03/09/2025

Code-A Phase 1

Aakash
Medical | IIT-JEE | Foundations

Corporate Office : AESL, 3rd Floor, Incuspaze Campus-2, Plot No. 13, Sector-18,
Udyog Vihar, Gurugram, Haryana - 122015, ***Ph.***+91-1244168300

MM : 720 Fortnightly Test for NEET-2026_RM(P1)_FT-05A **Time : 180 Min.**

PHYSICS

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CHEMISTRY

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ZOOLOGY

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Hints and Solutions

PHYSICS

(1) **Answer :** (4)
Hint:
β = 2α
Solution:
$\Delta L = L\alpha\Delta\theta \Rightarrow \frac{\Delta L}{L} \times 100 = 2\%$
$\Delta r = r\alpha\Delta\theta \Rightarrow \frac{\Delta r}{r} \times 100 = 2\%$
Area = πr^2
$\Rightarrow \frac{dA}{A} \times 100 = \frac{2\Delta r}{r} \times 100 = 4\%$

(2) **Answer :** (2)
Hint:
The sum of thermal strain is equal to longitudinal strain to keep length constant.
Solution:
$\alpha\ \Delta T = \frac{F}{A \times Y} \Rightarrow F = AY\ \alpha\ \Delta T$
$\Rightarrow \frac{F}{A} = Y\ \alpha\ \Delta T \Rightarrow \sigma = 2 \times 10^{11} \times 1.1 \times 10^{-5} \times 50$
$\Rightarrow \sigma = 1.1 \times 10^6 \times 100$
$= 1.1 \times 10^8\ N/m^2$

(3) **Answer :** (3)
Solution:
Thermal stress, $\frac{F}{A} = Y\alpha\Delta\theta$
$\Rightarrow\ Y_1\alpha_2 = Y_2\alpha_2\ \left[\frac{F}{A} \text{ is same for same } \Delta\theta\right]$
$\Rightarrow\ \frac{Y_1}{Y_2} = \frac{\alpha_2}{\alpha_1} = \frac{3}{2}$

(4) **Answer :** (1)
Solution:
The metal with a higher thermal expansion coefficient will expand and bend more than the metal with a lower thermal expansion coefficient, as a result bimetallic strip will bend towards the metal with lower thermal expansion coefficient.

(5) **Answer :** (2)
Solution:

$\gamma_{app} = \gamma_L - \gamma_S$
$\gamma_{abs} = \gamma_L$
$\frac{\gamma_{ab}}{\gamma_{app}} = \frac{\gamma_L}{\gamma_L - \gamma_S} = \frac{\frac{\gamma_L}{\gamma_S}}{\frac{\gamma_L}{\gamma_S} - 1}$ ... (1)
Given $\gamma_S = \frac{\lambda_L}{4} \Rightarrow \frac{\lambda_L}{\gamma_S} = 4$ ... (2)
From equation (1) & (2)
$\frac{\gamma_{aba}}{\gamma_{app}} = \frac{4}{4-1} = \frac{4}{3}$

(6) **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.

(7) **Answer :** (2)
Hint:
Heat lost = Heat gained

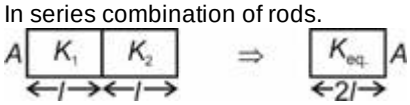
$\Rightarrow m\,x\,2\,x\,(\theta-60)=mx1x\,(90-\theta)$

Solve for θ.

(8) **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 $R_{\text{eq.}}=R_1+R_2$

$\frac{L_{\text{eq}}}{K_{\text{eq}}A_{\text{eq}}}=\frac{L}{K_1A}+\frac{L}{K_2A}$

$\frac{2L}{K_{\text{eq}}A}=\frac{L}{K_1A}+\frac{L}{K_2A}$

$\frac{2}{K_{\text{eq}}}=\frac{1}{K_1}+\frac{1}{K_2}\Rightarrow K_{\text{eq}}=\frac{2K_1K_2}{K_1+K_2}$

(9) **Answer :** (4)

Solution:

$\frac{E_{\text{half}}}{E_{\text{complete}}}=\frac{\left(\text{Area}\right)_{\text{half}}}{\left(\text{Area}\right)_{\text{complete}}}=\frac{2\pi R^2+\pi R^2}{4\pi R^2}=\frac{3}{4}$

(10) **Answer :** (1)

Solution:

Area under graph $\propto T^4$

$A\propto T^4$

$\frac{A_1}{A_2}=\left(\frac{T_1}{T_2}\right)^4$

(11) **Answer :** (3)

Solution:

$T=\frac{T_1+T_2+T_3+T_4}{4}$

(12) **Answer :** (4)

Solution:

$Q\ =KA\frac{\Delta T}{\Delta x}$

$80=\ K\pi r^2\times\frac{\Delta T}{l}$

$Q'=K\times\pi(2r)^2\times\frac{\Delta T}{2l}\ =\ 2\left(K\pi r^2\frac{\Delta T}{l}\right)=160\ \text{cal/s}$

(13) **Answer :** (2)

Hint:

$t\propto y^2$

Solution:

$\frac{t}{t'}=\frac{1}{4}$, $t' = 4t = 4 \times 5 = 20$ min

(14) **Answer :** (3)

Solution:

$\lambda_m T=\text{Constant}$

$\lambda_m(1500)=\lambda'_m(3000)$

(15) **Answer :** (3)

Solution:

This is used to determine specific heat of liquids using cooling technique.

(16) **Answer :** (2)

Solution:

In the cyclic process the work done is given by area enclosed by closed figure.

$W=\text{Area}\ of\ \Delta=\frac{1}{2}\times2V_1\times3P_1$

$W=3P_1V_1$

(17) **Answer :** (4)

Hint:

First law of thermodynamics

Solution:

$\Delta Q = \Delta U + \Delta W \Rightarrow \Delta U = Q - \frac{2Q}{5} = \frac{3Q}{5}$

$\Delta U = nC_v\Delta T = \frac{3}{2}nR\Delta T$

So, $\frac{3}{2}nR\Delta T = \frac{3}{5}nC\Delta T$

$\Rightarrow C = \frac{5}{2}R = C_p$

Also *p* is constant

(18) Answer : (1)

Hint:

Internal energy of gas is proportional to its temperature.

Solution:

From *A* to *B*, both volume (*V*) and pressure (*P*) increase. Using ideal gas law, $PV = nRT \Rightarrow T$ increases.

∴ Internal energy also continuously increases.

(19) Answer : (1)

Solution:

According to 1st law of thermodynamics

$Q = \Delta U + W$

$50 = \Delta U + 30$

$\Delta U = 20$ J

(20) Answer : (1)

Hint:

$W_{\text{isothermal}} = nRT_0 \ln\left(\frac{V_2}{V_1}\right)$

Solution:

$W_{\text{isobaric}} = nRT_0$

$W_1 = nRT_0$ (for isobaric process)

$W_2 = nRT_0 \ln\left(\frac{2V}{V}\right)$ (for isothermal process)

$W_2 = nRT_0 \ln 2$

$W_2 = W_1 \ln 2$

(21) Answer : (2)

Solution:

$\Delta Q_A = \Delta Q_B$

$\mu C_P \Delta T_A = \mu C_V \Delta T_B$

$\therefore \Delta T_B = \frac{C_P}{C_V}\Delta T_A = 1.4 \times 30$

$\Delta T_B = 42$ K

(22) Answer : (1)

Solution:

In an ideal gas internal energy is due to KE only.

