14/08/2025

Code-A

Aakash
Medical | IIT-JEE | Foundations

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

MM : 720

Time : 180 Min.

PRACTICE TEST-05

PHYSICS

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CHEMISTRY

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158. (4)

180. (3)

Hints and Solutions

PHYSICS

(1) **Answer :** (1)
Hint:
Use principle of moments
Solution:
$N_A + N_B = Mg$ ...(i)
$N_A \times \frac{L}{4} = N_B \times \frac{L}{2}$
$N_A = 2N_B$ ...(ii)
From (i) and (ii),
$3N_B = Mg$
$N_B = \frac{Mg}{3}$

(2) **Answer :** (3)
Solution:
If a particle moves in a straight line with constant velocity then its angular momentum remains constant.

(3) **Answer :** (2)
Hint:
Use work-energy theorem
Solution:
$s = \frac{t^4}{4}$
$v = \frac{4t^3}{4} = t^3$
W.D. (W) = ΔK.E.
$= \frac{1}{2}mv^2$
$= \frac{1}{2} \times 4 \times t^6$
$= 2 \times 2^6$
$= 2 \times 64$
= 128 J

(4) **Answer :** (4)
Hint:
Use, relation between kinetic energy and power
$\Delta K.E. = \int P dt$
Solution:
$\Delta K.E. = \int P dt$
$= \int_1^2 (2t+4)dt$
$= (t^2 + 4t)_1^2$
= 12 – 5
= 7 J

(5) **Answer :** (1)
Hint:
Use work-energy theorem
Solution:
W_{all} = ΔK.E.
$\Rightarrow W_{all} = \frac{1}{2} \times 4 \left[10^2 - 20^2\right]$
$= 2 \times (-300)$
= – 600 J

(6) **Answer :** (3)
Solution:
Work done by frictional force can be positive, negative or zero

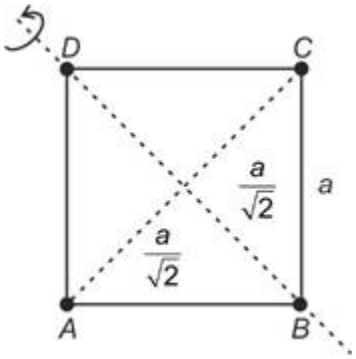
(7) **Answer :** (3)
Solution:
$W = \vec{f} . \vec{d}$
Work done by conservative force the round trip is zero.

(8) **Answer :** (2)
Solution:
$\because \quad \vec{F} = x\hat{i} + y\hat{j}$
Work done $W = \int \vec{F} \cdot d\vec{r}$
$W = \int \left(x\hat{i} + y\hat{j}\right) \cdot \left(dx\hat{i} + dy\hat{j} + dz\hat{k}\right)$
$W = \int_1^4 x dx + \int_1^4 y dy$
$W = \left[\frac{x^2}{2}\right]_1^4 + \left[\frac{y^2}{2}\right]_1^4 = \frac{15}{2} + \frac{15}{2}$ = 15 J

(9) **Answer :** (1)
Solution:
P.E. = mgh
= 1 × 10 × 30 = 300 J
K.E. = $\frac{1}{2}mv^2 = \frac{1}{2} \times 1 \times 400$
= 200 J
w_{air} = –100 J

(10) **Answer :** (2)
Solution:
$W = -mgH = -mg \times \frac{u^2 \sin^2\theta}{2g} = \frac{-mu^2 \sin^2\theta}{2}$

(11) **Answer :** (1)
Hint:
$I = \sum m_i r_i^2$
Solution:
$I = I_A + I_B + I_C + I_D$
$= m\left(\frac{a}{\sqrt{2}}\right)^2 + 0 + m\left(\frac{a}{\sqrt{2}}\right)^2 + 0$
$= ma^2$



(12) **Answer :** (1)
Solution:
Work done by conservative force is independent of path

(13) **Answer :** (2)
Solution:
Hint : Efficiency η = $\frac{\text{Useful work}}{\text{Total work}} \times 100\%$
Sol. : Useful work = 15g × 10

Total work = 75g × 10

$\eta=\frac{150g}{750g}\times 100=20\%$

(14) Answer : (1)

Solution:

$K=\frac{P^2}{2m}$

$k_2=\frac{\left(P+\frac{P}{5}\right)^2}{2m}\Rightarrow k_2=\frac{\left(\frac{6P}{5}\right)^2}{2m}$

$\frac{\Delta k}{K}\%=\left(\left(\frac{6}{5}\right)^2-1\right)\times 100$

$=\left(\frac{36}{25}-1\right)\times 100$

= 11 × 4 = 44%

(15) Answer : (2)

Solution:

KE of system can be changed by internal force and external force but momentum can be changed by only external force.

