04/10/2023

Code-A_Phase-1

Corporate Office : Aakash Tower, 8, Pusa Road, New Delhi-110005,
Ph.011-47623456

MM : 720 Fortnightly Test 2023-24_RM(P1)-Test-06A **Time : 200 Min.**

PHYSICS

SECTION-A

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SECTION-B

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CHEMISTRY

SECTION-A

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SECTION-B

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BOTANY

SECTION-A

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SECTION-B

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ZOOLOGY

SECTION-A

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181. (1)

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184. (2)

185. (2)

SECTION-B

186. (4)

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188. (2)

189. (2)

190. (3)

191. (2)

192. (4)

193. (4)

194. (3)

195. (2)

196. (3)

197. (3)

198. (2)

199. (4)

200. (3)

Hints and Solutions

PHYSICS

SECTION-A

(1) **Answer :** (3)
Solution:
The value of coefficient of volume expansion of the paraffin in (k^{-1}) is 58.8×10^{-5}.

(2) **Answer :** (3)
Solution:
$\frac{dQ}{dt} = eA(T^4)$

(3) **Answer :** (1)
Solution:
$\lambda_m = \frac{b}{T}$

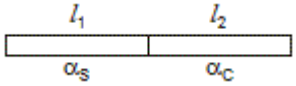
(4) **Answer :** (3)
Solution:
$I = I_0 (I + \alpha_1 t)$
$I_1' = I_1 + I_1\alpha_1 t$
$I_2 = I_2 + I_2\alpha_2 t$
$\Delta l_1 = \Delta l_2$
$l_1\alpha_1 t = l_2\alpha_2 t$
$l_1\alpha_1 = l_2\alpha_2$

(5) **Answer :** (4)
Solution:
According to wein's law
$\lambda_m T$ = constant
$\frac{CT}{\nu_{\max}} =$ constant
$\nu_m \propto T$

(6) **Answer :** (1)
Solution:
Heat is the form of energy transferred between two (or more) systems or a system and its surroundings by virtue of temperature difference and SI unit of temperature is Kelvin.

(7) **Answer :** (4)
Solution:
Natural convection requires gravity but force convection can occur in gravity or gravity free space.

(8) **Answer :** (4)
Solution:



$\Delta l_S = l_1\alpha_S t$
$\Delta l_C = l_2\alpha_C t$
$l_1\alpha_S = l_2\alpha_C$
$\frac{l_1}{l_2} = \frac{\alpha_C}{\alpha_S}$
$\frac{l_1 - l_2}{l_2} = \frac{\alpha_C - \alpha_S}{\alpha_S}$
$\frac{l_1 + l_2}{l_2} = \frac{\alpha_C + \alpha_S}{\alpha_S}$
$\frac{l_1 + l_2}{l_1 - l_2} = \frac{\alpha_C + \alpha_S}{\alpha_C - \alpha_S}$

(9) **Answer :** (2)
Solution:
Heat loss = heat gain
$0.2 \times 1000 \times S \times 10 - 0 = 25 \times 80$
$200 \times S(10) = 2000$
$S = \frac{2000}{2000} = 1 \text{ cal g}^{-1} (C^\circ)^{-1}$

(10) **Answer :** (2)
Solution:
In series combination of rods.

$K_{\text{eq}} = \frac{2K_1K_2}{K_1+K_2}$\
$\because\ R_{TH} = \frac{L}{KA}$
and $R_{\text{eq.}} = R_1 + R_2$
$\frac{L_{\text{eq}}}{K_{\text{eq}}A_{\text{eq}}} = \frac{L}{K_1A} + \frac{L}{K_2A}$
$\frac{2L}{K_{\text{eq}}A} = \frac{L}{K_1A} + \frac{L}{K_2A}$
$\frac{2}{K_{\text{eq}}} = \frac{1}{K_1} + \frac{1}{K_2} \Rightarrow K_{\text{eq}} = \frac{2K_1K_2}{K_1+K_2}$

(11) **Answer :** (3)
Solution:
$S = m \times c = 40 \times 0.2 = 8$ cal/°C

(12) **Answer :** (2)
Solution:
Heat loss = Heat gain.

(13) **Answer :** (1)
Solution:
As per Wien's Displacement Law,
λT = constant.
$\lambda 400 = \lambda' 1200$
$\lambda' = \frac{\lambda}{3}$
$\Delta\lambda = \frac{2\lambda}{3}$

(14) **Answer :** (1)
Solution:
Heat current flows from high temperature to low temperature.
Temperature of junction
$T = \frac{20+30+40+50+60}{5} = 40$ °C
So, no current flows from E, $\because\ \Delta T = 0$

(15) **Answer :** (2)
Solution:
When pressure increases, the boiling point of liquid increases. So, it will boil at higher temperature.

(16) **Answer :** (3)
Solution:
$T_J = \frac{K_1T_1+K_2T_2+K_3T_3}{K_1+K_2+K_3} = 45^\circ\text{C}$

(17) **Answer :** (2)
Solution:
For the cyclic process as $\Delta U = 0$
$\Delta Q = W$
Here W is area enclosed *i.e.*, = –400 J
(anticlockwise)

(18) **Answer :** (3)
Solution:
$\left.\begin{aligned} P^2V &= \text{constant} = K \\ PV &= nRT \end{aligned}\right\}$ hence $\sqrt{V} = \frac{nRT}{K}$
$\sqrt{\frac{V}{2V}} = \frac{T}{T}$
$\Rightarrow T' = \sqrt{2}T$

(19) **Answer :** (3)
Solution:
$V \propto T^{2/3}$
$\text{V} \propto \left(\frac{\text{PV}}{\text{nR}}\right)^{2/3}$
By solving