(23) Answer : (1)

Solution:

For air, γ = 1.4 (diatomic gas)

$\therefore \quad U = \frac{PV}{\gamma - 1} = \frac{10^5 \times 100}{1.4 - 1} = \frac{10^7}{0.4} = 2.5 \times 10^7 J$

(24) Answer : (1)

Solution:

$PV^2 =$ constant = K

$PV = \mu RT$

$\frac{K}{V^2} \times V = \mu RT$

$VT =$ constant

$\Rightarrow V_1T_1 = V_2T_2$

$\Rightarrow V \times T = V \times 2T$

$\Rightarrow \quad V' = \frac{V}{2}$

$\frac{\Delta V}{V} \times 100 = \frac{\frac{V}{2} - V}{V} \times 100 = -50\%$

(25) Answer : (4)

Hint:

Heat transfer at constant pressure is equal to change in enthalpy.

Solution:

$\frac{\Delta H}{w} = \frac{nC_p\Delta T}{P\Delta V} = \frac{nC_p\Delta T}{nR\Delta T}$

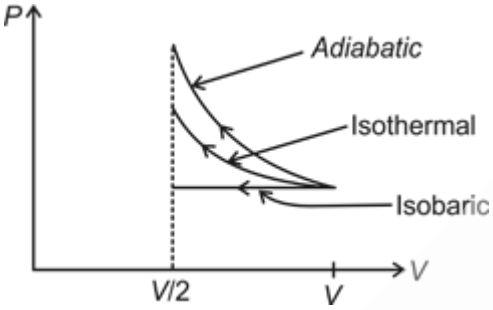
$\frac{C}{R} = \frac{C_P}{R} = \frac{\frac{7}{2}R}{R} = 7:2$

(26) Answer : (3)
Solution:
PV = constant
$P_1V_1 = P_2\left(\frac{V_2}{27}\right)$
$P_2 = 27P_1$

(27) Answer : (1)
Solution:
$\frac{\Delta W}{\Delta Q} = \frac{\Delta Q - \Delta U}{\Delta Q} = \frac{C_p - C_v}{C_p} = 1 - \frac{1}{\gamma} = \frac{2}{5}$

(28) Answer : (3)
Hint:
PV=nRT
Solution:
$\text{Pr}\,ocess\ AB \to V = cons\tan t\ and\ P \downarrow \Rightarrow T \uparrow$
Process $BC \to P \propto V\ and\ T \uparrow$
Process $CD \to V = cons\tan t\ and\ P \uparrow \Leftrightarrow T \downarrow$

(29) Answer : (3)
Solution:



Work done will be area under (*P*-*V*) graph. Which is maximum in adiabatic.

(30) Answer : (1)
Solution:
In adiabatic process heat exchange is zero

(31) Answer : (3)
Solution:
Efficiency of any heat engine cannot be greater than carnot engine between the same source and sink temperatures.
$\eta_{\text{camot}} = 1 - \frac{T_L}{T_H} \Rightarrow \eta = 1 - \frac{350}{500}$
$\eta_{\text{camot}} = 30\%$
$\eta < \eta_{\text{carnot}}$

(32) Answer : (4)
Solution:
$\frac{Q-30}{Q} = 0.7$
$Q - 30 = 0.7Q$
$0.3\,Q = 30$
$Q = 100$ J
Work done = 100 – 30 = 70 J

(33) Answer : (2)
Hint:
oyle's law
Solution:
PV = *nRT*
$\frac{P}{n} = \frac{RT}{V} = \text{constant}$
After 1st stoke, molecules of gas remained in cylinder = $n\left(1 - \frac{1}{10}\right)$
After second stoke, molecules of gas remained in cylinder = $n\left(1 - \frac{1}{10}\right)^2$

So, $P_2 = P_0\left(\frac{9}{10}\right)^2 = \frac{81}{100}P_0$

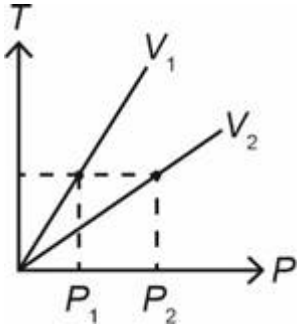
(34) Answer : (4)
Hint:
Molecules of an ideal gas moves randomly with different speeds.

(35) Answer : (4)
Solution:
The pressure exerted on the walls of a container by a gas is because momenta of molecules is changing due to collision with the walls.

(36) Answer : (3)
Solution:
$v_{av} = \sqrt{\frac{8RT}{\pi M}}$
$v_{rms} = \sqrt{\frac{3RT}{M}}$
Average translational kinetic energy per mole = $\frac{3}{2}RT$
Average translational kinetic energy per molecule = $\frac{3}{2}k_BT$

(37) Answer : (2)
Solution:
PV = constant
$P \propto \frac{1}{V}$

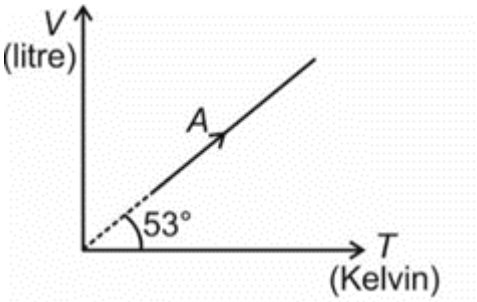
(38) Answer : (3)
Solution:
$PV = nRT$



$\frac{T}{P_1} \propto V_1$
$\frac{T}{P_2} \propto V_2$
$\frac{P_2}{P_1} = \frac{V_1}{V_2}$
$P_2 > P_1$
So, $V_1 > V_2$

(39) Answer : (2)
Solution:
For a given gas $P \propto M$
$\frac{P_1}{P_2} = \frac{M_1}{M_2} \Rightarrow M_2 = M_1 \times \frac{P_2}{P_1}$
$M_2 = 12 \times \frac{3\times10^6}{10^7}$ $\Rightarrow M_2 = 3.6$ kg
Quantity of gas taken out from the cylinder,
$\Delta M = M_1 - M_2 = 12 - 3.6$
$\Delta M = 8.4$ kg

(40) Answer : (1)
Solution:



$V = \tan 53° \, T$

$\therefore \quad V = \frac{4}{3}T$

$\therefore \quad V_A = \frac{4}{3}T_A$

As, $P_A V_A = nRT_A$

$\therefore P_A = 2R\frac{T_A}{V_A}$

$\therefore \quad P_A = \frac{3R}{2}$ J/litre

$\therefore P_A = \frac{3}{2} \times \frac{8.31}{10^{-3}} \, \mathrm{J/m^3}$

$\therefore P_A = 1.25 \times 10^4 \, \mathrm{N/m^2}$

(41) **Answer :** (2)
Solution:
$C_p - C_V = R$

$C_v = \frac{f}{2}R$

$C_p = C_v + R = \left(\frac{f}{2}R + R\right)$

$C_p = R\left(1 + \frac{f}{2}\right)$

(42) **Answer :** (3)
Solution:
Average KE per molecule $\frac{3}{2}k_BT$
Thus, average KE here depends only on temperature.
It is independent of nature of gas.

