## All India Aakash Test Series for Medical - 2020

## TEST - I (Code-E)

Test Date : 13/10/2019

## ANSWERS

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

## HINTS \& SOLUTIONS

## [PHYSICS]

1. Answer (3)

Hint \& Sol. : Lesser the value of least count, more will be the precision.
2. Answer (1)

Hint \& Sol. : 179 can be represented in scientific notation as $1.79 \times 10^{2}$. Then order of magnitude is 2 .
3. Answer (1)

Hint : Find mean value of measurement and
$\Delta a_{i}=a_{\text {mean }}-a_{i}$
Sol. : $a_{m}=(1.50+1.52+1.53+1.51+1.54) / 5$
$=1.52$
$\Delta a_{1}=1.52-1.50=0.02$
$\Delta a_{2}=1.52-1.52=0.00$
$\Delta a_{3}=1.52-1.53=-0.01$
$\Delta a_{4}=1.52-1.51=0.01$
$\Delta a_{5}=1.52-1.54=-0.02$
$\Delta a_{m}=\frac{\left|\Delta a_{1}\right|+\left|\Delta a_{2}\right|+\left|\Delta a_{3}\right|+\left|\Delta a_{4}\right|+\left|\Delta a_{5}\right|}{5}$
$=\frac{0.02+0.00+0.01+0.01+0.02}{5}$

$$
=0.012
$$

$$
=0.01
$$

$\frac{\Delta a_{m}}{a_{m}}=\frac{0.01}{1.52}=6.58 \times 10^{-3}$

$$
=0.00658=0.007
$$

$\frac{\Delta a_{m}}{a_{m}} \times 100=0.7 \%$
4. Answer (4)

Hint: Use dimensional formula of $R, C$ and $L$.
Sol. : RC= time constant of R-C circuit
$\frac{L}{R}=$ time constant of L-R circuit
Now $\left[\frac{R C}{\left(\frac{L}{R}\right)}\right]=\left[\mathrm{M}^{0} \mathrm{~L}^{0} \mathrm{~T}^{0}\right]$
5. Answer (2)

Hint \& Sol. : Electromagnetic and gravitational forces are fundamental forces having infinite range.
6. Answer (3)

Hint : Properties of fundamental forces.
Sol. : Strong nuclear is a fundamental force, mediated by the particle $\pi$-meson and it is 100 times stronger (approximately) than electromagnetic force. Gravitational force is central force. Sir C.V. Raman won the Nobel prize for study of scattering of light by molecules.
7. Answer (4)

Hint : Use dimensional analysis.
Sol. : $\frac{B^{2}}{2 \mu_{0}} \rightarrow$ represents energy density

$$
\begin{aligned}
\therefore \quad\left[\frac{B^{2}}{2 \mu_{0}}\right] & =\frac{[\text { Energy }]}{[\text { Volume }]}=\left[\frac{\mathrm{ML}^{2} \mathrm{~T}^{-2}}{\mathrm{~L}^{3}}\right] \\
& =\left[\mathrm{ML}^{-1} \mathrm{~T}^{-2}\right]
\end{aligned}
$$

8. Answer (1)

Hint : Use rules of propagation of error
Sol. : $v=\sqrt{\frac{T L}{M}}$

$$
\begin{aligned}
\frac{\Delta v}{v} \times 100 & =\frac{1}{2} \frac{\Delta T}{T} \times 100+\frac{1}{2} \frac{\Delta L}{L} \times 100+\frac{1}{2} \frac{\Delta M}{M} \times 100 \\
& =\frac{1}{2} \times 2+\frac{1}{2} \times 1+\frac{1}{2} \times 1 \\
& =2 \%
\end{aligned}
$$

9. Answer (2)

Hint \& Sol. : From dimensional analysis
[Torque] $=\left[\right.$ Work] $=\left[\mathrm{ML}^{2} \mathrm{~T}^{-2}\right.$ ]
[Surface tension] $=\left[\mathrm{ML}^{0} \mathrm{~T}^{-2}\right]$
[Velocity] $=\left[\mathrm{LT}^{-1}\right]$
10. Answer (3)

Hint : Use rule of arithmetic operations with significant figure.
Sol. : $7.5+2.71+4.732=14.942$
With proper significant figure, result can be written as 14.9. Hence addition has three significant figures.
11. Answer (1)

Hint : Use application of dimensional analysis.
Sol. : $U=\frac{\alpha x^{3 / 2}}{x^{3}+\beta}$

$$
\because \quad[\beta]=\left[L^{3}\right]
$$

and $[\alpha]\left[L^{3 / 2}\right]=\left[\mathrm{ML}^{2} \mathrm{~T}^{-2}\right]\left[L^{3}\right]$
$[\alpha]=\left[\mathrm{ML}^{7 / 2} \mathrm{~T}^{-2}\right]$
$\therefore\left[\frac{\alpha}{\beta}\right]=\left[\mathrm{ML}^{\frac{1}{2}} \mathrm{~T}^{-2}\right]$
12. Answer (4)

Hint : Rules of arithmetic operations with significant figures.
Sol. : Mass $=$ Density $\times$ Volume

$$
\begin{aligned}
& =1200.0 \times 1.00=1200.0 \mathrm{~g} \\
& =1.20 \times 10^{3} \mathrm{~g}
\end{aligned}
$$

13. Answer (3)

Hint : Application of differential calculus.
Sol. : $x=12 t^{2}-4 t^{3}$
$v=24 t-12 t^{2}$
$a=24-24 t$
Velocity will be maximum when $a=0$
$\Rightarrow t=1 \mathrm{~s}$
Now $x=12-4=8 \mathrm{~m}$
14. Answer (2)

Hint : Average speed $=\frac{\text { Total distance }}{\text { Total time }}$
Sol. : Let total distance covered be $s$
Then, $t_{1}=\frac{\frac{s}{5}}{12}=\frac{s}{60}$
$t_{2}=\frac{\frac{4 s}{5}}{8}=\frac{s}{10}$
$v_{\text {avg }}=\frac{s}{\frac{s}{10}+\frac{s}{60}}=\frac{60}{7} \mathrm{~m} / \mathrm{s}$
15. Answer (1)

Hint \& Sol. : At a given time instant the particle cannot have more than one velocity.
16. Answer (4)

Hint : Definite integration of trigonometrical function.

Sol. : $\int_{0}^{\pi} 4 \cos 2 \theta=4\left[\frac{\sin 2 \theta}{2}\right]_{0}^{\pi}$

$$
\begin{aligned}
& =2\left[\sin 2 \pi-\sin 0^{\circ}\right] \\
& =0
\end{aligned}
$$

17. Answer (1)

Hint : $a=v \frac{d v}{d z}$.
Sol. : Since $\frac{d v}{d z}=\frac{0-6}{2-0}=-3 \mathrm{~s}^{-1}$
Now from plot $v=-3 z+6$
$v(z=1 \mathrm{~m})=-3 \times 1+6=3 \mathrm{~m} / \mathrm{s}$
$a=v \frac{d v}{d z}$
$a(z=1 \mathrm{~m})=3 \times-3=-9 \mathrm{~m} / \mathrm{s}^{2}$
$\Rightarrow|a|=9 \mathrm{~m} / \mathrm{s}^{2}$
18. Answer (2)

Hint : $v_{\text {rel }}=\frac{s_{\text {rel }}}{\text { Time }}$.
Sol. : Given $s_{\text {rel }}=500 \mathrm{~m}$ and $t=50 \mathrm{~s}$
Then $v_{\text {rel }}=\frac{500}{50}=10 \mathrm{~m} / \mathrm{s}$
i.e., $v_{\text {jeep }}-v_{\text {bus }}=10$
$v_{\text {jeep }}=10+20=30 \mathrm{~m} / \mathrm{s}$
19. Answer (2)

Hint : Change in velocity $=$ area under $a-t$ curve.
Sol. : $v_{f}-v_{i}=$ area under a-t curve

$$
=\frac{(8+4)}{2}+4 \times 1+4 \times \frac{1}{2}-4 \times \frac{1}{2}
$$

$v_{f}-(-20)=10$
$v_{f}=-10 \mathrm{~m} / \mathrm{s}$
20. Answer (1)

Hint : Motion under gravity.
Sol. : Let the height of each storey be $h$ then total height will be 16 h
$16 h=0+\frac{1}{2} \times 10 \times 4^{2}$
$h=5 \mathrm{~m}$
Now in 1 s , packet travels,
$s=\frac{1}{2} \times 10 \times 1^{2}=5 \mathrm{~m}$
Hence the packet travels 1 storey i.e. $m=1$
21. Answer (2)

Hint: Use $h=-u t+\frac{1}{2} g t^{2}$.
Sol. : Given that $h=80 \mathrm{~m}, g=10 \mathrm{~m} / \mathrm{s}^{2}$ and $u=-20 \mathrm{~m} / \mathrm{s}$
$80=-20 t+5 t^{2}$
$t^{2}-4 t-16=0$
$t=\frac{4 \pm \sqrt{16+64}}{2} \simeq \frac{4+9}{2}$

$$
=6.5 \mathrm{~s}
$$

22. Answer (1)

Hint: $\vec{v}_{\text {rel }}=\vec{v}_{1}-\vec{v}_{2}$.

$$
\text { Sol. : } \begin{aligned}
\left|\vec{v}_{\text {bullet, train }}\right| & =\left|\vec{v}_{\text {bullet }}-\vec{v}_{\text {train }}\right| \\
& =180-(-20)=200 \mathrm{~m} / \mathrm{s}
\end{aligned}
$$

Now, length of train $=L=v_{\text {bullet, train }} \times t$

$$
\begin{aligned}
& =200 \times 1.5 \\
& =300 \mathrm{~m}
\end{aligned}
$$

23. Answer (2)

Hint : Use $R=\sqrt{A^{2}+B^{2}+2 A B \cos \theta}$.
Sol. :

$\vec{v}_{\text {boat }}=(36 \hat{j}) \mathrm{km} / \mathrm{h}$
$\vec{v}_{\text {river }}=10 \hat{i} \mathrm{~km} / \mathrm{h}$

$$
\text { Now } \begin{aligned}
\vec{v}_{\text {res }} & =\sqrt{v_{\text {boat }}^{2}+v_{\text {river }}^{2}} \\
& =\sqrt{36^{2}+10^{2}} \\
& =37 \mathrm{~km} / \mathrm{h}
\end{aligned}
$$

24. Answer (1)

Hint \& Sol. : If angle of projection is nearer to $45^{\circ}$, then range becomes larger.
Hence, $\Delta \theta_{A}=\left|45^{\circ}-39\right|=6^{\circ}$
$\Delta \theta_{B}=\left|45-43^{\circ}\right|=2^{\circ}$
$\Delta \theta_{C}=\left|45^{\circ}-52^{\circ}\right|=7^{\circ}$
$\Delta \theta_{D}=\left|45^{\circ}-46^{\circ}\right|=1^{\circ}$
Hence, $R_{D}>R_{B}>R_{A}>R_{C}$
25. Answer (2)

Hint : $R=\sqrt{P^{2}+Q^{2}+2 P Q \cos \theta}$.
Sol. : Given $R=\sqrt{9 A^{2}+4 A^{2}+12 A^{2} \cos \theta}$
$2 R=\sqrt{36 A^{2}+4 A^{2}+24 A^{2} \cos \theta}$
$\frac{1}{4}=\frac{13+12 \cos \theta}{40+24 \cos \theta}$
$\Rightarrow 40+24 \cos \theta=52+48 \cos \theta$
$\Rightarrow \cos \theta=-\frac{1}{2}$
$\Rightarrow \theta=120^{\circ}$
26. Answer (4)

Hint : Motion of particle in a plane
Sol. : Given $\vec{r}=\left[(3 t) \hat{i}-\left(2 t^{2}\right) \hat{j}+\hat{k}\right] \mathrm{m}$
$\vec{v}=\frac{d \vec{r}}{d t}=[3 \hat{i}-4 t \hat{j}] \mathrm{m} / \mathrm{s}$
$a=\frac{d v}{d t}=-4 \hat{j} \mathrm{~m} / \mathrm{s}^{2}$
27. Answer (2)

Hint : $t=\sqrt{\frac{2 h}{g}}$ and $R=u_{x} \cdot t$
Sol. : $u_{x}=216 \mathrm{~km} / \mathrm{h}=60 \mathrm{~m} / \mathrm{s}$
$t=\sqrt{\frac{2 \times 980}{9.8}}=10 \sqrt{2} \mathrm{~s}$
$R=u_{x} \cdot t=60 \times 10 \sqrt{2}$

$$
=600 \sqrt{2} \mathrm{~m}
$$

28. Answer (1)

Hint : $T=t_{1}+t_{2}=\frac{2 u \sin \theta}{g}$.
Sol. : $0.5+1.5=\frac{2 \times 20 \sin \theta}{10}$
$\sin \theta=\frac{1}{2}$
$\theta=30^{\circ}$
29. Answer (1)

Hint : Motion of particle in circular path.
Sol. : Given $\vec{r}=r_{0}(\cos \omega t \hat{i}+\sin \omega t \hat{j}) m$
$\vec{v}=r_{0} \omega(-\sin \omega t \hat{i}+\cos \omega t \hat{j}) \mathrm{m} / \mathrm{s}$
$\vec{a}=-r_{0} \omega^{2}(\cos \omega t \hat{i}+\sin \omega t \hat{j}) \mathrm{m} / \mathrm{s}^{2}$
$\vec{a}=-\omega^{2} \vec{r}$
Angle between $\vec{v}$ and $\vec{r}$ is $90^{\circ}$ while between $\vec{a}$ and $\vec{r}$ is $180^{\circ}$.
30. Answer (3)

Hint: $\vec{v}_{\text {avg }}=\frac{\text { Displacement }}{\text { Time }}$
Sol. : Displacement $\vec{r}=\vec{r}_{2}-\vec{r}_{1}$
$\vec{r}=(9 \hat{i}+9 \hat{j}) \mathrm{m}$
$\vec{v}_{\text {avg }}=\frac{\vec{r}}{t}=\frac{9}{6}(\hat{i}+\hat{j}) \mathrm{m} / \mathrm{s}$

$$
=\frac{3}{2}(\hat{i}+\hat{j}) \mathrm{m} / \mathrm{s}
$$

31. Answer (4)

Hint: $v_{w}=u_{s} \sin \theta$.
Sol. : $v_{w}=9 \mathrm{kmph} \times \sin \left(120^{\circ}-90^{\circ}\right)$

$$
\begin{aligned}
& =\frac{9}{2} \mathrm{kmph} \\
& =\frac{9}{2} \times \frac{5}{18}=1.25 \mathrm{~m} / \mathrm{s}
\end{aligned}
$$

32. Answer (3)

Hint : $v^{2}=u^{2}+2 a_{T} s$.
Sol. : $120^{2}=2\left[2\left(2 \pi \frac{40}{\pi}\right)\right] a_{T}$

$$
\begin{aligned}
a_{T} & =\frac{90}{2} \mathrm{~m} / \mathrm{s}^{2} \\
& =45 \mathrm{~ms}^{2}
\end{aligned}
$$

33. Answer (3)

Hint \& Sol. : Horizontal velocity of ball for person $P$ is zero and for person $Q$ it is non-zero. Hence for person $P$, ball moves in straight line path while for person $Q$, ball seems to move on parabolic path.
34. Answer (1)

Hint: $R=\frac{v^{2}}{a_{\perp}}$.

