali metal cation increases, thermal stability of their hydrides decreases.

Hence, the correct order is :

- **77.** (d) Since the oxidation number of Ni increases from 0 to 2, therefore it acts as a reducing agent.
- **78.** (d) In Schottky defect, equal number of cations and anions are missing from the lattice so the crystal remains neutral. Such defect is more common in highly ionic compounds of similar cationic and anionic size *i.e.*, NaCl.
- 79. (d) As copper crystallizes in fcc lattice, $r = \frac{u}{2\sqrt{2}}$

:.
$$r = \frac{361}{2\sqrt{2}} = 127.6 \approx 128 \text{ pm}$$

80. (d) Mole fraction of $P = \frac{3}{3+2} = \frac{3}{5}$

Mole fraction of Q =
$$\frac{2}{3+2} = \frac{2}{5}$$

Hence total vapour pressure

= [(Mole fraction of P) × (Vapour pressure of P)] + [(Mole fraction of Q) × (Vapour pressure of Q)]

$$=\left(\frac{3}{5} \times 80 + \frac{2}{5} \times 60\right) = 48 + 24 = 72$$
 torr

81. (a) Molality of non-electrolyte solute

$$= \frac{\text{Weight of solute in (g)}}{(\text{Molar weight of solute})} \times (\text{Weight of solvent in kg})$$

$$\frac{1}{250 \times 0.0512}$$
 = $\frac{1}{12.8}$ = 0.0781 m

 $\Delta T_f = k_f m = 5.12 \times 0.0781 = 0.399 \text{ K} \approx 0.4 \text{ K}$

82. (a) The carbanion which have more s-character will be more stable. Thus, the order of stability is :

$$\mathrm{RC} \equiv \bar{\mathrm{C}} > \mathrm{C}_{6}\mathrm{H}_{5}^{-} > \mathrm{R}_{2}\mathrm{C} = \bar{\mathrm{C}}\mathrm{H} > \mathrm{R}_{3}\mathrm{C} - \bar{\mathrm{C}}\mathrm{H}_{2}$$

83. (d) Boyle's law is applicable in isothermal process.

84. (b)
$$X_2O_{4(l)} \rightarrow 2XO_{2(g)}$$

 $\Delta n_g = 2 - 0 = 2$
 $\Delta H = \Delta U + \Delta n_g RT$
 $\Delta H = 2.1 \text{ kcal} + 2 \text{ mol} (2 \text{ cal } \text{K}^{-1} \text{ mol}^{-1})(300 \text{ K})$
 $= 2100 \text{ cal} + 2 \text{ mol} (2 \text{ cal } \text{K}^{-1} \text{ mol}^{-1})(300 \text{ K})$
 $= 2100 \text{ cal} + 1200 \text{ cal}$
 $= 3300 \text{ cal}$

Now, $\Delta G = \Delta H - T \Delta S$

=

$$= 3300 \text{ cal} - (300 \text{k}) (20 \text{ cal } \text{K}^{-1})$$

= 3300 cal – 6000 cal

$$= -2700$$
 cal $= -2.7$ kcal

85. (a) Electron withdrawing substituent, deactivates the benzene nucleus towards electrophilic substitution while electron releasing substituent activates the ring towards electrophilic substitution.

Among the given options —OH has the higher electron donating tendency and thus activates the ring more towards electrophilic substitution.



is more reactive towards electrophilic reagent.



87. (c) Hypophosphorus acid is H₃PO₂, *i.e.*,



- **88.** (a) Due to lesser energy difference between 5*f* and 6*d*-orbitals than between 4*f* and 5*d*-orbitals is the main reason for larger number of oxidation states exhibited by the actinides than the corresponding lanthanides.
- **89.** (a) *p*-type semiconductors are produced due to adding impurity containing less electrons (*i.e.*, atoms of group 13). Ge belongs to group 14 and In to group 13. So, *p*-type semiconductor is formed. This doping of Ge with In increases the electrical conductivity of the Ge crystal.
- **90.** (b) Biodegradable polymer can be formed by H₂N— CH₂—COOH and H₂N—(CH₂)₅—COOH.
- **91.** (c) pH + pOH = 14
- **92.** (a) CH₃OH forms intermolecular hydrogen bonding shown as follows :



Intermolecular hydrogen bonding

This hydrogen bonding must be overcome to convert liquid CH_3OH to a gas.