(43) **Answer :** (2)
Solution: $\frac{n_1+n_2}{\gamma-1} = \frac{n_1}{\gamma_1-1} + \frac{n_2}{\gamma_2-1}$

(44) **Answer :** (1)
Solution:
$\frac{\lambda_1}{\lambda_2} = \frac{{r_2}^2}{{r_1}^2}$

$= \frac{4r^2}{r^2}$

4 : 1

(45) **Answer :** (3)
Solution:
Total internal energy
$U = 2 \times \frac{5}{2}RT + 4 \times \frac{3}{2}RT$
$= 5RT + 6RT$
$= 11RT$

CHEMISTRY

(46) **Answer :** (3)
Hint:
K_C for a particular equilibrium change with temperature only.
Solution:
$\log\left(\frac{K_2}{K_1}\right) = \frac{\Delta H}{2.303\,R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$
If $T_2 > T_1$ (rise in temperature)

Then $K_2 > K_1$
If $\Delta H > 0$ (endothermic)
But $K_2 < K_1$
If $\Delta H < 0$ (exothermic)

(47) Answer : (2)
Hint:
At equilibrium $\Delta G = 0$
Hence $\Delta G° = -2.303\ RT \log K_C$
Solution:
$-9.2 \times 10^3 = -2.303 \times 2 \times 400 \log K_C$
$\log\ K_C = \frac{9.2\times1000}{2.303\times2\times400}$
$= 5$
$K_C = 10^5$

(48) Answer : (4)
Hint:
On mixing multiple acids resultant normally of H^+ can be calculated as following.
$[H^+] = \frac{N_1V_1+N_2V_2+...}{V_1+V_2...}$
Solution:
If pH = 2 then $N_1 = 10^{-2}$
pH = 3 then $N_2 = 10^{-3}$
$[H^+] = \frac{N_1V+N_2V}{2V}$
$= \frac{10^{-2}\times V+10^{-3}V}{2V} = \frac{1.1\times10^{-2}}{2} = 5.5\times10^{-3}$
pH = –log $[H^+]$ = –log (5.5×10^{-3})
$\simeq 2.26$

(49) Answer : (2)
Hint:
Equilibrium constant for the reverse reaction is the inverse of the equilibrium constant for the reaction in the forward direction.
Solution:
$\because\ 2SO_2 + O_2 \rightleftharpoons 2SO_3$, K = 9
$\therefore\ \ 2\,SO_3 \rightleftharpoons 2\,SO_2 + O_2,\ K' = \frac{1}{K} = \frac{1}{9}$
$SO_3 \rightleftharpoons SO_2 + \frac{1}{2}O_2,\ K'' = \sqrt{\frac{1}{K}} = \frac{1}{3}$

(50) Answer : (3)
Hint:
Equilibrium constant in terms of pressure is defined by $K_P = \frac{\left[P_{SO_2}\right]^2\left[P_{O_2}\right]}{\left[P_{SO_3}\right]^2}$
Solution:
$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$
P_0
$P_0 - 2P \qquad 2P \qquad P$
At equilibrium
Total pressure = $P_0 - 2P + 2P + P$
$P_T = P_0 + P$
$600 = 500 + P;$
$P = 100$
So, at equilibrium

$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$
$P_0 - 2P \qquad 2P \qquad P$
$= 500 - 200 \quad 200 \quad 100$
$= 300$

$K_p = \frac{(100)(200)^2}{(300)^2}$
$K_p = \frac{100\times40000}{90000} = 44.44$

(51) Answer : (2)
Hint:
For any gaseous equilibrium
$K_P = K_C(RT)^{\Delta ng}$
Solution:
$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$; $K_P = K_C$
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$; $K_P = K_C(RT)^{-2}$
$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$; $K_P = K_C(RT)$
$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$; $K_P = K_C(RT)^{-1}$

(52) Answer : (2)
Solution:
$\Delta G = -RT\ln K_C$
$= -8.314 \times 300 \times \ln(2 \times 10^{13})$
$\Delta G = -7.64 \times 10^4$ J mol^{-1}

(53) Answer : (4)
Solution:
If the volume is kept constant and an inert gas such as argon is added which does not take part in the reaction, the equilibrium remains undisturbed because the addition of an inert gas at constant volume does not change the partial pressure of the reaction.

(54) Answer : (1)
Hint:
Changing concentration at equilibrium does not affect equilibrium constant
Solution:
$Al(OH)_3(s) \rightleftharpoons Al^{3+}(aq) + 3OH^-(aq)$
$K_C = [Al^{3+}][OH^-]^3$
after concentration change
$K_c = \left[Al^{3+}\right]^{\beta}\left(\frac{[OH^-]}{2}\right)^3$
$[Al^{3+}]\beta = 8\,[Al^{3+}]$

(55) Answer : (3)
Solution:
Yield of the product generally depends on
· Temperature
· Concentration of reactant(s) and product(s)
· Pressure
As this is an endothermic reaction ($\Delta H = +180.7$ kJ mol^{-1}), so, increase in temperature will shift equilibrium in forward direction to increase yield of NO.
Increase in concentration of reactants (N_2 and O_2) also shifts the equilibrium in forward direction and increase the yield of NO.
Hence, (A), (C) and (D) only will increase yield of NO.

(56) Answer : (2)
Solution:
$K_1 = \frac{1}{K_2} = \frac{1}{(K_3)^2}$

(57) Answer : (3)
Solution:
For the system
$H_2O(s) \rightleftharpoons H_2O(l)$
On increasing pressure, equilibrium shifts to more denser side of the reaction.

(58) Answer : (1)
Solution:
If $Q_C > K_C$, the reaction will proceed in the backward direction
If $Q_C < K_C$, the reaction will proceed in the forward direction.

(59) Answer : (3)
Hint:
If all the components are in the same physical state, the equilibrium is called homogeneous equilibrium.
Solution:

In $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ physical state of all the components is not the same hence it is a heterogeneous equilibrium.

(60) Answer : (4)
Solution:
The equilibrium constant does not depend upon initial concentrations and has a definite value for every chemical reaction at a given temperature.

(61) Answer : (1)
Hint:
Catalyst does not affect equilibrium constant.
Solution:
Catalyst increases the rate of reaction by decrease of activation energy of the reaction.

(62) Answer : (3)
Hint:
At equilibrium K = Q
Solution:
$\Delta G = \Delta G^\circ + RT \ln Q$
At equilibrium, Q = K, ΔG = 0

(63) Answer : (3)
Solution:

	$2HI$	$\overset{\alpha=0.5}{\rightleftharpoons}$	H_2	$+$	I_2
initial mole	1		0		0
final mole	$1-\frac{1}{2}$		$\frac{1}{4}$		$\frac{1}{4}$

$K_{eq} = \frac{\frac{1}{4}\times\frac{1}{4}}{\left(\frac{1}{2}\right)^2} = \frac{1}{4}$

(64) Answer : (3)
Solution:
Physical equilibrium are dynamic in nature.
Both the opposing processes occur at the same rate during equilibrium.

