All India Aakash Test Series for NEET-2025

TEST - 3 (Code-C)

Test Date : 10/12/2023

ANSWERS

1. (4)	41. (3)	81. (3)	121. (4)	161. (3)
2. (1)	42. (2)	82. (4)	122. (1)	162. (4)
3. (2)	43. (1)	83. (4)	123. (3)	163. (4)
4. (3)	44. (1)	84. (2)	124. (2)	164. (2)
5. (3)	45. (1)	85. (2)	125. (3)	165. (2)
6. (2)	46. (1)	86. (2)	126. (4)	166. (1)
7. (3)	47. (4)	87. (1)	127. (4)	167. (2)
8. (3)	48. (3)	88. (2)	128. (4)	168. (3)
9. (3)	49. (1)	89. (3)	129. (3)	169. (4)
10. (2)	50. (2)	90. (4)	130. (3)	170. (4)
11. (3)	51. (3)	91. (1)	131. (1)	171. (1)
12. (2)	52. (1)	92. (2)	132. (2)	172. (1)
13. (2)	53. (3)	93. (4)	133. (1)	173. (4)
14. (1)	54. (1)	94. (4)	134. (2)	174. (1)
15. (1)	55. (4)	95. (4)	135. (4)	175. (3)
16. (1)	56. (2)	96. (2)	136. (2)	176. (3)
17. (4)	57. (4)	97. (4)	137. (3)	177. (4)
18. (3)	58. (3)	98. (2)	138. (3)	178. (3)
19. (1)	59. (1)	99. (2)	139. (3)	179. (4)
20. (1)	60. (3)	100. (3)	140. (4)	180. (3)
21. (2)	61. (2)	101. (4)	141. (2)	181. (4)
22. (3)	62. (3)	102. (2)	142. (2)	182. (4)
23. (1)	63. (2)	103. (2)	143. (1)	183. (4)
24. (3)	64. (3)	104. (3)	144. (3)	184. (2)
25. (3)	65. (2)	105. (4)	145. (3)	185. (2)
26. (2)	66. (1)	106. (2)	146. (2)	186. (2)
27. (2)	67. (1)	107. (3)	147. (2)	187. (4)
28. (2)	68. (2)	108. (2)	148. (2)	188. (4)
29. (4)	69. (4)	109. (4)	149. (3)	189. (3)
30. (3)	70. (4)	110. (3)	150. (1)	190. (2)
31. (3)	71. (2)	111. (3)	151. (2)	191. (3)
32. (2)	72. (1)	112. (4)	152. (3)	192. (1)
33. (2)	73. (1)	113. (2)	153. (3)	193. (4)
34. (2)	74. (3)	114. (1)	154. (1)	194. (2)
35. (1)	75. (1)	115. (3)	155. (4)	195. (3)
36. (4)	76. (1)	116. (2)	156. (3)	196. (1)
37. (1)	77. (3)	117. (2)	157. (2)	197. (2)
38. (1)	78. (3)	118. (1)	158. (2)	198. (2)
39. (3)	79. (2)	119. (3)	159. (4)	199. (4)
40. (2)	80. (1)	120. (3)	160. (1)	200. (2)

HINTS & SOLUTIONS

[PHYSICS]

SECTION - A

1. Answer (4)

Hint & Sol.: A scalar quantity only has magnitude and no direction.

Example → Distance, speed, mass, work, etc.

2. Answer (1)

Hint: $\vec{F} = m\vec{a}$

Sol.: $\vec{a} = 0$, as $\vec{v} = \text{constant}$

$\therefore \vec{F}_{net} = 0$

3. Answer (2)

Hint: Vector sum of all forces acting on object is zero.

Sol.: $\vec{a} = 0$

$s = ut + \frac{1}{2}at^2$

s = 16 m

4. Answer (3)

Hint & Sol.: In case of collision of the fly with the windshield of a fast-moving bus, the fly and the bus would have exerted and experienced identical impact force, because according to the third law of motion, every action has an equal and opposite reaction.

5. Answer (3)

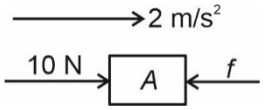
Hint: $\vec{F}_{net} = m\vec{a}$

Sol.: Net acceleration of system:

$10 = 5a$

a = 2 m/s^2

FBD of block A



$F_{net} = ma$

a = 2 m/s^2

$10 - f = 2 \times 2$

f = 6 N

6. Answer (2)

Hint: Work done by a constant force $W = \vec{F} \cdot \vec{s}$

Sol.: $W = 20 \times 5 \times \cos 0°$

W = 100 J

7. Answer (3)

Hint & Sol.: Work done by a conservative force is path independent it depends only on initial and find position.

8. Answer (3)

Hint: Work done by a constant force $W = \vec{F} \cdot \vec{s}$

Sol.: $\vec{s} = (5\hat{i} - 3\hat{j} - 6\hat{k}) - (2\hat{i} + 7\hat{j} - 3\hat{k})$

$= (3\hat{i} - 10\hat{j} - 3\hat{k})$

$\vec{F} = 20\hat{i} - 30\hat{j} + 15\hat{k}$

Now, $W = \vec{F} \cdot \vec{s}$ = 60 + 300 – 45

= 315 J

9. Answer (3)

Hint: Work done by a variable force $W = \int \vec{F} \cdot d\vec{s}$

Sol.: $dW = x\,dx + y^2\,dy$

$W = \int dW = \int_1^{-3} x\,dx + \int_2^4 y^2\,dy$

$= \left[\frac{x^2}{2}\right]_1^{-3} + \left[\frac{y^3}{3}\right]_2^4$

$= \frac{68}{3}$ J

10. Answer (2)

Hint: Work done = Area under F-x curve

Sol.: $W = 10 \times 2 + \frac{1}{2}(10)(4-2) + 0 + \frac{1}{2}(-5)(8-6)$

= 25 J

11. Answer (3)

Hint: According to work-energy theorem $W_{net} = \Delta KE$

Sol.: $W_g + W_{res} = 0 - \frac{1}{2}mu^2$

$-mgh + W_{res} = -\frac{1}{2}mu^2$

$W_{res} = 0.06 \times 10 \times 26 - \frac{1}{2} \times 0.06 \times (24)^2$

= – 1.68 J

12. Answer (2)

Hint: For equilibrium in any conservative field

$F = -\frac{dU}{dx} = 0$

Sol.: $F = -\frac{d}{dx}(ax^2 - bx) = (-2ax + b)$

$F = b - 2ax$

For equilibrium, $F = 0$

$b - 2ax = 0$

$x = \frac{b}{2a}$

13. Answer (2)

Hint & Sol.: $W = mgh + W_{fr}$

$300 = 4 \times 10 \times 5 + W_{fr}$

$W_{fr} = 100$ J

14. Answer (1)

Hint: $\vec{A} \cdot \vec{B} = AB\cos\theta$

Sol.: $\vec{A} \cdot \vec{B} = A \cdot B\cos\theta = A \cdot B\cos 90^\circ = 0$

15. Answer (1)

Hint: Average power $P_{avg} = \frac{\text{Total work done}}{\text{Time taken}}$

Sol.: $P_{avg} = \frac{mgh}{t} = \frac{200 \times 10 \times 20}{20} = 2$ kW

16. Answer (1)

Hint: For a particle to be in equilibrium $\frac{d(U(x))}{dx} = 0$

Sol.: $\frac{d}{dx}\left(\frac{x^3}{3} - \frac{x^2}{2}\right) = 0$

$x^2 - x = 0$

$\Rightarrow x = 1$

17. Answer (4)

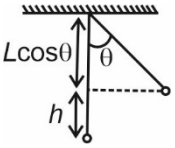
Hint & Sol.: KE = $\frac{1}{2}mv^2$, $p = mv$

KE = $\frac{1}{2}mv^2 \times \frac{m}{m} = \frac{p^2}{2m}$

18. Answer (3)

Hint: Work done by gravity $W_g = mgh$

Sol.:



$h = L(1 - \cos\theta)$

$W_g = mgL(1 - \cos\theta)$

19. Answer (1)

Hint: KE = $\frac{1}{2}mv^2$, $p = mv$

Sol.: $E' = E + 3E = 4E = 4 \times \frac{1}{2}mv^2 = 2mv^2$

If v' is new velocity of body then;

$\frac{1}{2}mv'^2 = 2mv^2 \Rightarrow v' = 2v$

So, $p' = mv' = 2mv$

Percentage change in momentum

$= \frac{2mv - mv}{mv} \times 100 = 100\%$

20. Answer (1)

Hint: $W_{net} = \Delta$KE

Sol.: According to work-energy theorem

$W_{all\ forces} = \Delta$KE

$W_N + W_S + W_g = \frac{1}{2}m\left[v_f^2 - v_i^2\right]$

$0 + mgh + \frac{1}{2}K(0 - x_{max}^2) = 0 - 0$

$x_{max} = \sqrt{\frac{2mgh}{K}}$

21. Answer (2)

Hint: & Sol.: Since the centripetal force will always be perpendicular to the displacement of object, hence work done by centripetal force will always be zero.

22. Answer (3)

Hint: Applying conservation of mechanical energy $K_i + U_i = K_f + U_f$

Sol.: $0 + 2 \times 10 \times 100 = \frac{1}{2} \times 2 \times v^2 + 2 \times 10 \times 20$

$v = 40$ m/s

$R = v\sqrt{\frac{2h}{g}} = 40\sqrt{\frac{2 \times 20}{10}} = 80$ m

23. Answer (1)

Hint: Power = $\frac{\text{Energy}}{\text{Time}}$

Sol.: $\frac{\Delta U_w}{t} = \frac{mgh}{t} = 54 \times 10^3 \times 10 \times 100$ J/H

$\frac{\Delta U_w}{t} = 54 \times 10^6$ J/H

Electrical power = $\frac{1}{3}\left(\frac{\Delta U}{\Delta t}\right)$

$= \frac{18 \times 10^6}{60 \times 60} = 5$ kW

24. Answer (3)

Hint & Sol.: $\int_0^v v \cdot dv = \frac{P_0}{M_0}\int_0^t dt$

$v^2 = \frac{2P_0}{M_0}t$

$v = \sqrt{\frac{2P_0}{M_0}t}$

25. Answer (3)

Hint: If the vectors are perpendicular then their dot product will be zero.

Sol. $(2\hat{i} + 3\hat{j} + 5\hat{k})\cdot(4\hat{i} - 4\hat{j} + \alpha\hat{k}) = 0$

$\Rightarrow \quad 8 - 12 + 5\alpha = 0 \Rightarrow 5\alpha = 4 \Rightarrow \alpha = \frac{4}{5}$

26. Answer (2)

Hint: Velocity of particle at lowest point under critical condition $v = \sqrt{5gR}$

Sol. Using energy conservation

$\frac{1}{2}m \times 5gR = \frac{1}{2}mv^2 + mgR$

$v^2 = 5gR - 2gR$

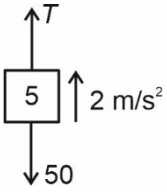
$v = \sqrt{3gR}$

27. Answer (2)

Hint: $F_{net} = ma$

$W = \vec{F} \cdot \vec{S}$

Sol.: *FBD* of block



$\Rightarrow T - 50 = 5 \times 2 \Rightarrow T = 60$

Now, $S = \frac{1}{2} \times 2 \times (2)^2 = 4$ m

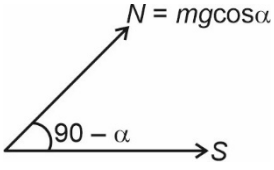
Work done = $FS\cos\theta = 60 \times 4 \times 1 = 240$ J

28. Answer (2)

Hint: Work done $W = \vec{F} \cdot \vec{S} = FS\cos\theta$

Sol.: Block is moving in horizontal direction and

Work done = $N.S\cos\alpha$



$= mg\cos\alpha \cdot vt \cdot \cos(90 - \alpha)$

$= \frac{mgvt\sin 2\alpha}{2}$

29. Answer (4)

Hint & Sol.: Area under *F-t* curve with time axis gives change in momentum or impulse.

30. Answer (3)

Hint: Thrust force on rocket

$\vec{F}_{thrust} = -\vec{v}_{rel} \cdot \frac{dm}{dt}$

Sol.: $v\frac{dm}{dt} = mg$

$\frac{dm}{dt} = \frac{mg}{v} = 600\ \frac{kg}{s}$

31. Answer (3)

Hint: Force imparted to wall $F = \frac{\Delta p}{\Delta t}$

Sol.: $\frac{\Delta p}{\Delta t} = \frac{2nmv}{t}$

$F = 300$ N

32. Answer (2)

Hint: Use equations of uniformly accelerated motion

Sol.: $a = \mu_k g$ and $2as = u^2 - v^2$, where $u = 0$

$\Rightarrow s = \frac{v^2}{2\mu_k g}$

33. Answer (2)

Hint: Tension in the rope should not exceed its breaking strength

Sol.: $T - mg = ma$

$T = m(g + a)$

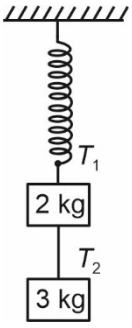
$250 = 20(10 + a)$

$a = 2.5$ m/s²

34. Answer (2)

Hint & Sol.: Initially:- $T_1 = 5g = 50$ N

$T_2 = 3g = 30$ N



Finally :- $T_2 = 0$

For 2 kg block; $T_1 - 2g = 2a$

$50 - 20 = 2a$

$a = 15$ m/s^2 upwards

35. Answer (1)

Hint & Sol.: As the length of the string remains constant

Hence, $v_1 - v_2 \sin\theta = 0$

$$\Rightarrow \quad v_1 = v_2 \sin\theta \Rightarrow v_2 = \frac{v_1}{\sin\theta}$$

SECTION - B

36. Answer (4)

Hint & Sol.: Since the applied force is less than the maximum value of static friction hence the acceleration of block would be zero.

37. Answer (1)

Hint: $v_{max} = \sqrt{\mu Rg}$

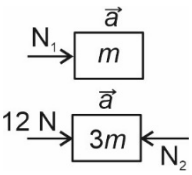
Sol.: $v = \sqrt{1 \times 10 \times 10} = 10$ m/s

38. Answer (1)

Hint: Use Newton's second law of motion and concept of free body diagram.

Sol.: Acceleration a of system of 3 masses

$$= \frac{12}{6m} = \frac{2}{m} \text{ m/s}^2$$



$N_1 = 2$ N

$12 - N_2 = 3ma$

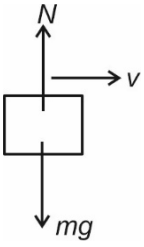
$N_2 = 6$ N

$$\frac{N_1}{N_2} = \frac{1}{3}$$

39. Answer (3)

Hint: Use the concept of free body diagram.

Sol.:



$$N - mg = \frac{mv^2}{R}$$

$$N = mg + \frac{mv^2}{R}$$

40. Answer (2)

Hint: Use $\vec{F} = \frac{d\vec{p}}{dt}$

Sol.: $F = \frac{dp}{dt} = 9t^2 + 4t$

at $t = 1$ s

$F = 13$ N

41. Answer (3)

Hint: Work done equals the area under the force-displacement curve.

Sol.: Work done $= \frac{1}{2} \times 5 \times 10 = 25$ J

42. Answer (2)

Hint: The minimum speed at the bottom must be $\sqrt{4gl}$ to complete the circle

Sol.: Using conservation of energy

$$\frac{1}{2}mu^2 + mg\ell = \frac{1}{2}mv^2$$

$$u = \sqrt{2g\ell}$$

43. Answer (1)

Hint & Sol.: $h_2 = e^{(2n)}h_0$

$= (0.5)^4 h_0$

$= 0.625$ m

44. Answer (1)

Hint & Sol.: Coefficient of restitution $e = \frac{v_{sep}}{v_{app}}$

Since for perfectly inelastic collision, $v_{sep} = 0$ hence $e = 0$.

45. Answer (1)

Hint & Sol.: If the displacement of point of application of force is zero then work done by force will be zero.