93. (d) Hydrolysis of (CH₃)₂SiCl₂ followed by condensation polymerization.





94. (a) Micelles are formed by the association of colloids. They are formed by lyophilic and lyophobic groups. As the concentration increases the lyophobic parts receding away from the solvent approach each other to form a cluster, the lyophobic ends are in the interior, lyophilic groups projecting outwards in contact with the solvent. **95.** (c) The acidity of halogenated acid increases with increase in electronegativity of the halogen present.

: Acidity order will be :

$$\label{eq:FCH2} \begin{split} \text{FCH}_2\text{COOH} > \text{ClCH}_2\text{COOH} > \text{BrCH}_2\text{COOH} \\ & > \text{CH}_3\text{COOH} \end{split}$$

96. (c) Al₂O₃ can be converted into anhydrous AlCl₃ by heating a mixture of Al₂O₃ and carbon in dry chlorine.

 $Al_2O_3 + 3C + 3Cl_2 \longrightarrow 2AlCl_3 + 3CO$ Anhy. AlCl_3 (dry)

- **97.** (c) $[SiO_3^{2^-}]n$ and $[Si_4O_{11}]^{6^-}$ have chain structure of silicates.
- 98. (c) $\Delta G = \Delta H T \Delta S$

For reaction to be spontaneous, $\Delta G < 0$

$$0 > \Delta H - T\Delta S$$

 $0 > 170 \text{ kJ} - T(170 \text{ JK}^{-1})$

$$T(170 \text{ JK}^{-1}) > 170000 \text{ J}$$

Among the given temperatures, only 1110K is greater than 1000K thus, at this temperature the reaction will be spontaneous.

99. (d) From E° values of M^{2+}/M , we have

$$E^{\circ}/V$$
 Cr Mn Fe Co
 $M^{2+}/M = 0.90 = 1.18 = 0.44 = 0.28$

 E° value for Mn is more negative than expected from general trend due to extra stability of half-filled Mn²⁺ ion.

Thus, correct order should be

Mn > Cr > Fe > Co

But an examination of E° values for redox couple M^{3+}/M^{2+} shows that Cr^{+2} is strong reducing agent $(E^{\circ}_{M}^{3+}/M^{2^{+}} = 0.41 \text{ V})$ and liberates H_2 from dilute acids.

$$2Cr^{+2}_{(aq)} + 2H^{+}_{(aq)} \longrightarrow 2Cr^{3+}_{(aq)} + H_2 \uparrow_{(g)}$$

Thus, correct order is Mn > Fe > Cr > Co.

100. (d) Reaction of HBr with propene in the presence of peroxide gives *n*-propyl bromide. This addition reaction is an example of anti-Markovnikov's addition reaction.

(*i.e.*, it is completed in form of free radical addition)