## Sol. :


$R_{1}=\frac{u^{2} \cos ^{2} \theta}{g}$
$R_{2}=\frac{u^{2}}{g \cos \theta}$
$\frac{R_{1}}{R_{2}}=\frac{\frac{u^{2} \cos ^{2} \theta}{g}}{\frac{u^{2}}{g \cos \theta}}$
$\Rightarrow \frac{R_{1}}{R_{2}}=\cos ^{3} \theta$
35. Answer (2)

Hint: $\vec{v}_{A B}=\vec{v}_{A}-\vec{v}_{B}$.
Sol. : Given $\vec{v}_{A}=v_{A} \hat{i}$
$\vec{v}_{B}=\frac{V_{B}}{\sqrt{2}}(\hat{i}-\hat{j})$
For $\vec{v}_{B A}$ to be due south, $x$ component of $\vec{v}_{B A}$ should be zero.
$\Rightarrow \quad v_{A}=\frac{v_{B}}{\sqrt{2}}$
$\frac{v_{A}}{v_{B}}=\frac{1}{\sqrt{2}}$
36. Answer (4)

Hint : Use $\vec{v}_{\text {avg }}=\frac{\vec{v}_{1}+\vec{v}_{2}}{2}$ for uniformly accelerated motion.

Sol. : $\vec{v}_{\text {avg }, y}=\frac{u \sin \theta+0}{2}=\frac{u \sin \theta}{2} \hat{j}$
$\vec{v}_{\mathrm{avg}, x}=u \cos \theta \hat{i}$

$$
\begin{aligned}
\text { Now } \begin{aligned}
\left\langle v_{\mathrm{avg}}\right\rangle & =\sqrt{v_{\mathrm{avg}, x}^{2}+v_{\mathrm{avg}, y}^{2}} \\
& =\sqrt{u^{2} \cos ^{2} \theta+\frac{u^{2}}{4} \sin ^{2} \theta} \\
& =\frac{u}{2} \sqrt{4 \cos ^{2} \theta+\sin ^{2} \theta} \\
\left\langle v_{\mathrm{avg}}\right\rangle=\frac{u}{2} & \sqrt{1+3 \cos ^{2} \theta}
\end{aligned}
\end{aligned}
$$

37. Answer (1)

Hint : Horizontal component of velocity remains constant.
Sol. :


$$
\begin{aligned}
u_{x} & =u \cos 60^{\circ}=20 \times \frac{1}{2} \\
& =10 \mathrm{~m} / \mathrm{s} \\
u_{y} & =u \sin 60^{\circ}=20 \times \frac{\sqrt{3}}{2} \\
& =10 \sqrt{3} \mathrm{~m} / \mathrm{s}
\end{aligned}
$$

$v_{x}=u_{x}$
$v \cos 30^{\circ}=10$
$\frac{v \sqrt{3}}{2}=10$
$v=\frac{20}{\sqrt{3}} \mathrm{~m} / \mathrm{s}$
38. Answer (2)

Hint: Use $y=x \tan \theta\left(1-\frac{x}{R}\right)$.
Sol. : Given $y=4 x\left(1-\frac{x}{3.9}\right)$
By comparing, $\tan \theta=4$
$R=3.9 \mathrm{~m}$
Hence, $R \tan \theta=3.9 \times 4=15.6 \mathrm{~m}$
39. Answer (1)

Hint: Use $v^{2}=u^{2}+2 g h$.
Sol. : $u_{x}=u$

$$
u_{y}=0
$$

$a_{y}=g$
And $s_{y}=\frac{H}{2}$
Then $v=\sqrt{u_{x}^{2}+\left(u_{y}^{2}+2 g \frac{H}{2}\right)}$

$$
=\sqrt{u^{2}+g H}
$$

40. Answer (4)

Hint \& Sol. : To produce zero resultant, sum of magnitude of any two vectors should be greater than or equal to the magnitude of third vector.
41. Answer (1)

Hint : $\tan \theta=\frac{a_{r}}{a_{T}}$.
Sol. : $\tan 45^{\circ}=\frac{a_{r}}{a_{T}} \Rightarrow a_{r}=a_{T}$
$r \alpha=r \omega^{2}$
$\Rightarrow \quad \alpha=(\alpha t)^{2}$
$t=\sqrt{\frac{1}{\alpha}}=\frac{2}{\sqrt{\pi}} \mathrm{~s}$
42. Answer (2)

Hint : Use law of vector addition.
Sol. :

$\tan \alpha=\frac{B \sin \theta}{A+B \cos \theta}$
$\tan \beta=\frac{B \sin \theta}{A-B \cos \theta}$
$\tan \alpha+\tan \beta=\frac{B \sin \theta}{A+B \cos \theta}+\frac{B \sin \theta}{A-B \cos \theta}$
$=\frac{A B \sin \theta-B^{2} \sin \theta \cos \theta+A B \sin \theta+B^{2} \sin \theta \cos \theta}{A^{2}-B^{2} \cos ^{2} \theta}$
i.e. $\tan \alpha+\tan \beta=\frac{2 A B \sin \theta}{A^{2}-B^{2} \cos ^{2} \theta}$
43. Answer (4)

Hint : Use $y=x \tan \theta-\frac{g x^{2}}{2 u^{2} \cos ^{2} \theta}$.
Sol. : Given $y=\frac{1}{2} \mathrm{~m}, x=\sqrt{3} \mathrm{~m}$ and $\theta=30^{\circ}$
i.e. $\frac{1}{2}=\sqrt{3} \times \frac{1}{\sqrt{3}}-\frac{10 \times 3}{2 \times v_{0}^{2} \cdot \frac{3}{4}}$
$\frac{20}{v_{0}^{2}}=\frac{1}{2}$
$v_{0}^{2}=40$
$v_{0}=\sqrt{40}=2 \sqrt{10} \mathrm{~m} / \mathrm{s}$
44. Answer (1)

Hint : Use $\vec{v}_{A B}=\vec{v}_{A}-\vec{v}_{B}$.
Sol. :

$\vec{v}_{r}=\left(-20 \sin 30 \hat{i}-20 \cos 30^{\circ} \hat{j}\right) \mathrm{m} / \mathrm{s}$
$=(-10 \hat{i}-10 \sqrt{3} \hat{j}) \mathrm{m} / \mathrm{s}$

Now $\vec{v}_{m}=-2 \cdot(20 \sin 30) \hat{i} \mathrm{~m} / \mathrm{s}$

$$
=-20 \hat{i} \mathrm{~m} / \mathrm{s}
$$

45. Answer (2)

Hint: Use $a_{T}=v \frac{d v}{d s}$ and $a=\sqrt{a_{T}^{2}+a_{R}^{2}}$.
Sol. : Given $v=\alpha \sqrt{x}$

$$
\begin{aligned}
& \frac{d v}{d x}=\frac{\alpha}{2 \sqrt{x}} \\
& a=v \frac{d v}{d x}=\alpha \sqrt{x} \frac{\alpha}{2 \sqrt{x}}=\frac{\alpha^{2}}{2} \\
& a=\sqrt{a_{T}^{2}+\left(\frac{v^{2}}{R}\right)^{2}} \\
&=\sqrt{\frac{\alpha^{4}}{4}+\left(\frac{\alpha^{2} x}{R}\right)^{2}} \\
&=\sqrt{\frac{\alpha^{4}}{4}+\alpha^{4} \frac{x^{2}}{R^{2}}} \\
&=\frac{\alpha^{2}}{2} \sqrt{1+4\left(\frac{2 R^{2}}{R^{2}}\right)} \\
& \Rightarrow a=\frac{3}{2} \alpha^{2}
\end{aligned}
$$

## [CHEMISTRY]

46. Answer (4)

Hint : Mole of molecule/atom

$$
=\frac{\text { Mass of molecule/atom }}{\text { Molar mass of molecule/atom }}
$$

Sol. : Mole of $\mathrm{He}=\frac{2 \mathrm{x}}{4}$
Mole of $N_{2}=\frac{x}{28}$
$\frac{\text { Mole of } \mathrm{He}}{\text { Mole of } \mathrm{N}_{2}}=\frac{\frac{2 \mathrm{x}}{4}}{\frac{\mathrm{x}}{28}}=\frac{2 x}{4} \times \frac{28}{\mathrm{x}}=14: 1$
47. Answer (3)

Hint: Mg is limiting reagent.

Sol. : $2 \mathrm{Mg}+\mathrm{O}_{2} \longrightarrow 2 \mathrm{MgO}$
Mole of $\mathrm{Mg}=\frac{4}{24}=\frac{1}{6}$
Mole of $\mathrm{O}_{2}=\frac{8}{32}=\frac{1}{4}$
Mg is limiting reagent
$\therefore \quad$ Mole of MgO formed $=\frac{1}{6}$
48. Answer (3)

Hint : No. of molecules $=$ Mole $\times N_{A}$
Sol. : Mole of $\mathrm{CO}_{2}=\frac{22}{44}=0.5$
Mole of $\mathrm{SO}_{3}=\frac{40}{80}=0.5$

Mole of $\mathrm{CH}_{4}=\frac{10}{16}=0.625$
Mole of $\mathrm{NO}_{2}=\frac{20}{46}=0.43$
49. Answer (1)

Hint : $E=\frac{h c}{\lambda}$
Sol. : $E=6.6 \times 10^{-34} \times \frac{3 \times 10^{8}}{600 \times 10^{-10}} \mathrm{~J}$
$\Rightarrow \mathrm{E}=3.3 \times 10^{-18} \mathrm{~J}$
50. Answer (3)

Hint: Orbital angular momentum $(\mathrm{L})=\sqrt{\ell(\ell+1)} \hbar$.
Sol. : For $s$-orbital, $\ell=0$
$\therefore \mathrm{L}=0$
51. Answer (3)

Hint : Magnetic orbital quantum number gives information about spatial orientation of the orbital with respect to standard set of co-ordinate axes.
52. Answer (4)

Hint : For principal quantum number n , azimuthal quantum number ( $\ell$ ) will be: $0,1,2, \ldots(n-1)$.

Sol. : For $\mathrm{n}=3$, $\ell$ cannot be 3 .
53. Answer (4)

Hint : Hydrogen does not form $\pi$-bond with sulphur.
54. Answer (2)

Hint : Bond order $=\frac{1}{2}$ (Number of electrons in bonding MO - Number of electrons in antibonding MO).
Sol. : Bond order of $\mathrm{N}_{2}=\frac{1}{2}(10-4)=3$
Bond order of $\mathrm{N}_{2}^{-}=\frac{1}{2}(10-5)=2.5$
Bond order of $\mathrm{N}_{2}^{2-}=\frac{1}{2}(10-6)=2$
Lesser the bond order, longer is the bond length
$\therefore$ Bond length order: $\mathrm{N}_{2}^{2-}>\mathrm{N}_{2}^{-}>\mathrm{N}_{2}$
55. Answer (3)

Hint : Xe in $\mathrm{XeO}_{2} \mathrm{~F}_{2}$ is $s p^{3} d$ hybridised.

## Sol. :


(see-saw shape)
56. Answer (2)

Hint : Number of $\pi$-bonds present in the given molecule is 3 .
Sol. :


Number of $\sigma$-bonds $=14$
Number of $\pi$-electrons $=6$
57. Answer (2)

Hint : S of $\mathrm{SO}_{3}$ and B in $\mathrm{BCl}_{3}$ are $s p^{2}$ hybridised.
Sol. : $\mathrm{NH}_{3} \longrightarrow$ Pyramidal
$\stackrel{\oplus}{\mathrm{N}} \mathrm{H}_{4} \longrightarrow$ Tetrahedral
$\mathrm{SO}_{3} \longrightarrow$ Trigonal planar
$\mathrm{BCl}_{3} \longrightarrow$ Trigonal planar
$\mathrm{SO}_{4}^{2-} \longrightarrow$ Tetrahedral
$\mathrm{NO}_{3}^{-} \longrightarrow$ Trigonal planar
$\mathrm{ClF}_{3} \longrightarrow$ T-shape
$\mathrm{I}_{3}^{-} \longrightarrow$ Linear
58. Answer (1)

Hint : The species which contains only paired electrons in the molecular orbitals are diamagnetic in nature.
Sol. : In $\mathrm{NO}^{+}$, all filled molecular orbitals contain paired electrons.
59. Answer (1)

Hint : For a given cation larger the size of anion greater is the covalent character of ionic compound.
60. Answer (1)

Hint : For isoelectronic species, more the negative charge greater is the ionic radii.
61. Answer (2)

Hint : Element ' X ' electronic configuration is [Ar] $3 d^{10} 4 s^{2} 4 p^{5}$.
Sol. : Since last electron enters in $p$-orbital so it is a $p$-block element.
62. Answer (1)

Hint : Chlorine has highest electron affinity.
63. Answer (3)

Hint : For single electron species, the orbitals of same shell have same energy.
Sol. : Hydrogen is one electron species hence $2 s$ and $2 p$ orbitals have same energy.
64. Answer (2)

Hint : $\lambda=\frac{\mathrm{h}}{\mathrm{mv}}$
Sol. : $\lambda=\frac{6.6 \times 10^{-34}}{1 \times 10^{-6} \times 200}=3.3 \times 10^{-30} \mathrm{~m}$
65. Answer (2)

Hint : Total number of orbital in $\mathrm{n}^{\text {th }}$ shell is $\mathrm{n}^{2}$.
Sol. : Number of atomic orbitals in $5^{\text {th }}$ shell $=5^{2}$

$$
=25
$$

66. Answer (2)

Hint : Dipole moment depends on shape, polarity of bond and direction of bond dipoles.
Sol. : $\mu\left(\mathrm{NH}_{3}\right)=1.47 \mathrm{D}$
$\mu\left(\mathrm{H}_{2} \mathrm{~S}\right)=0.95 \mathrm{D}$
$\mu\left(\mathrm{NF}_{3}\right)=0.23 \mathrm{D}$
$\mu\left(\mathrm{PCl}_{5}\right)=0.0 \mathrm{D}$
67. Answer (2)

Hint : The molecule will be linear in shape if the central atom is $s p$ hybridised.
Sol. :