46. Answer (1)

Hint & Sol.: Elastic potential energy stored in spring $E = \frac{1}{2}Kx^2$

Hence the graph would be parabolic

47. Answer (4)

Hint: Instantaneous power $P = \vec{F} \cdot \vec{v}$

Sol.: $P = mav$ But $a = v\frac{dv}{dx}$

$$v^2 dv = \frac{P}{m} dx$$

$$\int_u^v v^2\, dv = \int_0^x \frac{P}{m} dx$$

$$P = \frac{m(v^3 - u^3)}{3x}$$

= 100 W

48. Answer (3)

Hint: Use $\vec{F}_{\text{Conservative}} = \frac{-\partial U}{\partial x}\hat{i} - \frac{\partial U}{\partial y}\hat{j} - \frac{\partial U}{\partial z}\hat{k}$

Sol.: $\vec{F}_{\text{Conservative}}$

$$= \frac{-\partial}{\partial x}(3x + 4y)\hat{i} - \frac{\partial}{\partial y}(3x + 4y)\hat{j} - \frac{\partial}{\partial z}(3x + 4y)\hat{k}$$

$$\Rightarrow \vec{F}_{\text{Conservative}} = -3\hat{i} - 4\hat{j}$$

$$\Rightarrow \left|\vec{F}_{\text{Conservative}}\right| = 5$$

$$\Rightarrow |\vec{a}| = \frac{5}{m}$$

49. Answer (1)

Hint: & Sol.:

Since the body is moving with constant velocity hence the net contact force by plane on block will be equal to *mg*.

50. Answer (2)

Hint & Sol.: When the particle is moving in a vertical circle the force acting towards the centre and along the tangent vary from point to point hence its radial and tangential accelerations varies.

[CHEMISTRY]

SECTION - A

51. Answer (3)

Hint & Sol.:

Digit	Name
1	un
4	quad

52. Answer (1)

Hint: *s* and *p*-block elements are known as representative elements.

Sol.:

- V and Ni belongs to *d*-block.
- Gd belongs to *f*-block while As belongs to *p*-block.

∴ As is a representative element

53. Answer (3)

Hint: NO is a neutral oxide

Sol.

Oxide	**Nature**
NO	Neutral
Na_2O	Basic
As_2O_3	Amphoteric
Cl_2O_7	Acidic

54. Answer (1)

Hint: $\Delta G = \Delta G° + RT \ln Q$ (Q is the reaction quotient)

Sol. The correct relation between $\Delta G°$ and equilibrium constant (K) is

$\Delta G = \Delta G° + RT \ln Q$

At equilibrium, $\Delta G = 0$ and $Q = K$

$0 = \Delta G° + RT \ln K$

$\Delta G° = -RT \ln K$

$\Delta G° = -2.303\, RT \log K$

55. Answer (4)

Hint: Isoelectronic species have same number of electrons. More is the effective nuclear charge, smaller is the size of ion.

Sol: More the number of protons, greater is the effective nuclear charge.

∴ Correct order of ionic size : $F^- > Na^+ > Mg^{2+}$

56. Answer (2)

Hint: $HCl + NaOH \rightarrow NaCl + H_2O$

During neutralisation of one mole of NaOH by one mole of HCl, the heat evolved = 57.1 kJ

Sol. Number of moles of HCl $= \frac{400 \times 0.1}{1000} = 0.04$

Number of moles of NaOH $= \frac{600 \times 0.1}{1000} = 0.06$

So, 0.04 moles of HCl are neutralised by 0.04 moles of NaOH.

Therefore, the total heat released = 0.04 × 57.1

= 2.28 kJ

57. Answer (4)

Hint: Noble gases have large positive electron gain enthalpies due to their stable electronic configurations.

Sol.:

Element	$\Delta_{eg}H$(kJ/mol)
Na	–53
Se	–195
Br	–325
Ne	+116

58. Answer (3)

Hint & Sol. : For a reaction to occur spontaneously ΔG must be less than zero.

So, $\Delta H - T\Delta S$ must be negative.

59. Answer (1)

Hint: Elements having similar outer electronic configurations in their atoms are arranged in vertical columns, called groups.

Sol: Outer electronic configuration of elements with Z = 11 and Z = 19 respectively are $3s^1$ and $4s^1$.

60. Answer (3)

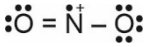
Hint: The reference state of an element is its most stable state of aggregation at 25°C and 1 bar pressure.

Sol.: The standard molar enthalpy of formation of $H_2(g)$, $Cl_2(g)$ and C(graphite) is zero while the standard molar enthalpy of formation of $Br_2(g)$ is +30.91 kJ mol^{-1}. The $\Delta_fH°$ of $Br_2(l)$ = 0.

61. Answer (2)

Hint: The species which contains odd number of electron in it is called odd electron molecule.

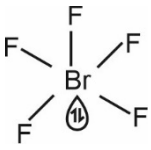
Sol. NO_2 is an odd-electron molecule having odd number of electron in nitrogen atom.



62. Answer (3)

Hint: BrF_5 molecule has 5 bonding pair of electrons and one lone pair of electrons.

Sol. Hybridisation of 'Br' in BrF_5 molecule is sp^3d^2 and shape is square pyramidal.



63. Answer (2)

Hint: The standard enthalpy of combustion is defined as the enthalpy change per mole of a substance when it undergo combustion and all reactants and products being in their standard states at the specified temperature.

Sol.

$$H_2 + \frac{1}{2}O_2 \longrightarrow H_2O,\ \Delta_CH = -x\ kJ/mol \quad ...(i)$$

$$C_6H_{10} + \frac{17}{2}O_2 \longrightarrow 6CO_2 + 5H_2O,\ \Delta_CH = -y\ kJ/mol \quad ...(ii)$$

$$C_6H_{12} + 9O_2(g) \longrightarrow 6CO_2(g) + 6H_2O(l),\ \Delta_CH = -z\ kJ/mol \quad ...(iii)$$

Add equations (i) and (ii) and subtract equation (iii)

$C_6H_{10}(l) + H_2(g) \rightarrow C_6H_{12}(l)$

$\Delta H = (-x-y+z)$ kJ/mol

$\therefore$ Correct answer is (2)

64. Answer (3)

Hint & Sol.: $C + O_2 \rightarrow CO_2$

Mole of $CO_2 = \frac{22}{44} = 0.5$

Mole of carbon reacted = 0.5

Energy released = 394 × 0.5 = 197 kJ

65. Answer (2)

Hint: Bond order $= \frac{1}{2}[N_b - N_a]$

Where, N_b and N_a are number of electrons occupying bonding and antibonding orbitals respectively.

Sol.:

- E.C of O_2 molecule: $(\sigma 1s)^2(\sigma^*1s)^2(\sigma 2s)^2$ $(\sigma^*2s)^2(\sigma 2p_z)^2 \left(\pi 2p_x^2 = \pi 2p_y^2\right)\left(\pi^* 2p_x^1 = \pi^* 2p_y^1\right)$

  Bond order $= \frac{1}{2}[10-6] = 2$

- E.C of O_2^- ion: $(\sigma 1s)^2(\sigma^*1s)^2(\sigma 2s)^2(\sigma^*2s)^2(\sigma 2p_z)^2$ $\left(\pi 2p_x^2 = \pi 2p_y^2\right)\left(\pi^* 2p_x^2 = \pi^* 2p_y^1\right)$

  Bond order $= \frac{1}{2}[10-7] = 1.5$

- E.C of O_2^+ ion: $(\sigma 1s)^2(\sigma^*1s)^2(\sigma 2s)^2(\sigma^*2s)^2(\sigma 2p_z)^2$ $\left(\pi 2p_x^2 = \pi 2p_y^2\right)\left(\pi^* 2p_x^1\right)$

  Bond order $= \frac{1}{2}[10-5] = 2.5$

- E.C of O_2^{2-} ion: $(\sigma 1s)^2(\sigma^*1s)^2(\sigma 2s)^2(\sigma^*2s)^2(\sigma 2pz)^2$ $\left(\pi 2p_x^2 \equiv \pi 2p_y^2\right)\left(\pi^* 2p_x^2 \equiv \pi^* 2p_y^2\right)$

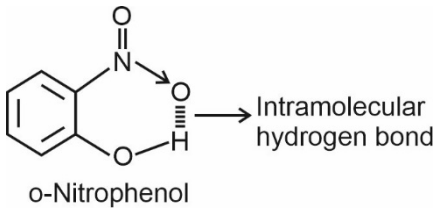
  Bond order $= \frac{1}{2}[10-8] = 1$

$\therefore$ O_2^+ has highest bond order *i.e.*, equal to 2.5.

66. Answer (1)

Hint: Intramolecular hydrogen bond is formed when hydrogen atom is in between the two highly electronegative (F, O, N) atoms present within the same molecule.

Sol:



o-Nitrophenol

67. Answer (1)

Hint: As the randomness decreases, entropy also decreases.

Sol.: During condensation of steam, randomness of water molecules decreases hence entropy change is negative.

68. Answer (2)

Hint: The lone pair (lp) electrons in a molecule occupy more space as compared to bonding pair (bp) of electrons.

Sol. There is greater repulsion between lone pair of electrons as compared to lone pair-bond pair and bond pair – bond pair repulsions.

The correct order of repulsive interactions is lp – lp > lp – bp > bp – bp

69. Answer (4)

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

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

Sol.: $\Delta H = \Delta U + \Delta n_g RT$

$\Delta n_g = 2$, $R = 2$ cal K^{-1} mol^{-1}, $T = 300$ K

$\Delta H = (2.1 \times 10^3) + (2 \times 2 \times 300)$

$\Delta H = (2.1 \times 10^3) + (1.2 \times 10^3)$

$\Delta H = 3.3 \times 10^3$ cal = 3.3 k cal

$\Delta G = 3.3 - (300 \times 20) \times 10^{-3}$

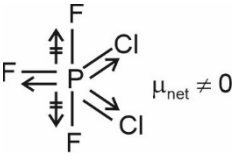
$= 3.3 - 6$

$\Delta G = -2.7$ k cal

70. Answer (4)

Hint: Molecule having non-zero dipole moment is polar in nature.

Sol.:



$\therefore$ PF_3Cl_2 is a polar molecule.

71. Answer (2)

Hint: At equilibrium $\Delta G = 0$

So, $T = \dfrac{\Delta H}{\Delta S}$

Sol.: $\Delta G = \Delta H - T\Delta S$

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

$T = \dfrac{\Delta H}{\Delta S} = \dfrac{31}{0.05} = 620$ K

$\Delta G = 0$ means the process is reversible in nature and it is the state of equilibrium.

Below this T, ΔG will be positive.

Hence, it is non-spontaneous in nature.

72. Answer (1)

Hint: Using Hess's Law of constant heat summation, ΔH of $C(s) + O_2(g) \rightarrow CO_2(g)$ can easily be calculated.

Sol.: $H_2O(g) + C(s) \rightarrow CO(g) + H_2(g)$,
$\Delta H = +131$ kJ …(i)

$CO(g) + \dfrac{1}{2}O_2(g) \rightarrow CO_2(g)$, $\Delta H = -282$ kJ …(ii)

$H_2(g) + \dfrac{1}{2}O_2(g) \rightarrow H_2O(g)$, $\Delta H = -242$ kJ …(iii)

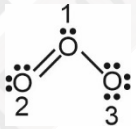
$C(s) + O_2(g) \rightarrow CO_2(g)$, $\Delta H = ?$ …(iv)

On adding equation (i), (ii) and (iii), we get eq. (iv)

$\Delta H = (131 - 282 - 242)$ kJ $= -393$ kJ

73. Answer (1)

Hint & Sol.



- The central O atom marked 1

Formal charge $= 6 - 2 - \dfrac{1}{2}(6) = +1$

74. Answer (3)

Hint: $w = -nRT \ln\dfrac{V_f}{V_i}$ [Reversible and isothermal]

Sol.: $V_1 = 2$ L, $V_2 = 20$ L

$T = 300$ K, $n = 5$ mol

$w = -nRT \ln\dfrac{V_f}{V_i}$

$w = -2.303nRT \log\dfrac{V_f}{V_i}$

$w = -2.303 \times 5 \times 8.314 \times 300 \log\dfrac{20}{2}$

$w = -2.303 \times 5 \times 8.314 \times 300$

$w = -28.72$ kJ

75. Answer (1)

Hint: Expansion of a gas in vacuum (p_{ex} = 0) is called free expansion.

Sol.: No work is done during free expansion of an ideal gas whether the process is reversible or irreversible.

So, $w = -p_{ext}\,\Delta V$

$w = 0$

76. Answer (1)

Hint: According to first law of thermodynamics $\Delta U = q + w$

Sol.: Heat given by system (q) = –40 J

Work done by system (w) = –60 J

$\Delta U = q + w$

$\Delta U = -40 - 60$

$\Delta U = -100$ J

77. Answer (3)

Hint: & Sol.:

- In a closed system, there is no exchange of matter, but exchange of energy is possible between system and surrounding.
- System + Surrounding = Universe
- In isolated system, there is no exchange of energy or matter between system and surrounding

$\therefore$ Correct answer is (3)

78. Answer (3)

Hint For a mole of an ideal gas, $\Delta H = \Delta U + R\Delta T$

Sol.: $\Delta H = C_p\Delta T$ and $\Delta U = C_v\Delta T$

$\Delta H = \Delta U + R\Delta T$

$C_p\Delta T = C_v\Delta T + R\Delta T$

$C_p = C_v + R$

$C_p - C_v = R$

79. Answer (2)

Hint: The standard enthalpy change for the formation of one mole of compound from its elements in their most stable states of aggregation is called enthalpy of formation.

Sol.: The reference state of bromine is Br_2 liquid and those of fluorine is F_2 gas.

So, BrF_3 is formed from $Br_2(l)$ and $F_2(g)$ in standard state.

$$\frac{1}{2}Br_2(l) + \frac{3}{2}F_2(g) \longrightarrow BrF_3(g)$$

$\therefore$ Correct answer is (2)

80. Answer (1)

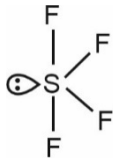
Hint: If excess bonding electrons are present in pi molecular orbital then π bonds are formed.

Sol: In C_2 and B_2, presence of four excess electrons and two electrons respectively in two pi molecular orbitals result in π bond formation in each species.

81. Answer (3)

Hint: If the central atom contains four bond pair and one lone pair then the species will be see-saw in shape.

Sol:



sp^3d hybridised and see-saw in shape.

82. Answer (4)

Hint: One mole of X_2 contains one mole of X – X bond.

Sol.: For the formation of 2 moles of X_2, total energy released is –900 kJ.

So, energy released for formation of one mole of X_2 is –450 kJ

Bond dissociation energy of X – X bond is +450 kJ

$\therefore$ The correct answer is (4)

83. Answer (4)

Hint: & Sol.: Stability of product $\propto$ more negative heat of formation.

$\therefore$ Product with +300 kcal heat of formation is least stable.

84. Answer (2)

Hint: The standard heat of formation of $H_2(g)$ and $Cl_2(g)$ is zero.

Sol.: $H_2(g) + Cl_2(g) \rightleftharpoons 2HCl(g)$

$\Delta_f H^0(H_2) = 0,\ \Delta_f H^0(Cl_2) = 0$

$\Delta H = 2\Delta_f H^0(HCl) - \Delta_f H^0(H_2) - \Delta_f H^0(Cl_2)$

$-x = 2 \times \Delta_f H^0(HCl)$

$\Delta_f H^0(HCl) = -\frac{x}{2}$ kJ mol^{-1}

85. Answer (2)

Hint: Heat and work are path functions which depends on the path followed by system.

Sol.: ΔU, ΔS and ΔH are state functions which depends only on initial and final state of system.

SECTION - B

86. Answer (2)

Hint: More is the negative electron gain enthalpy, greater is the electron affinity of the element.

Sol.:

Element	$\Delta_{eg}H$ (kJ mol^{-1})
F	–328
Cl	–349
Br	–325
I	–295

87. Answer (1)

Hint: Heat or reaction at constant pressure = ΔH

Heat of reaction of constant volume = ΔU

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

Sol.: $\Delta H = \Delta U + \Delta n_g RT$

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

$2C_6H_6(l) + 15O_2(g) \rightarrow 12CO_2(g) + 6H_2O(l)$

$\Delta n_g = 12 - 15 = -3$

$T = 273 + 27 = 300$ K

$\Delta H - \Delta U = -3 \times 300 \times 8.314$

$= -900 \times 8.314 = -7.48$ kJ

88. Answer (2)

Hint & Sol.