(65) Answer : (1)
Hint:
α = 0.40, it is comparable to 1 (unity).
Solution:

	$HA(aq)$	$\overset{K_a}{\rightleftharpoons}$	$H^+(aq)$	$+$	$A^-(aq)$
Eq.	$c(1-\alpha)$		$c\alpha$		$c\alpha$

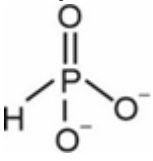
$K_a = \frac{(c\alpha)(c\alpha)}{\{c(1-\alpha)\}} = \frac{c\alpha^2}{1-\alpha}$

$= \frac{0.2\times(0.4)^2}{0.6} = 5.33\times10^{-2}$

(66) Answer : (1)
Solution:
Since NaOH and HCl gets completely ionised in water they are considered as strong electrolytes.

(67) Answer : (3)
Hint:
The acid-base pair that differs only by one proton is called conjugate acid-base pair.
Solution:
H_3PO_4 is the conjugate acid of $H_2PO_4^-$ and HPO_4^{2-} is the conjugate base of $H_2PO_4^-$.

(68) Answer : (1)
Solution:
HPO_3^{2-} does not contain any acidic hydrogen, hence will not act as Bronsted acid.



H_3PO_3 cannot accept H^+; hence can not be treated as Bronsted base.

HPO_4^{2-} has one acidic hydrogen and can take H^+ ion also. Hence, it can act as both Bronsted acid and Bronsted base.

(69) Answer : (4)

Solution:
Lewis bases are electron pair donor.

(70) **Answer :** (2)
Solution:

	Name of fluid	pH
(a)	Lemon juice	2.2
(b)	Human blood	7.4
(c)	Black coffee	5.0
(d)	Milk of magnesia	10

(71) **Answer :** (4)
Hint:
Compound in which hydrogen is attached with more electronegative element is more acidic in nature.
Solution:
Due to incomplete octet of Boron in BF_3, it can act as Lewis acid.

(72) **Answer :** (1)
Solution:
neutral pH = $\frac{pK_w}{2} = \frac{-\log 10^{-12}}{2} = 6$

(73) **Answer :** (1)
Solution:
pOH = –log(OH^-)
$[OH^-] = 10^{-8} + 10^{-7} = 1.1 \times 10^{-7}$
pOH = $-\log(1.1 \times 10^{-7}) = 6.96$
pH = 14 – 6.96 = 7.04

(74) **Answer :** (1)
Solution:
Ionisation of CH_3COOH decreases on addition of CH_3COONa due to common ion effect.

(75) **Answer :** (1)
Solution:

	$CH_3COOH \rightleftharpoons$	$CH_3COO^- +$	H^+
Initial	0.02	–	–
Final	$0.02 - 0.02\alpha$	0.02α	$0.02\alpha + 0.2$

$K_a = \frac{0.02\alpha(0.02\alpha+0.2)}{0.02(1-\alpha)}$
$K_a = \frac{0.2\alpha}{1}$
$\alpha = \frac{1.74\times10^{-5}}{0.2} = 8.7 \times 10^{-5} \times 100 = 8.7 \times 10^{-3} = 0.009\%$

(76) **Answer :** (2)
Hint:
Concentration of Cl^- increased from the dissociation of HCl.
Solution:
By passing HCl gas through saturated solution of NaCl, high purity NaCl is obtained and we can get rid of impurities like sodium and magnesium sulphate.

(77) **Answer :** (3)
Solution:
- $CH_3COO^-(aq) + H_2O(l) \rightleftharpoons CH_3COOH(aq) + OH^-(aq)$

  Acetate ion thus formed undergoes hydrolysis in water to give acetic acid and OH^- ions
  $CH_3COO^-(aq) + H_2O(l) \rightleftharpoons CH_3COOH(aq) + OH^-(aq)$
- pH of WAWB $= 7 + \frac{1}{2}[pK_a - pK_b]$

(78) **Answer :** (3)
Solution:
pH of salt of strong base and weak acid is
$pH = 7 + \frac{1}{2}[pK_a + \log C]$
$= 7 + \frac{1}{2}[4.74 + (-1.6990)]$

$= 7 + \frac{1}{2} \times 3.041 = 8.52$

(79) Answer : (4)
Solution:
• NaCl is a salt of strong acid and strong base so its aq. solution will be neutral.
$\mathrm{pH} = \frac{\mathrm{pk_w}}{2} = \frac{14}{2} = 7$
• NH_4Cl is a salt of strong acid and weak base so its pH will be less than 7.
$\mathrm{pH} = \frac{1}{2}\left[\mathrm{pk_w} - \mathrm{pk_b} - \log c\right]$
• CH_3COONa is a salt of strong base and weak acid so its pH will be more than 7.
$\mathrm{pH} = \frac{1}{2}\left[\mathrm{pk_w} + \mathrm{pk_a} + \log c\right]$
• NH_4CN is a salt of weak acid and weak base and pH of its aq. solution will be independent of concentration of salt.
$\mathrm{pH} = \frac{1}{2}\left[\mathrm{pk_w} + \mathrm{pK_a} - \mathrm{pk_b}\right]$

(80) Answer : (1)
Solution:
Salt of strong acid and weak base undergoes cationic hydrolysis.
$\mathrm{NH_4^{\oplus}} + \mathrm{H_2O} \rightleftharpoons \mathrm{NH_4\,OH} + \mathrm{H^+}$

(81) Answer : (3)
Hint:
Introduction of inert gas at constant pressure to a gaseous equilibrium mixture shifts the equilibrium in a direction where number of moles of gases formed are more

(82) Answer : (4)
Hint:
A buffer solution never contains a strong acid or a strong base.
Solution:
NH_4OH + NH_4Cl is a mixture of weak base and its salt with strong acid therefore act as a basic buffer.

(83) Answer : (2)
Hint:
Basic buffer = Weak base and its salt with strong acid.
Solution:

	HCl	+	NH_4OH	$\rightleftharpoons$	NH_4Cl	+	H_2O
Initial mole	0.1×0.1		0.2×0.1		–		–
	$= 0.01$		0.02				
Final mole	–		0.01		0.01		0.01

Since solution contains NH_4OH and NH_4Cl i.e. weak base and salt of weak base with strong acid. Hence, basic buffer.

(84) Answer : (3)
Solution:
Acidic buffer is formed by mixture of weak acid with salt of weak acid and strong base.