68. Answer (2)

Hint : Electronic configuration of $\mathrm{O}_{2}$ molecule: $\sigma 1 s^{2}, \sigma^{*} 1 s^{2}, \sigma 2 s^{2}, \sigma^{*} 2 s^{2}, \sigma 2 p_{z}^{2}, \pi 2 p_{x}^{2}=\pi 2 p_{y}^{2}$, $\pi^{*} 2 p_{x}{ }^{1}=\pi^{*} 2 p_{y}{ }^{1}$
Sol. : Number of bonding electrons $=10$.
69. Answer (1)

Hint : Hybridisation of central atom is determined by number of $\sigma$-bonds and lone pairs.
Sol.: Molecule
Hybridisation

| $\mathrm{SF}_{6}$ | $s p^{3} d^{R}$ |
| :---: | :---: |
| $\mathrm{SF}_{4}$ | $s p^{3} d$ |
| $\mathrm{H}_{2} \mathrm{SO}_{3}$ | $s p^{3}$ |

70. Answer (4)

Hint:
Molality $=\frac{\text { Mass of solute } \times 1000}{\text { Mass of solvent }(\mathrm{g}) \times \text { Molar mass of solute }}$
Sol. : Molality $=\frac{16 \times 1000}{84 \times 32}=5.95 \mathrm{~m}$
71. Answer (2)

Hint: NaCl is limiting reagent.

$$
\begin{aligned}
& \text { Sol. }: \mathrm{NaCl}(\mathrm{aq})+ \mathrm{AgNO}_{3}(\mathrm{aq}) \longrightarrow \\
& \mathrm{AgCl}(\mathrm{~s})+ \\
& \mathrm{NaNO}_{3}(\mathrm{aq})
\end{aligned}
$$

mmol of $\mathrm{NaCl}=100 \times 0.2=20 \mathrm{mmol}$
mmol of $\mathrm{AgNO}_{3}=50 \times 0.5=25 \mathrm{mmol}$
NaCl is limiting reagent
$\therefore \quad$ Mole of NaCl reacted $=$ Mole of AgCl formed

$$
=20 \times 10^{-3}=0.02
$$

72. Answer (3)

Hint : One mole of biomolecule will contain one mole of $\mathrm{Co}^{2+}$ to get minimum molecular weight of biomolecule.
Sol. : 0.59 g of $\mathrm{Co}^{2+}$ is present in 100 g of biomolecule.
59 g of $\mathrm{Co}^{2+}$ is present in $\frac{100}{0.59} \times 59=10000 \mathrm{~g}$.
73. Answer (1)

Hint : Average atomic mass $=\frac{\sum \mathrm{x}_{\mathrm{i}} \mathrm{M}_{\mathrm{i}}}{100}$.
Sol. : Average atomic mass

$$
\begin{aligned}
& =\frac{150 \times 40+148 \times 20+151 \times 40}{100} \\
& =150.0 u
\end{aligned}
$$

74. Answer (2)

Hint : $\frac{1}{\lambda}=R Z^{2}\left(\frac{1}{n_{1}^{2}}-\frac{1}{n_{2}^{2}}\right)$.
Sol. : $\frac{1}{\lambda}=R(2)^{2}\left(\frac{1}{1^{2}}-\frac{1}{4^{2}}\right)$
Or, $\frac{1}{\lambda}=4 \mathrm{R} \times \frac{15}{16}$
Or, $\lambda=\frac{4}{15 R}$
75. Answer (2)

Hint: Isoelectronic species have same number of electrons.
76. Answer (1)

Hint : $\Delta x \cdot \Delta p \geq \frac{h}{4 \pi}$.
Sol. : $\Delta p=2 \Delta x$
$\frac{\Delta p}{2} \cdot \Delta p=\frac{h}{4 \pi}$
$(\Delta \mathrm{p})^{2}=\frac{\mathrm{h}}{2 \pi}$
$\Delta \mathrm{p}=\sqrt{\frac{\mathrm{h}}{2 \pi}}$
$m \Delta v=\sqrt{\frac{\mathrm{h}}{2 \pi}}$
$\Delta v=\frac{1}{m} \sqrt{\frac{h}{2 \pi}}$
77. Answer (3)

Hint : During ionisation, electrons are always removed from outermost shell.
Sol. : $\mathrm{Mn}^{3+} \longrightarrow[\mathrm{Ar}] 3 d^{4} 4 s^{0}$
78. Answer (2)

Hint : Number of spectral lines $=\sum(n-1)$
Sol. : Number of spectral lines $=\sum(5-1)$

$$
\begin{aligned}
& =4+3+2+1 \\
& =10
\end{aligned}
$$

79. Answer (1)

Hint : $r_{n} \propto \frac{n^{2}}{Z}$.
Sol. : $r_{1}(H) \propto(1)^{2}$
$r_{2}\left(\mathrm{Li}^{2+}\right) \propto \frac{(2)^{2}}{3}$
$\frac{r_{1}(\mathrm{H})}{r_{2}\left(\mathrm{Li}^{2+}\right)}=\frac{3}{4}$
or, $\frac{\mathrm{a}}{\mathrm{r}_{2}\left(\mathrm{Li}^{2+}\right)}=\frac{3}{4}$
or, $r_{2}\left(\mathrm{Li}^{2+}\right)=\frac{4}{3} \mathrm{a} \AA$
80. Answer (4)

Hint : Electronegativity of fluorine is highest.
Sol. : Fluorine is $17^{\text {th }}$ group element and belongs to second period.
81. Answer (2)

Hint: $\mathrm{M}_{1} \mathrm{~V}_{1}+\mathrm{M}_{2} \mathrm{~V}_{2}=\left(\mathrm{V}_{1}+\mathrm{V}_{2}\right) \mathrm{M}_{3}$.
Sol. : $(400 \times 2+600 \times 1)=(600+400) \mathrm{M}_{3}$
$M_{3}=\frac{1400}{1000}=1.4 \mathrm{M}$
82. Answer (4)

Hint : Shape can be predicted if hybridisation of central atom of the given species is known.

## Sol. :



Square pyramidal


Trigonal planar


Bent


Bent
83. Answer (3)

Hint: Species having incomplete octet is electron deficient.
84. Answer (1)

Hint : Bond order $=\frac{1}{2}$ (Number of electrons in bonding $\mathrm{MO}-$ Number of electrons in antibonding MO)
Sol. : $\mathrm{O}_{2}^{+}=\frac{1}{2}(10-5)=2.5$
$\mathrm{O}_{2}^{-}=\frac{1}{2}(10-7)=1.5$
$C_{2}^{+}=\frac{1}{2}(7-4)=1.5$
$\mathrm{CO}=\frac{1}{2}(10-4)=3$
85. Answer (3)

Hint : The lone pairs of electrons are called nonbonding electrons.

Sol. :


Number of non-bonding pair of electrons $=3 \times 5$

$$
=15
$$

86. Answer (1)

Hint : HF forms intermolecular H -bonding.
Sol. : Boiling point : $\mathrm{HF}>\mathrm{HI}>\mathrm{HBr}>\mathrm{HCl}$.
87. Answer (2)

Hint : $\pi$-molecular orbital of $N_{2}$ is completely filled.

Sol. : Coming electron should be accommodated in vacant $\pi^{*}$-orbital of $\mathrm{N}_{2}$.
88. Answer (1)

Hint : Hydrogen bonding within the molecule is called intramolecular hydrogen bonding.

Sol. :

89. Answer (4)

Hint : $\mathrm{C}_{2}: \sigma 1 s^{2}, \sigma^{*} 1 s^{2}, \sigma 2 s^{2}, \sigma^{*} 2 s^{2}, \pi 2 p_{\mathrm{x}}{ }^{2}=\pi 2 p_{\mathrm{y}}{ }^{2}$.
Sol. : B.O. $\left(\right.$ of $\left.\mathrm{C}_{2}\right)=\frac{8-4}{2}=2$
$\therefore \quad$ Both the bonds in $\mathrm{C}_{2}$ are $\pi$-bonds.
90. Answer (3)

Hint $: E \propto \frac{Z^{2}}{\mathrm{n}^{2}}$.
Sol. : $\mathrm{E}_{2}\left(\mathrm{He}^{+}\right) \propto \frac{\mathrm{Z}^{2}}{(2)^{2}}$
$\mathrm{E}_{3}\left(\mathrm{He}^{+}\right) \propto \frac{\mathrm{Z}^{2}}{(3)^{2}}$
$\mathrm{E}_{2}\left(\mathrm{He}^{+}\right): \mathrm{E}_{3}\left(\mathrm{He}^{+}\right)=\frac{\mathrm{Z}^{2}}{4} \times \frac{9}{\mathrm{Z}^{2}}=\frac{9}{4}$

## [BIOLOGY]

91. Answer (2)

Hint : Ribosome, centriole and nucleolus, all are non membrane bound structures.

Sol. : Ribosome - Involved in protein synthesis.
Centriole - Formation of spindle fibres.
Nucleolus - Site for rRNA synthesis.
92. Answer (1)

Hint : In prokaryotes, both chromosomal and extra chromosomal DNA are double stranded.

Sol. : The genomic DNA of prokaryotes is circular and not enveloped by a nuclear membrane i.e., naked.
93. Answer (2)

Hint : This layer is the outermost layer of bacterial cell envelope.

Sol. : Capsule, the outermost layer of cell envelope allows bacterium to hide from host's immune system.
94. Answer (4)

Hint : This chemical is a part of cell wall.
Sol. : Secondary cell wall is made up of pectins. Plasma membrane contains phospholipids, proteins, cholesterols, glycolipids and carbohydrates.
95. Answer (1)

Hint : Plasma membrane is selectively permeable.
Sol. : Neutral solutes may move across the membrane freely by simple diffusion while polar molecules move across with help of carrier proteins (facilitated diffusion).
96. Answer (1)

Hint : This cementing layer is chiefly made up of calcium and magnesium pectate.
Sol. : Middle lamella is the cementing layer of two adjacent cells in plant tissue.
97. Answer (4)

Hint : Primary cell wall is elastic in nature.
Sol. : Primary cell wall is capable of expansion and grow by addition of more cell wall material within the existing one.
98. Answer (3)

Hint : 80S ribosome is made up of 60S and 40S subunits.
Sol. : - ER cisternae are usually attached with 60S subunit of 80 S ribosomes.

- Processing and packaging of lipids is a function of Golgi apparatus.

99. Answer (2)

Hint : Lysosomes have high concentration of $\mathrm{H}^{+}$ ions inside them.
Sol.: - Enzymes of lysosomes are functional at acidic pH .

- Lysosomes are single membrane bound structures formed by RER and Golgi body and function in coordination with organelles of endomembrane system.

100. Answer (3)

Hint : Membraneless vacuoles are found in prokaryotes.
Sol. : Gas vacuoles are membraneless vacuoles also called pseudovacuoles.
101. Answer (3)

Hint : Mitochondria is the site of aerobic respiration.
Sol. : Both mitochondria and chloroplasts

1. Are double membrane bound.
2. Have dsDNA
3. Execute ATP synthesis
4. Have ETS.

But only mitochondria is the site for oxidation of respiratory substrates like carbohydrates, proteins, fats, etc.
102. Answer (2)

Hint : Oxysomes are involved in oxidative phosphorylation.
Sol. : Oxysomes are found on cristae which are infoldings of inner mitochondrial membrane.
103. Answer (4)

Hint : Only chloroplasts are involved in synthesis of food.
Sol. : Leucoplast - Colourless plastid
Chromoplast - Rich in carotenoids
Elaioplast - Stores fats and oils
Chloroplast - Synthesis of carbohydrates.
104. Answer (4)

Hint : Some cell organelles have nucleic acids like DNA or RNA.

Sol. : Nucleus - Have DNA and RNA both
Ribosome - Have RNA
Plastids - DNA and RNA both
Golgi apparatus do not have either DNA or RNA.
105. Answer (2)

Sol. : During protein synthesis many ribosomes may attach to a single mRNA to form polysome or polyribosome.
106. Answer (4)

Sol. : Centromere is the primary constriction region of chromosome. It lacks microtubules.
107. Answer (4)

Sol. : Chromatin is nucleoprotein fibre composed of DNA, histone proteins and RNA but lacks ribosomes.
108. Answer (3)

Hint : This structure is present in some chromosomes only.
Sol. : Satellite is found in SAT chromosomes only.
Centromere, telomere and chromatids are essentially present in each normal chromosome.
109. Answer (3)

Hint : Such chromosomes appear J shaped during anaphase.
Sol. : Acrocentric chromosome has centromere close to one of its end and appears J shaped.
110. Answer (3)

Hint : Polytene chromosomes are found in salivary glands of dipteran insects.
Sol. : Chiasmata formation occurs between bivalents during meiosis. It is seen in lampbrush chromosomes.
111. Answer (2)

Sol. : Sphaerosomes are the site of synthesis as well as storage of fats.
112. Answer (4)

Sol. : Cilia are found in eukaryotes only.
113. Answer (2)

Hint : Nucleoli are the site of ribosomal RNA synthesis.
Sol. : • Assembly of ribosome units occur in cytoplasm.

- Numerous and larger nucleoli are found in those cells which are actively involved in protein synthesis.

114. Answer (1)

Hint : The microtubules are found in eukaryotes only.
Sol. : Eukaryotic cilia and flagella have $9+2$ arrangement of microtubules. Basal body of eukaryotic flagella have $9+0$ organisation of microtubules.
115. Answer (2)

Sol. : Chromatophores are analogous to chloroplasts of eukaryotes as they have photosynthetic pigments and are involved in photosynthesis.
116. Answer (4)

Sol. : Absence of cell plate i.e. failure of cytokinesis after karyokinesis result increase in chromosome number.
117. Answer (2)

Hint : Deoxyribonucleotides are required during DNA replication.
Sol. : Duplication of cell organelles and ATP synthesis occurs in both $G_{1}$ and $G_{2}$-phases. Whereas synthesis of tubulin proteins occur in $\mathrm{G}_{2}$-phase and deoxyribonucleotides are synthesised in $\mathrm{G}_{1}$-phase.
118. Answer (1)

Hint : Amount of DNA gets double during S-phase and becomes equal to the chromosome number after separation of chromatids in anaphase.
Sol. :
$\begin{aligned} & \text { Pre mitotic gap phase }\left(G_{2}\right) \\ & \text { Synthetic phase }(S) \\ & \text { Prophase }(M)\end{aligned} \quad \begin{aligned} & \text { DNA amount is } \\ & \text { double but no change } \\ & \text { in chromosome }\end{aligned}$
number
Post mitotic gap phase $\left(G_{1}\right)$ - Amount of DNA is half as compare to $S, G_{2}$ and $M$ phases.
119. Answer (2)

Sol. : Centrosomes radiate some microtubules called asters.
120. Answer (2)

Hint : Each bivalent has 2 chromosomes and four chromatids.
Sol. : Given meiocyte has 30 chromosomes with 60 chromatids.
Each daughter cell after meiosis I will have 15 chromosomes and total 30 chromatids and after meiosis II, 15 chromosomes and 15 chromatids.
121. Answer (3)

Hint : Splitting of centromere is responsible for separation of chromatids.
Sol. : Splitting of centromere and the separation of chromatids occur at anaphase.
122. Answer (3)

Hint : In plant cells, cytokinesis begins at the centre of the cell.
Sol. : In plants, cytokinesis occurs by formation of cell plate while in animal cells, it occurs by formation of furrow.
123. Answer (1)

Hint : Mitosis occurs in meristematic cells as they are somatic cells.
Sol. : Bivalent and chiasmata formation occurs in meiosis however formation of spindle fibres, metaphasic plate and condensation of chromatin material occur in both mitosis and meiosis.
124. Answer (1)

Sol. : A pair of synapsed homologous chromosomes is known as a bivalent.
125. Answer (4)

Hint : Synaptonemal complex is necessary for synapsis and bivalent formation.
Sol. : Synaptonemal complex forms at zygotene stage however it dissolves at diplotene stage.
126. Answer (1)

Hint : Meiosis I is responsible for reduction in chromosomes number.
Sol. : In metaphase I,

- Bivalents align at equator.
- Two equatorial plates are formed.
- Each chromosome has two chromatids.
- Each chromosome is attached to the spindle fibre from one pole only.