Half-filled and fully-filled subshells have greater stability.

$\therefore$ [Ne]$3s^2 3p^3$ has half filled configuration, so ionisation energy is highest.

89. Answer (3)

Hint: Greater the value of ionisation enthalpy, lesser is the tendency to remove the electrons.

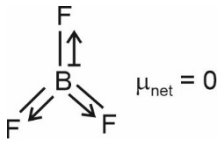
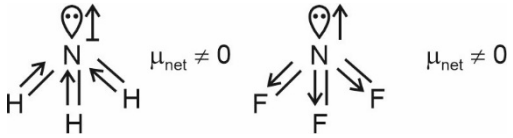
Sol.: Removal of fourth electron is difficult, hence the metal shows +3 oxidation state.

The formula of the metal chloride is MCl_3.

90. Answer (4)

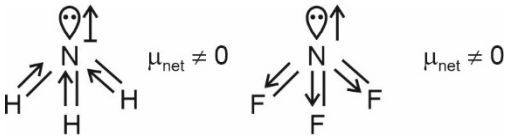
Hint: Dipole moment (μ) is a vector quantity and its value depends on shape and bond moment of the molecule.

Sol.:

-  $\mu_{net} = 0$
-  $\mu_{net} \neq 0$ $\mu_{net} \neq 0$

In case of NH_3, the orbital dipole is due to lone pair is in the same direction as the resultant dipole of N – H bonds.

$\therefore$ Dipole moment of NH_3 is greater than NF_3 molecule



$\mu_{net} \neq 0$ $\mu_{net} \neq 0$

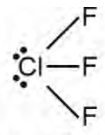
$\mu_{H_2O} > \mu_{NH_3}$

So, the correct order of dipole moment is

$\boxed{\mu_{H_2O} > \mu_{NH_3} > \mu_{NF_3} > \mu_{BF_3}}$

91. Answer (1)

Hint: ClF_3 has T-shape which is distorted

Sol.: 

Bent T-shaped

In ClF_3, there is no 90° bond angle

92. Answer (2)

Hint: The central metal atom which contains vacant d-orbitals can form pπ and dπ overlap with oxygen atom.

Sol.: O = C = O

In CO_2 molecule, 'C' atom is *sp* hybridised.

Hence, there are two pπ – pπ bonds present.

While, in SO_4^{2-}, SO_3 and SO_2 there is pπ – dπ overlap.

93. Answer (4)

Hint: For an isothermal process, $\Delta T = 0$

Sol.: $\Delta U = q + w$ [First law of thermodynamics]

For an isothermal expansion of gas,

$\Delta T = 0$, w = –ve

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

$0 = q + w$

$\boxed{w = -q}$

$\therefore$ Work done by the gas is equal to the heat supplied to the gas.

94. Answer (4)

Hint: The process is adiabatic hence q = 0

Sol. $w = -P\Delta V$

$= -4(5.5 - 3.5)$

$= -4 \times 2 = -8$ L atm

$= -8 \times 101.3 = -810.4$ J

From first law, we can write

$\Delta U = q + w$

$\Delta U = -810.4$ J

95. Answer (4)

Hint: & Sol.: When a system is in equilibrium, the entropy is maximum, and the change in entropy, $\Delta S = 0$

The total entropy change (ΔS_{total}) for spontaneous process is greater than zero.

96. Answer (2)

Hint: In a period, more is the atomic number, more is effective nuclear charge.

Sol. More is the effective nuclear charge, smaller is the size of atom.

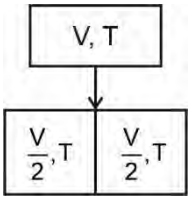
Correct order of atomic size.

Si > P > S > Cl

97. Answer (4)

Hint: An intensive property is the property whose value does not depend on the quantity present in the system.

Sol.: The value of temperature does not depend on amount of substance.



Temperature is an intensive property.

98. Answer (2)

Hint & Sol.: IUPAC official name of element with atomic number 106 is Seaborgium.

99. Answer (2)

Hint: $O_2 : (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\sigma 2p_z)^2$

$\left(\pi 2p_x^2 = \pi 2p_y^2\right)\left(\pi^* 2p_x^1 = \pi^* 2p_y^1\right)$

Sol: The orbital containing electron which has highest energy is called highest occupied molecular orbital.

100. Answer (3)

Hint: $\Delta_r H° = \Sigma$ bond enthalpies (reactants) – Σ bond enthalpies (product)

Sol.: $\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \rightarrow HCl(g)$

$\Delta_r H° = \left(\frac{1}{2} \times 436 + \frac{1}{2} \times 243\right) - 430$

$= 218 + 121.5 - 430 = -90.5$

[BOTANY]

SECTION - A

101. Answer (4)

Hint: When stamens are united into one bunch or one bundle, then it is monoadelphous condition.

Sol.: Monoadelphous stamens are found in china rose.

Diadelphous stamens are found in pea and polyadelphous stamens are found in *Citrus*.

102. Answer (2)

Hint: Intercalary meristems appear early in life of a plant and contribute to the formation of the primary plant body.

Sol.: Intercalary meristem is not only found in grasses but in other plants also.

103. Answer (2)

Hint: When a flower can be divided into two equal halves in any radial plane passing through the centre. It is said to be actinomorphic.

Sol.: Mustard, *Datura*, chilli, etc. have actinomorphic flowers. *Cassia*, pea and bean have zygomorphic flowers.

104. Answer (3)

Hint: Vascular cambium produces vascular tissues during secondary growth.

Sol.: Vascular cambium produces secondary xylem and secondary phloem in dicot stems during secondary growth.

105. Answer (4)

Hint: Stem tendrils are found in cucumber and pumpkin.

Sol.: Axillary buds form slender and spirally coiled tendrils in cucumber and pumpkin.

106. Answer (2)

Hint: Root and shoot apices have apical meristems which are primary meristematic tissue.

Sol.: Cork or phellem is redifferentiated tissue. Phellogen or cork cambium is dedifferentiated tissue.

Primary xylem is primary permanent tissue.

107. Answer (3)

Hint: When the primary root is short lived and is replaced by a large number of roots which originate from the base of the stem, then they constitute fibrous root system.

Sol.: Fibrous root system is a characteristic feature of monocots. Wheat is a monocot plant while mustard plant, mango tree and banyan tree are dicots.

108. Answer (2)

Hint: In epigynous flowers, the margin of thalamus grows upward enclosing the ovary completely and getting fused with it, the other parts of flowers arise above the ovary and hence, the ovary is said to be inferior.

Sol.: Ovary is inferior in flowers of guava, cucumber and the ray florets of sunflower. Superior ovary is seen in china rose.

109. Answer (4)

Hint: Vexillary aestivation and marginal placentation are the characteristic features of Fabaceae family.

Sol.:

- *Allium cepa* (onion) and *Colchicum autumnale* (Colchicine) belong to family Liliaceae.
- *Solanum nigrum* (makoi) belongs to family Solanaceae.
- *Pisum sativum* (garden pea) belongs to family Fabaceae.

110. Answer (3)

Hint: These cells of the adaxial epidermis are found along the veins of grass leaves.

Sol.: Bulliform cells are large, empty, colourless cells of adaxial epidermis along the veins of grass leaves which help in its curling and help in minimising transpirational loss of water.

Lenticels help in gaseous exchange. Subsidiary cells are specialised epidermal cells surrounding the guard cells of stomata.

111. Answer (3)

Hint: In monocot stems, ground tissue is parenchymatous and not differentiated into layers.

Sol.: Endodermis is absent in monocot stems.

112. Answer (4)

Hint: Collenchyma consists of cells which are much thickened at corners due to a deposition of cellulose, hemicellulose and pectin.

Sol.: Collenchyma is an elastic, living mechanical tissue, providing mechanical support, flexibility and elasticity to parts like petiole of leaf.

113. Answer (2)

Hint: This part is middle layer of fruit wall.

Sol.: In mango, edible part is mesocarp (middle layer of pericarp) fleshy, juicy in nature.

114. Answer (1)

Hint: In pea and bean flowers, vexillary aestivation of petals is observed where the two smallest anterior petals are keel.

Sol.: Keel is the characteristic feature of the family Fabaceae.

115. Answer (3)

Hint: The presence of vessels is a characteristic feature of angiosperms.

Sol.: Gymnosperms lack vessels in their xylem.

116. Answer (2)

Hint: Stomata are found in primary plant body

Sol.: Loose parenchyma cells rupturing the epidermis and forming a lens shaped opening in bark is lenticel.

117. Answer (2)

Hint: It is remnant of diploid tissue in the seed.

Sol.:
- Perisperm is persistent nucellus in the seed.
- Outer seed coat is testa.
- Hilum is the scar on the seed coat
- Micropyle is a small pore above hilum in the seed.

118. Answer (1)

Hint: Drupes develop from superior ovaries and are single seeded.

Sol.: In mango and coconut, fruits develop from monocarpellary superior ovaries.

119. Answer (3)

Hint: In the seeds of cereals the seed coat is membranous.

Sol.: In the seeds of cereals such as maize, seed coat is fused with fruit wall.

120. Answer (3)

Hint: Roots lack nodes, internodes and buds.

Sol.: Sweet potato is a modified edible root. Potato, *Colocasia* and zaminkand are modified edible underground stems.

121. Answer (4)

Hint: The calyx may be gamosepalous or polysepalous.

Sol.: When sepals are united it is termed as gamosepalous.

Gamopetalous term is used for fused petals.

122. Answer (1)

Hint: When the margins of sepals or petals overlap one another without any particular direction, this is termed as imbricate aestivation.

Sol.: Imbricate aestivation is seen in flowers of gulmohur.

- Flowers of *Calotropis* show valvate aestivation.
- Flowers of lady's finger show twisted aestivation.
- Bean flowers show vexillary aestivation.

123. Answer (3)

Hint: Vascular bundles in monocot stem are conjoint, collateral and are scattered in ground tissue.

Sol.: Vascular bundles in monocot stem are considered closed because cambium is absent.

124. Answer (2)

Hint: These structures are filled with secondary metabolites and act as tracheal plugs.

Sol.: The balloon shaped structures, which are extensions of xylem parenchyma cells into the vessels are known as tyloses.

125. Answer (3)

Hint: The peripheral region of the secondary xylem, is lighter in colour and involved in conduction of water and minerals from root to leaf.

Sol.: Heartwood is in the central or innermost region of secondary xylem.

126. Answer (4)

Hint: Interfascicular cambium is secondary meristem formed between two adjacent vascular bundles during secondary growth in dicot stems.

Sol.: Dedifferentiation of parenchyma cells of medullary rays results in formation of interfascicular cambium in dicot stems.

127. Answer (4)

Hint: This type of placentation is seen in *Dianthus* and *Primrose.*

Sol.: Placentation in which ovules are borne on central axis and septa are absent is free central placentation.

128. Answer (4)

Hint: When stamens are attached to the perianth, they are epiphyllous.

Sol.: Epiphyllous stamens are found in flowers of lily. Flowers of brinjal show epipetalous stamens.

129. Answer (3)

Hint: Pattern of arrangement of leaves on the stem or branch is called phyllotaxy.

Sol.: If more than two leaves arise at a node, form a whorl, it is called whorled phyllotaxy.

130. Answer (3)

Hint: Phyllode is modified petiole.

Sol.:

- Thorns are found in *Bougainvillea*.
- Phyllodes are found in Australian *Acacia*.
- Offsets are found in *Pistia*.
- Corm is modified underground stem of *Colocasia*.

131. Answer (1)

Hint: Trichomes are the epidermal hairs on stem.

Sol.: Trichomes in the shoot system are usually multicellular.

132. Answer (2)

Hint: Many cells of this layer protrude to form unicellular root hairs.

Sol.: The outermost layer of sunflower root is epiblema.

- Cuticle is absent in roots.
- Endodermis is innermost layer of cortex.
- Pericycle is outermost layer of stele.

133. Answer (1)

Hint: These cavities are found in vascular bundles which are scattered in ground tissue.

Sol.: Water containing cavities in vascular bundles is a characteristic feature of monocot stem.

134. Answer (2)

Hint: Ashwagandha is medicinal plant of Solanaceae family (potato family) which is a dicotyledonous family.

Sol.: Fabaceae family was earlier called papilionoideae.

Sunhemp is a member of Fabaceae family.

135. Answer (4)

Hint: Floral formula of family Fabaceae is $\% \, ♀♂ K_{(5)} C_{1+2+(2)} A_{(9)+1} \underline{G}_1$ and floral formula of family Solanaceae is $\oplus ♀♂ K_{(5)} \overset{\frown}{C_{(5)}} A_5 \underline{G}_{(2)}$.

Sol.: Floral formula of family Brassicaceae is $\oplus ♀♂ K_{2+2} C_4 A_{2+4} \underline{G}_{(2)}$ and floral formula of family Liliaceae is $Br \oplus ♀♂ \overset{\frown}{P_{(3+3)}} A_{3+3} \underline{G}_{(3)}$.

SECTION - B

136. Answer (2)

Hint: When oldest flower is present at the top and youngest at the bottom, then it is basipetal order.

Sol.: In cymose type of inflorescence the main floral axis (peduncle) terminates in a flower, hence is limited in growth.

137. Answer (3)

Hint: In dicot stems, the cells of cambium present between primary xylem and primary phloem is the intrafascicular cambium.

Sol.: It is primary in origin that is, it is primary meristem but is involved in secondary growth that forms secondary permanent tissues. Thus, it is cylindrical or lateral meristem.

138. Answer (3)

Hint: It is seen in ovary with parietal placentation.

Sol.: Ovary is one-chambered but it becomes two-chambered due to the formation of the false septum. It is seen in mustard.

139. Answer (3)

Hint: Prop roots arise from heavy branches to support tree trunk.

Sol.: The stems of maize and sugarcane have supporting roots coming out of the lower nodes of the stem. These are called stilt roots.

140. Answer (4)

Hint: All leaves have axillary buds.

Sol.: A leaf is said to be simple, when its lamina is entire or when incised, the incisions do not touch the midrib, thus, not divided into leaflets.

141. Answer (2)

Hint: Leaf tendrils are spirally coiled structures.

Sol.: Leaf tendrils help in climbing and supporting weak stems.

- Thorns provide defence against grazing herbivores.
- Leaves of certain insectivorous plant such as pitcher plant help in trapping insects.

142. Answer (2)

Hint:
- ♂ is used for bisexual flower.
- Br is used for bracteate flower.

Sol.:
- % is used for zygomorphic flower.
- ⊕ is used for actinomorphic flower.

143. Answer (1)

Hint: The protoxylem lies towards periphery and metaxylem lies towards the centre, such arrangement of primary xylem is called exarch.

Sol.: Exarch protoxylem is seen in roots.

Endarch protoxylem is seen in stems.

144. Answer (3)

Hint: In palmately compound leaves, the leaflets are attached at a common point, *i.e.*, at the tip of petiole.

Sol.: Palmately compound leaf is found in silk cotton. Pinnately compound leaf is found in Neem. Mango and china rose have simple leaves.

145. Answer (3)

Hint: Parenchyma performs functions like storage.

Sol.: Phloem parenchyma is absent in most of the monocots. The phloem parenchyma stores food material and other substances like resins, latex and mucilage.

146. Answer (2)

Hint: Parenchymatous cells have thin cell walls made up of cellulose and form the major components within organs of plants.

Sol.: The collenchyma occurs in layers below the epidermis in most of the dicotyledonous plants.

147. Answer (2)

Hint: This component is a characteristic feature of angiosperms.

Sol.: Vessel is a long cylindrical tube like structure made up of many cells called vessel members, interconnected through perforations in their common walls.

148. Answer (2)

Hint: Tissues inner to endodermis include pericycle, vascular bundles and pith.

Sol.: All tissues on the innerside of the endodermis constitute stele.