$PV^{-1/2}$ = constant
compare it with PV^{γ} = constant
$\Rightarrow \gamma = -\frac{1}{2}$
$W = -\frac{R\Delta T}{\gamma - 1} = \frac{(8.3)(30)}{1-\gamma}$
$W = \frac{2}{3} \times 8.3 \times (30) = 166\,\text{J}$

(20) **Answer :** (1)
Solution:
$\frac{1}{4} = \left(1 - \frac{T_2}{T_1}\right)$ ...(i)
$\frac{1}{2} = \left(1 - \frac{T_2 - 40}{T_1}\right)$ ...(ii)
From equation (i)
$\frac{T_2}{T_1} = \frac{3}{4} \Rightarrow T_1 = \frac{4}{3}T_2$
Substituting T_1 in eqn (ii)
$\frac{1}{2} = \left(\frac{1 - \frac{T_2 - 40}{4}T_2}{\frac{4}{2}}\right)$
$= 1 - \frac{3}{4} + \frac{30}{T_2}$
$\Rightarrow \frac{30}{T_2} = \frac{1}{4}$
$\Rightarrow T_2 = 120\,\text{K}$

(21) **Answer :** (4)
Solution:
$\because\ \eta = 1 - \frac{T_2}{T_1}\quad ...\left(\text{i}\right)\ \Rightarrow\ 3\eta = 1 - \frac{T_2}{2T_1}\quad ...\left(\text{ii}\right)$
After solving (i) and (ii)
η = 0.2 ∴ 3η = 0.6 = 60%

(22) **Answer :** (1)
Solution:
$\frac{Q_2}{W} = \frac{T_2}{T_1 - T_2} = \frac{273}{303-273} = \frac{273}{30} = 9.1$
Q_1 = 9.1 + 1 = 10.1

(23) **Answer :** (1)
Solution:
1 → Diatomic
2 → Monoatomic

(24) **Answer :** (3)
Solution:
$\Delta V = nC_V\Delta T$
$= 2 \times \frac{3}{2}R\Delta T = 2 \times \frac{3}{2} \times 8.31 \times \left(150 - 300\right)$
$= -3735\,\text{J}$
$\left(T_2 = T_1 \times \left(\frac{V_1}{V_2}\right)^{\gamma-1} = 300 \times \left(\frac{1}{2\sqrt{2}}\right)^{2/3} = 150\,\text{K}\right)$

(25) **Answer :** (1)
Solution:
$\Delta U = nC_V\,\Delta T = 2 \times \frac{3}{2}R \times 50 = 150 \times 8.3 = 1245\,\text{J}$
$\Delta Q = \Delta U + \Delta W$ = 1245 + 50 = 1295 J

(26) **Answer :** (3)
Solution:
In cyclic process $\Delta U = 0$
$\therefore W = Q_{\text{net}}$ = 5960 – 5585 – 2980 + 3645 = 1040 J
Efficiency $= \frac{W}{Q_{\text{supplied}}} = \frac{1040}{5960 + 3645}$ = 0.108

(27) **Answer :** (3)
Solution:
$\because TV^2$ = constant = K
$V = \frac{K}{\sqrt{T}}$

$dV = -\frac{K}{2T^{3/2}}dT$

$\because PV = nRT$

$P = \frac{nRT}{V} = \frac{nRT}{K/\sqrt{T}}$

$P = \frac{nRT^{3/2}}{K}$

$\because \quad W = \int PdV = -\frac{nR}{2}\int_{300}^{600} dT$

$W = -\frac{1\times R}{2}[600 - 300]$

$W = -\frac{R}{2} \times 300 = -150R.$

(28) **Answer :** (4)
Solution:

$P_1V_1^{\gamma} = P_2V_2^{\gamma}$

$\frac{P_1}{P_2} = \left(\frac{V_2}{V_1}\right)^r$

= 32 : 1

(29) **Answer :** (2)
Solution:

$\Delta W_{AB} = 1 \times R\,(2T - T) = RT$

$\Delta W_{BC} = 1 \times R\,2T \ln\frac{2p}{p}$

$= 2\,RT \ln 2$

$\Delta W_{CD} = 1 \times R\,(T - 2T)$

$= -RT$

$\Delta W_{DA} = -RT \ln 2$

$\therefore \Delta W = \Delta W_{AB} + \Delta W_{BC} + \Delta W_{CD} + \Delta W_{DA}$

(30) **Answer :** (4)
Solution:

In adiabatic process

$T^{\gamma}P^{1-\gamma}$ = Constant

$\Rightarrow \quad P \propto T^{\frac{-\gamma}{1-\gamma}}$

As given data $P^2 \propto T^5$ *i.e.*, $\frac{-\gamma}{1-\gamma} = \frac{5}{2}$

$-2\gamma = 5 - 5\gamma$

$3\gamma = 5$

$\gamma = \frac{5}{3}$

(31) **Answer :** (4)
Solution:

$Q = \Delta U + W$

$0 = -75 + W$

$W = 75$ J

(32) **Answer :** (4)
Solution:

Process *AB* and *CD* are isochoric

$W_{AB} = 0$ and $W_{CD} = 0$

Process *BC* and *DA* are isobaric.