(16) Answer : (3)

Solution:

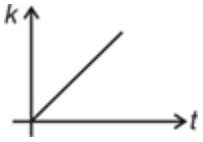
$\frac{1}{2}kx^2=\frac{1}{2}k(1)^2=50$

$\frac{1}{2}k(2)^2=4\times 50=200\text{ J}$

$\therefore\ \frac{1}{2}\text{k}(2)^2-\frac{1}{2}\text{k}(1)^2=150\text{ J}$

(17) Answer : (3)

Solution:



$k\propto t$

$v^2\propto t$

$v\propto t^{1/2}$

$\frac{dv}{dt}\propto\frac{1}{2}t^{-1/2}$

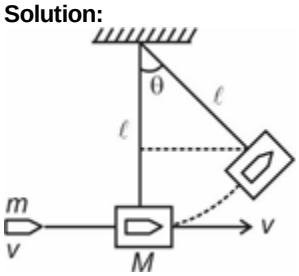
$a\propto t^{-1/2}$

$a\propto\frac{1}{\sqrt{t}}$

$F\propto\frac{1}{\sqrt{t}}$

(18) Answer : (1)

Solution:



∵ Applying conversation of momentum

$mv=(m+M)V$ ...(i)

$V=\frac{mv}{m+M}$

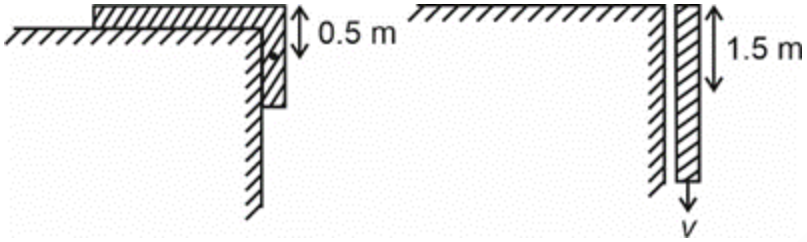
By energy conservation

$\frac{1}{2}\left(M+m\right)\frac{m^2v^2}{(m+M)^2}=\left(M+m\right)gl\left(1-\cos\theta\right)$

$\cos\theta=1-\frac{m^2v^2}{2gl(m+M)^2}$

$\theta=\cos^{-1}\left[1-\frac{m^2v^2}{2gl(m+M)^2}\right]$

(19) Answer : (2)
Solution:
Hint : Use law of conservation of mechanical energy.
Sol.:



From the figure

$0+\frac{mg}{3}\left(-0.5\right)=\frac{1}{2}mv^2+mg\left(-1.5\right)$

$\Rightarrow\ 2g\left(1.5-\frac{0.5}{3}\right)=v^2$

$\Rightarrow\ v=\sqrt{\frac{80}{3}}$ m/s

(20) Answer : (1)
Solution:

Power = $\vec{F}\,.\,\vec{V}$
$F = m(g + g)$
$V = gt$
$P = 2mg(gt) = 2mg^2t$

(21) Answer : (1)
Solution:

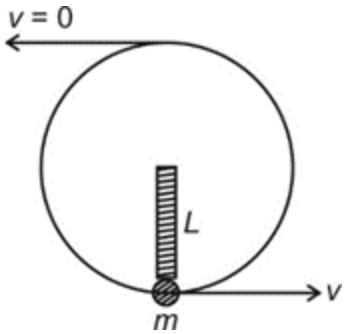
W.D.$_{min}$ = [ΔP.E.] hanging part = $\left[\frac{M}{4}\right]g\frac{1}{2}\left[\frac{1}{4}\right]$

$=\frac{MgL}{32}$

(22) Answer : (4)
Solution:

$U=\frac{x^4}{4}-\frac{x^2}{2}$
$U = U_{min}$ at $x = \pm1$
$U_{\min}=\frac{1}{4}-\frac{1}{2}=-\frac{1}{4}$
K.E. + P.E. = ME
$\frac{1}{2}mv^2-\frac{1}{4}=2$
$V=\frac{3}{\sqrt{2}}\ \mathrm{m/s}$