149. Answer (3)

Hint: Hypodermis is absent in roots

Sol.: Monocot roots differ from dicot roots in having large and well developed pith.

150. Answer (1)

Hint: Stipules are small leaf like structures near leaf base.

Sol.: Bracts are reduced leaf found at the base of the pedicel.

[ZOOLOGY]

SECTION - A

151. Answer (2)

Hint: The property of blood related with blood volume and blood pressure.

Sol.: Albumins help in maintaining osmotic balance of the body. Globulins are primarily involved in defence mechanisms of the body. Albumin is not a clotting factor and is present in serum.

152. Answer (3)

Hint: Animal with closed type of circulation

Sol.: Porifers (*Sycon*) and coelenterates (*Hydra* and *Obelia*), circulate water from their surroundings through their body cavities to facilitate the cells to exchange useful substances. Annelids (*Pheretima*) use special fluid called blood for this purpose.

153. Answer (3)

Hint: This fluid contains RBCs

Sol.: Blood is the most commonly used body fluid for circulation of various substances. Haemolymph is circulatory fluid in arthropods. Water is most abundant chemical in body of organisms but circulates in the body cavities of sponges and coelenterates. Lymph is also a circulating fluid in the body of complex animals but is not commonly used body fluid by most of the higher organisms.

154. Answer (1)

Hint: This limb is almost permeable to water.

Sol.: The glomerular filtrate gets concentrated as it moves down the descending limb of loop of Henle and gets diluted when it moves up the ascending limb of loop of Henle. Blood passes through ascending and descending limbs of vasa recta.

155. Answer (4)

Hint: The process of release of urine from urinary bladder.

Sol.: Urine formation involves three main processes, *i.e.,* filtration, reabsorption and secretion. Micturition is the process of release of urine and neural mechanism causing it is called micturition reflex.

156. Answer (3)

Hint: Fluid connective tissue

Sol.: Blood is a special connective tissue. Adipose and areolar tissues are included in loose connective tissues. Dense connective tissues include tendons, ligaments and dermis of skin.

157. Answer (2)

Hint: Bean-shaped organ

Sol.: Malfunctioning of kidneys leads to accumulation of urea in blood, a condition called uremia. Liver is involved in the synthesis of urea by urea cycle. Lungs are accessory excretory organs as they remove CO_2. Intestine is helpful in elimination of bile pigments.

158. Answer (2)

Hint: The cells which produce thrombocytes.

Sol.: Platelets/Thrombocytes are cell fragments produced by megakaryocytes. Erythrocytes and monocytes are cellular components of formed elements. Erythrocytes transport respiratory gases and monocytes participate in the process of phagocytosis.

159. Answer (4)

Hint: Mammalian heart is four-chambered.

Sol.: The sequential event in the heart which is cyclically repeated is called the cardiac cycle and it consists of systole and diastole of both the atria and ventricles. The duration of each cardiac cycle is 0.8 seconds in an adult man under normal conditions.

Cardiac cycle (0.8 sec) = Atrial systole (0.1 sec) + Ventricular systole (0.3 sec) + Joint diastole (0.4 sec)

160. Answer (1)

Hint: Kidneys are situated in thoraco-lumbar region of posterior region of abdominal cavity.

Sol.: Kidneys are reddish brown, bean shaped structures situated between the levels of last thoracic and third lumbar vertebra close to the dorsal inner wall of abdominal cavity.

161. Answer (3)

Hint: Largest blood cell

Sol.: Monocytes are largest among all formed elements.

WBCs		Per cent of total WBCs
Monocytes	–	6-8
Neutrophils	–	60-65
Eosinophils	–	2-3
Lymphocytes	–	20-25

162. Answer (4)

Hint: Individuals without Anti-A antibodies in their plasma.

Sol.: Blood group 'O' due to absence of antigens on RBCs can be donated to persons with any other blood group and hence 'O' group individuals are called universal donors. Persons with 'AB' group can accept blood from persons with any other blood group due to lack of antibodies in their blood plasma. Therefore, such persons are called universal recipients.

163. Answer (4)

Hint: Antibodies are produced in mother against Rh antigen.

Sol.: Rh incompatibility occurs when a pregnant mother is Rh –ve and foetus is Rh +ve. In such cases, the antibodies are produced in mother against Rh factor and leaks into foetal circulation through placental barriers. This may cause anaemia, jaundice or could be fatal to the foetus. This condition is called erythroblastosis foetalis.

164. Answer (2)

Hint: Ammonia is the most toxic nitrogenous waste.

Sol.: Ammonia is the most toxic form and requires large amount of water for its elimination, whereas uric acid, being the least toxic, can be removed with a minimum loss of water. Urea is less toxic than ammonia and more toxic than uric acid and requires a moderate amount of water for its elimination.

165. Answer (2)

Hint: Prothrombin is an inactive protein.

Sol.: Coagulum / clot is formed by a network of fibrins in which dead cells of blood are trapped. Prothrombin is an inactive protein which is activated by enzyme thrombokinase complex into thrombin that is responsible for conversion of fibrinogens into fibrins.

166. Answer (1)

Hint: It is protected by pericardium.

Sol.: Heart, the mesodermally derived organ is situated in the thoracic cavity, in between the two lungs, slightly tilted to the left. Thymus and liver are endodermally derived organs. Kidneys are situated close to the dorsal inner wall of abdominal cavity.

167. Answer (2)

Hint: Characterised by jointed appendages

Sol.: Arthropods, hemichordates, urochordates and molluscs possess open circulatory system whereas, annelids, certain molluscs and chordates have closed circulatory system, except urochordates.

168. Answer (3)

Hint: Synthesized from ammonia and CO_2

Sol.: Uric acid is excreted by birds, reptiles and land snails. Hydrocarbons, sterols and waxes are present in sebum. Sweat contains NaCl, small amounts of urea, lactic acid, *etc*.

169. Answer (4)

Hint: Ions are filtered out passively through capillary pores.

Sol.: Tissue fluid does not contain large plasma proteins. The fluid released out from capillaries is called tissue fluid. Exchange of nutrients, gases, *etc*. always takes place between the blood and body cells through tissue fluid.

It has same mineral distribution as that in plasma.

170. Answer (4)

Hint: Performs pumping of blood in arterial system

Sol.: All vertebrates possess a muscular chambered heart. It is two-chambered in fishes, 3-chambered in amphibians and reptiles except crocodiles and four chambered in birds, mammals and crocodiles. Cutaneous respiration is present in annelids and amphibians. Single circulation is present in fishes. Incomplete double circulation is present in amphibians and reptiles and double circulation is present in crocodiles, birds and mammals.

171. Answer (1)

Hint: This tissue contains collagen fibres.

Sol.: The atrium and ventricle of the same side are separated by a thick fibrous tissue called atrio-ventricular septum. Both auricles are separated by a thin, muscular tissue called inter-atrial septum.

172. Answer (1)

Hint: Possess tuft of blood capillaries

Sol.: Each nephron consists of two parts glomerulus and renal tubule. Renal tubule is further differentiated into Bowman's capsule, PCT, loop of Henle and DCT. Collecting duct is neither a part of nephron nor a part of renal tubule but glomerulus is a part of nephron but not a part of renal tubule.

173. Answer (4)

Hint: This valve is formed by a contractile tissue.

Sol.: The tricuspid valve present between the opening of right atrium and right ventricle is formed by three muscular flaps/cusps whereas Mitral valve/bicuspid valve is formed by two muscular flaps. Heart valves are not formed by fibrous tissue.

174. Answer (1)

Hint: SAN is considered as pacemaker of the heart.

Sol.: SAN is situated in the right upper corner of the right atrium. AVN is situated in the lower left corner of the left atrium.

175. Answer (3)

Hint: Semilunar valves are present at the opening of blood vessels in ventricles.

Sol.: Semilunar valve – Aorta
Deoxygenated blood – Pulmonary artery
Size of clenched fist – Heart
Bean shaped structure – Kidney

176. Answer (3)

Hint: It is present in both cortex and medulla.

Sol.: The DCTs of many nephrons open into a straight tube called collecting duct, many of which converge and open into renal pelvis through medullary pyramids in the calyces. Vasa recta is a blood vessel. Loop of Henle is a part of nephron present in renal medulla. Invagination of cortex between medullary pyramids is called column of Bertini.

177. Answer (4)

Hint: The stage of cardiac cycle after ventricular systole.

Sol.: In each cardiac cycle, both auricles and ventricles are in a relaxed state during joint diastole. During joint diastole, AV valves remain open and semilunar valves become closed. The four chambers of heart are not in depolarised state during this phase but remain in a relaxed condition.

178. Answer (3)

Hint: Cardiac output = Heart rate × Stroke volume

Sol.: Duration of cardiac cycle = 1 second

So, heart rate = 60/1 = 60 min^{-1}

CO = HR × SV = 60 × 80 mL = 4800 mL = 4.8 L

179. Answer (4)

Hint: Right and left bundle branches are present in the region of inter-ventricular septum.

Sol.: AV bundle continues from the AVN which passes through the atrio-ventricular septa to emerge on the top of the inter-ventricular septum and immediately divides into a right and left bundle branch.

180. Answer (3)

Hint: Salts of calcium oxalate

Sol.: Renal calculi are stones or insoluble masses of crystalised salts of calcium oxalates formed within the kidney. Uremia is accumulation of urea in blood. Kidney transplantation is ultimate treatment of patients suffering from acute renal failure.

181. Answer (4)

Hint: Three leads are used to obtain a standard ECG.

Sol.: For a detailed evaluation of heart's function, multiple leads are attached to the chest region. To obtain a standard ECG, a patient is connected to the machine with three electrical leads, one to each wrist and one to the left ankle.

182. Answer (4)

Hint: The part of systemic circulation.

Sol.: The pulmonary circulation starts with right ventricle which pumps blood into the lungs through pulmonary artery and after oxygenation, blood returns to the left atrium through pulmonary veins. Left ventricle and right atrium are associated with systemic circulation.

183. Answer (4)

Hint: Fraction of blood filtered by each kidney is equal to the half of the fraction of blood filtered by both kidneys.

Sol.: Fraction of blood filtered by both kidneys

$$= \frac{\text{GFR}}{\text{Renal blood flow}} = \frac{125}{1250} = \frac{1}{10} = 0.1$$

So, fraction of blood filtered by each kidney

$$= \frac{0.1}{2} = 0.05 = \frac{5}{100} = \frac{1}{20} = 5\%$$

184. Answer (2)

Hint: Lumen of coronary artery becomes narrower.

Sol.: A symptom of acute chest pain is called angina. In heart failure, heart is not pumping blood effectively enough to meet the needs of the body. When heart muscle is suddenly damaged by an inadequate blood supply, it is called myocardial infarction.

185. Answer (2)

Hint: Vasa recta acts as counter current exchanger.

Sol.: NaCl and urea are mainly responsible for increasing osmolarity of medullary interstitium. NaCl is transported by the ascending limb of Henle's loop which is exchanged with descending limb of vasa recta and is returned to the interstitium by the ascending portion of vasa recta.

SECTION - B

186. Answer (2)

Hint: Contraction of heart muscle occurs just after depolarisation.

Sol.: The QRS complex represents depolarisation of ventricles, which initiates ventricular contraction.

The contraction starts shortly after Q and marks the beginning of the ventricular systole.

187. Answer (4)

Hint: Myocardium of the heart

Sol.: Coronary system of blood vessels include coronary arteries and veins. This system is present in our body exclusively for the circulation of blood to and from the cardiac musculature. Coronary blood vessels are a part of coronary system.

188. Answer (4)

Hint: Our heart is myogenic.

Sol.: Normal activities of heart are regulated intrinsically, *i.e.*, autoregulated by specialised muscles (nodal tissue), hence the heart is called myogenic. Sympathetic stimulation can increase the rate of heart beat, the strength of ventricular contraction and thereby the cardiac output. The effect of parasympathetic neural signals on heart is antagonistic to the effect of sympathetic neural signals.

189. Answer (3)

Hint: Exception is RBCs of camel

Sol.: RBCs are devoid of nucleus in most of the mammals including human beings, but nucleus is present in RBCs of members of family camelidae *e.g.* camel and llamma. Due to lack of nucleus and most of the cellular organelles in mammalian RBCs, all of their internal space is available for gaseous transport.

190. Answer (2)

Hint: Absorption of substances down their concentration gradient

Sol.: Glucose, amino acids, Na^+, *etc*. are reabsorbed actively whereas water, nitrogenous wastes, Cl^- and HCO_3^- are reabsorbed by passive transport without expenditure of energy. Nitrogenous wastes are absorbed by simple diffusion and water is reabsorbed by osmosis.

191. Answer (3)

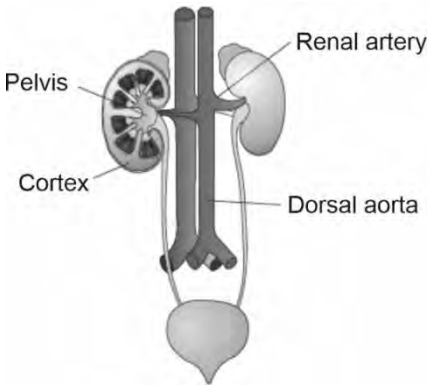
Hint: Molecules move passively from their higher concentration to lower concentration.

Sol.: Dialysing fluid has same chemical composition as that of plasma except the nitrogenous wastes. As nitrogenous wastes are absent in the dialysing fluid, these substances freely move out, thereby clearing the blood. So nitrogenous wastes move to dialysing fluid down their concentration gradient.

192. Answer (1)

Hint: Renal pelvis projects into calyces

Sol.:



193. Answer (4)

Hint: Kidney synthesises vitamin D_3 and erythropoietin.

Sol.: Kidney is responsible for transformation of inactive vitamin D_2 into its active form called calcitriol or vitamin D_3. Deficiency of this vitamin leads to reduced absorption of calcium ions from GIT. Due to low erythropoietin, RBC production is reduced. Blood glucose remains normal because concentration of dialysing fluid is nearly equal to blood glucose concentration. Nitrogenous wastes are not accumulated in blood as they diffuse out in dialysing fluid.

194. Answer (2)

Hint: It constitutes 90-92 per cent of plasma.

Sol.: Water is the most abundant chemical present in blood plasma which constitutes 90-92 per cent of plasma. Plasma proteins constitute only 6-8% per cent of plasma. Minerals and metabolites constitute only 1-2 per cent of plasma.

195. Answer (3)

Hint: In between per cent of basophils and monocytes

Sol.: Neutrophils – 60-65 % of total WBCs
Lymphocytes – 20-25 % of total WBCs
Eosinophils – 2-3 % of total WBCs
Basophils – 0.5-1 % of total WBCs
Monocytes – 6-8 % of total WBCs

196. Answer (1)

Hint: Incomplete double circulation

Sol.: In amphibians and reptiles, the left atrium receives oxygenated blood from gills / lungs / skin and the right atrium gets the deoxygenated blood from other body parts. However, they get mixed up in single ventricle which pumps out mixed blood.

197. Answer (2)

Hint: Maximum amount of urea is present in the vein which drains blood from liver.

Sol.: In mammals, hepatic vein carries maximum amount of urea as it drains blood from liver. Renal veins carry minimum amount of urea as they drain blood from kidneys. Endothelium of blood vessels remains in contact with blood which is considered as a fluid connective tissue.

198. Answer (2)

Hint: Projections of renal pelvis

Sol.: Kidney is divided into outer cortex and inner medulla. Inner to the hilum is a broad funnel shaped space called the renal pelvis with projections called calyces. The medulla is divided into few conical masses projecting into the calyces.

199. Answer (4)

Hint: Filtration takes place through slit pores.

Sol.: The glomerular capillary blood pressure causes filtration of blood through 3 layers, *i.e.*, the endothelium of glomerular blood vessels, the epithelium of Bowman's capsule and a basement membrane between these two layers.

200. Answer (2)

Hint: Increase in blood pressure increases GFR

Sol.: Fall in GFR can activate JG cells to release renin. Rennin is a proteolytic enzyme synthesised from gastric mucosa. Renin-angiotensin mechanism increases blood pressure and thus increases GFR. ANF is antagonistic to renin, aldosterone and vasopressin.