$W_{BC} = P(V_C - V_B) = nR(T_C - T_B)$

$W_{BC} = nR(1800 - 600) = 1200\,nR$

$\because n = 3$

$W_{BC} = 3600\,R$

$W_{DA} = nR(T_A - T_D) = 3R(300 - 900)$

$W_{DA} = -1800\,R.$

$\therefore W_{\text{Net}} = W_{BC} + W_{DA} = 1800\,R = 14.9 \times 10^3$ J

[$\because R = 8.31$ JK^{-1} mol^{-1}]

(33) **Answer :** (4)
Solution:

$\Delta W = 4.5 \times 10^5 \times (2 - 0.5) = 6.75 \times 10^5$ J

$\Delta Q = 800000$ J

$\Delta Q = \Delta W + \Delta U$

$\Delta U = 800000 - 675000 = 1.25 \times 10^5$ J

(34) **Answer :** (2)

Solution:

For helium $\gamma = \frac{5}{3}$

For an adiabatic process

$TV^{\gamma-1} =$

$T_f V_f^{y-1} = T_i V_i^{y-1}$

$T_f = T_i \left(\frac{V_i}{V_f}\right)^{\gamma-1}$

$T_f = T_0\left(\frac{11.2}{1.4}\right)^{\left(\frac{5}{3}-1\right)} = T_0(8)^{2/3} = 4T_0$

Number of moles $n = \frac{11.2}{22.4} = \frac{1}{2}$

$\therefore$ Work $W = \frac{nR(T_f - T_i)}{1-\gamma}$

$W = \frac{\frac{1}{2}R(4T_0 - T_0)}{1-\frac{5}{3}}$

$W = \frac{\frac{R}{2}\times 3T_0}{-\frac{2}{3}}$

$W = -\frac{9RT_0}{4}$

(35) Answer : (3)

Solution:

β = coefficient of performance

$\beta = \frac{T_2}{T_1 - T_2} = \frac{10+273}{20-10} = \frac{283}{10} = 28.3$

SECTION-B

(36) Answer : (2)

Solution:

$Q = \int msdT$

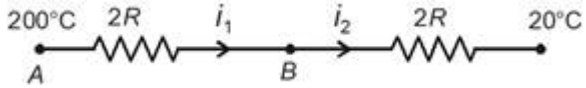
$= m\int_{300}^{500}\left(A + BT\right)dT = \left[100T + \frac{0.02}{2}T^2\right]_{300}^{500}$

= 21600 cal

(37) Answer : (3)

Solution:

From concept of thermal resistance



$i_1 = i_2$

$\frac{200 - T_B}{2R} = \frac{200-20}{4R}$

$400 - 2T_B = 200 - 20$

$T_B = \frac{220}{2} = 110^\circ\text{C}$

(38) Answer : (3)

Solution:

$\frac{60-50}{10} = \left(\frac{60+50}{2} - 25\right)$ ...(i)

$\frac{40-30}{t} = \left(\frac{40+30}{2} - 25\right)$ ...(ii)

Now, $\frac{t}{10} = \frac{30}{10}$

t = 30 s

(39) Answer : (3)

Solution:

$R = \frac{l}{KA} \Rightarrow l = RKA \Rightarrow \frac{l_1}{l_2} = \frac{K_1}{K_2}$

(40) Answer : (3)

Solution:

For any thermometer

$\frac{\text{Reading} - \text{L.F.P}}{\text{U.F.P} - \text{L.F.P}}$ = Constant

$\frac{R-(-20)}{100-(-20)} = \frac{R-10}{90-10}$
$\Rightarrow \frac{R+20}{120} = \frac{R-10}{80}$
⇒ 8*R* + 160 = 12*R* – 120
⇒ *R* = 70°

(41) **Answer :** (1)
Solution:
When ratio of mass of ice at 0°C and steam at 100°C is 8 : 1 or more, then final temperature is 0°C.
$Q_1 = m_1 L_f$ = 30 × 80 = 2400 cal
$Q_2 = ms\Delta T$ = 30 × 1 × 100 = 3000 cal
Total heat required to raise temperature is 5400 cal.
∴ Heat absorbed by ice = $m_s L_v$
= 2 × 540 = 1080 cal
∴ Final temperature is 0°C.

(42) **Answer :** (4)
Hint:
Use Wien's displacement law
Solution:
$\lambda_m \propto \frac{1}{T} \Rightarrow \lambda_{m_1} T_1 = \lambda_{m_2} T_2$
$\Rightarrow \lambda_0 T = \lambda_0' \cdot 8T$
$\Rightarrow \lambda_0' = \frac{\lambda_0}{8}$

(43) **Answer :** (2)
Solution:
∴ Δ*L* = ΔL_1 + ΔL_2
3*L*α_{eq} Δθ = *L*αΔθ + 2*L*2αΔθ
$\alpha_{eq} = \frac{5\alpha}{3}$

(44) **Answer :** (2)
Solution:
∵ *PV* = *nRT*
$\Rightarrow P = \left(\frac{nR}{V}\right) T$
$\frac{nR}{V}$ is slope of *P* – *T* graphs
∴ $V_1 < V_2$

(45) **Answer :** (4)
Solution:
$\eta_{engine} = \frac{75}{100}\eta_{carnot}$
$\frac{W}{Q_1} == \frac{3}{4} \times \left(1 - \frac{T_2}{T_1}\right)$
$\frac{300}{Q_1} = \frac{3}{4} \times \left(1 - \frac{300}{400}\right)$
$\frac{300}{Q_1} = \frac{3}{4} \times \frac{1}{4}$
Q_1 = 1600 J
Heat discharged per second,
$Q_2 = Q_1 - W$
= 1600 – 300
= 1300 J

(46) **Answer :** (3)
Hint:
$\gamma = \frac{dV}{VdT}$
Solution:
PT^3 = constant
PV = *nRT*
$\frac{nRT^4}{V}$ = constant
$\frac{4T^3 dT}{V} - \frac{T^4}{V^2} dV = 0$
$\frac{dV}{VdT} = \frac{4}{T}$