127. Answer (2)

Hint : Chromatids do not separate in meiosis I.
Sol. : In meiosis I, only homologous chromosomes separate and each chromosome has two chromatids.
Thus, in interkinesis there is no need of DNA duplication as duplicated DNA forms sister chromatids.
128. Answer (3)

Sol. : Crossing over or exchange of genetic material between non-sister chromatids of homologous chromosomes takes place in pachytene stage.
129. Answer (4)

Hint : Meiosis is responsible for bringing new genetic combinations.
Sol. : Mitosis does not cause variations. Meiosis which involves crossing over, produces variations and new genetic combinations.
130. Answer (4)

Sol. : Amitosis occurs in both prokaryotes and eukaryotes and it does not involve spindle fibres formation.
131. Answer (2)

Sol. : Solanaceae, Anacardiaceae, Poaceae, Hominidae, Muscidae, Felidae - Family
Primata - Order
Insecta - Class
132. Answer (4)

Hint : This taxonomic aid is an index of plants of a given area.

Sol. : Flora has the informations of plants only
Museum, Key - for both plant and animals
Zoological park - only for animals.
133. Answer (3)

Hint : The feature exclusive to living beings is absent in non living things.
Sol. : Growth is also shown by non living things whereas metabolism, consciousness and reproduction are shown by living beings only.
134. Answer (3)

Sol. : Poales, Polymoniales - Order
Anacardiaceae - Family
Monocotyledonae - Class
Thus highest rank is Monocotyledonae.
135. Answer (2)

Hint : A correct scientific name includes generic name and specific epithet written in italics and name of discoverer.
Sol. : Correct scientific name of potato is Solanum tuberosum Linn.
136. Answer (2)

Hint : Site of digestion.
Sol. :

| Epithelium | Location |
| :--- | :--- |
| Brush bordered <br> columnar epithelium | Small intestine |
| Brush bordered <br> cuboidal | PCT |
| Ciliated cuboidal | Smaller bronchioles |
| Ciliated columnar | Oviduct/fallopian tube |

137. Answer (4)

Hint : Goblet cells are unicellular glands.
Sol. : A single celled gland i.e., goblet cells secrete mucus and are considered as unicellular glands.
138. Answer (1)

Hint : Found as supporting structure of pinna and nose.
Sol. : Cartilage consists of chondrocytes surrounded by lacunae and matrix rich in chondroitin sulfate.
139. Answer (4)

Hint : Endothelium receives nutrients indirectly by diffusion.

Sol. : Epithelial tissue has no blood supply i.e., it is avascular.
140. Answer (3)

Hint : Structure produced by fibroblasts.
Sol. : Blood lacks fibroblasts, which are responsible for producing fibres.
Basophils are WBCs and plasma proteins i.e., albumin, globulin and immunoglobulins are present in blood.
141. Answer (3)

Hint : Neurolemmocytes secrete myelin sheath.
Sol. : Schwann cells or neurolemmocytes form the insulating myelin rich sheath in peripheral nervous system (PNS) while oligodendrocytes form myelin sheath in central nervous system (CNS).
142. Answer (4)

Hint : Yellow fibrocartilage forms epiglottis.
Sol. :

| Cartilage | Location |
| :--- | :--- |
| Hyaline cartilage | Nasal septum |
| Elastic cartilage | Epiglottis |
| White fibrocartilage | Between vertebrae |
| Calcified cartilage | Pubis of pelvic girdle of <br> frog |

143. Answer (2)

Hint : Type of neuron with one axon and one dendrite.

Sol. :

| Neuron | Location |
| :--- | :--- |
| Unipolar | Early embryo |
| Bipolar | Retina of eye and olfactory <br> epithelium |
| Apolar | Nerve net of cnidarians |
| Pseudounipolar | Dorsal root of ganglion of the <br> spinal nerve |

144. Answer (2)

Hint : Functional syncytium is seen in these fibres.

Sol. : Multinucleated (structural) condition is shown by skeletal muscle fibres while cardiac muscle fibres are uninucleated.
145. Answer (4)

Hint : Smooth muscles are found in wall of visceral organs.
Sol. : Skeletal muscles are found in neck, face, bodywall and anterior $1 / 3^{\text {rd }}$ of oesophagus.
Smooth muscles are found in stomach, intestine, blood vessels, iris of eye etc.
146. Answer (3)

Hint : It is a type of adhering junction.
Sol. : Tight junctions help to stop substances from leaking across the tissue. Gap junctions help the cells to communicate with each other by connecting the cytoplasm of adjoining cells for rapid transfer of ions, small molecules and sometimes big molecules.
147. Answer (2)

Hint : Dense connective tissue is poorly vascularized.
Sol. : Haversian canal is present in compact bone and it is a feature of long mammalian bones. Areolar and adipose tissue are loose connective tissues.
148. Answer (2)

Hint : Uracil is a monocyclic base.
Sol. : Uridine is a nucleoside made up of ribose sugar and nitrogenous base uracil.
149. Answer (2)

Hint : Basic amino acids have more than one amino group.
Sol. : Lysine is a basic amino acid.
150. Answer (2)

Hint : It is a carbohydrate binding protein.
Sol. : Concanavalin A is a lectin. Toxins are abrin and ricin
151. Answer (3)

Hint : Macromolecules are present in retentate.
Sol. :
Galactose - Monosaccharide found in acid soluble pool.
Glycine - Amino acid found in acid soluble pool.
Adenine - Nitrogenous base found in acid soluble pool.
Myoglobin - Protein found in acid insoluble pool or retentate.
152. Answer (1)

Hint : Most abundant sugar on earth is made up of $\beta$ glucose units.

Sol. : Starch and Glycogen have $\alpha(1,4)$ glycosidic bonds in unbranched parts.

Maltose has $\alpha(1,4)$ glycosidic bond between two $\alpha$-glucose residues, Isomaltose is a disaccharide.
Lactose has $\beta(1,4)$ glycosidic bond between $\beta$-galactose and $\beta$-glucose.
153. Answer (3)

Hint : Inhibitor competes with PABA for the active site of enzyme.
Sol. : Inhibition of hexokinase by glucose-6phosphate and inhibition of threonine deaminase by isoleucine are the examples of allosteric inhibition. Inhibition of cytochrome oxidase by cyanide is an example of non-competitive inhibition.
154. Answer (3)

Hint : The base pairs in DNA are stacked $3.4 \AA$ apart.
Sol. : The rise per base pair is $3.4 \AA$,
Pitch $=$ Number of $b p \times$ rise/bp.
Therefore, pitch of $34 \AA$ has 10 bp .
155. Answer (2)

Hint: Receptors are proteinaceous in nature.
Sol. : Adenosine $=\underset{\substack{\text { (nitrogenous } \\ \text { base) }}}{\text { Adenine }}+$ Ribose sugar
Exoskeleton of arthropods is made up of chitin (Homopolysaccharides)
Cotton fibres are made up of cellulose (Homo polysaccharides)
156. Answer (4)

Hint : Identify a sugar.
Sol. : Sucrose is a non-reducing sugar with no free aldehyde or keto group.
157. Answer (1)

Hint : Systems at equilibrium do not perform work.

Sol. : Living organism can't afford to reach equilibrium as they work continuously.
Enzymes lower the activation energy barrier.
158. Answer (4)

Hint : Prostaglandins are derived from 20C unsaturated fatty acid.

Sol. : Prostaglandins are paracrine hormones and are derived lipids obtained from arachidonic acid. Arachidic acid is 20C saturated fatty acid.
159. Answer (1)

Hint : ATP is adenosine triphosphate.
Sol. : Nucleotides consist of nitrogenous base + sugar + phosphate moieties.
ATP consists of adenine $+\beta$-ribose +3 phosphates.
160. Answer (3)

Hint : The structural level with a 3-dimensional view of a protein.

Sol. : In biologically active form, the enzymes have tertiary structure as their active site is well defined.
161. Answer (3)

Hint : Water is required to catalyse this conversion.

Sol. :

- Class III of enzymes i.e., hydrolases breakdown sucrose into glucose and fructose by addition of water.
- Ligases catalyse covalent bonding of two substrates to form another molecule.
- Oxidoreductase is also known as dehydrogenase enzyme.
- Lyases catalyse the cleavage of substrate into two parts without the use of water e.g., aldolase.

162. Answer (4)

Hint : Ribozyme and ribonuclease $P$ are RNA molecules.
Sol. :

- Inulin is a polymer of fructose.
- Apoenzyme is the protein part of enzyme.

163. Answer (2)

Hint: Oesophagus opens into the cardiac part of stomach.

Sol.: V=Oesophagus
W = Pyloric
$X=$ fundus
$Y=$ cardiac
$Z=$ body
164. Answer (2)

Hint : Lateral attachment to jaw bone.
Sol. : Presence of pleurodont teeth are a feature of reptiles.
165. Answer (1)

Hint : This hexose is maximally absorbed in small intestine.
Sol. : In stomach - Absorption of water, simple sugars and alcohol occurs.
In small intestine - Absorption of glucose, fructose, fatty acid, glycerol, vitamins and amino acid occurs.
In large intestine - Absorption of some amount of water, minerals and drugs occurs.
166. Answer (1)

Hint : These cells secrete zymogenic form of proteolytic enzymes.
Sol. : Chief cells secrete pepsinogen that does not help in erythropoiesis.
Physiological value of calorific values is as follows:
Carbohydrates - $4 \mathrm{kcal} / \mathrm{g}$
Proteins - $4 \mathrm{kcal} / \mathrm{g}$
Fats - $9 \mathrm{kcal} / \mathrm{g}$
167. Answer (2)

Hint : Pancreatic enzymes work at a pH around 7.8.

Sol. :

| Gastric <br> enzymes <br> (stomach) | Pancreatic <br> enzymes | Intestinal <br> enzymes |
| :---: | :--- | :--- |
| Pepsinogen | Trypsinogen <br> Amylopsin <br> Nucleases <br> Steapsin | Enterokinase <br> Lactase <br> Dipeptidase <br> Nucleotidase |

168. Answer (2)

Hint : Reduced absorption of food is seen in this disorder.
Sol. : In constipation, the faeces are retained within the colon as the bowel movement is irregular. Vomiting is ejection of stomach contents through the mouth. In indigestion, the food is not properly digested leading to feeling of fullness.
169. Answer (2)

Hint : Mucosa is the innermost layer in the wall of alimentary canal.
Sol. :

170. Answer (2)

Hint : Wisdom teeth are absent in a 14 year old child.

Sol. : Dental formula of a 20 year old

$$
\left.\left.\begin{array}{rl} 
& \begin{array}{ccc} 
& C & P \\
M
\end{array} \\
= & \frac{2}{2} \\
\hline 2 & 1
\end{array}\right) 2 \begin{array}{ll}
3 & 2
\end{array}\right)
$$

As wisdom teeth (3 ${ }^{\text {rd }}$ molar) are absent in upper jaw of a 14 year old.
So, number of teeth in upper jaw is
$16-2=14$
171. Answer (4)

Hint : Disease which occurs due to deficiency of proteins.

Sol. : Scurvy occurs due to deficiency of vitamin C. Beri-Beri occurs due to deficiency of vitamin $B_{1}$. Marasmus occurs due to deficiency of protein and calories.
172. Answer (3)

Hint : Glisson's capsule is the characteristic feature of mammalian bile forming organ.
Sol. :

- Sphincter of Boyden guards the common bile duct.
- Duct of gall bladder is called cystic duct.
- Hepatic lobule is covered by a thin connective tissue sheath called Glisson's capsule.

173. Answer (4)

Hint : It is present between small and large intestine.
Sol. :

- lleocaecal valve is present between small intestine and caecum.
- Cardiac sphincter is present between oesophagus and stomach.

174. Answer (4)

Hint : Chylomicrons are formed in intestinal cells.
Sol. : Chylomicrons are formed in enterocytes and are absorbed in lacteals (lymphatic capillaries).
175. Answer (3)

Hint : Milk sugar consists of glucose and galactose.
Sol. : $\underset{\text { (Milk sugar) }}{\text { Lactose }} \xrightarrow{\text { Lactase }}$ Glucose + Galactose.
176. Answer (3)

Hint : Neutrophils are phagocytic WBCs.
Sol. : Histiocytes or clasmatocytes are macrophages of areolar tissue. Kupffer cell is a macrophage of liver.
177. Answer (4)

Hint : Milk sugar is lactose.

Sol. : Lactase is part of succus entericus found in small intestine.
178. Answer (4)

Hint : These cells secrete inactive precursors of proteolytic enzymes.
Sol. : Zymogen cells are present in gastric mucosa and pancreas.
179. Answer (2)

Hint : The burning sensation in oesophagus due to opening of cardiac sphincter is heart burn.
Sol. : Inguinal hernia is the protrusion of the intestine into inguinal canal.
Haemorrhoids or Piles - Rectal veins can get distended or enlarged due to weakening of their valves.
180. Answer (3)

Hint : It occurs due to deficiency of a water soluble vitamin.
Sol. :

- Pernicious anaemia, occurs due to deficiency of Vitamin $\mathrm{B}_{12}$.
- Scurvy occurs due to deficiency of Vit. C.
- Rickets in children occurs due to deficiency of Vit. D.
- Pellagra occurs due deficiency of Vit. $B_{3}$.