❑ ❑ ❑

All India Aakash Test Series for NEET-2025

TEST - 3 (Code-D)

Test Date : 10/12/2023

ANSWERS

1. (4)	41. (1)	81. (2)	121. (3)	161. (2)
2. (1)	42. (1)	82. (3)	122. (2)	162. (2)
3. (2)	43. (1)	83. (2)	123. (3)	163. (4)
4. (3)	44. (2)	84. (3)	124. (1)	164. (4)
5. (3)	45. (3)	85. (2)	125. (4)	165. (4)
6. (2)	46. (2)	86. (3)	126. (3)	166. (3)
7. (3)	47. (3)	87. (2)	127. (3)	167. (4)
8. (3)	48. (1)	88. (2)	128. (1)	168. (3)
9. (3)	49. (1)	89. (4)	129. (2)	169. (4)
10. (2)	50. (4)	90. (2)	130. (2)	170. (3)
11. (1)	51. (3)	91. (4)	131. (3)	171. (3)
12. (2)	52. (1)	92. (4)	132. (1)	172. (1)
13. (2)	53. (3)	93. (4)	133. (2)	173. (4)
14. (2)	54. (1)	94. (2)	134. (4)	174. (1)
15. (3)	55. (4)	95. (1)	135. (3)	175. (1)
16. (3)	56. (2)	96. (4)	136. (1)	176. (4)
17. (4)	57. (4)	97. (3)	137. (3)	177. (4)
18. (2)	58. (3)	98. (2)	138. (2)	178. (3)
19. (2)	59. (1)	99. (1)	139. (2)	179. (2)
20. (2)	60. (3)	100. (2)	140. (2)	180. (1)
21. (3)	61. (2)	101. (4)	141. (3)	181. (2)
22. (3)	62. (2)	102. (2)	142. (3)	182. (2)
23. (1)	63. (4)	103. (2)	143. (1)	183. (4)
24. (3)	64. (4)	104. (3)	144. (2)	184. (4)
25. (2)	65. (3)	105. (4)	145. (2)	185. (3)
26. (1)	66. (1)	106. (2)	146. (4)	186. (2)
27. (1)	67. (2)	107. (3)	147. (3)	187. (4)
28. (3)	68. (3)	108. (2)	148. (3)	188. (2)
29. (4)	69. (3)	109. (4)	149. (3)	189. (2)
30. (1)	70. (1)	110. (3)	150. (2)	190. (1)
31. (1)	71. (1)	111. (4)	151. (2)	191. (3)
32. (1)	72. (3)	112. (2)	152. (3)	192. (2)
33. (2)	73. (1)	113. (1)	153. (3)	193. (4)
34. (2)	74. (1)	114. (2)	154. (1)	194. (1)
35. (3)	75. (2)	115. (1)	155. (4)	195. (3)
36. (2)	76. (4)	116. (3)	156. (3)	196. (2)
37. (1)	77. (4)	117. (3)	157. (2)	197. (3)
38. (3)	78. (2)	118. (4)	158. (2)	198. (4)
39. (4)	79. (1)	119. (4)	159. (4)	199. (4)
40. (1)	80. (1)	120. (4)	160. (1)	200. (2)

HINTS & SOLUTIONS

[PHYSICS]

SECTION - A

1. Answer (4)

Hint & Sol.: A scalar quantity only has magnitude and no direction.

Example → Distance, speed, mass, work, etc.

2. Answer (1)

Hint: $\vec{F} = m\vec{a}$

Sol.: $\vec{a} = 0$, as $\vec{v} = \text{constant}$

$\therefore \vec{F}_{net} = 0$

3. Answer (2)

Hint: Vector sum of all forces acting on object is zero.

Sol.: $\vec{a} = 0$

$s = ut + \frac{1}{2}at^2$

s = 16 m

4. Answer (3)

Hint & Sol.: In case of collision of the fly with the windshield of a fast-moving bus, the fly and the bus would have exerted and experienced identical impact force, because according to the third law of motion, every action has an equal and opposite reaction.

5. Answer (3)

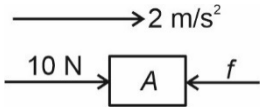
Hint: $\vec{F}_{net} = m\vec{a}$

Sol.: Net acceleration of system:

$10 = 5a$

$a = 2$ m/s^2

FBD of block A



$F_{net} = ma$

$a = 2$ m/s^2

$10 - f = 2 \times 2$

$f = 6$ N

6. Answer (2)

Hint: Work done by a constant force $W = \vec{F} \cdot \vec{s}$

Sol.: $W = 20 \times 5 \times \cos 0°$

$W = 100$ J

7. Answer (3)

Hint & Sol.: Work done by a conservative force is path independent it depends only on initial and find position.

8. Answer (3)

Hint: Work done by a constant force $W = \vec{F} \cdot \vec{s}$

Sol.: $\vec{s} = (5\hat{i} - 3\hat{j} - 6\hat{k}) - (2\hat{i} + 7\hat{j} - 3\hat{k})$

$= (3\hat{i} - 10\hat{j} - 3\hat{k})$

$\vec{F} = 20\hat{i} - 30\hat{j} + 15\hat{k}$

Now, $W = \vec{F} \cdot \vec{s}$ = 60 + 300 – 45

= 315 J

9. Answer (3)

Hint: Work done by a variable force $W = \int \vec{F} \cdot d\vec{s}$

Sol.: $dW = x\,dx + y^2\,dy$

$W = \int dW = \int_1^{-3} x\,dx + \int_2^4 y^2\,dy$

$= \left[\frac{x^2}{2}\right]_1^{-3} + \left[\frac{y^3}{3}\right]_2^4$

$= \frac{68}{3}$ J

10. Answer (2)

Hint: Work done = Area under F-x curve

Sol.: $W = 10 \times 2 + \frac{1}{2}(10)(4-2) + 0 + \frac{1}{2}(-5)(8-6)$

= 25 J

11. Answer (1)

Hint & Sol.: As the length of the string remains constant

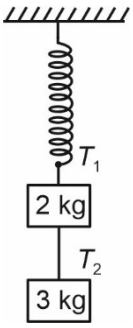
Hence, $v_1 - v_2 \sin\theta = 0$

$\Rightarrow \quad v_1 = v_2 \sin\theta \Rightarrow v_2 = \frac{v_1}{\sin\theta}$

12. Answer (2)

Hint & Sol.: Initially:- $T_1 = 5g = 50$ N

$T_2 = 3g = 30$ N



Finally :- $T_2 = 0$

For 2 kg block; $T_1 - 2g = 2a$

$50 - 20 = 2a$

$a = 15$ m/s^2 upwards

13. Answer (2)

Hint: Tension in the rope should not exceed its breaking strength

Sol.: $T - mg = ma$

$T = m(g + a)$

$250 = 20(10 + a)$

$a = 2.5$ m/s^2

14. Answer (2)

Hint: Use equations of uniformly accelerated motion

Sol.: $a = \mu_k g$ and $2as = u^2 - v^2$, where $u = 0$

$$\Rightarrow s = \frac{v^2}{2\mu_k g}$$

15. Answer (3)

Hint: Force imparted to wall $F = \frac{\Delta p}{\Delta t}$

Sol.: $$\frac{\Delta p}{\Delta t} = \frac{2nmv}{t}$$

$F = 300$ N

16. Answer (3)

Hint: Thrust force on rocket

$$\vec{F}_{\text{thrust}} = -\vec{v}_{\text{rel}} \cdot \frac{dm}{dt}$$

Sol.: $$v\frac{dm}{dt} = mg$$

$$\frac{dm}{dt} = \frac{mg}{v} = 600\ \frac{\text{kg}}{\text{s}}$$

17. Answer (4)

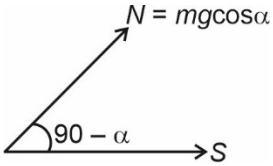
Hint & Sol.: Area under F-t curve with time axis gives change in momentum or impulse.

18. Answer (2)

Hint: Work done $W = \vec{F} \cdot \vec{S} = FS\cos\theta$

Sol.: Block is moving in horizontal direction and

Work done = $N.S\cos\alpha$



$= mg\cos\alpha \cdot vt \cdot \cos(90 - \alpha)$

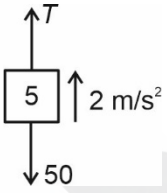
$$= \frac{mgvt\sin 2\alpha}{2}$$

19. Answer (2)

Hint: $F_{\text{net}} = ma$

$W = \vec{F} \cdot \vec{S}$

Sol.: *FBD* of block



$\Rightarrow T - 50 = 5 \times 2 \Rightarrow T = 60$

Now, $S = \frac{1}{2} \times 2 \times (2)^2 = 4$ m

Work done = $FS\cos\theta = 60 \times 4 \times 1 = 240$ J

20. Answer (2)

Hint: Velocity of particle at lowest point under critical condition $v = \sqrt{5gR}$

Sol. Using energy conservation

$$\frac{1}{2}m \times 5gR = \frac{1}{2}mv^2 + mgR$$

$v^2 = 5gR - 2gR$

$v = \sqrt{3gR}$

21. Answer (3)

Hint: If the vectors are perpendicular then their dot product will be zero.

Sol. $(2\hat{i} + 3\hat{j} + 5\hat{k}) \cdot (4\hat{i} - 4\hat{j} + \alpha\hat{k}) = 0$

$\Rightarrow \quad 8 - 12 + 5\alpha = 0 \Rightarrow 5\alpha = 4 \Rightarrow \alpha = \frac{4}{5}$

22. Answer (3)

Hint & Sol.: $$\int_0^v v \cdot dv = \frac{P_0}{M_0}\int_0^t dt$$

$$v^2 = \frac{2P_0}{M_0}t$$

$$v = \sqrt{\frac{2P_0}{M_0}t}$$

23. Answer (1)

Hint: Power = $\frac{\text{Energy}}{\text{Time}}$

Sol.: $\frac{\Delta U_w}{t} = \frac{mgh}{t} = 54\times10^3\times10\times100$ J/H

$\frac{\Delta U_w}{t} = 54 \times 10^6$ J/H

Electrical power = $\frac{1}{3}\left(\frac{\Delta U}{\Delta t}\right)$

$= \frac{18\times10^6}{60\times60} = 5$ kW

24. Answer (3)

Hint: Applying conservation of mechanical energy $K_i + U_i = K_f + U_f$

Sol.: $0 + 2\times10\times100 = \frac{1}{2}\times2\times v^2 + 2\times10\times20$

v = 40 m/s

$R = v\sqrt{\frac{2h}{g}} = 40\sqrt{\frac{2\times20}{10}} = 80$ m

25. Answer (2)

Hint: & Sol.: Since the centripetal force will always be perpendicular to the displacement of object, hence work done by centripetal force will always be zero.

26. Answer (1)

Hint: $W_{net} = \Delta$KE

Sol.: According to work-energy theorem

$W_{\text{all forces}} = \Delta$KE

$W_N + W_S + W_g = \frac{1}{2}m\left[v_f^2 - v_i^2\right]$

$0 + mgh + \frac{1}{2}K(0 - x_{max}^2) = 0 - 0$

$x_{max} = \sqrt{\frac{2mgh}{K}}$

27. Answer (1)

Hint: KE = $\frac{1}{2}mv^2$, $p = mv$

Sol.: $E' = E + 3E = 4E = 4\times\frac{1}{2}mv^2 = 2mv^2$

If v' is new velocity of body then;

$\frac{1}{2}mv'^2 = 2mv^2 \Rightarrow v' = 2v$

So, $p' = mv' = 2mv$

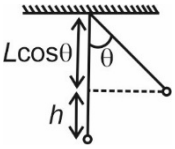
Percentage change in momentum

$= \frac{2mv - mv}{mv}\times100 = 100\%$

28. Answer (3)

Hint: Work done by gravity $W_g = mgh$

Sol.:



$h = L(1 - \cos\theta)$

$W_g = mgL(1 - \cos\theta)$

29. Answer (4)

Hint & Sol.: KE = $\frac{1}{2}mv^2$, $p = mv$

KE = $\frac{1}{2}mv^2\times\frac{m}{m} = \frac{p^2}{2m}$

30. Answer (1)

Hint: For a particle to be in equilibrium $\frac{d(U(x))}{dx} = 0$

Sol.: $\frac{d}{dx}\left(\frac{x^3}{3} - \frac{x^2}{2}\right) = 0$

$x^2 - x = 0$

$\Rightarrow x = 1$

31. Answer (1)

Hint: Average power $P_{avg} = \frac{\text{Total work done}}{\text{Time taken}}$

Sol.: $P_{avg} = \frac{mgh}{t} = \frac{200\times10\times20}{20} = 2$ kW

32. Answer (1)

Hint: $\vec{A}\cdot\vec{B} = AB\cos\theta$

Sol.: $\vec{A}\cdot\vec{B} = A\cdot B\cos\theta = A\cdot B\cos90^\circ = 0$

33. Answer (2)

Hint & Sol.: $W = mgh + W_{fr}$

$300 = 4 \times 10 \times 5 + W_{fr}$

$W_{fr} = 100$ J

34. Answer (2)

Hint: For equilibrium in any conservative field

$F = -\frac{dU}{dx} = 0$

Sol.: $F = -\frac{d}{dx}(ax^2 - bx) = (-2ax + b)$

$F = b - 2ax$

For equilibrium, $F = 0$

$b - 2ax = 0$

$x = \frac{b}{2a}$

35. Answer (3)

Hint: According to work-energy theorem $W_{net} = \Delta KE$

Sol.: $W_g + W_{res} = 0 - \frac{1}{2}mu^2$

$-mgh + W_{res} = -\frac{1}{2}mu^2$

$W_{res} = 0.06 \times 10 \times 26 - \frac{1}{2} \times 0.06 \times (24)^2$

= – 1.68 J

SECTION - B

36. Answer (2)

Hint & Sol.: When the particle is moving in a vertical circle the force acting towards the centre and along the tangent vary from point to point hence its radial and tangential accelerations varies.

37. Answer (1)

Hint: & Sol.:

Since the body is moving with constant velocity hence the net contact force by plane on block will be equal to *mg*.

38. Answer (3)

Hint: Use $\vec{F}_{Conservative} = \frac{-\partial U}{\partial x}\hat{i} - \frac{\partial U}{\partial y}\hat{j} - \frac{\partial U}{\partial z}\hat{k}$

Sol.: $\vec{F}_{Conservative}$

$= \frac{-\partial}{\partial x}(3x+4y)\hat{i} - \frac{\partial}{\partial y}(3x+4y)\hat{j} - \frac{\partial}{\partial z}(3x+4y)\hat{k}$

$\Rightarrow \vec{F}_{Conservative} = -3\hat{i} - 4\hat{j}$

$\Rightarrow \left|\vec{F}_{Conservative}\right| = 5$

$\Rightarrow |\vec{a}| = \frac{5}{m}$

39. Answer (4)

Hint: Instantaneous power $P = \vec{F} \cdot \vec{v}$

Sol.: $P = mav$ But $a = v\frac{dv}{dx}$

$v^2 dv = \frac{P}{m}dx$

$\int_u^v v^2\, dv = \int_0^x \frac{P}{m}dx$

$P = \frac{m(v^3 - u^3)}{3x}$

= 100 W

40. Answer (1)

Hint & Sol.: Elastic potential energy stored in spring $E = \frac{1}{2}Kx^2$

Hence the graph would be parabolic

41. Answer (1)

Hint & Sol.: If the displacement of point of application of force is zero then work done by force will be zero.

42. Answer (1)

Hint & Sol.: Coefficient of restitution $e = \frac{v_{sep}}{v_{app}}$

Since for perfectly inelastic collision, $v_{sep} = 0$
hence $e = 0$.

43. Answer (1)

Hint & Sol.: $h_2 = e^{(2n)}h_0$

$= (0.5)^4\, h_0$

= 0.625 m

44. Answer (2)

Hint: The minimum speed at the bottom must be $\sqrt{4gl}$ to complete the circle

Sol.: Using conservation of energy

$\frac{1}{2}mu^2 + mg\ell = \frac{1}{2}mv^2$

$u = \sqrt{2g\ell}$

45. Answer (3)

Hint: Work done equals the area under the force-displacement curve.