(47) **Answer :** (4)
Solution:

$Q = W + \Delta U$
$Q = x\Delta U + \Delta U$
$Q = (x+1)\Delta U$
$nC_p\Delta T = (x+1)nC_v\Delta T$
$\Rightarrow \quad \gamma = x+1$
$\frac{5}{3} = x+1$
$x = \frac{2}{3}$

(48) Answer : (2)
Solution:
$P = mV$ ($PV = nRT$)
$\frac{nRT}{V} = mV$
$T = \frac{m}{nR}V^2 \quad \Rightarrow \quad T \propto V^2 \quad \Rightarrow \quad \frac{T_A}{T_B} = \left(\frac{V_A}{V_B}\right)^2$
$\frac{300}{T_B} = \left(\frac{V_0}{3V_0}\right)^2$
T_B = 9 × 300 = 2700 K
= 2427°C

(49) Answer : (3)
Solution:
Heat given to system is used in performing mechanical work as well as raising internal energy.
Work done $\frac{dW}{dQ} = \frac{\gamma-1}{\gamma}$

(50) Answer : (4)
Solution:
$U = \alpha + \beta PV$
$\because PV = RT$
$U = \alpha + \beta RT$
$C_v = \frac{dU}{dT}$
$C_V = \beta R$
$\because \quad C_v = \frac{R}{\gamma-1}$
Then $\beta R = \frac{R}{\gamma-1}$
$\gamma - 1 = \frac{1}{\beta}$
$\gamma = 1 + \frac{1}{\beta}$
$\gamma = \frac{\beta+1}{\beta}$

CHEMISTRY

SECTION-A

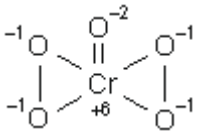
(51) Answer : (3)
Solution:
$p^o - p_s = \frac{10}{100}p^\circ$
$\frac{p^0 - p_s}{p^0} = 0.1$
$0.1 = \frac{n_{\text{urea}}}{n_{\text{urea}} + N_{H_2O}}$
$0.1 = \frac{\frac{w}{60}}{\frac{w}{60} + \frac{162}{18}}$
w = 60 g

(52) Answer : (2)
Solution:
The potential of mercury cell remains constant during its life as the overall reaction does not involve any ion in solution whose concentration can change during its lifetime.

(53) Answer : (2)
Solution:

Unit of Ebullioscopic constant is K kgmol^{-1}

(54) **Answer :** (4)
Solution:



(55) **Answer :** (1)
Solution:

$E_{Cell} = E^{\circ}_{Cell} - \frac{0.0591}{2}\log_{10}\left[\frac{0.1}{0.01}\right]$

$= 0 - \frac{0.0591}{2}\log 10$

= –0.0295 V

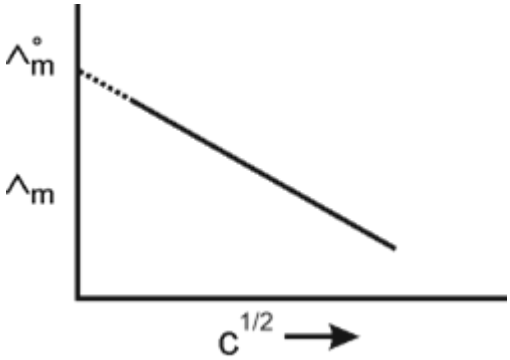
(56) **Answer :** (3)
Solution:

$\Delta T_b = iK_bm$

= 3 × K_b × 0.1

= 0.3 K_b

(57) **Answer :** (1)
Solution:



(58) **Answer :** (3)
Solution:

H_2S is a reducing agent.

(59) **Answer :** (3)
Solution:

For a spontaneous reaction

$E^{o}_{cell} = +ve$

ΔG = –ve

K = +ve

(60) **Answer :** (1)
Solution:

$\overset{+2}{Ca}\overset{+4-2}{CO_3}\left(s\right) \overset{\Delta}{\rightarrow} \overset{+2-2}{CaO}\left(s\right) + \overset{+4-2}{CO_2}\left(g\right)$

It is not a redox reaction.

(61) **Answer :** (3)
Solution:

$E^{o}_{cell} = \frac{0.059}{n}\log K_c \quad \left[at\ 298\ K\right]$

$0.295 = \frac{0.059}{2}\log K_c$

0. 295 × 2 = 0.059 $\log K_c$

$\frac{0.59}{0.059} = \log K_c$

10 = $\log K_c$

$\therefore K_c = 10^{10} = 1.0 \times 10^{10}$

(62) **Answer :** (4)
Solution:

Element in its highest and lowest oxidation state will not undergo disproportionation reaction.

(63) **Answer :** (1)
Solution:
$p_{total} = p_A^\circ X_A + p_B^\circ X_B = 100 \times \frac{1}{1+3} + 150 \times \frac{3}{1+3}$
= 137.5 mm of Hg

(64) **Answer :** (2)
Solution:
i = 1 + (n – 1)α
2.74 = 1 + (3 – 1)α
1 + 2α = 2.74
α = 0.87

(65) **Answer :** (4)
Solution:
Salt bridge maintains electrical neutrality of solution in two half cell by supplying suitable ions.

(66) **Answer :** (4)
Solution:
• Higher the value of i × C, higher will be the osmotic pressure of solution.

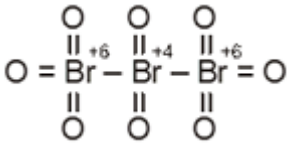
Solution	Sucrose	NaCl	$Al_2(SO_4)_3$	$Al(NO_3)_3$
i × C	1 × 0.2	2 × 0.1	5 × 0.15	4 × 0.2
	= 0.2	= 0.2	= 0.75	= 0.8

(67) **Answer :** (3)
Solution:
(38% by mass) aqueous H_2SO_4 is used as an electrolyte.