(85) Answer : (3)
Hint:
The solubility of AgCl decreases because of common ion effect.
Solution:
Let the solubility of AgCl in 0.1 M $CaCl_2$ be S.
K_{sp} (AgCl) = $[Ag^+]\,[Cl^-]$
$1.8 \times 10^{-10} = S \times 0.2$ [S << 0.2, S + 0.2 ≈ 0.2]
$S = \frac{1.8 \times 10^{-10}}{0.2}$
$= 9 \times 10^{-10}$ mol L^{-1}

(86) Answer : (3)
Hint:
For a general sparingly soluble salt:
At equilibrium $\mathrm{M_xX_y\,(s) \rightleftharpoons \underset{xs}{xM^{y+}_{(aq)}} + \underset{ys}{yX^{x-}_{(aq)}}}$
$K_{sp} = [M^{y+}]^x\,[X^{x-}]^y$
$= (xs)^x\,(ys)^y$

$K_{sp} = x^x \cdot y^y \cdot (s)^{x+y}$

Solution:

- $CaF_2 \rightleftharpoons \underset{s}{Ca^{2+}} + \underset{2s}{2F^-}$

K_{sp} = (s) $(2s)^2 = 4s^3$

- $Mg_3(PO_4)_2 \rightleftharpoons \underset{3s}{3Mg^{2+}} + \underset{2s}{2PO_4^{3-}}$

$K_{sp} = (3s)^3 (2s)^2 = 108s^5$

- $Fe(OH)_3 \rightleftharpoons \underset{s}{Fe^{3+}} + \underset{3s}{3OH^-}$

K_{sp} = (s) $(3s)^3 = 27s^4$

- $ZnS \rightleftharpoons \underset{s}{Zn^{2+}} + \underset{s}{S^{2-}}$

K_{sp} = (s) (s) = s^2

(87) Answer : (3)

Hint:

Common ion effect decreases solubility of sparingly soluble salt.

Solution:

$BaCl_2$, Na_2SO_4, H_2SO_4 will provide common ion due to presence of Ba^{2+}(aq), $SO_4^{2-}(aq)$ and $SO_4^{2-}(aq)$ respectively.

NaCl will not give any common ion effect hence solubility will be maximum in 0.1 M NaCl solution.

(88) Answer : (2)

Hint:

For a saturated solution of $BaSO_4$, the product of concentration of ions will be equal to its solubility product.

Solution:

$BaSO_4(s) \rightleftharpoons \underset{S}{Ba^{2+}}(aq) + \underset{S}{SO_4^{2-}}(aq)$

K_{sp} = (S) (S)

$1.1 \times 10^{-10} = S^2$

$S = 1.05 \times 10^{-5}$

(89) Answer : (2)

Solution:

For same type of salts, as K_{sp} increases, solubility of salt also increases.

- K_{sp} order is, CuCl > $PbCO_3$ > SnS
- Solubility order will be, CuCl > $PbCO_3$ > SnS

(90) Answer : (3)

Solution:

$$CH_3CO_2H + NaOH \rightarrow CH_3CO_2Na + H_2O$$

t = 0	0.04 mol	0.04 mol	0	0
Final	0	0	0.04 mol	0.04 mol

$[CH_3CO_2Na] = \frac{0.04}{0.4}\frac{mol}{l} = 0.1M$

It is a salt of W.A. and S.B.

$\therefore pH = \frac{1}{2}[14 + pK_a + \log C] = \frac{1}{2}[14 + 4.74 + \log\ 0.1]$

$pH = \frac{1}{2}[17.74] = 8.87$

BOTANY

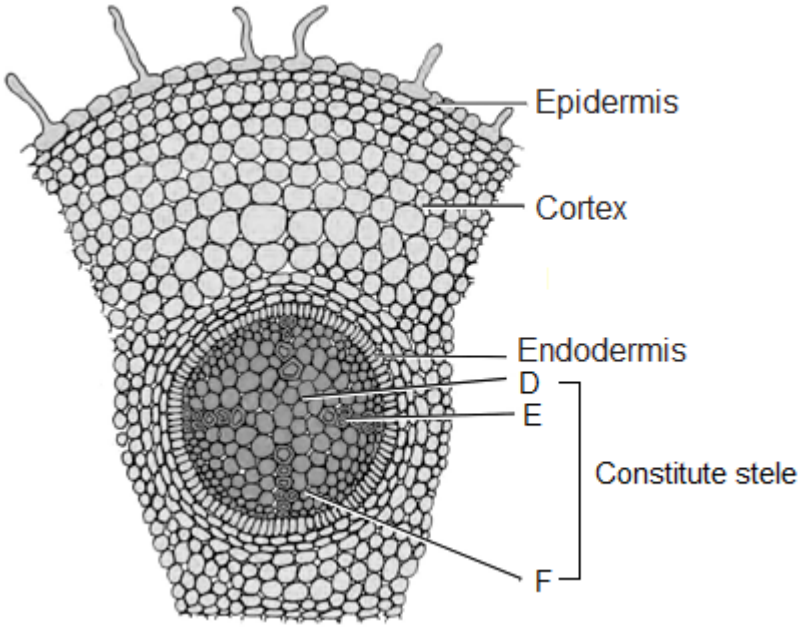
(91) Answer : (3)

Solution:

Hypodermis is sclerenchymatous in monocot stem.

(92) Answer : (3)

Solution:



(93) **Answer :** (3)
Solution:
Trichomes are usually multicellular and they may be unicellular also.

(94) **Answer :** (3)
Solution:
Parenchyma tissue can have small intercellular spaces.

(95) **Answer :** (3)
Hint:
Epidermis remains in direct contact with the external environment.
Solution:
Epidermis forms a continuous layer and it is generally single-layered.

(96) **Answer :** (1)
Solution:
In roots, the protoxylem lies towards periphery and metaxylem lies towards the centre. Such arrangement of primary xylem is called exarch.

(97) **Answer :** (3)
Solution:
Bulliform cells are large, empty, colourless adaxial epidermal cells which curl leaves inwards to prevent water loss.

(98) **Answer :** (2)
Solution:
Hypodermis is absent in roots and collenchyma is generally absent in monocots.

(99) **Answer :** (3)
Hint:
Medullary rays are seen in stems.
Solution:
Conjunctive tissues are seen in root.

(100) **Answer :** (2)
Solution:
Both monocot stem and dicot leaf shows bundle sheath around their vascular bundles.

(101) **Answer :** (3)
Solution:
Root epidermis is termed as epiblema.

(102) **Answer :** (3)
Solution:
Guard cells contain chloroplasts, surrounds stomatal aperture and are of dumb-bell shape in grasses.

(103) **Answer :** (2)

(104) **Answer :** (3)
Solution:
X → Monocot stem, Y → Roots of dicot or monocot plants

In monocot stem, hypodermis is sclerenchymatous, endodermis is absent and vascular bundles are of endarch type. In roots, exarch type of vascular bundles are found and hypodermis is absent.

(105) Answer : (1)
Hint:
There are usually more than six (polyarch) xylem bundles in the monocot root.
Solution:
All the given features are of dicot root. Ground tissue is not differentiated in monocot stem. Radial vascular bundles are not observed in stem.

(106) Answer : (2)
Solution:

Vessels	–	Members are interconnected through perforations in their common walls
Phloem parenchyma	–	Absent in most of the monocotyledons
Tracheids	–	Elongated tube like cells with thick lignified walls and tapering ends
Albuminous cells	–	Present in gymnosperms in place of companion cells

(107) Answer : (4)
Solution:
Barley stem lacks pericycle. Ground tissue is not differentiated in monocot leaves.