$$CH_2 - CH = CH_2 + HBr \xrightarrow{Peroxide}$$

 $CH_3 \underbrace{-CH_2 - CH_2Br}_{\mathit{n}\text{-propyl bromide}}Br$

ZOOLOGY

- 101. (d) The squamous epithelium is made of a single thin layer of flattened cells with irregular boundaries. They are found in the walls of blood vessels and air sacs of lungs and are involved in a function like forming a diffusion boundary.
- **102. (b)** Transition state structure of the substrate formed during an enzymatic reaction is transient and unstable.
- **103. (a)** Trypsinogen is activated by an enzyme, enterokinase, secreted by the intestinal mucosa into active trypsin, which in turn activates the other enzymes in the pancreatic juice to pour into the duodenum.
- **104.** (b) Our tissues usually take up approx 25% of the oxygen in the tissue and the rest 75% remains unused. This remaining O_2 acts as a reserve during muscular exercise.
- **105. (c)** Heart attack is when critical regions of cardiac muscle get deprived of oxygen and nutrients; Heart block is blockage of conduction at any stage; Heart failure is when heart is unable to pump sufficient amount of blood as per demand of body. Measurer, estrogen levels decreases and resultant increases in GnRH section. Progesterone also decreases GnRH secretion at the level of hypothalamus complete stoppage of heart beat is cardiac arrest.
- **106. (b)** Maximum reabsorption of electrolytes and water occurs in PCT.
- **107. (b)** Myosin itself act like ATPase enzyme with two active sites : One for actin and other for ATP.
- **108. (a)** The photopigment present in rods is called rhodopsin. It is a purplish red protein with opsin and retinal, a derivative of Vitamin A.
- **109. (c)** Endocrine glands lack ducts and are hence, called ductless glands. Their secretions are called hormones. Hormones are nonnutrient chemicals which act as intercellular messengers and are produced in trace amounts.
- **110. (b)** Flatworms or Platyhelminthes are the first triploblastic organisms.
- 111. (d) Amphibians and mammals have dicondylic skull.
- **112.** (c) In cockroaches, the nitrogenous wastes such as urates of sodium and potassium formed in the tissues enter the haemolymph and enter the lumen of the malpighian tubule, where uric acid is formed.
- 113. (d) Parturition is triggered by oxytocin which initiates uterine contractions. Prostaglandins are produced in response to oxytocin which are effective in causing uterine contractions at times. Oestrogen, progesterone level marks the beginning of parturition. Prolactin hormone is responsible for milk secretion at the end of pregnancy.
- **114. (d)** The increased levels of GnRH then acts at the anterior pituitary gland and stimulates secretion

of two gonadotropins – luteinizing hormone (LH) and follicle stimulating hormone (FSH).

- **115. (c)** In tubectomy, a small part of the fallopian tube is removed and tied up through a small incision in the abdomen or through vagina.
- **116. (b)** Flying squirrel in placental mammals and flying phalanger in marsupial mammals show adaptive convergence regarding gliding nature.
- 117. (c) Once HIV is in your body the virus attaches to and gets into the CD4 T cells. The virus then uses the DNA (the genetic code inside the cell) to replicate (make copies of itself). As new virus particles break out of a CD4 T cell, the cell dies. The new virus particles then attach and enter new CD4 T cells and so the process continues. Millions of new virus particles are made in CD4 T cells each day and millions of CD4 T cells die each day. To counter the virus destruction, the body continues to make new CD4 T cells each day. However, over time, the virus usually wins and the number of CD4 T cells gradually falls (usually over several years). Once the level of CD4 T cells goes below a certain level, your immune system is weakened. If your immune system is severely weakened by HIV infection then you are likely to develop various opportunistic infections. So, HIV that causes AIDS, first starts destroying helper T lymphocytes and not B lymphocytes, leukocytes and thrombocytes.
- **118. (c)** *Anguilla* is a marine fish.
- 119. (d) Each restriction endonuclease recognises a specific palindromic nucleotide sequences in the DNA. The sequences read the same on the two strands in 5' 3' direction. This is also true if read in the 3' 5' direction.
- 120. (a) Fact.
- **121. (c)** In competitive inhibition of enzyme action, Km increases but Vmax is same. Vmax is same because competitive inhibition is reversible, on increasing the substrate concentration, the effect of the inhibitor is removed.
- **122.** (d) Secretin Enhances release bicarbonate in bile juice and pancreatic juice.

Enterocrinin – Stimulates crypts of lieberkuhn. Enterogastrone – Stop release of Gastrin.