(23) Answer : (4)
Solution:



$v^2 = 0^2 + 2(-g)(-2L)$

$v = \sqrt{4gL}$

(24) Answer : (4)

Solution:

$v_a = 2 - (-1) = 3$ m/s

$v_s = 1 - (-1) = 2$ m/s

$\therefore \quad e = \frac{v_s}{v_a} = \frac{2}{3}$

(25) Answer : (1)

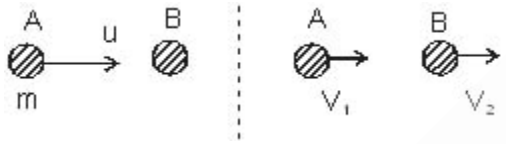
Solution:

Elastic potential energy stored in spring $E = \frac{1}{2}Kx^2$

Hence the graph would be parabolic

(26) Answer : (1)

Solution:



$mu = mv_1 + mv_2$

$e = \frac{v_2 - v_1}{u} \Rightarrow v_2 - v_1 = eu$ ...(11)

on solving $\Rightarrow 2v_2 = (1+e)u$

$v_2 = \left(\frac{1+e}{2}\right)u$

hence $\frac{v_1}{v_2} = \frac{1-e}{1+e}$

(27) Answer : (1)

Solution:

For collision, physical touch is not necessary and in inelastic collision some energy is lost.

(28) Answer : (4)

Solution:

$V' = eV$

$n' = e^2 n$

$= (0.5)^2 \times 10$

$= \frac{5}{10} \times \frac{5}{10} \times 10 = 2.5 \text{ m}$

(29) Answer : (3)

Solution:

Acceleration of centre of mass is = *g*

Initial velocity of centre of mass

$u_{cm} = \frac{m_1u_1 + m_2u_2}{m_1 + m_2}$

$u_{cm} = \frac{1 \times 10 \sin 30° + 2 \times 4 \sin 30}{1+2}$

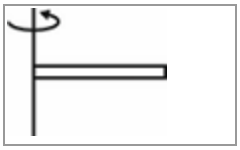
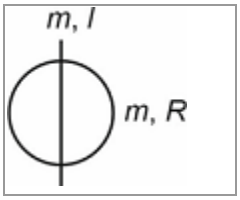
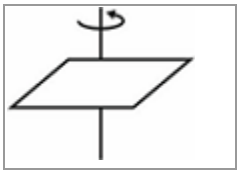
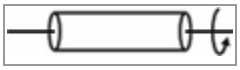
$= \frac{5+4}{3} = \frac{9}{3} = 3 \text{ m/s}$

Maximum height = $\frac{u^2}{2g} = \frac{3 \times 3}{2g} = \frac{9}{20} \text{ m}$

(30) Answer : (2)
Solution:
The velocity of centre of mass will be zero.
$\therefore 4 \times (10 - v) = 40 \times v$
$\Rightarrow 40 - 4v = 40v$
$\Rightarrow 44v = 40$
$\Rightarrow v = \frac{10}{11}$ m/s

(31) Answer : (4)
Solution:
Initially the centre of mass is at rest, so it will remain at rest.

(32) Answer : (4)
Solution:

	$I = \frac{ml^2}{3}$
	$I = \frac{2mR^2}{3}$
	$I = \frac{ma^2}{6}$
	$I = \frac{mR^2}{2}$

(33) Answer : (1)
Hint:
Use parallel axis theorem
Solution:
$MK^2 = \frac{MR^2}{2} + M\left(R^2\right)$
$MK^2 = \frac{MR^2}{2} + MR^2$
$MK^2 = \frac{3}{2}MR^2$
$K = \sqrt{\frac{3}{2}}\ R$

(34) Answer : (2)
Solution:

$$\vec{\tau} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 2 & 2 \\ 2 & 3 & 4 \end{vmatrix}$$

$= \hat{i}(8-6) - \hat{j}(8-4) + \hat{k}(6-4)$
$\vec{\tau} = 2\hat{i} - 4\hat{j} + 2\hat{k}$
$\left|\vec{\tau}\right| = \sqrt{2^2 + 4^2 + 2^2}$ N-m
$\left|\vec{\tau}\right| = \sqrt{4+16+4} = \sqrt{24}$
$= 2\sqrt{6}$ N-m

(35) Answer : (2)
Solution:

$\tau = \frac{\left|\overrightarrow{\Delta L}\right|}{\Delta t} = \frac{\left|\vec{L}_f - \vec{L}_i\right|}{\Delta t} = \frac{mu\sin\theta R}{T}$

$\tau = \frac{mu\sin\theta . u^2(2\sin\theta\cos\theta)}{2u\sin\theta}$

$\tau = \frac{mu^2\sin 2\theta}{2}$

(36) Answer : (4)
Solution:

$\alpha = \frac{2\pi\left(n_2 - n_1\right)}{t} = \frac{2\pi\left(0 - \frac{30}{60}\right)}{60} = \frac{\pi}{60}$ rad/s^2

$\tau = I\alpha = 3 \times \frac{\pi}{60} = \frac{\pi}{20}$ N-m

(37) Answer : (1)
Solution:
Hint : $I = \Sigma m_i r_i^2$
Sol.:

$X_{cm} = \frac{2m\cdot l}{3m} = \frac{2l}{3}$

MOI $= m \times \left(\frac{2l}{3}\right)^2 + 2m\left(\frac{l}{3}\right)^2$

$= \frac{6}{9}ml^2 = \frac{2}{3}ml^2$

(38) Answer : (4)
Hint:

M.O.I. of ring passing through C.O.M. & lying in the plane of ring $= \frac{mr^2}{2}$

Solution:

$I = 2 \times \left(\frac{m\left(\frac{R}{2}\right)^2}{2}\right) + 2 \times \left(\frac{m\left(\frac{R}{2}\right)^2}{2} + m\left(\frac{R}{2}\right)^2\right)$

$I = mR^2$

(39) Answer : (2)
Solution:

Here $\alpha = \pi$ rad/s^2

$\omega_0 = 0, \quad t = 3$ s

$\omega_0 = \omega_0 + \alpha t = 0 + \pi \times 3 = 3\pi$ rad s^{-1}

(40) Answer : (3)
Solution:
In a perfectly rigid body, there is no internal motion. The work done by external torques is therefore, not dissipated and goes on to increase the rotational kinetic energy of the body.
Torque $\tau = I\alpha \Rightarrow \alpha$ is proportional to $\frac{1}{I}$

(41) Answer : (1)
Solution:

$P = \vec{\tau} \cdot \vec{\omega} = \tau\omega$

$\omega = \frac{P}{\tau} = \frac{500}{100} = 5$ rad/s

(42) Answer : (1)
Solution:
By conservation of energy

$mg\frac{l}{2} = \frac{1}{2}I\omega^2$

$\frac{mgl}{2} = \frac{1}{2}\frac{ml^2}{3}\omega^2$

$\omega = \sqrt{\frac{3g}{l}}$

(43) Answer : (2)
Hint:
Apply angular momentum conservation.
Solution:
From law of conservation of angular momentum about hinge.

$\frac{mv3L}{4} = \frac{3mL^2}{3} \times \omega + m\left(\frac{3L}{4}\right)^2 \omega$

$\frac{3mvL}{4} = mL^2\omega + \frac{9}{16}mL^2\omega$

$\frac{3mvL}{4} = \frac{25mL^2\omega}{16}$

$\omega = \frac{12v}{25L}$

(44) Answer : (2)
Solution:
Since no internal torque act, angular momentum remains constant, by bending decreases MOI and increases angular speed.

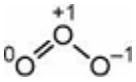
(45) Answer : (2)
Solution:
Using conservation of Angular momentum

$I\omega = (I + mR^2 + mR^2)\omega'$

$\omega' = \frac{I\omega}{I+2mR^2}$

CHEMISTRY

(46) Answer : (2)
Solution:



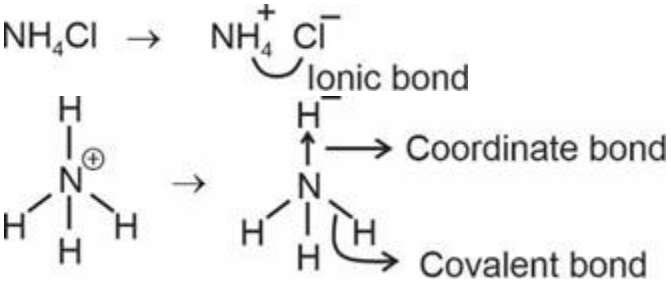
$$\text{Formal charge} = \left[\begin{matrix}\text{Total number}\\ \text{of valence}\\ \text{electrons}\\ \text{in free atom}\end{matrix} - \begin{matrix}\text{Total}\\ \text{number}\\ \text{of lone}\\ \text{pair(s)}\end{matrix} - \frac{1}{2}\left(\begin{matrix}\text{Total}\\ \text{number}\\ \text{of bonding}\\ \text{electrons}\end{matrix}\right)\right]$$