(68) **Answer :** (2)
Solution:
In CaH_2, H is present in –1 oxidation state.

(69) **Answer :** (3)
Solution:
Disproportionation is a type of redox reaction, in which an element in one oxidation state is simultaneously oxidised and reduced.

(70) **Answer :** (1)
Solution:

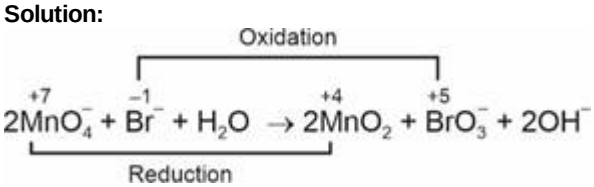


(71) **Answer :** (4)
Solution:
$Cr_2O_7^{2-} \rightarrow 2Cr^{3+}$ (n factor = 6)

$$6e^- + Cr_2O_7^{2-} \rightarrow 2Cr^{3+}$$

1 mole of $Cr_2O_7^{2-}$ requires 6F of charge.
So, 0.2 mole of $Cr_2O_7^{2-}$ requires charge = 6 × 0.2 = 1.2 F

(72) **Answer :** (2)
Solution:



Br^- is the reducing agent as the oxidation number of Br increases from –1 to +5.

(73) **Answer :** (1)
Solution:
More is the ratio of $\frac{[Cu^{2+}]}{[Mg^{2+}]}$, more is the EMF of the cell

(74) **Answer :** (2)
Solution:
$M_{eq.}$ of $K_2Cr_2O_7$ = $m_{eq.}$ of SO_3^{2-}
n × 6 = 1 × 2
n = 2/6 = 1/3

(75) **Answer :** (4)
Solution:
When A-B interactions are weaker than A-A or B-B interactions then positive deviation takes place. In positive deviation, $\Delta H_{mix} > 0$, $\Delta S_{mix} > 0$, $\Delta V_{mix} > 0$ and $\Delta G_{mix} < 0$.

(76) **Answer :** (3)
Solution:
Lower is the standard reduction potential, higher will be the reducing power.

(77) **Answer :** (3)
Solution:
Mass percentage is given as:
$\frac{W_{NaCl}}{W_{NaCl}+W_{H_2O}} = \frac{20}{100}$
$\frac{W}{W+60} = \frac{1}{5}$
W_{NaCl} = 15 g

(78) **Answer :** (1)
Solution:
Molar conductivity ($\wedge_m$) $= \frac{K \times 1000}{C}$
$\Lambda_m = \frac{0.015 \times 1000}{0.2} = 75\ S\ cm^2 mol^{-1}$

(79) **Answer :** (3)
Solution:
Lower the reduction potential, more will be the reducing power.

(80) **Answer :** (3)
Solution:
The higher the value of K_H, the lower is the solubility of gas.

(81) **Answer :** (4)
Solution:
Moles of ethyl alcohol = $\frac{92}{46} = 2$
Moles of water = $\frac{144}{18} = 8$
Mole fraction of water = $\frac{8}{8+2} = 0.8$

(82) **Answer :** (3)
Solution:
$E^{o}_{Cu^{2+}/Cu} = +0.34\ V$
Reduction potential of Cu^{2+}/Cu couple is positive hence it will not liberate H_2 gas from dilute HCl solution.

(83) **Answer :** (1)
Solution:
m = Zit
$m = \frac{63.5}{2 \times 96500} \times 1 \times 965$
m = 0.317 g

(84) **Answer :** (2)
Hint:
$\Delta_{mix}S$ is always greater than zero while $\Delta_{mix}G$ is always less than zero.
Solution:
$\Delta_{mix}S$ is always greater than zero also, $\Delta_{mix}G$ is always less than zero. While, $\Delta_{mix}V$ and $\Delta_{mix}H$ both are zero for ideal solution.

(85) **Answer :** (4)
Solution:
68% HNO_3 and 32% water by mass form maximum boiling azeotrope due to negative deviation.

SECTION-B

(86) **Answer :** (3)
Solution:

Volume independent concentration terms are temperature independent

(87) **Answer :** (1)
Solution:
$\overset{-3+1}{\mathrm{NH_3}} + \overset{+1\ -2}{\mathrm{H_2O}} \rightarrow \overset{-3+1\ -2+1}{\mathrm{NH_4\,OH}}$
$\therefore$ There is no change in the oxidation state.

(88) **Answer :** (4)
Solution:
Colligative properties depend on the number of solute particles irrespective of their nature. Vapour pressure of solvent is not dependent on its amount.