(108) Answer : (2)
Hint:
Xylem parenchyma helps in radial conduction of water.
Solution:
Xylem parenchyma is thin walled and living xylary element. Cells of the parenchyma have prominent nucleus and dense cytoplasm.

(109) Answer : (2)
Solution:
Generally, abaxial epidermis bears large number of stomata in dicots leaves.

(110) Answer : (1)
Solution:
Both monocot root and a dicot stem have well developed pith.

(111) Answer : (4)
Solution:
Root hair is epidermal in origin.

(112) Answer : (2)
Hint:
Endodermis of dicot stems is called starch sheath due to storage of starch.
Solution:
Pericycle, vascular bundles and pith are combindly called stele.

(113) Answer : (1)
Solution:
Cortex is the region present between epidermis and stele.

(114) Answer : (2)
Solution:
Guard cells are bordered by one or more modified epidermal cells called subsidiary cells or accessory cells.

(115) Answer : (3)
Solution:
In dicot leaf, vascular bundles differ in size due to the presence of reticulate venation.

(116) Answer : (4)
Solution:
In monocot stem, vascular bundles are found scattered in whole ground tissue. The larger vascular bundles are loosely arranged towards the centre of the stem.

(117) Answer : (2)
Solution:
The given vascular bundle is conjoint closed as it does not have cambium.
Phloem is located on the outer side of vascular bundle.
Conjoint closed vascular bundle are commonly found in monocot stems and leaves.

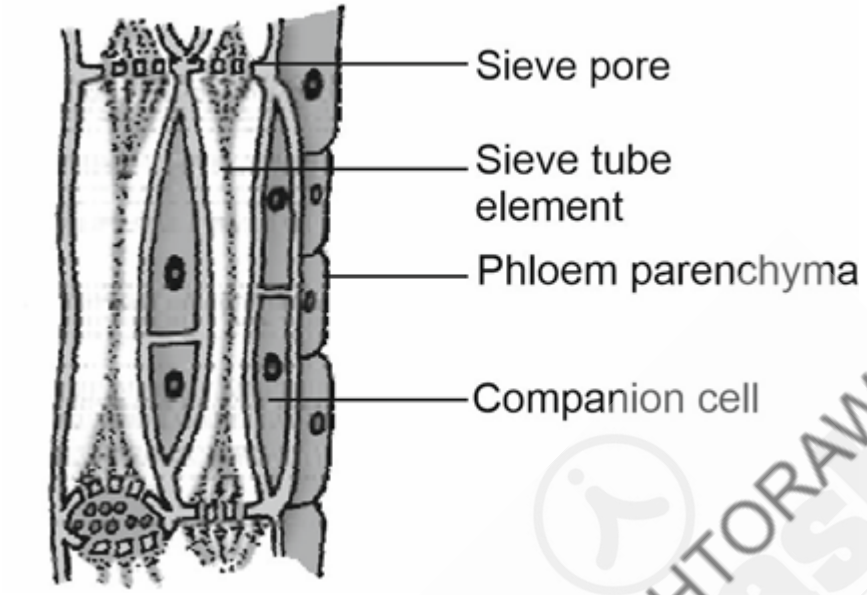
(118) Answer : (2)
Solution:
In monocot and dicot roots, conjunctive tissue is present between the xylem and pholem.

(119) Answer : (3)
Solution:
Mesophyll is not differentiated into two regions in monocot leaf.

(120) Answer : (3)
Solution:
The tissue in the given diagram is collenchyma. Its cells can have chloroplasts and are thickened at the corners due to deposition of cellulose, hemicellulose and pectin.

(121) Answer : (3)
Solution:
In dicot stems, pericycle forms semi-lunar patches of sclerenchymatous cells.

(122) Answer : (4)
Solution:



Companion cells are helpful in maintaining pressure gradient in sieve tubes. These are absent in gymnosperms and pteridophytes.
Phloem fibres are the only dead element of phloem.

(123) Answer : (2)
Solution:
Endodermis is component of ground tissue system.

(124) Answer : (1)
Solution:
Cells of the outer-most covering of the whole plant body are parenchymatous epidermal cells. These cells have small amount of cytoplasm lining the cell wall and a large vacuole.

(125) Answer : (3)
Solution:
Sol.: Guard cells + stomatal aperture + subsidiary cells = Stomatal apparatus.

(126) Answer : (3)
Solution:
Suberin is the waxy substance deposited in the radial and tangential wall of endodermal cells of both monocot and dicot roots.

(127) Answer : (4)
Solution:
Protoxylem and metaxylem are similar in being the primary xylem

(128) Answer : (3)
Hint:
Cuticle prevents water loss.
Solution:
Cuticle can be found on the epidermis of stem and leaves, but absent in roots.

(129) Answer : (2)
Solution:
Pericycle in dicot roots is of thick-walled parenchymatous cells.

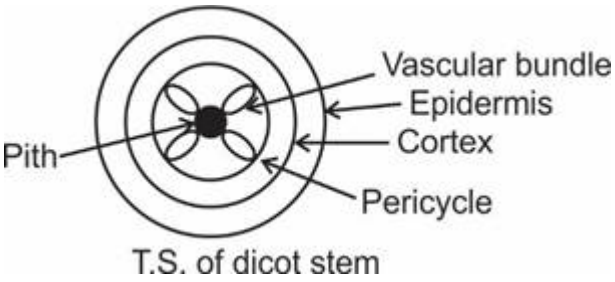
(130) Answer : (1)

Solution:
Dumb-bell shaped guard cells are seen in grasses.

(131) Answer : (2)
Solution:
Vascular bundles in dicotyledons are considered as open because cambium is present.

(132) Answer : (2)
Solution:
Monocot stems, such as maize, have scattered vascular bundles.

(133) Answer : (3)
Solution:



(134) Answer : (3)
Solution:
Root hair – Unicellular, unbranched
Trichome – Usually multicellular and branched/unbranched
Both are epidermal appendages.

(135) Answer : (4)
Hint:
Vascular tissue system is involved in the transport of substances within a plant.
Solution:
Absorption of water occurs by root hairs whereas, transport of water and minerals occur by vascular tissue system.

ZOOLOGY

(136) Answer : (1)
Solution:
Brain stem forms the connection between the brain and spinal cord.
Left and right cerebral hemispheres are connected to each other by bundle of nerve fibres called corpus callosum.

(137) Answer : (2)
Solution:
Option (2) is the correct answer as impulse transmission across an electrical synapse is always faster than that across a chemical synapse.
Chemical synapses use chemicals for impulse transmission which are known as neurotransmitters.
The membranes of pre-synaptic and post-synaptic neurons are in close proximity in an electrical synapse.
In an electrical synapse, the transmission of the impulse occurs in the form of an electrical current from one neuron to the next neuron.

(138) Answer : (4)
Solution:
There are two types of synapses, namely, electrical synapses and chemical synapses. At electrical synapses, the membranes of pre- and post-synaptic neurons are in very close proximity. Electrical current can flow directly from one neuron into the other across these synapses. Impulse transmission across an electrical synapse is always faster than that across a chemical synapse. Electrical synapses are rare in our system.