## All India Aakash Test Series for Medical - 2020

## TEST - I (Code-F)

Test Date : 13/10/2019

## ANSWERS

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

# HINTS \& SOLUTIONS <br> [PHYSICS] 

1. Answer (2)

Hint: Use $a_{T}=v \frac{d v}{d s}$ and $a=\sqrt{a_{T}^{2}+a_{R}^{2}}$.
Sol. : Given $v=\alpha \sqrt{x}$

$$
\begin{aligned}
& \frac{d v}{d x}=\frac{\alpha}{2 \sqrt{x}} \\
& a=v \frac{d v}{d x}=\alpha \sqrt{x} \frac{\alpha}{2 \sqrt{x}}=\frac{\alpha^{2}}{2} \\
& \begin{aligned}
a & =\sqrt{a_{T}^{2}+\left(\frac{v^{2}}{R}\right)^{2}} \\
& =\sqrt{\frac{\alpha^{4}}{4}+\left(\frac{\alpha^{2} x}{R}\right)^{2}} \\
& =\sqrt{\frac{\alpha^{4}}{4}+\alpha^{4} \frac{x^{2}}{R^{2}}} \\
& =\frac{\alpha^{2}}{2} \sqrt{1+4\left(\frac{2 R^{2}}{R^{2}}\right)} \\
\Rightarrow & a=\frac{3}{2} \alpha^{2}
\end{aligned}
\end{aligned}
$$

2. Answer (1)

Hint : Use $\vec{v}_{A B}=\vec{v}_{A}-\vec{v}_{B}$.
Sol. :

$\vec{v}_{r}=\left(-20 \sin 30 \hat{i}-20 \cos 30^{\circ} \hat{j}\right) \mathrm{m} / \mathrm{s}$
$=(-10 \hat{i}-10 \sqrt{3} \hat{j}) \mathrm{m} / \mathrm{s}$
Now $\vec{v}_{m}=-2 \cdot(20 \sin 30) \hat{i} \mathrm{~m} / \mathrm{s}$

$$
=-20 \hat{i} \mathrm{~m} / \mathrm{s}
$$

3. Answer (4)

Hint: Use $y=x \tan \theta-\frac{g x^{2}}{2 u^{2} \cos ^{2} \theta}$.
Sol. : Given $y=\frac{1}{2} \mathrm{~m}, x=\sqrt{3} \mathrm{~m}$ and $\theta=30^{\circ}$
i.e. $\frac{1}{2}=\sqrt{3} \times \frac{1}{\sqrt{3}}-\frac{10 \times 3}{2 \times v_{0}^{2} \cdot \frac{3}{4}}$
$\frac{20}{v_{0}^{2}}=\frac{1}{2}$
$v_{0}^{2}=40$
$v_{0}=\sqrt{40}=2 \sqrt{10} \mathrm{~m} / \mathrm{s}$
4. Answer (2)

Hint : Use law of vector addition.
Sol. :

$\tan \alpha=\frac{B \sin \theta}{A+B \cos \theta}$
$\tan \beta=\frac{B \sin \theta}{A-B \cos \theta}$
$\tan \alpha+\tan \beta=\frac{B \sin \theta}{A+B \cos \theta}+\frac{B \sin \theta}{A-B \cos \theta}$
$=\frac{A B \sin \theta-B^{2} \sin \theta \cos \theta+A B \sin \theta+B^{2} \sin \theta \cos \theta}{A^{2}-B^{2} \cos ^{2} \theta}$
i.e. $\tan \alpha+\tan \beta=\frac{2 A B \sin \theta}{A^{2}-B^{2} \cos ^{2} \theta}$
5. Answer (1)

Hint : $\tan \theta=\frac{a_{r}}{a_{T}}$.
Sol. : $\tan 45^{\circ}=\frac{a_{r}}{a_{T}} \Rightarrow a_{r}=a_{T}$

$$
\begin{aligned}
& r \alpha=r \omega^{2} \\
& \Rightarrow \alpha=(\alpha t)^{2} \\
& t=\sqrt{\frac{1}{\alpha}}=\frac{2}{\sqrt{\pi}} \mathrm{~s}
\end{aligned}
$$

6. Answer (4)

Hint \& Sol. : To produce zero resultant, sum of magnitude of any two vectors should be greater than or equal to the magnitude of third vector.
7. Answer (1)

Hint: Use $v^{2}=u^{2}+2 g h$.
Sol. : $u_{x}=u$
$u_{y}=0$
$a_{y}=g$
And $s_{y}=\frac{H}{2}$
Then $v=\sqrt{u_{x}^{2}+\left(u_{y}^{2}+2 g \frac{H}{2}\right)}$

$$
=\sqrt{u^{2}+g H}
$$

8. Answer (2)

Hint: Use $y=x \tan \theta\left(1-\frac{x}{R}\right)$.
Sol. : Given $y=4 x\left(1-\frac{x}{3.9}\right)$
By comparing, $\tan \theta=4$
$R=3.9$ m
Hence, $R \tan \theta=3.9 \times 4=15.6 \mathrm{~m}$
9. Answer (1)

Hint : Horizontal component of velocity remains constant.
Sol. :


$$
\begin{aligned}
& u_{x}=u \cos 60^{\circ}=20 \times \frac{1}{2} \\
&=10 \mathrm{~m} / \mathrm{s} \\
& u_{y}=u \sin 60^{\circ}=20 \times \frac{\sqrt{3}}{2} \\
&=10 \sqrt{3} \mathrm{~m} / \mathrm{s} \\
& v_{x}=u_{x} \\
& v \cos 30^{\circ}=10 \\
& \frac{v \sqrt{3}}{2}=10 \\
& v=\frac{20}{\sqrt{3}} \mathrm{~m} / \mathrm{s}
\end{aligned}
$$

10. Answer (4)

Hint : Use $\vec{v}_{\text {avg }}=\frac{\vec{v}_{1}+\vec{v}_{2}}{2}$ for uniformly accelerated motion.
Sol. : $\vec{v}_{\text {avg }, y}=\frac{u \sin \theta+0}{2}=\frac{u \sin \theta}{2} \hat{j}$
$\vec{v}_{\text {avg }, x}=u \cos \theta \hat{i}$
Now $\left\langle v_{\text {avg }}\right\rangle=\sqrt{v_{\text {avg }, x}^{2}+v_{\text {avg }, y}^{2}}$
$=\sqrt{u^{2} \cos ^{2} \theta+\frac{u^{2}}{4} \sin ^{2} \theta}$
$=\frac{u}{2} \sqrt{4 \cos ^{2} \theta+\sin ^{2} \theta}$
$\left\langle v_{\text {avg }}\right\rangle=\frac{u}{2} \sqrt{1+3 \cos ^{2} \theta}$
11. Answer (2)

Hint : $\vec{v}_{A B}=\vec{v}_{A}-\vec{v}_{B}$.
Sol. : Given $\vec{v}_{A}=v_{A} \hat{i}$
$\vec{v}_{B}=\frac{V_{B}}{\sqrt{2}}(\hat{i}-\hat{j})$
For $\vec{v}_{B A}$ to be due south, $x$ component of $\vec{v}_{B A}$ should be zero.
$\Rightarrow \quad v_{A}=\frac{v_{B}}{\sqrt{2}}$
$\frac{v_{A}}{v_{B}}=\frac{1}{\sqrt{2}}$
12. Answer (1)

Hint : $R=\frac{v^{2}}{a_{\perp}}$.
Sol. :

$R_{1}=\frac{u^{2} \cos ^{2} \theta}{g}$
$R_{2}=\frac{u^{2}}{g \cos \theta}$
$\frac{R_{1}}{R_{2}}=\frac{\frac{u^{2} \cos ^{2} \theta}{g}}{\frac{u^{2}}{g \cos \theta}}$
$\Rightarrow \frac{R_{1}}{R_{2}}=\cos ^{3} \theta$
13. Answer (3)

Hint \& Sol. : Horizontal velocity of ball for person $P$ is zero and for person $Q$ it is non-zero. Hence for person $P$, ball moves in straight line path while for person $Q$, ball seems to move on parabolic path.
14. Answer (3)

Hint : $v^{2}=u^{2}+2 a_{T} s$.
Sol. : $120^{2}=2\left[2\left(2 \pi \frac{40}{\pi}\right)\right] a_{T}$

$$
\begin{aligned}
a_{T} & =\frac{90}{2} \mathrm{~m} / \mathrm{s}^{2} \\
& =45 \mathrm{~ms}^{2}
\end{aligned}
$$

15. Answer (4)

Hint : $v_{w}=u_{s} \sin \theta$.
Sol. : $v_{w}=9 \mathrm{kmph} \times \sin \left(120^{\circ}-90^{\circ}\right)$

$$
\begin{aligned}
& =\frac{9}{2} \mathrm{kmph} \\
& =\frac{9}{2} \times \frac{5}{18}=1.25 \mathrm{~m} / \mathrm{s}
\end{aligned}
$$

16. Answer (3)

Hint : $\vec{v}_{\text {avg }}=\frac{\text { Displacement }}{\text { Time }}$
Sol. : Displacement $\vec{r}=\vec{r}_{2}-\vec{r}_{1}$
$\vec{r}=(9 \hat{i}+9 \hat{j}) \mathrm{m}$

$$
\begin{aligned}
\vec{v}_{\mathrm{avg}} & =\frac{\vec{r}}{t}=\frac{9}{6}(\hat{i}+\hat{j}) \mathrm{m} / \mathrm{s} \\
& =\frac{3}{2}(\hat{i}+\hat{j}) \mathrm{m} / \mathrm{s}
\end{aligned}
$$

17. Answer (1)

Hint : Motion of particle in circular path.
Sol. : Given $\vec{r}=r_{0}(\cos \omega t \hat{i}+\sin \omega t \hat{j}) m$
$\vec{v}=r_{0} \omega(-\sin \omega t \hat{i}+\cos \omega t \hat{j}) \mathrm{m} / \mathrm{s}$
$\vec{a}=-r_{0} \omega^{2}(\cos \omega t \hat{i}+\sin \omega t \hat{j}) \mathrm{m} / \mathrm{s}^{2}$
$\vec{a}=-\omega^{2} \vec{r}$
Angle between $\vec{v}$ and $\vec{r}$ is $90^{\circ}$ while between $\vec{a}$ and $\vec{r}$ is $180^{\circ}$.
18. Answer (1)

Hint : $T=t_{1}+t_{2}=\frac{2 u \sin \theta}{g}$.
Sol. : $0.5+1.5=\frac{2 \times 20 \sin \theta}{10}$
$\sin \theta=\frac{1}{2}$
$\theta=30^{\circ}$
19. Answer (2)

Hint : $t=\sqrt{\frac{2 h}{g}}$ and $R=u_{x} \cdot t$
Sol. : $u_{x}=216 \mathrm{~km} / \mathrm{h}=60 \mathrm{~m} / \mathrm{s}$

$$
\begin{aligned}
& t=\sqrt{\frac{2 \times 980}{9.8}}=10 \sqrt{2} \mathrm{~s} \\
& \begin{aligned}
R=u_{x} \cdot t & =60 \times 10 \sqrt{2} \\
= & 600 \sqrt{2} \mathrm{~m}
\end{aligned}
\end{aligned}
$$

20. Answer (4)

Hint : Motion of particle in a plane
Sol. : Given $\vec{r}=\left[(3 t) \hat{i}-\left(2 t^{2}\right) \hat{j}+\hat{k}\right] \mathrm{m}$
$\vec{v}=\frac{d \vec{r}}{d t}=[3 \hat{i}-4 t \hat{j}] \mathrm{m} / \mathrm{s}$
$a=\frac{d v}{d t}=-4 \hat{j} \mathrm{~m} / \mathrm{s}^{2}$
21. Answer (2)

Hint : $R=\sqrt{P^{2}+Q^{2}+2 P Q \cos \theta}$.
Sol. : Given $R=\sqrt{9 A^{2}+4 A^{2}+12 A^{2} \cos \theta}$
$2 R=\sqrt{36 A^{2}+4 A^{2}+24 A^{2} \cos \theta}$
$\frac{1}{4}=\frac{13+12 \cos \theta}{40+24 \cos \theta}$
$\Rightarrow 40+24 \cos \theta=52+48 \cos \theta$
$\Rightarrow \cos \theta=-\frac{1}{2}$
$\Rightarrow \theta=120^{\circ}$
22. Answer (1)

Hint \& Sol. : If angle of projection is nearer to $45^{\circ}$, then range becomes larger.
Hence, $\Delta \theta_{A}=\left|45^{\circ}-39^{\circ}\right|=6^{\circ}$
$\Delta \theta_{B}=\left|45^{\circ}-43^{\circ}\right|=2^{\circ}$
$\Delta \theta_{C}=\left|45^{\circ}-52^{\circ}\right|=7^{\circ}$
$\Delta \theta_{D}=\left|45^{\circ}-46^{\circ}\right|=1^{\circ}$
Hence, $R_{D}>R_{B}>R_{A}>R_{C}$
23. Answer (2)

Hint : Use $R=\sqrt{A^{2}+B^{2}+2 A B \cos \theta}$.
Sol. :

$\vec{v}_{\text {boat }}=(36 \hat{j}) \mathrm{km} / \mathrm{h}$
$\vec{v}_{\text {river }}=10 \hat{i} \mathrm{~km} / \mathrm{h}$

Now $\vec{v}_{\text {res }}=\sqrt{v_{\text {boat }}^{2}+v_{\text {river }}^{2}}$

$$
\begin{aligned}
& =\sqrt{36^{2}+10^{2}} \\
& =37 \mathrm{~km} / \mathrm{h}
\end{aligned}
$$

24. Answer (1)

Hint : $\vec{v}_{\text {rel }}=\vec{v}_{1}-\vec{v}_{2}$.
Sol. : $\left|\vec{v}_{\text {bullet, train }}\right|=\left|\vec{v}_{\text {bullet }}-\vec{v}_{\text {train }}\right|$

$$
=180-(-20)=200 \mathrm{~m} / \mathrm{s}
$$

Now, length of train $=L=v_{\text {bullet, train }} \times t$

$$
\begin{aligned}
& =200 \times 1.5 \\
& =300 \mathrm{~m}
\end{aligned}
$$

25. Answer (2)

Hint: Use $h=-u t+\frac{1}{2} g t^{2}$.
Sol. : Given that $h=80 \mathrm{~m}, g=10 \mathrm{~m} / \mathrm{s}^{2}$ and $u=-20 \mathrm{~m} / \mathrm{s}$
$80=-20 t+5 t^{2}$
$t^{2}-4 t-16=0$
$t=\frac{4 \pm \sqrt{16+64}}{2} \simeq \frac{4+9}{2}$

$$
=6.5 \mathrm{~s}
$$

26. Answer (1)

Hint : Motion under gravity.
Sol. : Let the height of each storey be $h$ then total height will be 16 h
$16 h=0+\frac{1}{2} \times 10 \times 4^{2}$
$h=5 \mathrm{~m}$
Now in 1 s , packet travels,
$s=\frac{1}{2} \times 10 \times 1^{2}=5 \mathrm{~m}$
Hence the packet travels 1 storey i.e. $m=1$
27. Answer (2)