(89) **Answer :** (2)
Solution:
$2H^+(aq) + 2e^- \rightarrow H_2(g)$
$E_{H^+/H_2} = 0 - \frac{0.0591}{2}\log\left[\frac{p_{H_2}}{[H^+]^2}\right] = -\frac{0.0591}{2}\log\left[\frac{1}{0.1^2}\right]$
$= -\frac{0.0591}{2}\log 100 \ = \ -\ 0.0591\ volt$

(90) **Answer :** (3)
Solution:
$\frac{1}{R} = k\frac{A}{\ell}$
or $\left(\frac{\ell}{A}\right) = k \times R$
= 0.015 × 50
= 0.75 cm^{-1}

(91) **Answer :** (1)
Solution:
$\Lambda^o_m\left(\mathrm{Mg(OH)_2}\right) = \lambda^o_{Mg^{2+}} + \ 2\lambda^o_{OH^-}$
= 106 + 2 × (199.1)
= 504.2 S cm^2 mol^{-1}

(92) **Answer :** (2)
Solution:
In NH_4NO_3, $\mathrm{NH_4^+}$ and $\mathrm{NO_3^{\ominus}}$ ions are there.
O.S of 'N' in $\mathrm{NH_4^+}$ ion = –3
O.S of 'N' in $\mathrm{NO_3^{\ominus}}$ ion = +5

(93) **Answer :** (3)
Solution:
For association, $i = 1 + \left(\frac{1}{n} - 1\right)\alpha$
$i = 1 + \left(\frac{1}{2} - 1\right) \times 0.4$ = 1 – 0.2 = 0.8

(94) **Answer :** (1)
Solution:

Ions	H^+	Na^+	Mg^{2+}	Ca^{2+}
λ° (S cm^2 mol^{-1})	349.6	50.1	106.0	119.0

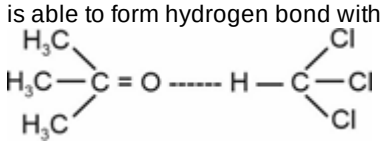
(95) **Answer :** (3)
Solution:
$\mathrm{MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O}$
$\eta = \ 5$

(96) **Answer :** (2)
Solution:
$\because$ ΔG° = – nF E^o_{cell} = – 2F × 1.2 = – 2.4 F

(97) **Answer :** (1)
Solution:
In mercury cell cathode used is paste of HgO and carbon.

(98) **Answer :** (4)

Solution:
Chloroform + acetone forms a solution with negative deviation from Raoult's law because chloroform molecule is able to form hydrogen bond with acetone molecule.



(99) **Answer :** (4)
Solution:
K_H of gas increases with increase in temperature.

(100) **Answer :** (4)
Solution:

$$\overset{+2}{O} = \overset{0}{C} = \overset{+2}{C} = \overset{+2}{C} = O$$

Average oxidation number (C) = $\frac{+2+0+2}{3} = +\frac{4}{3}$

BOTANY

SECTION-A

(101) **Answer :** (1)
Solution:
Sequoia is one of the tallest trees. It is a gymnosperm.

(102) **Answer :** (4)
Solution:
Main plant body of pteridophytes is sporophyte and it is differentiated into root, stem and leaves

(103) **Answer :** (1)
Solution:
Most common asexual spores in algae are zoospores. These are motile asexual structures. Motility of zoospores is due to presence of flagella.

(104) **Answer :** (2)
Solution:
Sulphated polysaccharides or hydrocolloids are found in the cell wall of rhodophyceae.

(105) **Answer :** (3)
Solution:
In phaeophyceae, body is divided into holdfast, stipe and frond.

(106) **Answer :** (1)
Solution:
In chlorophyceae outer layer of cell wall is made up of pectose, while inner layer is constituted by cellulose.

(107) **Answer :** (4)
Solution:
In red algae, Sexual reproduction is oogamous and accompanied by complex post fertilisation developments. The common members are: *Polysiphonia*, *Porphyra*, *Gracilaria* and *Gelidium*.

(108) **Answer :** (4)
Solution:
The protonema, grows directly from the spore, is a branched system of multicellular filaments. Branches of the protonema form the small buds, which in turn produce the leafy gametophyte.

(109) **Answer :** (1)
Solution:
Bryophytes do not show heterospory.

(110) **Answer :** (4)
Solution:
Red algae have photosynthetic pigments – Chlorophyll-a, chlorophyll-d, r- phycoerythrin and r-phycocyanin.

(111) **Answer :** (3)
Solution:
DNA sequence, chemical nature of proteins, crystals and aromatic compounds are used in chemotaxonomy by scientists to resolve confusions in classification.

(112) **Answer :** (4)

Solution:
Gymnosperms produce naked seeds.

(113) Answer : (2)
Solution:
Leaves of conifers have thick cuticle.

(114) Answer : (4)
Solution:
Algae lack post fertilisation development and embryo formation.

(115) Answer : (1)
Solution:
Due to great water retention capacity, *Sphagnum* is used in transportation of living plants.

(116) Answer : (4)
Solution:
Red algae have chl a, cellulosic cell wall and specialised sex organs. They lack flagella throughout their life cycle.

(117) Answer : (3)
Solution:
Pteridophytes require water for fertilization.

(118) Answer : (1)
Solution:
Egg apparatus is haploid and situated at micropylar end.

(119) Answer : (3)
Solution:
Coralloid roots are dichotomously branched roots having *Anabaena* associated with them and are found in *Cycas*.

(120) Answer : (2)
Solution:
External and internal features like anatomy, embryology and phytochemistry were also considered in natural system.

(121) Answer : (4)
Solution:
Pteridophytes do not retain megaspores permanently within the megasporangia.

(122) Answer : (2)
Solution:
Chlorella and *Spirullina* are unicellular algae used as food supplements.

(123) Answer : (4)
Solution:
Water channels are made up of eight different types of aquaporins.

(124) Answer : (3)
Solution:
Symplast pathway is the pathway formed by the system of interconnected protoplasts of different cells.

(125) Answer : (4)
Solution:
Water potential of pure water at standard temperature, which is not under any pressure is taken to be zero. As the concentration of solutes increase, the water potential becomes more negative.

(126) Answer : (3)
Solution:
Root pressure develops due to positive pressure. Root pressure may be observed late at the night when evaporation is low and absorption is high. Effect of root pressure is observable at night and early morning when evaporation is low, and excess water collects in the form of droplets around special openings.