(139) Answer : (1)
Solution:
Cerebellum, a part of hind brain, integrates information received from semicircular canals of the ear and the auditory system.
Medulla oblongata controls cardiovascular reflexes.
Hypothalamus along with limbic system is involved in the regulation of sexual behaviour.

(140) Answer : (2)
Hint:
It is produced by ovary.
Solution:
Osteoporosis is an age related disorder. Decreased levels of estrogen is a common cause of osteoporosis.

Thymosin helps in the differentiation of T-lymphocytes.
ADH and oxytocin are released from the posterior pituitary.

(141) Answer : (4)
Solution:
· Option (4) is correct because myasthenia gravis is a chronic auto immune disorder affecting neuromuscular junction leading to fatigue, weakening and paralysis of skeletal muscle.
· Gout is caused due to deposition of uric acid crystals in joints leading to inflammation.
· Inflammation of joints is commonly known as arthritis.
· Muscular dystrophy is a genetic disorder which results in progressive degeneration of skeletal muscle.

(142) Answer : (2)
Hint:
The central nervous system lies along the central axis of our body.
Solution:
The CNS consists of the brain and spinal cord. It is the site of processing of information and control. Cranial and spinal nerves lie along the periphery of our body and are the components of PNS.

(143) Answer : (4)
Solution:
Adrenaline and nor-adrenaline (catecholamines) are called emergency hormones. Both hormones help to cope up with the emergency conditions. Parasympathetic neural signals reduce the rate of heart beat.

(144) Answer : (3)
Solution:
The hormones secreted by hypothalamic neurons or neurosecretory cells are called hypothalamic hormones.

(145) Answer : (3)
Solution:
Unipolar neurons are present in embryonic stage and have single process.

(146) Answer : (3)
Solution:
Femur is the longest bone in the human body.
Sternum is a flat bone on the ventral midline of thorax.
A cup-shaped bone, called patella, covers the knee ventrally (knee cap).

(147) Answer : (2)
Solution:
Somatic neural system relays impulses from CNS to voluntary muscles.

(148) Answer : (3)
Solution:

Between frontal and parietal bones	– Fibrous joint, a suture is present between bones
Between atlas and axis vertebrae	– Pivot joint which provides sidewise rotational movement of skull
Between carpal and metacarpal of thumb	– Saddle joint which is responsible for oppositional movement of thumb
Between femur and tibia	– Knee joint placed in category of hinge joint

(149) Answer : (2)
Solution:
Thalamus is the major coordinating centre for sensory and motor signaling. It is present in forebrain. Pons, medulla oblongata and cerebellum are the parts of hind brain.

(150) Answer : (2)
Hint:
Hypothalamus is a part of forebrain and it controls the pituitary gland for secretion of trophic hormones.
Solution:
Hypothalamus contains both neurons and neurosecretory cells. The secretory cells perform endocrine function by releasing neurohormones. Hypothalamus also regulates body temperature, urge for eating and drinking, sexual behaviour.

(151) Answer : (4)
Hint:
Sternum is present ventrally
Solution:
Vertebral column is placed dorsally.
• First vertebra is atlas and axis is the 2^{nd} vertebra.
• Each vertebra has a central canal (neural canal) through which spinal cord passes.

(152) Answer : (3)
Solution:
At the point of fusion of ilium, ischium and pubis is a cavity called acetabulum to which the thigh bone articulates.
Glenoid cavity and acromion are associated with the pectoral girdle.

The two halves of the pelvic girdle meet ventrally to form the pubic symphysis containing fibrous cartilage.

(153) Answer : (2)

Solution:

Girdle bones as well as ear ossicles are six in number.
Total number of facial bones = 14
Total number of cranial bones = 8
The pectoral girdle has a total of 4 bones in which 2 bones are on each side of the body namely, the clavicle and scapula.
The pelvic girdle has a total of 2 bones known as coxal bones in which each bone is formed with the fusion of three bones namely, ilium, ischium and pubis.

(154) Answer : (2)

Hint:

Equal to the number of ear ossicles in a ear

Solution:

Appendicular skeleton includes bones of limbs and girdles. Bones of skull and vertebral column are included in axial skeleton. Zygomatic is a facial bone while stapes is a tiny bone present in middle ear. Sacrum is a component of vertebral column. Hence, sacrum, stapes and zygomatic can not be included in appendicular skeleton.

(155) Answer : (4)

Solution:

Short fibres which branch repeatedly and project out of the cell body are called dendrites. These fibres transmit impulses towards the cell body.

(156) Answer : (1)

Solution:

There are 12 pairs of ribs. Each true rib is a thin flat bone connected dorsally to the vertebral column and ventrally to the sternum. The 8^{th}, 9^{th} and 10^{th} pairs of ribs do not articulate directly with the sternum but join the seventh rib with the help of hyaline cartilage. These are called vertebrochondral (false) ribs.

(157) Answer : (4)

Solution:

Pectoral girdle includes 4 bones whereas pelvic girdle includes 2 bones.

(158) Answer : (4)

Solution:

The property common to both nerve cells (neurons) and muscle cells (myocytes) is excitability.
Excitability refers to the ability of a cell to respond to stimuli by generating and propagating electrical impulses. Both neurons and muscle cells possess excitable membranes that can produce electrochemical impulses and conduct them along their surfaces.
The other properties listed-contractility, elasticity, and extensibility are primarily associated with muscle cells and are not the characteristics of nerve cells. Contractility is the ability of muscle cells to shorten and generate force. Elasticity refers to their ability to return to original length after stretching and extensibility is the capacity to be stretched without damage.

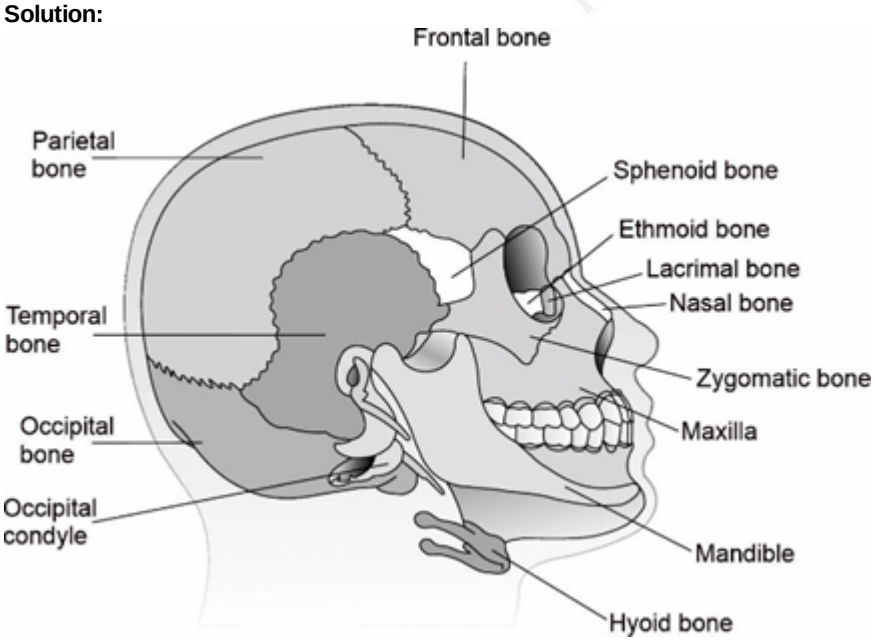
(159) Answer : (3)

Solution:

Number of carpal bones in one forelimbs = 8 and number of tarsal bones in one hindlimb = 7

(160) Answer : (2)

Solution:



Parietal and temporal bones are paired cranial bones.