Hint : Change in velocity $=$ area under $a-t$ curve.
Sol. : $v_{f}-v_{i}=$ area under a-t curve

$$
=\frac{(8+4)}{2}+4 \times 1+4 \times \frac{1}{2}-4 \times \frac{1}{2}
$$

$v_{f}-(-20)=10$
$v_{f}=-10 \mathrm{~m} / \mathrm{s}$
28. Answer (2)

Hint : $v_{\text {rel }}=\frac{S_{\text {rel }}}{\text { Time }}$.
Sol. : Given $s_{\text {rel }}=500 \mathrm{~m}$ and $t=50 \mathrm{~s}$
Then $v_{\text {rel }}=\frac{500}{50}=10 \mathrm{~m} / \mathrm{s}$
i.e., $v_{\text {jeep }}-v_{\text {bus }}=10$
$v_{\text {jeep }}=10+20=30 \mathrm{~m} / \mathrm{s}$
29. Answer (1)

Hint : $a=v \frac{d v}{d z}$.
Sol. : Since $\frac{d v}{d z}=\frac{0-6}{2-0}=-3 \mathrm{~s}^{-1}$
Now from plot $v=-3 z+6$
$v(z=1 \mathrm{~m})=-3 \times 1+6=3 \mathrm{~m} / \mathrm{s}$
$a=v \frac{d v}{d z}$
$a(z=1 \mathrm{~m})=3 \times-3=-9 \mathrm{~m} / \mathrm{s}^{2}$
$\Rightarrow|a|=9 \mathrm{~m} / \mathrm{s}^{2}$
30. Answer (4)

Hint : Definite integration of trigonometrical function.
Sol. : $\int_{0}^{\pi} 4 \cos 2 \theta=4\left[\frac{\sin 2 \theta}{2}\right]_{0}^{\pi}$

$$
\begin{aligned}
& =2\left[\sin 2 \pi-\sin 0^{\circ}\right] \\
& =0
\end{aligned}
$$

31. Answer (1)

Hint \& Sol. : At a given time instant the particle cannot have more than one velocity.
32. Answer (2)

Hint : Average speed $=\frac{\text { Total distance }}{\text { Total time }}$
Sol. : Let total distance covered be $s$
Then, $t_{1}=\frac{\frac{s}{5}}{12}=\frac{s}{60}$

$$
\begin{aligned}
& t_{2}=\frac{\frac{4 s}{5}}{8}=\frac{s}{10} \\
& v_{\text {avg }}=\frac{s}{\frac{s}{10}+\frac{s}{60}}=\frac{60}{7} \mathrm{~m} / \mathrm{s}
\end{aligned}
$$

33. Answer (3)

Hint : Application of differential calculus.
Sol. : $x=12 t^{2}-4 t^{3}$
$v=24 t-12 t^{2}$
$a=24-24 t$
Velocity will be maximum when $a=0$
$\Rightarrow t=1 \mathrm{~s}$
Now $x=12-4=8 \mathrm{~m}$
34. Answer (4)

Hint : Rules of arithmetic operations with significant figures.
Sol. : Mass $=$ Density $\times$ Volume

$$
\begin{aligned}
& =1200.0 \times 1.00=1200.0 \mathrm{~g} \\
& =1.20 \times 10^{3} \mathrm{~g}
\end{aligned}
$$

35. Answer (1)

Hint : Use application of dimensional analysis.
Sol. : $U=\frac{\alpha x^{3 / 2}}{x^{3}+\beta}$

$$
\because \quad[\beta]=\left[L^{3}\right]
$$

and $[\alpha]\left[\mathrm{L}^{3 / 2}\right]=\left[\mathrm{ML}^{2} \mathrm{~T}^{-2}\right]\left[\mathrm{L}^{3}\right]$
$[\alpha]=\left[\mathrm{ML}^{7 / 2 \mathrm{~T}^{-2}}\right]$
$\therefore\left[\frac{\alpha}{\beta}\right]=\left[\mathrm{ML}^{\frac{1}{2}} \mathrm{~T}^{-2}\right]$
36. Answer (3)

Hint : Use rule of arithmetic operations with significant figure.
Sol. : $7.5+2.71+4.732=14.942$
With proper significant figure, result can be written as 14.9. Hence addition has three significant figures.
37. Answer (2)

Hint \& Sol. : From dimensional analysis
[Torque] $=[$ Work $]=\left[\mathrm{ML}^{2 \mathrm{~T}^{-2}}\right]$
[Surface tension $]=\left[\mathrm{ML}^{0} \mathrm{~T}^{-2}\right]$
[Velocity] $=\left[\mathrm{LT}^{-1}\right]$
38. Answer (1)

Hint : Use rules of propagation of error
Sol. : $v=\sqrt{\frac{T L}{M}}$

$$
\begin{aligned}
\frac{\Delta v}{v} \times 100 & =\frac{1}{2} \frac{\Delta T}{T} \times 100+\frac{1}{2} \frac{\Delta L}{L} \times 100+\frac{1}{2} \frac{\Delta M}{M} \times 100 \\
& =\frac{1}{2} \times 2+\frac{1}{2} \times 1+\frac{1}{2} \times 1 \\
& =2 \%
\end{aligned}
$$

39. Answer (4)

Hint : Use dimensional analysis.
Sol. : $\frac{B^{2}}{2 \mu_{0}} \rightarrow$ represents energy density

$$
\begin{aligned}
\therefore\left[\frac{B^{2}}{2 \mu_{0}}\right] & =\frac{[\text { Energy }]}{[\text { Volume }]}=\left[\frac{\mathrm{ML}^{2} \mathrm{~T}^{-2}}{\mathrm{~L}^{3}}\right] \\
& =\left[\mathrm{ML}^{-1} \mathrm{~T}^{-2}\right]
\end{aligned}
$$

40. Answer (3)

Hint : Properties of fundamental forces.
Sol. : Strong nuclear is a fundamental force, mediated by the particle $\pi$-meson and it is 100 times stronger (approximately) than electromagnetic force. Gravitational force is central force. Sir C.V. Raman won the Nobel prize for study of scattering of light by molecules.
41. Answer (2)

Hint \& Sol. : Electromagnetic and gravitational forces are fundamental forces having infinite range.
42. Answer (4)

Hint : Use dimensional formula of $R, C$ and $L$.
Sol. : RC= time constant of R-C circuit
$\frac{L}{R}=$ time constant of $\mathrm{L}-\mathrm{R}$ circuit
Now $\left[\frac{R C}{\left(\frac{L}{R}\right)}\right]=\left[\mathrm{M}^{0} \mathrm{~L}^{0} \mathrm{~T}^{0}\right]$
43. Answer (1)

Hint : Find mean value of measurement and

$$
\Delta a_{i}=a_{\text {mean }}-a_{i} .
$$

Sol. $: a_{m}=(1.50+1.52+1.53+1.51+1.54) / 5$

$$
=1.52
$$

$\Delta a_{1}=1.52-1.50=0.02$
$\Delta a_{2}=1.52-1.52=0.00$
$\Delta a_{3}=1.52-1.53=-0.01$
$\Delta a_{4}=1.52-1.51=0.01$
$\Delta a_{5}=1.52-1.54=-0.02$

$$
\begin{aligned}
\Delta a_{m} & =\frac{\left|\Delta a_{1}\right|+\left|\Delta a_{2}\right|+\left|\Delta a_{3}\right|+\left|\Delta a_{4}\right|+\left|\Delta a_{5}\right|}{5} \\
& =\frac{0.02+0.00+0.01+0.01+0.02}{5} \\
& =0.012 \\
& =0.01 \\
\frac{\Delta a_{m}}{a_{m}} & =\frac{0.01}{1.52}=6.58 \times 10^{-3} \\
& =0.00658=0.007 \\
\frac{\Delta a_{m}}{a_{m}} & \times 100=0.7 \%
\end{aligned}
$$

44. Answer (1)

Hint \& Sol. : 179 can be represented in scientific notation as $1.79 \times 10^{2}$. Then order of magnitude is 2 .
45. Answer (3)

Hint \& Sol. : Lesser the value of least count, more will be the precision.
[CHEMISTRY]
46. Answer (3)

Hint $: E \propto \frac{\mathrm{Z}^{2}}{\mathrm{n}^{2}}$.
Sol. : $\mathrm{E}_{2}\left(\mathrm{He}^{+}\right) \propto \frac{\mathrm{Z}^{2}}{(2)^{2}}$
$\mathrm{E}_{3}\left(\mathrm{He}^{+}\right) \propto \frac{\mathrm{z}^{2}}{(3)^{2}}$
$\mathrm{E}_{2}\left(\mathrm{He}^{+}\right): \mathrm{E}_{3}\left(\mathrm{He}^{+}\right)=\frac{\mathrm{Z}^{2}}{4} \times \frac{9}{\mathrm{Z}^{2}}=\frac{9}{4}$
47. Answer (4)

Hint : $\mathrm{C}_{2}: \sigma 1 s^{2}, \sigma^{*} 1 s^{2}, \sigma 2 s^{2}, \sigma^{*} 2 s^{2}, \pi 2 p_{\mathrm{x}}^{2}=\pi 2 p_{\mathrm{y}}{ }^{2}$.
Sol. : B.O. $\left(\right.$ of $\left.\mathrm{C}_{2}\right)=\frac{8-4}{2}=2$
$\therefore \quad$ Both the bonds in $\mathrm{C}_{2}$ are $\pi$-bonds.
48. Answer (1)

Hint : Hydrogen bonding within the molecule is called intramolecular hydrogen bonding.
Sol. :

49. Answer (2)

Hint : $\pi$-molecular orbital of $N_{2}$ is completely filled.

Sol. : Coming electron should be accommodated in vacant $\pi^{*}$-orbital of $\mathrm{N}_{2}$.
50. Answer (1)

Hint : HF forms intermolecular H -bonding.
Sol. : Boiling point : $\mathrm{HF}>\mathrm{HI}>\mathrm{HBr}>\mathrm{HCl}$.
51. Answer (3)

Hint : The lone pairs of electrons are called nonbonding electrons.
Sol. :


Number of non-bonding pair of electrons $=3 \times 5$

$$
=15
$$

52. Answer (1)

Hint : Bond order $=\frac{1}{2}$ (Number of electrons in bonding $\mathrm{MO}-$ Number of electrons in antibonding MO)
Sol. : $\mathrm{O}_{2}^{+}=\frac{1}{2}(10-5)=2.5$
$\mathrm{O}_{2}^{-}=\frac{1}{2}(10-7)=1.5$
$\mathrm{C}_{2}^{+}=\frac{1}{2}(7-4)=1.5$
$\mathrm{CO}=\frac{1}{2}(10-4)=3$
53. Answer (3)

Hint: Species having incomplete octet is electron deficient.
54. Answer (4)

Hint : Shape can be predicted if hybridisation of central atom of the given species is known.
Sol. :


Square pyramidal


Trigonal planar


Bent


Bent
55. Answer (2)

Hint: $\mathrm{M}_{1} \mathrm{~V}_{1}+\mathrm{M}_{2} \mathrm{~V}_{2}=\left(\mathrm{V}_{1}+\mathrm{V}_{2}\right) \mathrm{M}_{3}$.
Sol. : $(400 \times 2+600 \times 1)=(600+400) \mathrm{M}_{3}$
$M_{3}=\frac{1400}{1000}=1.4 \mathrm{M}$
56. Answer (4)

Hint : Electronegativity of fluorine is highest.
Sol. : Fluorine is $17^{\text {th }}$ group element and belongs to second period.
57. Answer (1)

Hint $: r_{n} \propto \frac{n^{2}}{Z}$.
Sol. : $r_{1}(H) \propto(1)^{2}$
$r_{2}\left(\mathrm{Li}^{2+}\right) \propto \frac{(2)^{2}}{3}$
$\frac{r_{1}(\mathrm{H})}{r_{2}\left(\mathrm{Li}^{2+}\right)}=\frac{3}{4}$
or, $\frac{\mathrm{a}}{\mathrm{r}_{2}\left(\mathrm{Li}^{2+}\right)}=\frac{3}{4}$
or, $\quad r_{2}\left(\mathrm{Li}^{2+}\right)=\frac{4}{3} \mathrm{a} \AA$
58. Answer (2)

Hint : Number of spectral lines $=\sum(n-1)$
Sol. : Number of spectral lines $=\sum(5-1)$

$$
\begin{aligned}
& =4+3+2+1 \\
& =10
\end{aligned}
$$

59. Answer (3)

Hint : During ionisation, electrons are always removed from outermost shell.

Sol. : $\mathrm{Mn}^{3+} \longrightarrow[\mathrm{Ar}] 3 d^{4} 4 s^{0}$
60. Answer (1)

Hint : $\Delta x \cdot \Delta p \geq \frac{h}{4 \pi}$.
Sol. : $\Delta p=2 \Delta x$
$\frac{\Delta p}{2} \cdot \Delta p=\frac{h}{4 \pi}$
$(\Delta \mathrm{p})^{2}=\frac{\mathrm{h}}{2 \pi}$
$\Delta \mathrm{p}=\sqrt{\frac{\mathrm{h}}{2 \pi}}$
$m \Delta v=\sqrt{\frac{h}{2 \pi}}$
$\Delta v=\frac{1}{m} \sqrt{\frac{h}{2 \pi}}$
61. Answer (2)

Hint : Isoelectronic species have same number of electrons.
62. Answer (2)

Hint : $\frac{1}{\lambda}=R Z^{2}\left(\frac{1}{n_{1}^{2}}-\frac{1}{n_{2}^{2}}\right)$.
Sol. : $\frac{1}{\lambda}=R(2)^{2}\left(\frac{1}{1^{2}}-\frac{1}{4^{2}}\right)$
Or, $\frac{1}{\lambda}=4 \mathrm{R} \times \frac{15}{16}$
Or, $\lambda=\frac{4}{15 R}$
63. Answer (1)

Hint : Average atomic mass $=\frac{\sum x_{i} M_{i}}{100}$.
Sol. : Average atomic mass

$$
\begin{aligned}
& =\frac{150 \times 40+148 \times 20+151 \times 40}{100} \\
& =150.0 u
\end{aligned}
$$

64. Answer (3)

Hint : One mole of biomolecule will contain one mole of $\mathrm{Co}^{2+}$ to get minimum molecular weight of biomolecule.
Sol. : 0.59 g of $\mathrm{Co}^{2+}$ is present in 100 g of biomolecule.
59 g of $\mathrm{Co}^{2+}$ is present in $\frac{100}{0.59} \times 59=10000 \mathrm{~g}$.
65. Answer (2)

Hint: NaCl is limiting reagent.
Sol. : $\mathrm{NaCl}(\mathrm{aq})+\mathrm{AgNO}_{3}(\mathrm{aq}) \longrightarrow \mathrm{AgCl}(\mathrm{s})+$ $\mathrm{NaNO}_{3}(\mathrm{aq})$
mmol of $\mathrm{NaCl}=100 \times 0.2=20 \mathrm{mmol}$
mmol of $\mathrm{AgNO}_{3}=50 \times 0.5=25 \mathrm{mmol}$
NaCl is limiting reagent
$\therefore \quad$ Mole of NaCl reacted $=$ Mole of AgCl formed

$$
=20 \times 10^{-3}=0.02
$$

66. Answer (4)

Hint :
Molality $=\frac{\text { Mass of solute } \times 1000}{\text { Mass of solvent }(\mathrm{g}) \times \text { Molar mass of solute }}$
Sol. : Molality $=\frac{16 \times 1000}{84 \times 32}=5.95 \mathrm{~m}$
67. Answer (1)

Hint : Hybridisation of central atom is determined by number of $\sigma$-bonds and lone pairs.
Sol. : Molecule

| $\mathrm{SF}_{6}$ | $s p^{3} d^{2}$ |
| :---: | :---: |
| $\mathrm{SF}_{4}$ | $s p^{3} d$ |
| $\mathrm{H}_{2} \mathrm{SO}_{3}$ | $s p^{3}$ |

68. Answer (2)

Hint : Electronic configuration of $\mathrm{O}_{2}$ molecule: $\sigma 1 s^{2}, \sigma^{*} 1 s^{2}, \sigma 2 s^{2}, \sigma^{*} 2 s^{2}, \sigma 2 p_{z}^{2}, \pi 2 p_{x}^{2}=\pi 2 p_{y}^{2}$, $\pi^{*} 2 p_{x}{ }^{1}=\pi^{*} 2 p_{y}{ }^{1}$
Sol. : Number of bonding electrons $=10$.
69. Answer (2)

Hint : The molecule will be linear in shape if the central atom is $s p$ hybridised.