(127) Answer : (2)
Solution:
Simple diffusion and facilitated transport both are not uphill processes.

(128) Answer : (3)
Solution:
In imbibition, water movement is along a concentration gradient.

(129) Answer : (3)
Solution:

Girdling experiment demonstrated that phloem is the tissue responsible for translocation of food and that transport takes place in one direction i.e. towards the roots.

(130) Answer : (2)
Solution:
The sugar moves into the living sieve tube cells by active transport which creates a hypertonic condition. After absorbing water from nearby xylem elements, osmotic pressure inside the sieve tube increases.

(131) Answer : (4)
Solution:
Phloem sap is mainly water and sucrose, but other sugars, hormones and amino acids are also transported or translocated through phloem.

(132) Answer : (3)
Solution:
Root pressure re-establishes the continuous chains of water molecules in the xylem.

(133) Answer : (3)
Solution:
The inner walls of guard cells are thick and elastic which prevents its breakage when water enters the guard cells. The outer walls bulge out and force the inner walls into a crescent shape

(134) Answer : (3)
Solution:
For fully plasmolysed cell, DPD = OP –(–TP),
DPD = OP + TP
So DPD > OP

(135) Answer : (1)
Solution:
Deplasmolysis occurs due to endosmosis of water.

SECTION-B

(136) Answer : (3)
Solution:
(i) Bryophytes and Pteridophytes exhibit an intermediate condition (Haplo-Diplontic) both phases are multicellular.
(ii) All seed bearing plants show diplontic pattern.
(iii) Algae mostly show haplontic life cycle.

(137) Answer : (2)
Solution:
Pyriform gametes with laterally attached flagella are present in brown algae.

(138) Answer : (1)
Solution:
When plants are classified on the basis of their chemical constituents then it is called Chemotaxonomy.

(139) Answer : (3)
Solution:
In bryophytes, the sporophyte is not free-living but attached to the photosynthetic gametophyte and derives nourishment from it

(140) Answer : (1)
Solution:
Pyrenoids contain protein and starch.

(141) Answer : (4)
Solution:
Gemmae are multicellular asexual buds.

(142) Answer : (2)
Solution:
Stored food in *Polysiphonia* is floridean starch which is structurally very similar to amylopectin and glycogen

(143) Answer : (4)
Solution:
Selaginella belongs to class lycopsida

(144) Answer : (1)
Solution:
Humidity is an external factors that affects transpiration.

(145) Answer : (2)

Solution:
Cohesion, adhesion and surface tension are the physical properties of water responsible for ascent of xylem sap.

(146) Answer : (2)
Solution:
The relationship among water potential, solute potential and pressure potential is $\psi_w = \psi_s + \psi_p$

(147) Answer : (2)
Solution:
Endodermis acts as control point and it adjusts the quantity and types of solutes entering in xylem tissues.

(148) Answer : (4)
Solution:
When turgor pressure of the guard cells increases, the thin outer walls bulge out and force the inner walls into a crescent shape.
When osmotic concentration of guard cells increases, water comes in, guard cells become turgid and stomata get open.

(149) Answer : (3)
Solution:
The fungus provides minerals and water to the roots, in turn the roots provide sugars and N-containing compounds to the mycorrhizae. Some plants have an obligate association with the mycorrhizae. For example, Pinus seeds cannot germinate and establish without the presence of mycorrhizae.

(150) Answer : (2)
Solution:
Solute potential is developed when solute is added to water. ψ_w of pure water is zero and ψ_s is always negative for a solution.

ZOOLOGY

SECTION-A

(151) Answer : (3)
Solution:
A centre present in pons called pneumotaxic centre can moderate the functions of the respiratory rhythm centre located in the medulla oblongata.

(152) Answer : (3)
Solution:
Limbic lobe/limbic system is a complex structure formed by association of Amygdala, Hippocampus and Hypothalamus etc.
It is also known as emotional brain that regulates emotional expressions and sexual behaviour.

(153) Answer : (2)
Solution:
Photoreceptor cells are not present in that region and hence it is called the blind spot. The fovea is a thinned-out portion of the retina where only the cones are densely packed. It is the point where the visual acuity (resolution) is the greatest.

(154) Answer : (2)
Solution:
Hypothalamus regulates thirst and hunger while Medulla controls vomiting.

(155) Answer : (3)
Solution:
Eustachian tube connects middle ear to pharynx.

(156) Answer : (3)
Solution:
Schwann cells are present in both myelinated and non-myelinated axons.
Nodes of Ranvier and biological insulation are characteristics of myelinated axons.

(157) Answer : (2)
Hint:
Medial surface is close to the central axis of the body.
Solution:
At the posterior pole of the eye lateral to the blind spot, there is a yellowish pigmented spot called macula lutea.

(158) Answer : (3)

Hint:
Maintenance of internal environment of the body

Solution:
The neural system and the endocrine system jointly coordinate and regulate the physiological functions in the body to maintain homeostasis. The neural system provides an organised network of point-to-point connections for quick coordination.

(159) Answer : (2)

Solution:
Cerebral aqueduct is present in midbrain.

(160) Answer : (4)

Hint:
Hypothalamus lies at the base of thalamus.

Solution:
The medulla oblongata contains centres which control respiration, cardiovascular reflexes and gastric secretions. Thermoregulatory centre is present in the hypothalamus.

(161) Answer : (3)

Solution:
Knee jerk reflex is a monosynaptic reflex which does not involve interneurons.

(162) Answer : (4)

Hint:
Common passage for both food and air

Solution:
Eustachian tube connects the middle ear cavity with the pharynx and helps in equalising the pressures on either sides of the ear drum. The fluid filled inner ear is called labyrinth. The coiled portion of labyrinth is called cochlea. Outer ear consists of pinna and external auditory meatus.