(161) Answer : (1)
Solution:
When a stimulus is applied at a site on the polarised membrane, the membrane at that site becomes freely permeable to Na^+ . This leads to a rapid influx of Na^+ followed by the reversal of the polarity at that site, *i.e.*, the outer surface of the membrane becomes negatively charged and the inner side becomes positively charged. The polarity of the membrane at that site is thus reversed and hence depolarised.

(162) Answer : (2)
Solution:
Fibres of the tract are covered with the myelin sheath, which constitute the inner part of cerebral hemisphere. They give an opaque white appearance to the layer and, hence, is called the white matter.
Neuronal cell bodies are concentrated in the cerebral cortex.

(163) Answer : (2)
Hint:
Jaw bone is a single bone.
Solution:
Ethmoid and sphenoid are unpaired cranial bones. Sacrum (1) and coccyx (1) are fused bones in adult humans.
Maxilla and zygomatic are paired facial bones. Mandible is an unpaired bone.

(164) Answer : (4)
Solution:
The hypothalamus lies at the base of the thalamus. It contains a number of centres which control body temperature, urge for eating and drinking. It also contains several groups of neurosecretory cells, which secrete hormones called hypothalamic hormones.
The cerebrum wraps around a structure called thalamus, which is a major coordinating centre for sensory and motor signalling.

(165) Answer : (4)
Solution:
The inner parts of cerebral hemispheres and a group of associated deep structures like amygdala, hippocampus, *etc*., form a complex structure called the limbic lobe or the limbic system. Along with the hypothalamus, it is involved in the regulation of sexual behaviour, expression of emotional reactions, autonomic responses, olfaction and motivation.

(166) Answer : (1)
Solution:
Both cerebral hemispheres are connected by a tract of nerve fibres called corpus callosum.

(167) Answer : (2)
Solution:
Ethmoid is a cranial bone. Maxilla, zygomatic, nasal, lacrimal, palatine, vomer and mandible are facial bones.

(168) Answer : (4)
Solution:
Ion channels open in post synaptic membrane. Receptors for binding of neuro transmitters are present in post-synaptic membrane.

(169) Answer : (1)
Solution:
A – Cartilage has pliable matrix due to presence of chondroitin salts.
B – Bone has non-pliable matrix due to presence of calcium salts.

(170) Answer : (3)
Solution:
In the human brain, centres are located in the medulla oblongata that can regulate cardiac functions.
The autonomous nerve fibres connected to the medulla oblongata work to control heart rate with the release of neurotransmitters.
The dorsal portion of the midbrain consists mainly of four round swellings (lobes) called corpora quadrigemina.

(171) Answer : (1)
Solution:
Cerebellum is the part of the hind brain, while corpus callosum, association areas and hypothalamus are part of forebrain.

(172) Answer : (2)
Solution:
Cranial meninges consist of an outer layer called dura mater, a very thin middle layer called arachnoid and an inner layer called pia mater.

(173) Answer : (3)
Solution:

In humans, each half of the pectoral girdle consists of a clavicle and a scapula. Scapula is a large triangular flat bone situated in the dorsal part of the thorax between the second and seventh ribs.
Clavicle, commonly called collar bone, articulates with acromion. Acromion is a flat expanded process of spine of scapula.

(174) Answer : (2)
Solution:
Patella is present in each hind limb. It is a cup-shaped bone which covers the knee ventrally (knee cap).

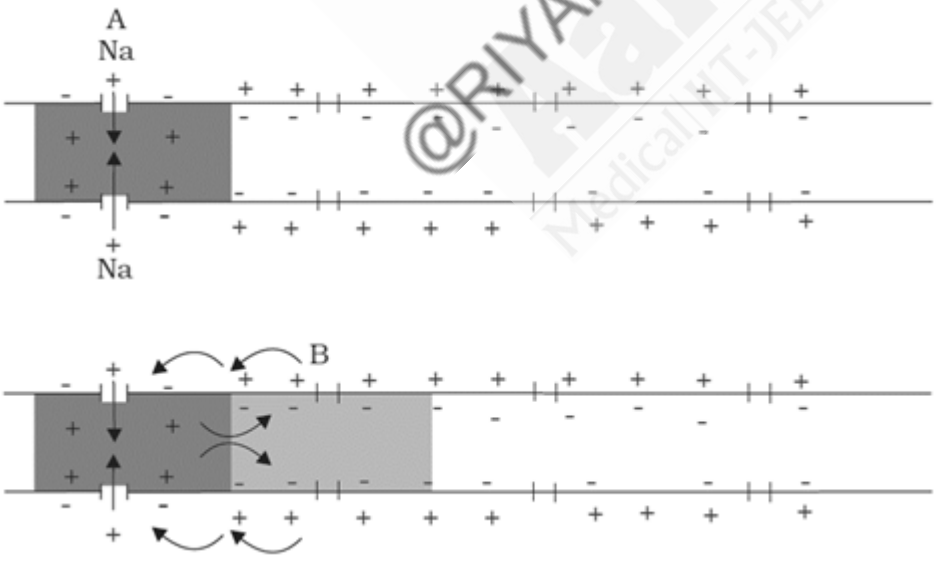
(175) Answer : (2)
Hint:
A part of brain stem
Solution:
The hindbrain comprises pons, cerebellum and medulla.
Hypothalamus and thalamus are the parts of forebrain.
The medulla of the brain is connected to the spinal cord. The medulla contains centres which control respiration, cardiovascular reflexes and gastric secretions.

(176) Answer : (2)
Hint:
True for nodes of Ranvier
Solution:
Myelinated nerve fibres are found in spinal and cranial nerves.
Unmyelinated nerve fibres are enclosed by Schwann cells that do not form a myelin sheath around the axon, and are commonly found in autonomous and the somatic neural systems.

(177) Answer : (3)
Solution:
Total number of bones in an adult human is 206.

(178) Answer : (1)
Solution:
Scapula is present between the second and the seventh ribs.

(179) Answer : (2)
Hint:
During depolarisation of an axonal membrane, the polarity gets reversed at the site where impulse is applied.
Solution:
After depolarisation of a segment of axon, the inner surface becomes positively charged and the outer surface becomes negatively charged.
Impulse conduction through an axon:



(180) Answer : (3)
Hint:

In resting condition, the axoplasm contains high concentration of K^+.
Solution:
The ionic gradients across the resting neuronal membrane are maintained by the active transport of ions by sodium-potassium pump which transports 3 Na^+ outwards for 2 K^+ into the cell. As a result, the outer surface of the axonal membrane possesses a positive charge while its inner surface becomes negatively charged.