- **123. (a)** Allergy is due to the release of chemicals like histamine and serotonin from the mast cells.
- 124. (c) Fact.
- **125. (b)** JGA is a special sensitive region formed by cellular modification of DCT and the afferent arteriole at the location of their contact.
- **126. (a)** When the stimulus is applied, the permeability of the membrane for Na^+ changes. This leads to rapid influx of Na^+ from extracellular fluid

to intracellular fluid, the outer surface of the membrane becomes negatively charged and the inner becomes positive. The membrane is depolarised.

- **127. (b)** After the production of ADH in the cell bodies of neurosecretory cells in the hypothalamus, it is transported axonally to neurohypophysis (posterior pituitary) where they are stored and released.
- **128. (b)** Bacterial artificial chromosomes (BAC) vectors are vectors which are based on fertility plasmid of bacteria. They are used for mapping of large eukaryotic genome. Yeast Artificial chromosomes (YAC) are used for the cloning of DNA fragments.
- **129. (c)** Some strains of *Bacillus thuringiensis* produce proteins that kill certain insects such as *lepidopterans* (tobacco budworm, armyworm), *coleopterans* (beetles) and *dipterans* (flies, mosquitoes).
- **130. (c)** Human eggs are alecithal *i.e.*, devoid of yolk. In humans, these eggs get nourishment from mothers body.
- **131. (d)** Amniocentesis is used to check for any genetic abnormality of the foetus.
- **132. (b)** The hormone releasing IUDs are Progestasert, LNG-20.
- **133. (d)** According to Hardy Weinberg principle the amount of genetic variation in a population will remain constant, genetic equilibrium from one generation to the next if the disturbing factors are absent. Natural selection or lack of random mating can disturb genetic equilibrium.
- **134. (b)** Coca alkaloid is a white crystalline powder, act as a mild stimulant.
- 135. (b) Ramapithecus (12.2million years old in the Miocene) has human-like jaw and are supposed to be first branched off from apes lineage that gradually evolved into modern man. Australopithecus, a hominid that lived 4.5 to 4 million years ago, was discovered in 1924 from South Africa and hence is also called as "Southern ape of Africa". Genus homo consists of six members out of whom Homo habilis (2.3 mya) is the oldest one characterized by small stature with a larger brain and smaller molars and premolars than Australopithecus which are considered to be immediate ancestor of the genus homo. Fossils of Homo erectus (1.7 mya) were discovered from Pleistocene rocks of Central Jawa and hence the name Jawa man. Also known as Peking man, they are supposed to be the first one to use fire.
- **136. (a)** Some lipids have phosphorous and a phosphorylated organic compound in them. These are phospholipids. They are found in cell membrane. Lecithin is one example.
- **137.** (b) Macrocystic anaemia can be due to deficiency of B_9 (folic acid) and B_{12} (cyanocobalmin). In this

condition RBC's are large in size and exist in immature form so have less space available for haemoglobin.

- **138. (d)** If one kidney damage, the other kidney will enlarge to compensate the work of damaged kidney *i.e.*, kidney show compensatory hypertrophy.
- **139. (c)** Pseudounipolar neuron means 'pseudo= false, uni= one instead they are bipolar with two branches.

It is a type of sensory neuron in the peripheral nervous system.

They have an axon that has split into two branches where one of the branches runs to the periphery and the other to the spinal cord.

The axons of dorsal ganglion neurons are also known as afferents nerves.

In the peripheral nervous system, the afferents neurons relay sensory information into the central nervous system i.e. the brain and the spinal cord.