(163) Answer : (3)

Hint:
Suspensory ligaments

Solution:
The eye ball contains a transparent crystalline lens which is held in place by ligaments attached to the ciliary body.

(164) Answer : (3)

Solution:
Cones are densely packed in fovea.

(165) Answer : (3)

Solution:
The waves in the lymphs induce a ripple in the basilar membrane.

(166) Answer : (3)

Solution:
Vitreous humor is present between the lens and the retina.

(167) Answer : (1)

Solution:
Ear ossicles increase the intensity of sound waves 10 times.

(168) Answer : (3)

Solution:
During depolarization the outer surface of the neural membrane ultimately becomes negatively charged compared to inner surface and leads to action potential or nerve impulse.

(169) Answer : (3)

Solution:
Another centre present in the pons region of the brain called pneumotaxic centre can moderate the functions of the respiratory rhythm centre.

(170) Answer : (3)

Solution:
Photoreceptor become hyperpolarised in response to light because 11 cis retinal in rhodopsin gets converted into all trans-retinal that leads to closing of Na^+ channels eventually resulting in hyperpolarisation

(171) Answer : (4)

Solution:
Three major regions make up the brain stem; mid brain, pons and medulla oblongata. Brain stem forms the connections between the brain and spinal cord.

(172) Answer : (3)

Solution:
The electrical potential difference across the resting plasma membrane is called as the resting potential.

(173) Answer : (1)
Solution:
Choroid is the middle layer which contains many blood vessels and looks bluish in colour.

(174) Answer : (3)
Solution:
Saccule is a structural constituent of vestibular apparatus.

(175) Answer : (2)
Solution:
The crista and macula are the specific receptors of the vestibular apparatus responsible for maintenance of balance of the body and posture.

(176) Answer : (1)
Solution:
Size of pupil is regulated by iris muscle.

(177) Answer : (1)
Solution:
The malleus is attached to the tympanic membrane and the stapes is attached to the oval window.

(178) Answer : (1)
Solution:
The process through which two or more organs interact and complement the functions of one another is called coordination.

(179) Answer : (1)
Solution:
Electrical synapses are rare in our body. Transmission across electrical synapse is faster than chemical synapse.

(180) Answer : (2)
Solution:
Tectorial membrane is a thin elastic membrane that covers the hair cells of organ of Corti.

(181) Answer : (1)
Solution:
Pia mater is the inner layer which is in contact with the brain tissue.

(182) Answer : (3)
Hint:
Potential difference is generated in photoreceptor cells.
Solution:
The light rays in visible spectrum focused on the retina through the cornea and lens generate potentials in rods and cones.

(183) Answer : (2)
Hint:
Rods and cones are present in outermost layer of retina.
Solution:
In human eyes, retina consists of 3 layers of neural cells– from inside to outside are– ganglionic cells, bipolar cells, photoreceptor cells.

(184) Answer : (2)
Solution:
A canal called cerebral aqueduct passes through the midbrain. The tract of nerve fibres which connects the two cerebral hemispheres is called corpus callosum. The largest nuclei in basal ganglia is corpus striatum which regulates planning and execution of stereotyped movements.

(185) Answer : (2)
Solution:
Motor neurons are connected with effectors.
In reflex action, reflex arc is represented as Receptor → Sensory neuron → Interneuron → Motor neuron → Effector organ

SECTION-B

(186) Answer : (4)
Solution:
Hypothalamus regulates the body temperature.

(187) Answer : (2)

Solution:
When erythropsin, chloropsin and cyanopsin in cones are stimulated equally, a sensation of white light is produced.

(188) Answer : (2)
Solution:
Knee jerk is an example of monosynaptic reflex.

(189) Answer : (2)
Solution:
Endolymph is present inside the membranous labyrinth.

(190) Answer : (3)
Solution:
CNS controls both voluntary and involuntary movements.

(191) Answer : (2)
Solution:
Gustation means sense of taste

(192) Answer : (4)
Solution:
Macula is sensory part of utricle and saccule responsible for maintaining equilibrium of the body.

(193) Answer : (4)
Solution:
In human ear, organ of Corti is present on basilar membrane.

(194) Answer : (3)
Hint:
No image formation occurs at this point and it is devoid of photopigments.
Solution:
Blind spot is located medial to and slightly above the posterior pole of the eye ball.
Fovea is the central pit of a yellowish pigmented spot located lateral to the blind spot at the posterior pole of the eye.

(195) Answer : (2)
Solution:
Neurons can detect, receive and transmit different kinds of stimuli in the form of electrical impulses. Astrocytes, Schwann cells and oligodendrocytes are glial cells that constitute more than one-half of the nervous system.

(196) Answer : (3)
Hint:
Blood vessels in this layer provide oxygen and nourishment to the layer called retina.
Solution:
Choroid is a thin, highly vascular layer that contains a pigment that absorbs excess light and prevents blurred vision.
Lens is a transparent crystalline structure that refracts the incoming light rays.

(197) Answer : (3)
Hint:
The fluid that is present inside the inner ear is called lymph which is of two types - endolymph and perilymph.
Solution:
The bony labyrinth is a series of channels filled with perilymph which has relatively low K^+ concentration. The membranous labyrinth contains endolymph which is K^+ rich.

(198) Answer : (2)
Solution:
Na^+ is the chief cation in ECF.

(199) Answer : (4)
Solution:
Property of elasticity is exhibited by muscle cells and not by nerve cells.

(200) Answer : (3)
Solution:
Dendrites transmit impulses towards the cell body.