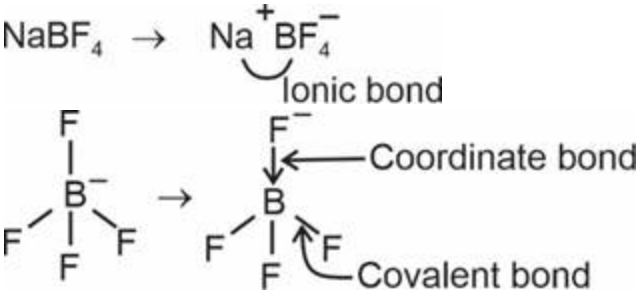
(47) Answer : (3)
Solution:
In molecules with an odd number of electron like NO and NO_2 act as odd electron species.

(48) Answer : (3)
Solution:
N_2O is not an odd electron molecule.

(49) Answer : (4)
Solution:
In SF_4, sulphur has 10 electrons in valence orbitals.

(50) Answer : (2)
Hint:
Coordinate bond is formed by unequal sharing of electrons.
Solution:





(51) **Answer :** (2)
Solution:
Formula of the compound will be X_3Y_2.

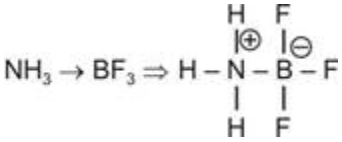
(52) **Answer :** (2)
Solution: Answer (2)

(53) **Answer :** (1)
Solution:

$$\text{Lattice energy} \propto \frac{\text{Charge on ion}}{\text{Size of ion}}$$

(54) **Answer :** (3)
Solution:
Resonating structures are not in equilibrium with each other.

(55) **Answer :** (2)
Solution:



Hybridisation of B in BF_3 is sp^2

Hybridisation of N in NH_3 is sp^3.

Hybridisation of B in $BH_3 \leftarrow NH_3$ is sp^3

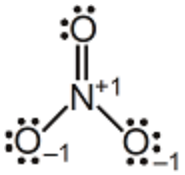
Hybridisation of N in $NH_3 \rightarrow BF_3$ is sp^3

(56) **Answer :** (1)
Hint:
If the total number of electrons are same and shape is same then the species are called isoelectronic and isostructural respectively with respect to each other.
Solution:

Species	Shape	Total number of electrons
ClO_4^-	Tetrahedral	50
PO_4^{3-}	Tetrahedral	50
SO_4^{2-}	Tetrahedral	50
XeF_4	Square planar	90
SO_3^{2-}	Pyramidal	42
PCl_3	Pyramidal	66
CO_3^{2-}	Trigonal planar	38

(57) **Answer :** (4)
Solution:
According to Fajan's rule, for the same anion higher the charge on cation more will be the covalent nature.

(58) **Answer :** (3)
Solution:
Structure of nitrate ion.
$Na^+ NO_3^-$



(59) **Answer :** (2)
Hint:
Electronic configuration of calcium is
Ca (Z = 20) : $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
Solution:
$1s^2 2s^2 2p^5$ is electronic configuration of F.
• Calcium will lose two electrons and two fluorine atoms will gain one electron each to attain inert gas configuration.
Therefore the formula of the compound will be CaX_2.

(60) **Answer :** (2)
Hint:
If bonding electrons are present in pi molecular orbital(s) then pi-bonds are formed
Solution:
B_2 : $(\sigma 1s)^2(\sigma^* 1s)^2(\sigma 2s)^2$ $\left(\pi 2p_x^1 = \pi 2p_y^1\right)$
one π-bond in B_2 molecule
C_2 : $(\sigma 1s)^2(\sigma^* 1s)^2(\sigma 2s)^2$ $\left(\pi 2p_x^2 = \pi 2p_y^2\right)$
two π-bonds in C_2 molecule

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

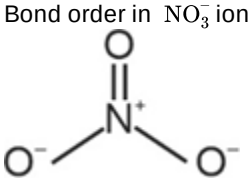
Species	**Bond enthalpy/(kJ mol^{-1})**
O_2(O = O)	498
N_2(N ≡ N)	946
HCl	431
H_2	435.8

(62) **Answer :** (3)
Solution:

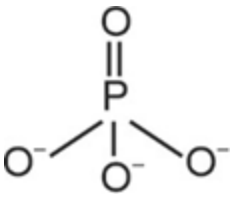
Bond	**Bond length**
C–C	154 pm
C–O	143 pm
C–H	107 pm
O–H	96 pm

(63) **Answer :** (3)
Solution:
BrF_5 is square pyramidal with sp^3d^2 hybridisation.