Sol.: Work done $= \frac{1}{2} \times 5 \times 10 = 25$ J

46. Answer (2)

Hint: Use $\vec{F} = \frac{d\vec{p}}{dt}$

Sol.: $F = \frac{dp}{dt} = 9t^2 + 4t$

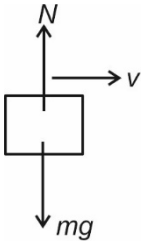
at t = 1 s

F = 13 N

47. Answer (3)

Hint: Use the concept of free body diagram.

Sol.:



$$N - mg = \frac{mv^2}{R}$$

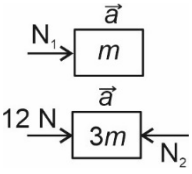
$$N = mg + \frac{mv^2}{R}$$

48. Answer (1)

Hint: Use Newton's second law of motion and concept of free body diagram.

Sol.: Acceleration a of system of 3 masses

$$= \frac{12}{6m} = \frac{2}{m} \text{ m/s}^2$$



$N_1 = 2$ N

$12 - N_2 = 3ma$

$N_2 = 6$ N

$$\frac{N_1}{N_2} = \frac{1}{3}$$

49. Answer (1)

Hint: $v_{max} = \sqrt{\mu Rg}$

Sol.: $v = \sqrt{1 \times 10 \times 10} = 10$ m/s

50. Answer (4)

Hint & Sol.: Since the applied force is less than the maximum value of static friction hence the acceleration of block would be zero.

[CHEMISTRY]

SECTION - A

51. Answer (3)

Hint & Sol.:

Digit	Name
1	un
4	quad

52. Answer (1)

Hint: s and p-block elements are known as representative elements.

Sol.:

- V and Ni belongs to d-block.
- Gd belongs to f-block while As belongs to p-block.

$\therefore$ As is a representative element

53. Answer (3)

Hint: NO is a neutral oxide

Sol.

Oxide	Nature
NO	Neutral
Na_2O	Basic
As_2O_3	Amphoteric
Cl_2O_7	Acidic

54. Answer (1)

Hint: $\Delta G = \Delta G° + RT \ln Q$ (Q is the reaction quotient)

Sol. The correct relation between $\Delta G°$ and equilibrium constant (K) is

$\Delta G = \Delta G° + RT \ln Q$

At equilibrium, $\Delta G = 0$ and $Q = K$

$0 = \Delta G° + RT \ln K$

$\Delta G° = -RT \ln K$

$\Delta G° = -2.303\ RT \log K$

55. Answer (4)

Hint: Isoelectronic species have same number of electrons. More is the effective nuclear charge, smaller is the size of ion.

Sol: More the number of protons, greater is the effective nuclear charge.

$\therefore$ Correct order of ionic size : $F^- > Na^+ > Mg^{2+}$

56. Answer (2)

Hint: $HCl + NaOH \rightarrow NaCl + H_2O$

During neutralisation of one mole of NaOH by one mole of HCl, the heat evolved = 57.1 kJ

Sol. Number of moles of HCl $= \frac{400 \times 0.1}{1000} = 0.04$

Number of moles of NaOH $= \frac{600 \times 0.1}{1000} = 0.06$

So, 0.04 moles of HCl are neutralised by 0.04 moles of NaOH.

Therefore, the total heat released = 0.04 × 57.1

= 2.28 kJ

57. Answer (4)

Hint: Noble gases have large positive electron gain enthalpies due to their stable electronic configurations.

Sol.:

Element	$\Delta_{eg}H$(kJ/mol)
Na	–53
Se	–195
Br	–325
Ne	+116

58. Answer (3)

Hint & Sol. : For a reaction to occur spontaneously ΔG must be less than zero.

So, $\Delta H - T\Delta S$ must be negative.

59. Answer (1)

Hint: Elements having similar outer electronic configurations in their atoms are arranged in vertical columns, called groups.

Sol: Outer electronic configuration of elements with Z = 11 and Z = 19 respectively are $3s^1$ and $4s^1$.

60. Answer (3)

Hint: The reference state of an element is its most stable state of aggregation at 25°C and 1 bar pressure.

Sol.: The standard molar enthalpy of formation of $H_2(g)$, $Cl_2(g)$ and C(graphite) is zero while the standard molar enthalpy of formation of $Br_2(g)$ is +30.91 kJ mol^{-1}. The $\Delta_fH°$ of $Br_2(l)$ = 0.

61. Answer (2)

Hint: Heat and work are path functions which depends on the path followed by system.

Sol.: ΔU, ΔS and ΔH are state functions which depends only on initial and final state of system.

62. Answer (2)

Hint: The standard heat of formation of $H_2(g)$ and $Cl_2(g)$ is zero.

Sol.: $H_2(g) + Cl_2(g) \rightleftharpoons 2HCl(g)$

$\Delta_fH^0(H_2) = 0, \Delta_fH^0(Cl_2) = 0$

$\Delta H = 2\Delta_fH^0(HCl) - \Delta_fH^0(H_2) - \Delta_fH^0(Cl_2)$

$-x = 2 \times \Delta_fH^0(HCl)$

$\Delta_fH^0(HCl) = -\frac{x}{2}$ kJ mol^{-1}

63. Answer (4)

Hint: & Sol.: Stability of product $\propto$ more negative heat of formation.

$\therefore$ Product with +300 kcal heat of formation is least stable.

64. Answer (4)

Hint: One mole of X_2 contains one mole of X – X bond.

Sol.: For the formation of 2 moles of X_2, total energy released is –900 kJ.

So, energy released for formation of one mole of X_2 is –450 kJ

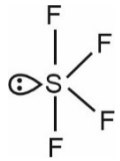
Bond dissociation energy of X – X bond is +450 kJ

$\therefore$ The correct answer is (4)

65. Answer (3)

Hint: If the central atom contains four bond pair and one lone pair then the species will be see-saw in shape.

Sol:



sp^3d hybridised and see-saw in shape.

66. Answer (1)

Hint: If excess bonding electrons are present in pi molecular orbital then π bonds are formed.

Sol: In C_2 and B_2, presence of four excess electrons and two electrons respectively in two pi molecular orbitals result in π bond formation in each species.

67. Answer (2)

Hint: The standard enthalpy change for the formation of one mole of compound from its elements in their most stable states of aggregation is called enthalpy of formation.

Sol.: The reference state of bromine is Br_2 liquid and those of fluorine is F_2 gas.

So, BrF_3 is formed from $Br_2(l)$ and $F_2(g)$ in standard state.

$$\frac{1}{2}Br_2(l) + \frac{3}{2}F_2(g) \longrightarrow BrF_3(g)$$

$\therefore$ Correct answer is (2)

68. Answer (3)

Hint For a mole of an ideal gas, $\Delta H = \Delta U + R\Delta T$

Sol.: $\Delta H = C_p\Delta T$ and $\Delta U = C_v\Delta T$

$\Delta H = \Delta U + R\Delta T$

$C_p\Delta T = C_v\Delta T + R\Delta T$

$C_p = C_v + R$

$C_p - C_v = R$

69. Answer (3)

Hint: & Sol.:

- In a closed system, there is no exchange of matter, but exchange of energy is possible between system and surrounding.
- System + Surrounding = Universe

- In isolated system, there is no exchange of energy or matter between system and surrounding

∴ Correct answer is (3)

70. Answer (1)

Hint: According to first law of thermodynamics $\Delta U = q + w$

Sol.: Heat given by system (q) = –40 J

Work done by system (w) = –60 J

$\Delta U = q + w$

$\Delta U = -40 - 60$

$\Delta U = -100$ J

71. Answer (1)

Hint: Expansion of a gas in vacuum ($p_{ex} = 0$) is called free expansion.

Sol.: No work is done during free expansion of an ideal gas whether the process is reversible or irreversible.

So, $w = -p_{ext}\,\Delta V$

$w = 0$

72. Answer (3)

Hint: $w = -nRT\ \ln\frac{V_f}{V_i}$ [Reversible and isothermal]

Sol.: $V_1 = 2$ L, $V_2 = 20$ L

T = 300 K, n = 5 mol

$$w = -nRT\ \ln\frac{V_f}{V_i}$$

$$w = -2.303nRT\ \log\frac{V_f}{V_i}$$

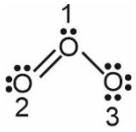
$$w = -2.303\times 5\times 8.314\times 300\ \log\frac{20}{2}$$

$w = -2.303 \times 5 \times 8.314 \times 300$

$w = -28.72$ kJ

73. Answer (1)

Hint & Sol.



- The central O atom marked 1

$$\text{Formal charge} = 6 - 2 - \frac{1}{2}(6) = +1$$

74. Answer (1)

Hint: Using Hess's Law of constant heat summation, ΔH of $C(s) + O_2(g) \rightarrow CO_2(g)$ can easily be calculated.

Sol.: $H_2O(g) + C(s) \rightarrow CO(g) + H_2(g)$, $\Delta H = +131$ kJ …(i)

$CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$, $\Delta H = -282$ kJ …(ii)

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g)$, $\Delta H = -242$ kJ …(iii)

$C(s) + O_2(g) \rightarrow CO_2(g)$, $\Delta H = ?$ …(iv)

On adding equation (i), (ii) and (iii), we get eq. (iv)

$\Delta H = (131 - 282 - 242)$ kJ = –393 kJ

75. Answer (2)

Hint: At equilibrium $\Delta G = 0$

So, $T = \frac{\Delta H}{\Delta S}$

Sol.: $\Delta G = \Delta H - T\Delta S$

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

$$T = \frac{\Delta H}{\Delta S} = \frac{31}{0.05} = 620\ K$$

$\Delta G = 0$ means the process is reversible in nature and it is the state of equilibrium.

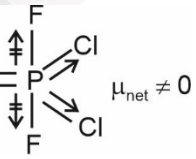
Below this T, ΔG will be positive.

Hence, it is non-spontaneous in nature.

76. Answer (4)

Hint: Molecule having non-zero dipole moment is polar in nature.

Sol.:



$\mu_{net} \neq 0$

∴ PF_3Cl_2 is a polar molecule.

77. Answer (4)

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

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

Sol.: $\Delta H = \Delta U + \Delta n_g RT$

$\Delta n_g = 2$, $R = 2$ cal K^{-1} mol^{-1}, T = 300 K

$\Delta H = (2.1 \times 10^3) + (2 \times 2 \times 300)$

$\Delta H = (2.1 \times 10^3) + (1.2 \times 10^3)$

$\Delta H = 3.3 \times 10^3$ cal = 3.3 k cal

$\Delta G = 3.3 - (300 \times 20) \times 10^{-3}$

$= 3.3 - 6$

$\Delta G = -2.7$ k cal

78. Answer (2)

Hint: The lone pair (lp) electrons in a molecule occupy more space as compared to bonding pair (bp) of electrons.

Sol. There is greater repulsion between lone pair of electrons as compared to lone pair-bond pair and bond pair – bond pair repulsions.

The correct order of repulsive interactions is lp – lp > lp – bp > bp – bp

79. Answer (1)

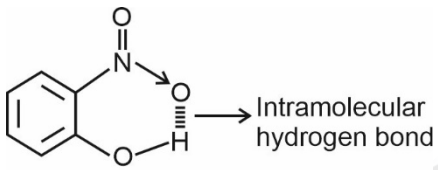
Hint: As the randomness decreases, entropy also decreases.

Sol.: During condensation of steam, randomness of water molecules decreases hence entropy change is negative.

80. Answer (1)

Hint: Intramolecular hydrogen bond is formed when hydrogen atom is in between the two highly electronegative (F, O, N) atoms present within the same molecule.

Sol:



o-Nitrophenol

81. Answer (2)

Hint: Bond order $= \frac{1}{2}[N_b - N_a]$

Where, N_b and N_a are number of electrons occupying bonding and antibonding orbitals respectively.

Sol.:

- E.C of O_2 molecule: $(\sigma 1s)^2(\sigma^* 1s)^2(\sigma 2s)^2$ $(\sigma^* 2s)^2(\sigma 2p_z)^2 \left(\pi 2p_x^2 = \pi 2p_y^2\right)\left(\pi^* 2p_x^1 = \pi^* 2p_y^1\right)$

Bond order $= \frac{1}{2}[10 - 6] = 2$

- E.C of O_2^- ion: $(\sigma 1s)^2(\sigma^* 1s)^2(\sigma 2s)^2(\sigma^* 2s)^2(\sigma 2p_z)^2$ $\left(\pi 2p_x^2 = \pi 2p_y^2\right)\left(\pi^* 2p_x^2 = \pi^* 2p_y^1\right)$

Bond order $= \frac{1}{2}[10 - 7] = 1.5$

- E.C of O_2^+ ion: $(\sigma 1s)^2(\sigma^* 1s)^2(\sigma 2s)^2(\sigma^* 2s)^2(\sigma 2p_z)^2$ $\left(\pi 2p_x^2 = \pi 2p_y^2\right)\left(\pi^* 2p_x^1\right)$

Bond order $= \frac{1}{2}[10 - 5] = 2.5$

- E.C of O_2^{2-} ion: $(\sigma 1s)^2(\sigma^* 1s)^2(\sigma 2s)^2(\sigma^* 2s)^2(\sigma 2pz)^2$ $\left(\pi 2p_x^2 \equiv \pi 2p_y^2\right)\left(\pi^* 2p_x^2 \equiv \pi^* 2p_y^2\right)$

Bond order $= \frac{1}{2}[10 - 8] = 1$

$\therefore$ O_2^+ has highest bond order *i.e.*, equal to 2.5.

82. Answer (3)

Hint & Sol.: $C + O_2 \rightarrow CO_2$

Mole of $CO_2 = \frac{22}{44} = 0.5$

Mole of carbon reacted = 0.5

Energy released = 394 × 0.5 = 197 kJ

83. Answer (2)

Hint: The standard enthalpy of combustion is defined as the enthalpy change per mole of a substance when it undergo combustion and all reactants and products being in their standard states at the specified temperature.

Sol.

$$H_2 + \frac{1}{2}O_2 \longrightarrow H_2O,\ \Delta_C H = -x\ kJ/mol \quad \ldots(i)$$

$$C_6H_{10} + \frac{17}{2}O_2 \longrightarrow 6CO_2 + 5H_2O,\ \Delta_C H = -y\ kJ/mol \quad \ldots(ii)$$

$$C_6H_{12} + 9O_2(g) \longrightarrow 6CO_2(g) + 6H_2O(l),\ \Delta_C H = -z\ kJ/mol \quad \ldots(iii)$$

Add equations (i) and (ii) and subtract equation (iii)

$C_6H_{10}(l) + H_2(g) \rightarrow C_6H_{12}(l)$

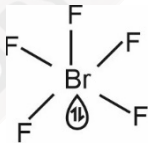
$\Delta H = (-x-y+z)$ kJ/mol

$\therefore$ Correct answer is (2)

84. Answer (3)

Hint: BrF_5 molecule has 5 bonding pair of electrons and one lone pair of electrons.

Sol. Hybridisation of 'Br' in BrF_5 molecule is sp^3d^2 and shape is square pyramidal.



85. Answer (2)

Hint: The species which contains odd number of electron in it is called odd electron molecule.

Sol. NO_2 is an odd-electron molecule having odd number of electron in nitrogen atom.

$:\ddot{O} = \overset{+}{N} - \ddot{O}:$

SECTION - B

86. Answer (3)

Hint: $\Delta_r H° = \Sigma$ bond enthalpies (reactants) – Σ bond enthalpies (product)

Sol.: $\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \rightarrow HCl(g)$

$$\Delta_r H° = \left(\frac{1}{2} \times 436 + \frac{1}{2} \times 243\right) - 430$$

= 218 + 121.5 – 430 = –90.5

87. Answer (2)

Hint: O_2 : $(\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\sigma 2p_z)^2$

$\left(\pi 2p_x^2 = \pi 2p_y^2\right)\left(\pi^* 2p_x^1 = \pi^* 2p_y^1\right)$

Sol.: The orbital containing electron which has highest energy is called highest occupied molecular orbital.