## Sol. :





70. Answer (2)

Hint : Dipole moment depends on shape, polarity of bond and direction of bond dipoles.

Sol. : $\mu\left(\mathrm{NH}_{3}\right)=1.47 \mathrm{D}$

$$
\begin{aligned}
& \mu\left(\mathrm{H}_{2} \mathrm{~S}\right)=0.95 \mathrm{D} \\
& \mu\left(\mathrm{NF}_{3}\right)=0.23 \mathrm{D} \\
& \mu\left(\mathrm{PCl}_{5}\right)=0.0 \mathrm{D}
\end{aligned}
$$

71. Answer (2)

Hint : Total number of orbital in $\mathrm{n}^{\text {th }}$ shell is $\mathrm{n}^{2}$.
Sol. : Number of atomic orbitals in $5^{\text {th }}$ shell $=5^{2}$

$$
=25
$$

72. Answer (2)

Hint : $\lambda=\frac{\mathrm{h}}{\mathrm{mv}}$
Sol. : $\lambda=\frac{6.6 \times 10^{-34}}{1 \times 10^{-6} \times 200}=3.3 \times 10^{-30} \mathrm{~m}$
73. Answer (3)

Hint : For single electron species, the orbitals of same shell have same energy.
Sol. : Hydrogen is one electron species hence $2 s$ and $2 p$ orbitals have same energy.
74. Answer (1)

Hint : Chlorine has highest electron affinity.
75. Answer (2)

Hint : Element ' $X$ ' electronic configuration is [Ar] $3 d^{10} 4 s^{2} 4 p^{5}$.
Sol. : Since last electron enters in $p$-orbital so it is a $p$-block element.
76. Answer (1)

Hint : For isoelectronic species, more the negative charge greater is the ionic radii.
77. Answer (1)

Hint : For a given cation larger the size of anion greater is the covalent character of ionic compound.
78. Answer (1)

Hint : The species which contains only paired electrons in the molecular orbitals are diamagnetic in nature.
Sol. : In $\mathrm{NO}^{+}$, all filled molecular orbitals contain paired electrons.
79. Answer (2)

Hint : S of $\mathrm{SO}_{3}$ and B in $\mathrm{BCl}_{3}$ are $s p^{2}$ hybridised.
Sol. : $\mathrm{NH}_{3} \longrightarrow$ Pyramidal

$$
\begin{aligned}
& \stackrel{\oplus}{\mathrm{NH}_{4}} \longrightarrow \text { Tetrahedral } \\
& \mathrm{SO}_{3} \longrightarrow \text { Trigonal planar } \\
& \mathrm{BCl}_{3} \longrightarrow \text { Trigonal planar } \\
& \mathrm{SO}_{4}^{2-} \longrightarrow \text { Tetrahedral } \\
& \mathrm{NO}_{3}^{-} \longrightarrow \text { Trigonal planar } \\
& \mathrm{CIF}_{3} \longrightarrow \text { T-shape } \\
& \mathrm{I}_{3}^{-} \longrightarrow \text { Linear }
\end{aligned}
$$

80. Answer (2)

Hint : Number of $\pi$-bonds present in the given molecule is 3 .

Sol. :


Number of $\sigma$-bonds $=14$
Number of $\pi$-electrons $=6$
81. Answer (3)

Hint : Xe in $\mathrm{XeO}_{2} \mathrm{~F}_{2}$ is $s p^{3} d$ hybridised.

## Sol. :


(see-saw shape)
82. Answer (2)

Hint: Bond order $=\frac{1}{2}$ (Number of electrons in bonding MO - Number of electrons in antibonding MO).

Sol. : Bond order of $\mathrm{N}_{2}=\frac{1}{2}(10-4)=3$
Bond order of $\mathrm{N}_{2}^{-}=\frac{1}{2}(10-5)=2.5$
Bond order of $\mathrm{N}_{2}^{2-}=\frac{1}{2}(10-6)=2$
Lesser the bond order, longer is the bond length
$\therefore$ Bond length order: $\mathrm{N}_{2}^{2-}>\mathrm{N}_{2}^{-}>\mathrm{N}_{2}$
83. Answer (4)

Hint : Hydrogen does not form $\pi$-bond with sulphur.
84. Answer (4)

Hint : For principal quantum number n , azimuthal quantum number ( $\ell$ ) will be: $0,1,2, \ldots(n-1)$.

Sol. : For $n=3, \ell$ cannot be 3 .
85. Answer (3)

Hint : Magnetic orbital quantum number gives information about spatial orientation of the orbital with respect to standard set of co-ordinate axes.
86. Answer (3)

Hint : Orbital angular momentum $(\mathrm{L})=\sqrt{\ell(\ell+1)} \hbar$.
Sol. : For $s$-orbital, $\ell=0$
$\therefore \mathrm{L}=0$
87. Answer (1)

Hint: $E=\frac{h c}{\lambda}$
Sol. : $E=6.6 \times 10^{-34} \times \frac{3 \times 10^{8}}{600 \times 10^{-10}} \mathrm{~J}$
$\Rightarrow E=3.3 \times 10^{-18} \mathrm{~J}$
88. Answer (3)

Hint : No. of molecules $=$ Mole $\times N_{A}$
Sol. : Mole of $\mathrm{CO}_{2}=\frac{22}{44}=0.5$
Mole of $\mathrm{SO}_{3}=\frac{40}{80}=0.5$
Mole of $\mathrm{CH}_{4}=\frac{10}{16}=0.625$
Mole of $\mathrm{NO}_{2}=\frac{20}{46}=0.43$
89. Answer (3)

Hint : Mg is limiting reagent.
Sol. : $2 \mathrm{Mg}+\mathrm{O}_{2} \longrightarrow 2 \mathrm{MgO}$
Mole of $\mathrm{Mg}=\frac{4}{24}=\frac{1}{6}$
Mole of $\mathrm{O}_{2}=\frac{8}{32}=\frac{1}{4}$
Mg is limiting reagent
$\therefore \quad$ Mole of MgO formed $=\frac{1}{6}$
90. Answer (4)

Hint : Mole of molecule/atom

$$
=\frac{\text { Mass of molecule/atom }}{\text { Molar mass of molecule/atom }}
$$

Sol. : Mole of $\mathrm{He}=\frac{2 \mathrm{x}}{4}$
Mole of $N_{2}=\frac{x}{28}$
$\frac{\text { Mole of } \mathrm{He}}{\text { Mole of } \mathrm{N}_{2}}=\frac{\frac{2 x}{4}}{\frac{x}{28}}=\frac{2 x}{4} \times \frac{28}{\mathrm{x}}=14: 1$

## [BIOLOGY]

91. Answer (2)

Hint : A correct scientific name includes generic name and specific epithet written in italics and name of discoverer.
Sol. : Correct scientific name of potato is Solanum tuberosum Linn.
92. Answer (3)

Sol. : Poales, Polymoniales - Order
Anacardiaceae - Family
Monocotyledonae - Class
Thus highest rank is Monocotyledonae.
93. Answer (3)

Hint : The feature exclusive to living beings is absent in non living things.
Sol. : Growth is also shown by non living things whereas metabolism, consciousness and reproduction are shown by living beings only.
94. Answer (4)

Hint : This taxonomic aid is an index of plants of a given area.
Sol. : Flora has the informations of plants only
Museum, Key - for both plant and animals
Zoological park - only for animals.
95. Answer (2)

Sol. : Solanaceae, Anacardiaceae, Poaceae, Hominidae, Muscidae, Felidae - Family
Primata - Order
Insecta - Class
96. Answer (4)

Sol. : Amitosis occurs in both prokaryotes and eukaryotes and it does not involve spindle fibres formation.
97. Answer (4)

Hint : Meiosis is responsible for bringing new genetic combinations.
Sol. : Mitosis does not cause variations. Meiosis which involves crossing over, produces variations and new genetic combinations.
98. Answer (3)

Sol. : Crossing over or exchange of genetic material between non-sister chromatids of homologous chromosomes takes place in pachytene stage.
99. Answer (2)

Hint : Chromatids do not separate in meiosis I.
Sol. : In meiosis I, only homologous chromosomes separate and each chromosome has two chromatids.
Thus, in interkinesis there is no need of DNA duplication as duplicated DNA forms sister chromatids.
100. Answer (1)

Hint : Meiosis I is responsible for reduction in chromosomes number.
Sol. : In metaphase I,

- Bivalents align at equator.
- Two equatorial plates are formed.
- Each chromosome has two chromatids.
- Each chromosome is attached to the spindle fibre from one pole only.

101. Answer (4)

Hint : Synaptonemal complex is necessary for synapsis and bivalent formation.
Sol. : Synaptonemal complex forms at zygotene stage however it dissolves at diplotene stage.
102. Answer (1)

Sol. : A pair of synapsed homologous chromosomes is known as a bivalent.
103. Answer (1)

Hint : Mitosis occurs in meristematic cells as they are somatic cells.
Sol. : Bivalent and chiasmata formation occurs in meiosis however formation of spindle fibres, metaphasic plate and condensation of chromatin material occur in both mitosis and meiosis.
104. Answer (3)

Hint : In plant cells, cytokinesis begins at the centre of the cell.
Sol. : In plants, cytokinesis occurs by formation of cell plate while in animal cells, it occurs by formation of furrow.
105. Answer (3)

Hint : Splitting of centromere is responsible for separation of chromatids.
Sol. : Splitting of centromere and the separation of chromatids occur at anaphase.
106. Answer (2)

Hint : Each bivalent has 2 chromosomes and four chromatids.
Sol. : Given meiocyte has 30 chromosomes with 60 chromatids.
Each daughter cell after meiosis I will have 15 chromosomes and total 30 chromatids and after meiosis II, 15 chromosomes and 15 chromatids.
107. Answer (2)

Sol. : Centrosomes radiate some microtubules called asters.
108. Answer (1)

Hint : Amount of DNA gets double during S-phase and becomes equal to the chromosome number after separation of chromatids in anaphase.

## Sol. :

$\begin{aligned} & \text { Pre mitotic gap phase }\left(G_{2}\right) \\ & \text { Synthetic phase }(S) \\ & \text { Prophase }(M)\end{aligned} \quad \begin{aligned} & \text { DNA amount is } \\ & \text { double but no change } \\ & \text { in chromosome }\end{aligned}$
$\begin{aligned} & \text { number }\end{aligned}$
Post mitotic gap phase $\left(G_{1}\right)$ - Amount of DNA is half as compare to $S, G_{2}$ and $M$ phases.
109. Answer (2)

Hint : Deoxyribonucleotides are required during DNA replication.
Sol. : Duplication of cell organelles and ATP synthesis occurs in both $G_{1}$ and $G_{2}$-phases. Whereas synthesis of tubulin proteins occur in $\mathrm{G}_{2}$-phase and deoxyribonucleotides are synthesised in $\mathrm{G}_{1}$-phase.
110. Answer (4)

Sol. : Absence of cell plate i.e. failure of cytokinesis after karyokinesis result increase in chromosome number.
111. Answer (2)

Sol. : Chromatophores are analogous to chloroplasts of eukaryotes as they have photosynthetic pigments and are involved in photosynthesis.
112. Answer (1)

Hint : The microtubules are found in eukaryotes only.
Sol. : Eukaryotic cilia and flagella have $9+2$ arrangement of microtubules. Basal body of eukaryotic flagella have $9+0$ organisation of microtubules.
113. Answer (2)

Hint : Nucleoli are the site of ribosomal RNA synthesis.
Sol.: - Assembly of ribosome units occur in cytoplasm.

- Numerous and larger nucleoli are found in those cells which are actively involved in protein synthesis.

114. Answer (4)

Sol. : Cilia are found in eukaryotes only.
115. Answer (2)

Sol. : Sphaerosomes are the site of synthesis as well as storage of fats.
116. Answer (3)

Hint : Polytene chromosomes are found in salivary glands of dipteran insects.
Sol. : Chiasmata formation occurs between bivalents during meiosis. It is seen in lampbrush chromosomes.
117. Answer (3)

Hint : Such chromosomes appear J shaped during anaphase.
Sol. : Acrocentric chromosome has centromere close to one of its end and appears J shaped.
118. Answer (3)

Hint : This structure is present in some chromosomes only.
Sol. : Satellite is found in SAT chromosomes only.
Centromere, telomere and chromatids are essentially present in each normal chromosome.
119. Answer (4)

Sol. : Chromatin is nucleoprotein fibre composed of DNA, histone proteins and RNA but lacks ribosomes.
120. Answer (4)

Sol. : Centromere is the primary constriction region of chromosome. It lacks microtubules.
121. Answer (2)

Sol. : During protein synthesis many ribosomes may attach to a single mRNA to form polysome or polyribosome.
122. Answer (4)

Hint : Some cell organelles have nucleic acids like DNA or RNA.
Sol. : Nucleus - Have DNA and RNA both
Ribosome - Have RNA
Plastids - DNA and RNA both
Golgi apparatus do not have either DNA or RNA.
123. Answer (4)

Hint : Only chloroplasts are involved in synthesis of food.
Sol. : Leucoplast - Colourless plastid
Chromoplast - Rich in carotenoids
Elaioplast - Stores fats and oils
Chloroplast - Synthesis of carbohydrates.
124. Answer (2)

Hint : Oxysomes are involved in oxidative phosphorylation.
Sol. : Oxysomes are found on cristae which are infoldings of inner mitochondrial membrane.
125. Answer (3)

Hint : Mitochondria is the site of aerobic respiration.
Sol. : Both mitochondria and chloroplasts

1. Are double membrane bound.
2. Have dsDNA
3. Execute ATP synthesis
4. Have ETS.

But only mitochondria is the site for oxidation of respiratory substrates like carbohydrates, proteins, fats, etc.
126. Answer (3)

Hint : Membraneless vacuoles are found in prokaryotes.
Sol. : Gas vacuoles are membraneless vacuoles also called pseudovacuoles.
127. Answer (2)

Hint : Lysosomes have high concentration of $\mathrm{H}^{+}$ ions inside them.
Sol.: - Enzymes of lysosomes are functional at acidic pH .