- 140. (c) Body is unsegmented in Pila.
- **141. (c)** The nymphs look very much like adults. The nymph grows by moulting about 13 times to reach the adult form. The next to last nymphal stage has wing pads but only adult cockroaches have wings.
- **142. (c)** IUDs increase phagocytosis of sperms within the uterus and the Cu ions released suppress sperm motility and the fertilising capacity of sperms.
- **143. (a)** Super-ovulation and embryo transplantation are the new techniques for cattle and other livestock improvement.
- **144. (a)** Normally, the genes encoding resistance to antibiotics such as ampicillin, chloramphenicol, tetracycline or kanamycin, etc., are considered useful selectable markers for *E. coli*.
- **145. (d)** The first clinical gene therapy was given in 1990 to a 4-year old girl with adenosine deaminase deficiency (ADA).
- **146. (d)** *Platypus* is oviparous. It is the only mammal that is egg-laying.
- **147. (b)** Gametocytes remain in the blood for several weeks but are unable to develop further due to high temperature of the human host. Mosquitoes are cold blooded animals and it is therefore necessary for them to be taken into the body of Anopheles for further development.
- **148. (b)** Obturator foramen is the largest foramen of skeleton but closed by fibrous membrane. It is formed by ischium and pubis.
- 149. (d) Estrogen is ovarian hormone.
- **150. (b)** Changes in allele frequency in natural population occurring by chance is known as genetic drift.

BOTANY

- **151. (c)** NADPH reductase enzyme is located on grana lamella towards stroma side. Break down of proton gradient releases energy.
- **152. (a)** Root cap \rightarrow Zone of meristematic activity \rightarrow Zone of elongation \rightarrow Zone of root hairs.
- 153. (b) The seed of orchids are endospermic.
- **154.** (a) IAA \rightarrow weed free lawns,
 - Cytokinin \rightarrow Herring sperm DNA,

ABA \rightarrow stomatal closure, ethylene \rightarrow ripening of fruits,

- $GA \rightarrow promotes bolting.$
- **155.** (d) Interphase constitutes more than 95% duration of cell cycle. It is divided into G_1 , S and G_2 phase.



% of offspring to get affected by both disorders

$$\frac{1}{4} = 25\%$$

157. (c) Aspergillus niger \rightarrow Citric acid, Acetobacter aceti \rightarrow Acetic acid

Clostridium butylicum \rightarrow Butyric acid,

Lactobacillus \rightarrow Lactic acid.

- **158. (c)** Hexokinase phosphorylates glucose using ATP as the source of the phosphate, producing glucose-6-phosphate, a more reactive form of glucose.
- 159. (b) Synergids and antipodal cells.
- **160. (a)** AaBbCcDd contain three heterozygotes (n = 3) types of gamates $= 2^n = 2^3 = 8$.
- 161. (c) Chloroplast contains 70 S ribsome.
- 162. (a) Cyanobacteria have both PS-I and PS-II.
- 163. (a) Fact.
- **164.** (d) Several ruminant animals such as cow and buffaloes have methanogens in their gut.
- **165. (a)** Mycoplasma species are widespread examples and some can be intracellular pathogens that grow inside their hosts. This bacterial lifestyle is called parasitic or saprophytic. Cell walls are unnecessary here because the cells only live in the controlled osmotic environment of other cells.
- **166. (c)** Archae have primitive forms with histones, no organized nucleus, membrane bound organelles are absent and proteinaceous and non-cellulosic carbohydrate nature of cell wall.