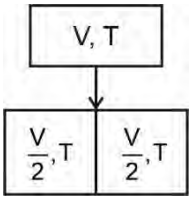
88. Answer (2)

Hint & Sol.: IUPAC official name of element with atomic number 106 is Seaborgium.

89. Answer (4)

Hint: An intensive property is the property whose value does not depend on the quantity present in the system.

Sol.: The value of temperature does not depend on amount of substance.



Temperature is an intensive property.

90. Answer (2)

Hint: In a period, more is the atomic number, more is effective nuclear charge.

Sol. More is the effective nuclear charge, smaller is the size of atom.

Correct order of atomic size.

Si > P > S > Cl

91. Answer (4)

Hint: & Sol.: When a system is in equilibrium, the entropy is maximum, and the change in entropy, $\Delta S = 0$

The total entropy change (ΔS_{total}) for spontaneous process is greater than zero.

92. Answer (4)

Hint: The process is adiabatic hence q = 0

Sol.: $w = -P\Delta V$

$= -4 (5.5 - 3.5)$

$= -4 \times 2 = -8$ L atm

$= -8 \times 101.3 = -810.4$ J

From first law, we can write

$\Delta U = q + w$

$\Delta U = -810.4$ J

93. Answer (4)

Hint: For an isothermal process, $\Delta T = 0$

Sol.: $\Delta U = q + w$ [First law of thermodynamics]

For an isothermal expansion of gas,

$\Delta T = 0$, w = –ve

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

$0 = q + w$

$\boxed{w = -q}$

$\therefore$ Work done by the gas is equal to the heat supplied to the gas.

94. Answer (2)

Hint: The central metal atom which contains vacant d-orbitals can form $p\pi$ and $d\pi$ overlap with oxygen atom.

Sol.: O = C = O

In CO_2 molecule, 'C' atom is *sp* hybridised.

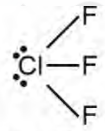
Hence, there are two $p\pi - p\pi$ bonds present.

While, in SO_4^{2-}, SO_3 and SO_2 there is $p\pi - d\pi$ overlap.

95. Answer (1)

Hint: ClF_3 has T-shape which is distorted

Sol.:



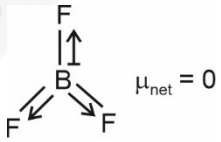
Bent T-shaped

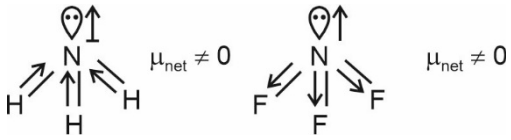
In ClF_3, there is no 90° bond angle

96. Answer (4)

Hint: Dipole moment (μ) is a vector quantity and its value depends on shape and bond moment of the molecule.

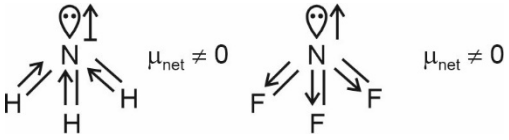
Sol.:





In case of NH_3, the orbital dipole is due to lone pair is in the same direction as the resultant dipole of N – H bonds.

$\therefore$ Dipole moment of NH_3 is greater than NF_3 molecule



$\mu_{H_2O} > \mu_{NH_3}$

So, the correct order of dipole moment is

$\boxed{\mu_{H_2O} > \mu_{NH_3} > \mu_{NF_3} > \mu_{BF_3}}$

97. Answer (3)

Hint: Greater the value of ionisation enthalpy, lesser is the tendency to remove the electrons.

Sol.: Removal of fourth electron is difficult, hence the metal shows +3 oxidation state.

The formula of the metal chloride is MCl_3.

98. Answer (2)

Hint & Sol.:

Half-filled and fully-filled subshells have greater stability.

$\therefore$ [Ne]$3s^2 3p^3$ has half filled configuration, so ionisation energy is highest.

99. Answer (1)

Hint: Heat or reaction at constant pressure = ΔH

Heat of reaction of constant volume = ΔU

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

Sol.: $\Delta H = \Delta U + \Delta n_g RT$

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

$2C_6H_6(l) + 15O_2(g) \rightarrow 12CO_2(g) + 6H_2O(l)$

$\Delta n_g = 12 - 15 = -3$

$T = 273 + 27 = 300$ K

$\Delta H - \Delta U = -3 \times 300 \times 8.314$

$= -900 \times 8.314 = -7.48$ kJ

100. Answer (2)

Hint: More is the negative electron gain enthalpy, greater is the electron affinity of the element.

Sol.:

Element	**$\Delta_{eg}H$ (kJ mol^{-1})**
F	–328
Cl	–349
Br	–325
I	–295

[BOTANY]

SECTION - A

101. Answer (4)

Hint: When stamens are united into one bunch or one bundle, then it is monoadelphous condition.

Sol.: Monoadelphous stamens are found in china rose.

Diadelphous stamens are found in pea and polyadelphous stamens are found in *Citrus*.

102. Answer (2)

Hint: Intercalary meristems appear early in life of a plant and contribute to the formation of the primary plant body.

Sol.: Intercalary meristem is not only found in grasses but in other plants also.

103. Answer (2)

Hint: When a flower can be divided into two equal halves in any radial plane passing through the centre. It is said to be actinomorphic.

Sol.: Mustard, *Datura*, chilli, etc. have actinomorphic flowers. *Cassia*, pea and bean have zygomorphic flowers.

104. Answer (3)

Hint: Vascular cambium produces vascular tissues during secondary growth.

Sol.: Vascular cambium produces secondary xylem and secondary phloem in dicot stems during secondary growth.

105. Answer (4)

Hint: Stem tendrils are found in cucumber and pumpkin.

Sol.: Axillary buds form slender and spirally coiled tendrils in cucumber and pumpkin.

106. Answer (2)

Hint: Root and shoot apices have apical meristems which are primary meristematic tissue.

Sol.: Cork or phellem is redifferentiated tissue. Phellogen or cork cambium is dedifferentiated tissue.

Primary xylem is primary permanent tissue.

107. Answer (3)

Hint: When the primary root is short lived and is replaced by a large number of roots which originate from the base of the stem, then they constitute fibrous root system.

Sol.: Fibrous root system is a characteristic feature of monocots. Wheat is a monocot plant while mustard plant, mango tree and banyan tree are dicots.

108. Answer (2)

Hint: In epigynous flowers, the margin of thalamus grows upward enclosing the ovary completely and getting fused with it, the other parts of flowers arise above the ovary and hence, the ovary is said to be inferior.

Sol.: Ovary is inferior in flowers of guava, cucumber and the ray florets of sunflower. Superior ovary is seen in china rose.

109. Answer (4)

Hint: Vexillary aestivation and marginal placentation are the characteristic features of Fabaceae family.

Sol.:

- *Allium cepa* (onion) and *Colchicum autumnale* (Colchicine) belong to family Liliaceae.
- *Solanum nigrum* (makoi) belongs to family Solanaceae.
- *Pisum sativum* (garden pea) belongs to family Fabaceae.

110. Answer (3)

Hint: These cells of the adaxial epidermis are found along the veins of grass leaves.

Sol.: Bulliform cells are large, empty, colourless cells of adaxial epidermis along the veins of grass leaves which help in its curling and help in minimising transpirational loss of water.

Lenticels help in gaseous exchange. Subsidiary cells are specialised epidermal cells surrounding the guard cells of stomata.

111. Answer (4)

Hint: Floral formula of family Fabaceae is $\% \, ♀♂ K_{(5)} C_{1+2+(2)} A_{(9)+1} \underline{G}_1$ and floral formula of family Solanaceae is $\oplus ♀♂ K_{(5)} \overset{\frown}{C_{(5)}} A_5 \underline{G}_{(2)}$.

Sol.: Floral formula of family Brassicaceae is $\oplus ♀♂ K_{2+2} C_4 A_{2+4} \underline{G}_{(2)}$ and floral formula of family Liliaceae is $Br \oplus ♀♂ \overset{\frown}{P_{(3+3)}} A_{3+3} \underline{G}_{(3)}$.

112. Answer (2)

Hint: Ashwagandha is medicinal plant of Solanaceae family (potato family) which is a dicotyledonous family.

Sol.: Fabaceae family was earlier called papilionoideae.

Sunhemp is a member of Fabaceae family.

113. Answer (1)

Hint: These cavities are found in vascular bundles which are scattered in ground tissue.

Sol.: Water containing cavities in vascular bundles is a characteristic feature of monocot stem.

114. Answer (2)

Hint: Many cells of this layer protrude to form unicellular root hairs.

Sol.: The outermost layer of sunflower root is epiblema.

- Cuticle is absent in roots.
- Endodermis is innermost layer of cortex.
- Pericycle is outermost layer of stele.

115. Answer (1)

Hint: Trichomes are the epidermal hairs on stem.

Sol.: Trichomes in the shoot system are usually multicellular.

116. Answer (3)

Hint: Phyllode is modified petiole.

Sol.:

- Thorns are found in *Bougainvillea*.
- Phyllodes are found in Australian *Acacia*.
- Offsets are found in *Pistia*.
- Corm is modified underground stem of *Colocasia*.

117. Answer (3)

Hint: Pattern of arrangement of leaves on the stem or branch is called phyllotaxy.

Sol.: If more than two leaves arise at a node, form a whorl, it is called whorled phyllotaxy.

118. Answer (4)

Hint: When stamens are attached to the perianth, they are epiphyllous.

Sol.: Epiphyllous stamens are found in flowers of lily. Flowers of brinjal show epipetalous stamens.

119. Answer (4)

Hint: This type of placentation is seen in *Dianthus* and *Primrose.*

Sol.: Placentation in which ovules are borne on central axis and septa are absent is free central placentation.

120. Answer (4)

Hint: Interfascicular cambium is secondary meristem formed between two adjacent vascular bundles during secondary growth in dicot stems.

Sol.: Dedifferentiation of parenchyma cells of medullary rays results in formation of interfascicular cambium in dicot stems.

121. Answer (3)

Hint: The peripheral region of the secondary xylem, is lighter in colour and involved in conduction of water and minerals from root to leaf.

Sol.: Heartwood is in the central or innermost region of secondary xylem.

122. Answer (2)

Hint: These structures are filled with secondary metabolites and act as tracheal plugs.

Sol.: The balloon shaped structures, which are extensions of xylem parenchyma cells into the vessels are known as tyloses.

123. Answer (3)

Hint: Vascular bundles in monocot stem are conjoint, collateral and are scattered in ground tissue.

Sol.: Vascular bundles in monocot stem are considered closed because cambium is absent.

124. Answer (1)

Hint: When the margins of sepals or petals overlap one another without any particular direction, this is termed as imbricate aestivation.

Sol.: Imbricate aestivation is seen in flowers of gulmohur.

- Flowers of *Calotropis* show valvate aestivation.
- Flowers of lady's finger show twisted aestivation.
- Bean flowers show vexillary aestivation.

125. Answer (4)

Hint: The calyx may be gamosepalous or polysepalous.

Sol.: When sepals are united it is termed as gamosepalous.

Gamopetalous term is used for fused petals.

126. Answer (3)

Hint: Roots lack nodes, internodes and buds.

Sol.: Sweet potato is a modified edible root. Potato, *Colocasia* and zaminkand are modified edible underground stems.

127. Answer (3)

Hint: In the seeds of cereals the seed coat is membranous.

Sol.: In the seeds of cereals such as maize, seed coat is fused with fruit wall.

128. Answer (1)

Hint: Drupes develop from superior ovaries and are single seeded.

Sol.: In mango and coconut, fruits develop from monocarpellary superior ovaries.

129. Answer (2)

Hint: It is remnant of diploid tissue in the seed.

Sol.:
- Perisperm is persistent nucellus in the seed.
- Outer seed coat is testa.
- Hilum is the scar on the seed coat
- Micropyle is a small pore above hilum in the seed.

130. Answer (2)

Hint: Stomata are found in primary plant body

Sol.: Loose parenchyma cells rupturing the epidermis and forming a lens shaped opening in bark is lenticel.

131. Answer (3)

Hint: The presence of vessels is a characteristic feature of angiosperms.

Sol.: Gymnosperms lack vessels in their xylem.

132. Answer (1)

Hint: In pea and bean flowers, vexillary aestivation of petals is observed where the two smallest anterior petals are keel.

Sol.: Keel is the characteristic feature of the family Fabaceae.

133. Answer (2)

Hint: This part is middle layer of fruit wall.

Sol.: In mango, edible part is mesocarp (middle layer of pericarp) fleshy, juicy in nature.

134. Answer (4)

Hint: Collenchyma consists of cells which are much thickened at corners due to a deposition of cellulose, hemicellulose and pectin.

Sol.: Collenchyma is an elastic, living mechanical tissue, providing mechanical support, flexibility and elasticity to parts like petiole of leaf.

135. Answer (3)

Hint: In monocot stems, ground tissue is parenchymatous and not differentiated into layers.

Sol.: Endodermis is absent in monocot stems.

SECTION - B

136. Answer (1)

Hint: Stipules are small leaf like structures near leaf base.

Sol.: Bracts are reduced leaf found at the base of the pedicel.

137. Answer (3)

Hint: Hypodermis is absent in roots

Sol.: Monocot roots differ from dicot roots in having large and well developed pith.

138. Answer (2)

Hint: Tissues inner to endodermis include pericycle, vascular bundles and pith.

Sol.: All tissues on the innerside of the endodermis constitute stele.

139. Answer (2)

Hint: This component is a characteristic feature of angiosperms.

Sol.: Vessel is a long cylindrical tube like structure made up of many cells called vessel members, interconnected through perforations in their common walls.

140. Answer (2)

Hint: Parenchymatous cells have thin cell walls made up of cellulose and form the major components within organs of plants.

Sol.: The collenchyma occurs in layers below the epidermis in most of the dicotyledonous plants.

141. Answer (3)

Hint: Parenchyma performs functions like storage.

Sol.: Phloem parenchyma is absent in most of the monocots. The phloem parenchyma stores food material and other substances like resins, latex and mucilage.

142. Answer (3)

Hint: In palmately compound leaves, the leaflets are attached at a common point, *i.e.*, at the tip of petiole.

Sol.: Palmately compound leaf is found in silk cotton. Pinnately compound leaf is found in Neem. Mango and china rose have simple leaves.

143. Answer (1)

Hint: The protoxylem lies towards periphery and metaxylem lies towards the centre, such arrangement of primary xylem is called exarch.

Sol.: Exarch protoxylem is seen in roots.

Endarch protoxylem is seen in stems.

144. Answer (2)

Hint:
- ♂ is used for bisexual flower.
- Br is used for bracteate flower.

Sol.:
- % is used for zygomorphic flower.
- ⊕ is used for actinomorphic flower.

145. Answer (2)

Hint: Leaf tendrils are spirally coiled structures.

Sol.: Leaf tendrils help in climbing and supporting weak stems.
- Thorns provide defence against grazing herbivores.
- Leaves of certain insectivorous plant such as pitcher plant help in trapping insects.

146. Answer (4)

Hint: All leaves have axillary buds.

Sol.: A leaf is said to be simple, when its lamina is entire or when incised, the incisions do not touch the midrib, thus, not divided into leaflets.

147. Answer (3)

Hint: Prop roots arise from heavy branches to support tree trunk.

Sol.: The stems of maize and sugarcane have supporting roots coming out of the lower nodes of the stem. These are called stilt roots.

148. Answer (3)

Hint: It is seen in ovary with parietal placentation.

Sol.: Ovary is one-chambered but it becomes two-chambered due to the formation of the false septum. It is seen in mustard.

149. Answer (3)

Hint: In dicot stems, the cells of cambium present between primary xylem and primary phloem is the intrafascicular cambium.

Sol.: It is primary in origin that is, it is primary meristem but is involved in secondary growth that forms secondary permanent tissues. Thus, it is cylindrical or lateral meristem.

150. Answer (2)

Hint: When oldest flower is present at the top and youngest at the bottom, then it is basipetal order.