- Lysosomes are single membrane bound structures formed by RER and Golgi body and function in coordination with organelles of endomembrane system.

128. Answer (3)

Hint : 80S ribosome is made up of 60S and 40S subunits.
Sol. : - ER cisternae are usually attached with 60S subunit of 80 S ribosomes.

- Processing and packaging of lipids is a function of Golgi apparatus.

129. Answer (4)

Hint : Primary cell wall is elastic in nature.

Sol. : Primary cell wall is capable of expansion and grow by addition of more cell wall material within the existing one.
130. Answer (1)

Hint : This cementing layer is chiefly made up of calcium and magnesium pectate.
Sol. : Middle lamella is the cementing layer of two adjacent cells in plant tissue.
131. Answer (1)

Hint : Plasma membrane is selectively permeable.
Sol. : Neutral solutes may move across the membrane freely by simple diffusion while polar molecules move across with help of carrier proteins (facilitated diffusion).
132. Answer (4)

Hint : This chemical is a part of cell wall.
Sol. : Secondary cell wall is made up of pectins. Plasma membrane contains phospholipids, proteins, cholesterols, glycolipids and carbohydrates.
133. Answer (2)

Hint : This layer is the outermost layer of bacterial cell envelope.
Sol. : Capsule, the outermost layer of cell envelope allows bacterium to hide from host's immune system.
134. Answer (1)

Hint : In prokaryotes, both chromosomal and extra chromosomal DNA are double stranded.
Sol. : The genomic DNA of prokaryotes is circular and not enveloped by a nuclear membrane i.e., naked.
135. Answer (2)

Hint : Ribosome, centriole and nucleolus, all are non membrane bound structures.
Sol. : Ribosome - Involved in protein synthesis.
Centriole - Formation of spindle fibres.
Nucleolus - Site for rRNA synthesis.
136. Answer (3)

Hint : It occurs due to deficiency of a water soluble vitamin.
Sol. :

- Pernicious anaemia, occurs due to deficiency of Vitamin $\mathrm{B}_{12}$.
- Scurvy occurs due to deficiency of Vit. C.
- Rickets in children occurs due to deficiency of Vit. D.
- Pellagra occurs due deficiency of Vit. $\mathrm{B}_{3}$.

137. Answer (2)

Hint : The burning sensation in oesophagus due to opening of cardiac sphincter is heart burn.
Sol. : Inguinal hernia is the protrusion of the intestine into inguinal canal.
Haemorrhoids or Piles - Rectal veins can get distended or enlarged due to weakening of their valves.
138. Answer (4)

Hint : These cells secrete inactive precursors of proteolytic enzymes.
Sol. : Zymogen cells are present in gastric mucosa and pancreas.
139. Answer (4)

Hint : Milk sugar is lactose.
Sol. : Lactase is part of succus entericus found in small intestine.
140. Answer (3)

Hint : Neutrophils are phagocytic WBCs.
Sol. : Histiocytes or clasmatocytes are macrophages of areolar tissue. Kupffer cell is a macrophage of liver.
141. Answer (3)

Hint : Milk sugar consists of glucose and galactose.
Sol. : $\underset{\text { (Milk sugar) }}{\text { Lactose }} \xrightarrow{\text { Lactase }}$ Glucose + Galactose.
142. Answer (4)

Hint : Chylomicrons are formed in intestinal cells.
Sol. : Chylomicrons are formed in enterocytes and are absorbed in lacteals (lymphatic capillaries).
143. Answer (4)

Hint : It is present between small and large intestine.
Sol. :

- lleocaecal valve is present between small intestine and caecum.
- Cardiac sphincter is present between oesophagus and stomach.

144. Answer (3)

Hint : Glisson's capsule is the characteristic feature of mammalian bile forming organ.
Sol. :

- Sphincter of Boyden guards the common bile duct.
- Duct of gall bladder is called cystic duct.
- Hepatic lobule is covered by a thin connective tissue sheath called Glisson's capsule.

145. Answer (4)

Hint : Disease which occurs due to deficiency of proteins.
Sol. : Scurvy occurs due to deficiency of vitamin C. Beri-Beri occurs due to deficiency of vitamin $B_{1}$. Marasmus occurs due to deficiency of protein and calories.
146. Answer (2)

Hint : Wisdom teeth are absent in a 14 year old child.
Sol. : Dental formula of a 20 year old

$$
\begin{aligned}
& =\begin{array}{llll} 
& C & P & M \\
2 & 1 & 2 & 3 \times 2 \\
2 & 1 & 2 & 3 \times 2
\end{array} \\
& =\frac{16 \text { (full upper jaw) }}{16 \text { (full lower jaw) }}
\end{aligned}
$$

As wisdom teeth (3 ${ }^{\text {rd }}$ molar) are absent in upper jaw of a 14 year old.
So, number of teeth in upper jaw is
$16-2=14$
147. Answer (2)

Hint : Mucosa is the innermost layer in the wall of alimentary canal.
Sol. :

148. Answer (2)

Hint : Reduced absorption of food is seen in this disorder.
Sol. : In constipation, the faeces are retained within the colon as the bowel movement is irregular. Vomiting is ejection of stomach contents through the mouth. In indigestion, the food is not properly digested leading to feeling of fullness.
149. Answer (2)

Hint : Pancreatic enzymes work at a pH around 7.8 .

Sol. :

| Gastric <br> enzymes <br> (stomach) | Pancreatic <br> enzymes | Intestinal <br> enzymes |
| :---: | :--- | :--- |
| Pepsinogen | Trypsinogen <br> Amylopsin <br> Nucleases <br> Steapsin | Enterokinase <br> Lactase <br> Dipeptidase <br> Nucleotidase |

150. Answer (1)

Hint : These cells secrete zymogenic form of proteolytic enzymes.
Sol. : Chief cells secrete pepsinogen that does not help in erythropoiesis.
Physiological value of calorific values is as follows:
Carbohydrates - $4 \mathrm{kcal} / \mathrm{g}$
Proteins - $4 \mathrm{kcal} / \mathrm{g}$
Fats - $9 \mathrm{kcal} / \mathrm{g}$
151. Answer (1)

Hint : This hexose is maximally absorbed in small intestine.
Sol. : In stomach - Absorption of water, simple sugars and alcohol occurs.
In small intestine - Absorption of glucose, fructose, fatty acid, glycerol, vitamins and amino acid occurs.
In large intestine - Absorption of some amount of water, minerals and drugs occurs.
152. Answer (2)

Hint : Lateral attachment to jaw bone.
Sol. : Presence of pleurodont teeth are a feature of reptiles.
153. Answer (2)

Hint : Oesophagus opens into the cardiac part of stomach.
Sol. : V=Oesophagus

$$
\begin{aligned}
& \mathrm{W}=\text { Pyloric } \\
& \mathrm{X}=\text { fundus } \\
& \mathrm{Y}=\text { cardiac } \\
& \mathrm{Z}=\text { body }
\end{aligned}
$$

154. Answer (4)

Hint : Ribozyme and ribonuclease P are RNA molecules.

## Sol. :

- Inulin is a polymer of fructose.
- Apoenzyme is the protein part of enzyme.

155. Answer (3)

Hint : Water is required to catalyse this conversion.
Sol. :

- Class III of enzymes i.e., hydrolases breakdown sucrose into glucose and fructose by addition of water.
- Ligases catalyse covalent bonding of two substrates to form another molecule.
- Oxidoreductase is also known as dehydrogenase enzyme.
- Lyases catalyse the cleavage of substrate into two parts without the use of water e.g., aldolase.

156. Answer (3)

Hint : The structural level with a 3-dimensional view of a protein.
Sol. : In biologically active form, the enzymes have tertiary structure as their active site is well defined.
157. Answer (1)

Hint : ATP is adenosine triphosphate.
Sol. : Nucleotides consist of nitrogenous base + sugar + phosphate moieties.
ATP consists of adenine $+\beta$-ribose +3 phosphates.
158. Answer (4)

Hint : Prostaglandins are derived from 20C unsaturated fatty acid.
Sol. : Prostaglandins are paracrine hormones and are derived lipids obtained from arachidonic acid. Arachidic acid is 20C saturated fatty acid.
159. Answer (1)

Hint : Systems at equilibrium do not perform work.
Sol. : Living organism can't afford to reach equilibrium as they work continuously.
Enzymes lower the activation energy barrier.
160. Answer (4)

Hint : Identify a sugar.
Sol. : Sucrose is a non-reducing sugar with no free aldehyde or keto group.
161. Answer (2)

Hint : Receptors are proteinaceous in nature.

## Sol. : Adenosine $=\underset{\substack{\text { (nitrogenous } \\ \text { base) }}}{\text { Adenine }}+$ Ribose sugar

Exoskeleton of arthropods is made up of chitin (Homopolysaccharides)
Cotton fibres are made up of cellulose (Homo polysaccharides)
162. Answer (3)

Hint : The base pairs in DNA are stacked $3.4 \AA$ apart.
Sol. : The rise per base pair is $3.4 \AA$,
Pitch $=$ Number of $b p \times$ rise/bp.
Therefore, pitch of $34 \AA$ has 10 bp.
163. Answer (3)

Hint: Inhibitor competes with PABA for the active site of enzyme.
Sol. : Inhibition of hexokinase by glucose-6phosphate and inhibition of threonine deaminase by isoleucine are the examples of allosteric inhibition. Inhibition of cytochrome oxidase by cyanide is an example of non-competitive inhibition.
164. Answer (1)

Hint : Most abundant sugar on earth is made up of $\beta$ glucose units.
Sol. : Starch and Glycogen have $\alpha(1,4)$ glycosidic bonds in unbranched parts.
Maltose has $\alpha(1,4)$ glycosidic bond between two $\alpha$-glucose residues, Isomaltose is a disaccharide.
Lactose has $\beta(1,4)$ glycosidic bond between $\beta$-galactose and $\beta$-glucose.
165. Answer (3)

Hint : Macromolecules are present in retentate.
Sol. :
Galactose - Monosaccharide found in acid soluble pool.
Glycine - Amino acid found in acid soluble pool.
Adenine - Nitrogenous base found in acid soluble pool.
Myoglobin - Protein found in acid insoluble pool or retentate.
166. Answer (2)

Hint : It is a carbohydrate binding protein.
Sol. : Concanavalin $A$ is a lectin. Toxins are abrin and ricin
167. Answer (2)

Hint : Basic amino acids have more than one amino group.
Sol. : Lysine is a basic amino acid.
168. Answer (2)

Hint : Uracil is a monocyclic base.
Sol. : Uridine is a nucleoside made up of ribose sugar and nitrogenous base uracil.
169. Answer (2)

Hint : Dense connective tissue is poorly vascularized.
Sol. : Haversian canal is present in compact bone and it is a feature of long mammalian bones. Areolar and adipose tissue are loose connective tissues.
170. Answer (3)

Hint : It is a type of adhering junction.
Sol. : Tight junctions help to stop substances from leaking across the tissue. Gap junctions help the cells to communicate with each other by connecting the cytoplasm of adjoining cells for rapid transfer of ions, small molecules and sometimes big molecules.
171. Answer (4)

Hint : Smooth muscles are found in wall of visceral organs.
Sol. : Skeletal muscles are found in neck, face, bodywall and anterior $1 / 3^{\text {rd }}$ of oesophagus.
Smooth muscles are found in stomach, intestine, blood vessels, iris of eye etc.
172. Answer (2)

Hint : Functional syncytium is seen in these fibres.
Sol. : Multinucleated (structural) condition is shown by skeletal muscle fibres while cardiac muscle fibres are uninucleated.
173. Answer (2)

Hint : Type of neuron with one axon and one dendrite.
Sol. :

| Neuron | Location |
| :--- | :--- |
| Unipolar | Early embryo |
| Bipolar | Retina of eye and olfactory <br> epithelium |
| Apolar | Nerve net of cnidarians |
| Pseudounipolar | Dorsal root of ganglion of the <br> spinal nerve |

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174. Answer (4)

Hint : Yellow fibrocartilage forms epiglottis.

## Sol. :

| Cartilage | Location |
| :--- | :--- |
| Hyaline cartilage | Nasal septum |
| Elastic cartilage | Epiglottis |
| White fibrocartilage | Between vertebrae |
| Calcified cartilage | Pubis of pelvic girdle of <br> frog |

175. Answer (3)

Hint : Neurolemmocytes secrete myelin sheath.
Sol. : Schwann cells or neurolemmocytes form the insulating myelin rich sheath in peripheral nervous system (PNS) while oligodendrocytes form myelin sheath in central nervous system (CNS).
176. Answer (3)

Hint : Structure produced by fibroblasts.
Sol. : Blood lacks fibroblasts, which are responsible for producing fibres.
Basophils are WBCs and plasma proteins i.e., albumin, globulin and immunoglobulins are present in blood.
177. Answer (4)

Hint : Endothelium receives nutrients indirectly by diffusion.
Sol. : Epithelial tissue has no blood supply i.e., it is avascular.
178. Answer (1)

Hint : Found as supporting structure of pinna and nose.
Sol. : Cartilage consists of chondrocytes surrounded by lacunae and matrix rich in chondroitin sulfate.
179. Answer (4)

Hint : Goblet cells are unicellular glands.
Sol. : A single celled gland i.e., goblet cells secrete mucus and are considered as unicellular glands.
180. Answer (2)

Hint : Site of digestion.
Sol. :

| Epithelium | Location |
| :--- | :--- |
| Brush bordered <br> columnar epithelium | Small intestine |
| Brush bordered <br> cuboidal | PCT |
| Ciliated cuboidal | Smaller bronchioles |
| Ciliated columnar | Oviduct/fallopian tube |