- **167. (b)** *Selaginella* and *Salvinia* produce two kinds of spores, macro and microspores. They are known as heterosporous.
- **168. (d)** Grasses belong to Angiosperma in which endosperm formation is after fertilization.
- **169. (b)** Leaves are modified into spines in Opuntia, a xerophytic plant.
- 170. (b) Halophytes grow in saline swampy soil and show vivipary which is *in-situ* seed germination. Pneumatophores are for gaseous exchange.
- **171. (a)** Anthocyanins are water soluble vacuolar pigments that may appear red, purple or blur depending upon the pH. The remaining are present in the chloroplasts. Carotenoids are also present in chromoplasts.
- **172. (d)** Ribosomes are naked ribonucleoprotein protoplasmic particles (RNP, particles) which function as the sites of protein synthesis.
- **173. (c)** Ribosomes may occur singly a monosomes or in rosettes and helical groups called polysomes. The different ribosomes of a polysome are connected with a strand of *m*-RNA. Nucleosome is a basic unit of DNA packaging in eukaryotes. Plastidome are the plastids of a cell when they are referred to a functional unit. Polyhedral bodies are involved in carbon fixation are present in autotrophic bacteria.
- **174. (d)** Nuclei, mitochondria and chloroplast are double membraned bound organelles. Lysosomes are single membrane bound organelles.
- **175. (d)** The light independent reaction refers to dark reaction. It takes place in the stromal matrix of the chloroplasts.
- **176. (b)** The energy released during the electron transport system is utilised in synthesizing ATP with the help of ATP synthase (complex V). This complex consists of two major components, F_1 and F_0 . The F_1 headpiece is a peripheral membrane protein complex and contains the site for synthesis of ATP from ADP and inorganic phosphate. F_0 is an integral membrane protein complex that forms the channel through which protons cross the inner membrane. The passage of protons through the channel is coupled to the catalytic site of the F_1 component for the production of ATP. For each ATP produced, $2H^+$ passes through F_0 from the intermembrane space to the matrix down the electrochemical proton gradient.
- **177. (d)** Cytokinin promote cell division in tissue culture provided auxins are present. For division in tissue cytokinin should be proportionate in order to allow shoot and root development.
- **178. (a)** Gibberellin hormone induces aleurone cells to secrete enzyme to break stored food in seed.
- **179. (c)** In a majority of aquatic plants such as water hyacinth and water lily, the flowers emerge above

the level of water and are pollinated by insects or wind as in most of the land plants.

- **180. (c)** A test cross is performed to determine the genotype of a dominant parent if it is a heterozygous or homozygous-dominant. For the purpose, the hybrid is crossed with homozygous recessive parent.
- **181. (b)** The template DNA strand serve in RNA synthesis during transcription is called anticoding or antisense strand while the other strand is called coding or sense strand as its base sequence is same as that of newly synthesized mRNA.
- 182. (b) The three hotspots such as Western Ghats and Sri Lanka, Indo-Burma and Himalaya cover India's biodiversity regions.
- **183. (c)** Greenhouse gases include carbon dioxide, methane, N₂O, CFCs etc.
- **184.** (d) RNA was the first genetic material. There are evidences to suggest that essential life process, such as metabolism, translation, splicing etc. evolved around RNA.
- **185. (c)** In pteridophytes prothallus is haploid, free living gametophytic structure.
- **186. (c)** Collenchyma is a living tissue of plants having thickening of cellulose, hemicellulose and pectin at corners of cells. It is a mechanical tissue.
- **187. (d)** *Frankia* form symbiotic association with non leguminous plant *i.e., Alnus*.
- **188. (d)** BOD test measures the rate of uptake of oxygen by microorganisms in a sample of water. It

indirectly gives idea of organic matter present in the water.

- 189. (b) Viroids are infectious RNA particle which are devoid of protein coat. Molecular weight of viroid is low.
- **190. (b)** Maize is a C_4 plant. In these plants primary CO_2 acceptor is PEP, catalysed by enzyme PEP carboxylase in mesophyll cells.
- **191. (a)** Protonema is haploid thin thread like structure found in mosses. It represents juvenile phase.
- **192.** (a) During anaphase I homologous chromosomes of a pair separate.
- **193.** (d) Floridean starch is stored food of red algae.

- **194.** (b) Golgi complex is organelle for cell secretion.
- **195. (c)** In wind pollinated flowers pollen grains are light, non-sticky and produced in large amount.
- **196. (c)** In brown algae (Phaeophyceae) large body is differentiated into holdfast, stipe and frond.
- **197. (a)** In aquatic ecosystem, the pyramid of biomass may be inverted.
- 198. (c) Fact
- **199. (d)** *Nitrosomonas, Nitrococcus* and *Nitrobacter* are chemoautotrophs.
- **200. (b)** Dioecious plants bear unisexual flowers that promote only xenogamy.