Sol.: In cymose type of inflorescence the main floral axis (peduncle) terminates in a flower, hence is limited in growth.

[ZOOLOGY]

SECTION - A

151. Answer (2)

Hint: The property of blood related with blood volume and blood pressure.

Sol.: Albumins help in maintaining osmotic balance of the body. Globulins are primarily involved in defence mechanisms of the body. Albumin is not a clotting factor and is present in serum.

152. Answer (3)

Hint: Animal with closed type of circulation

Sol.: Porifers (*Sycon*) and coelenterates (*Hydra* and *Obelia*), circulate water from their surroundings through their body cavities to facilitate the cells to exchange useful substances. Annelids (*Pheretima*) use special fluid called blood for this purpose.

153. Answer (3)

Hint: This fluid contains RBCs

Sol.: Blood is the most commonly used body fluid for circulation of various substances. Haemolymph is circulatory fluid in arthropods. Water is most abundant chemical in body of organisms but circulates in the body cavities of sponges and coelenterates. Lymph is also a circulating fluid in the body of complex animals but is not commonly used body fluid by most of the higher organisms.

154. Answer (1)

Hint: This limb is almost permeable to water.

Sol.: The glomerular filtrate gets concentrated as it moves down the descending limb of loop of Henle and gets diluted when it moves up the ascending limb of loop of Henle. Blood passes through ascending and descending limbs of vasa recta.

155. Answer (4)

Hint: The process of release of urine from urinary bladder.

Sol.: Urine formation involves three main processes, *i.e.,* filtration, reabsorption and secretion. Micturition is the process of release of urine and neural mechanism causing it is called micturition reflex.

156. Answer (3)

Hint: Fluid connective tissue

Sol.: Blood is a special connective tissue. Adipose and areolar tissues are included in loose connective tissues. Dense connective tissues include tendons, ligaments and dermis of skin.

157. Answer (2)

Hint: Bean-shaped organ

Sol.: Malfunctioning of kidneys leads to accumulation of urea in blood, a condition called uremia. Liver is involved in the synthesis of urea by urea cycle. Lungs are accessory excretory organs as they remove CO_2. Intestine is helpful in elimination of bile pigments.

158. Answer (2)

Hint: The cells which produce thrombocytes.

Sol.: Platelets/Thrombocytes are cell fragments produced by megakaryocytes. Erythrocytes and monocytes are cellular components of formed elements. Erythrocytes transport respiratory gases and monocytes participate in the process of phagocytosis.

159. Answer (4)

Hint: Mammalian heart is four-chambered.

Sol.: The sequential event in the heart which is cyclically repeated is called the cardiac cycle and it consists of systole and diastole of both the atria and ventricles. The duration of each cardiac cycle is 0.8 seconds in an adult man under normal conditions.

Cardiac cycle (0.8 sec) = Atrial systole (0.1 sec) + Ventricular systole (0.3 sec) + Joint diastole (0.4 sec)

160. Answer (1)

Hint: Kidneys are situated in thoraco-lumbar region of posterior region of abdominal cavity.

Sol.: Kidneys are reddish brown, bean shaped structures situated between the levels of last thoracic and third lumbar vertebra close to the dorsal inner wall of abdominal cavity.

161. Answer (2)

Hint: Vasa recta acts as counter current exchanger.

Sol.: NaCl and urea are mainly responsible for increasing osmolarity of medullary interstitium. NaCl is transported by the ascending limb of Henle's loop which is exchanged with descending limb of vasa recta and is returned to the interstitium by the ascending portion of vasa recta.

162. Answer (2)

Hint: Lumen of coronary artery becomes narrower.

Sol.: A symptom of acute chest pain is called angina. In heart failure, heart is not pumping blood effectively enough to meet the needs of the body. When heart muscle is suddenly damaged by an inadequate blood supply, it is called myocardial infarction.

163. Answer (4)

Hint: Fraction of blood filtered by each kidney is equal to the half of the fraction of blood filtered by both kidneys.

Sol.: Fraction of blood filtered by both kidneys

$$= \frac{\text{GFR}}{\text{Renal blood flow}} = \frac{125}{1250} = \frac{1}{10} = 0.1$$

So, fraction of blood filtered by each kidney

$$= \frac{0.1}{2} = 0.05 = \frac{5}{100} = \frac{1}{20} = 5\%$$

164. Answer (4)

Hint: The part of systemic circulation.

Sol.: The pulmonary circulation starts with right ventricle which pumps blood into the lungs through pulmonary artery and after oxygenation, blood returns to the left atrium through pulmonary veins. Left ventricle and right atrium are associated with systemic circulation.

165. Answer (4)

Hint: Three leads are used to obtain a standard ECG.

Sol.: For a detailed evaluation of heart's function, multiple leads are attached to the chest region. To obtain a standard ECG, a patient is connected to the machine with three electrical leads, one to each wrist and one to the left ankle.

166. Answer (3)

Hint: Salts of calcium oxalate

Sol.: Renal calculi are stones or insoluble masses of crystalised salts of calcium oxalates formed within the kidney. Uremia is accumulation of urea in blood. Kidney transplantation is ultimate treatment of patients suffering from acute renal failure.

167. Answer (4)

Hint: Right and left bundle branches are present in the region of inter-ventricular septum.

Sol.: AV bundle continues from the AVN which passes through the atrio-ventricular septa to emerge on the top of the inter-ventricular septum and immediately divides into a right and left bundle branch.

168. Answer (3)

Hint: Cardiac output = Heart rate × Stroke volume

Sol.: Duration of cardiac cycle = 1 second

So, heart rate = 60/1 = 60 min^{-1}

CO = HR × SV = 60 × 80 mL = 4800 mL = 4.8 L

169. Answer (4)

Hint: The stage of cardiac cycle after ventricular systole.

Sol.: In each cardiac cycle, both auricles and ventricles are in a relaxed state during joint diastole. During joint diastole, AV valves remain open and semilunar valves become closed. The four chambers of heart are not in depolarised state during this phase but remain in a relaxed condition.

170. Answer (3)

Hint: It is present in both cortex and medulla.

Sol.: The DCTs of many nephrons open into a straight tube called collecting duct, many of which converge and open into renal pelvis through medullary pyramids in the calyces. Vasa recta is a blood vessel. Loop of Henle is a part of nephron present in renal medulla. Invagination of cortex between medullary pyramids is called column of Bertini.

171. Answer (3)

Hint: Semilunar valves are present at the opening of blood vessels in ventricles.

Sol.: Semilunar valve – Aorta

Deoxygenated blood – Pulmonary artery

Size of clenched fist – Heart

Bean shaped structure – Kidney

172. Answer (1)

Hint: SAN is considered as pacemaker of the heart.

Sol.: SAN is situated in the right upper corner of the right atrium. AVN is situated in the lower left corner of the left atrium.

173. Answer (4)

Hint: This valve is formed by a contractile tissue.

Sol.: The tricuspid valve present between the opening of right atrium and right ventricle is formed by three muscular flaps/cusps whereas Mitral valve/bicuspid valve is formed by two muscular flaps. Heart valves are not formed by fibrous tissue.

174. Answer (1)

Hint: Possess tuft of blood capillaries

Sol.: Each nephron consists of two parts glomerulus and renal tubule. Renal tubule is further differentiated into Bowman's capsule, PCT, loop of Henle and DCT. Collecting duct is neither a part of nephron nor a part of renal tubule but glomerulus is a part of nephron but not a part of renal tubule.

175. Answer (1)

Hint: This tissue contains collagen fibres.

Sol.: The atrium and ventricle of the same side are separated by a thick fibrous tissue called atrio-ventricular septum. Both auricles are separated by a thin, muscular tissue called inter-atrial septum.

176. Answer (4)

Hint: Performs pumping of blood in arterial system

Sol.: All vertebrates possess a muscular chambered heart. It is two-chambered in fishes, 3-chambered in amphibians and reptiles except crocodiles and four chambered in birds, mammals and crocodiles. Cutaneous respiration is present in annelids and amphibians. Single circulation is present in fishes. Incomplete double circulation is present in amphibians and reptiles and double circulation is present in crocodiles, birds and mammals.

177. Answer (4)

Hint: Ions are filtered out passively through capillary pores.

Sol.: Tissue fluid does not contain large plasma proteins. The fluid released out from capillaries is called tissue fluid. Exchange of nutrients, gases, *etc.* always takes place between the blood and body cells through tissue fluid.

It has same mineral distribution as that in plasma.

178. Answer (3)

Hint: Synthesized from ammonia and CO_2

Sol.: Uric acid is excreted by birds, reptiles and land snails. Hydrocarbons, sterols and waxes are present in sebum. Sweat contains NaCl, small amounts of urea, lactic acid, *etc.*

179. Answer (2)

Hint: Characterised by jointed appendages

Sol.: Arthropods, hemichordates, urochordates and molluscs possess open circulatory system whereas, annelids, certain molluscs and chordates have closed circulatory system, except urochordates.

180. Answer (1)

Hint: It is protected by pericardium.

Sol.: Heart, the mesodermally derived organ is situated in the thoracic cavity, in between the two lungs, slightly tilted to the left. Thymus and liver are endodermally derived organs. Kidneys are situated close to the dorsal inner wall of abdominal cavity.

181. Answer (2)

Hint: Prothrombin is an inactive protein.

Sol.: Coagulum / clot is formed by a network of fibrins in which dead cells of blood are trapped. Prothrombin is an inactive protein which is activated by enzyme thrombokinase complex into thrombin that is responsible for conversion of fibrinogens into fibrins.

182. Answer (2)

Hint: Ammonia is the most toxic nitrogenous waste.

Sol.: Ammonia is the most toxic form and requires large amount of water for its elimination, whereas uric acid, being the least toxic, can be removed with a minimum loss of water. Urea is less toxic than ammonia and more toxic than uric acid and requires a moderate amount of water for its elimination.

183. Answer (4)

Hint: Antibodies are produced in mother against Rh antigen.

Sol.: Rh incompatibility occurs when a pregnant mother is Rh –ve and foetus is Rh +ve. In such cases, the antibodies are produced in mother against Rh factor and leaks into foetal circulation through placental barriers. This may cause anaemia, jaundice or could be fatal to the foetus. This condition is called erythroblastosis foetalis.

184. Answer (4)

Hint: Individuals without Anti-A antibodies in their plasma.

Sol.: Blood group 'O' due to absence of antigens on RBCs can be donated to persons with any other blood group and hence 'O' group individuals are called universal donors. Persons with 'AB' group can accept blood from persons with any other blood group due to lack of antibodies in their blood plasma. Therefore, such persons are called universal recipients.

185. Answer (3)

Hint: Largest blood cell

Sol.: Monocytes are largest among all formed elements.

WBCs		Per cent of total WBCs
Monocytes	–	6-8
Neutrophils	–	60-65
Eosinophils	–	2-3
Lymphocytes	–	20-25

SECTION - B

186. Answer (2)

Hint: Increase in blood pressure increases GFR

Sol.: Fall in GFR can activate JG cells to release renin. Rennin is a proteolytic enzyme synthesised from gastric mucosa. Renin-angiotensin mechanism increases blood pressure and thus increases GFR. ANF is antagonistic to renin, aldosterone and vasopressin.

187. Answer (4)

Hint: Filtration takes place through slit pores.

Sol.: The glomerular capillary blood pressure causes filtration of blood through 3 layers, *i.e.*, the endothelium of glomerular blood vessels, the epithelium of Bowman's capsule and a basement membrane between these two layers.

188. Answer (2)

Hint: Projections of renal pelvis

Sol.: Kidney is divided into outer cortex and inner medulla. Inner to the hilum is a broad funnel shaped space called the renal pelvis with projections called calyces. The medulla is divided into few conical masses projecting into the calyces.

189. Answer (2)

Hint: Maximum amount of urea is present in the vein which drains blood from liver.

Sol.: In mammals, hepatic vein carries maximum amount of urea as it drains blood from liver. Renal veins carry minimum amount of urea as they drain blood from kidneys. Endothelium of blood vessels remains in contact with blood which is considered as a fluid connective tissue.

190. Answer (1)

Hint: Incomplete double circulation

Sol.: In amphibians and reptiles, the left atrium receives oxygenated blood from gills / lungs / skin and the right atrium gets the deoxygenated blood from other body parts. However, they get mixed up in single ventricle which pumps out mixed blood.

191. Answer (3)

Hint: In between per cent of basophils and monocytes

Sol.: Neutrophils – 60-65 % of total WBCs
Lymphocytes – 20-25 % of total WBCs
Eosinophils – 2-3 % of total WBCs
Basophils – 0.5-1 % of total WBCs
Monocytes – 6-8 % of total WBCs

192. Answer (2)

Hint: It constitutes 90-92 per cent of plasma.

Sol.: Water is the most abundant chemical present in blood plasma which constitutes 90-92 per cent of plasma. Plasma proteins constitute only 6-8% per cent of plasma. Minerals and metabolites constitute only 1-2 per cent of plasma.

193. Answer (4)

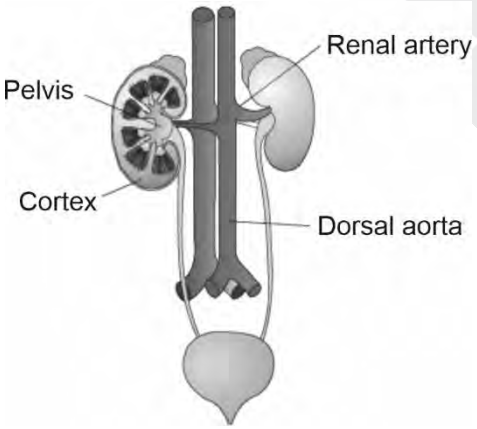
Hint: Kidney synthesises vitamin D_3 and erythropoietin.

Sol.: Kidney is responsible for transformation of inactive vitamin D_2 into its active form called calcitriol or vitamin D_3. Deficiency of this vitamin leads to reduced absorption of calcium ions from GIT. Due to low erythropoietin, RBC production is reduced. Blood glucose remains normal because concentration of dialysing fluid is nearly equal to blood glucose concentration. Nitrogenous wastes are not accumulated in blood as they diffuse out in dialysing fluid.

194. Answer (1)

Hint: Renal pelvis projects into calyces

Sol.:



195. Answer (3)

Hint: Molecules move passively from their higher concentration to lower concentration.

Sol.: Dialysing fluid has same chemical composition as that of plasma except the nitrogenous wastes. As nitrogenous wastes are absent in the dialysing fluid, these substances freely move out, thereby clearing the blood. So nitrogenous wastes move to dialysing fluid down their concentration gradient.

196. Answer (2)

Hint: Absorption of substances down their concentration gradient

Sol.: Glucose, amino acids, Na^+, *etc*. are reabsorbed actively whereas water, nitrogenous wastes, Cl^- and HCO_3^- are reabsorbed by passive transport without expenditure of energy. Nitrogenous wastes are absorbed by simple diffusion and water is reabsorbed by osmosis.

197. Answer (3)

Hint: Exception is RBCs of camel

Sol.: RBCs are devoid of nucleus in most of the mammals including human beings, but nucleus is present in RBCs of members of family camelidae *e.g.* camel and llamma. Due to lack of nucleus and most of the cellular organelles in mammalian RBCs, all of their internal space is available for gaseous transport.

198. Answer (4)

Hint: Our heart is myogenic.

Sol.: Normal activities of heart are regulated intrinsically, *i.e.*, autoregulated by specialised muscles (nodal tissue), hence the heart is called myogenic. Sympathetic stimulation can increase the rate of heart beat, the strength of ventricular contraction and thereby the cardiac output. The effect of parasympathetic neural signals on heart is antagonistic to the effect of sympathetic neural signals.

199. Answer (4)

Hint: Myocardium of the heart

Sol.: Coronary system of blood vessels include coronary arteries and veins. This system is present in our body exclusively for the circulation of blood to and from the cardiac musculature. Coronary blood vessels are a part of coronary system.

200. Answer (2)

Hint: Contraction of heart muscle occurs just after depolarisation.

Sol.: The QRS complex represents depolarisation of ventricles, which initiates ventricular contraction. The contraction starts shortly after Q and marks the beginning of the ventricular systole.

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