(64) **Answer :** (1)
Solution:
Bond order in NO_3^- ion



$= \frac{4}{3} = 1.33$
Bond order in $\left(PO_4^{3-}\right)$ ion



$= \frac{5}{4} = 1.25$

(65) Answer : (4)
Hint:
More the difference in electronegativities of bonded atoms, more will be the bond polarity.
Solution:

Species	Dipole Moment
HF	1.78
HCl	1.07
HBr	0.79
HI	0.38

(66) Answer : (2)
Solution:

$\mu_{theoretical} = 1.6 \times 10^{-19} \times 2 \times 10^{-10}$ C-m

$= 3.2 \times 10^{-29}$ C-m

1D = 3.33×10^{-30} C-m

μ theoretical $= \frac{3.2\times10^{-29}}{3.33\times10^{-30}} D = 9.6\ D$

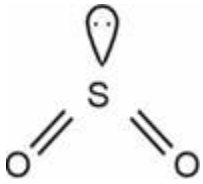
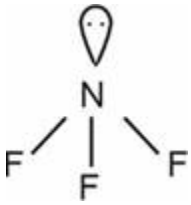
% ionic character = $\frac{\mu_{observed}}{\mu_{theoretical}} \times 100$

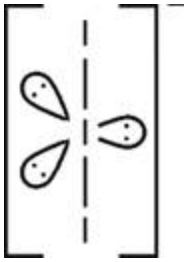
$= \frac{1.92}{9.6} \times 100 = 20\,\%$

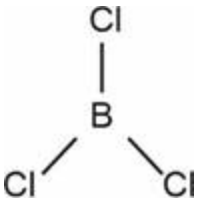
(67) Answer : (4)
Solution:

For cations of same size and charge, the one with electronic configuration $(n-1)d^{10}ns^2$ is more polarising than the one with noble gas configuration, $ns^2\ np^6$.

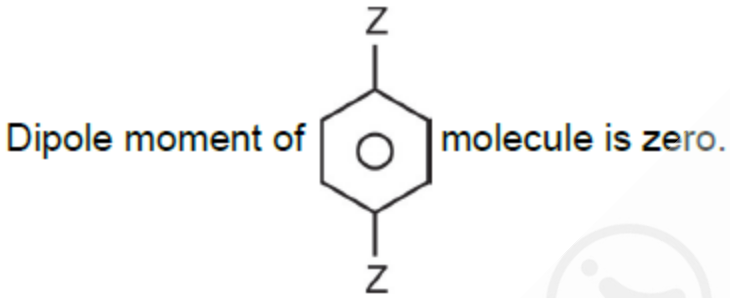
(68) Answer : (3)
Hint:
The species which is linear in shape will have maximum bond angle
Solution:

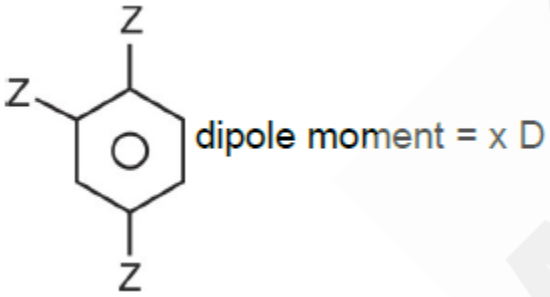
Species	Shape	Bond angle
SO_2		117°
NF_3		102.5°
I_3^-		180°



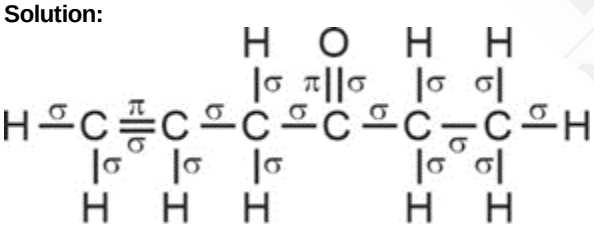
BCl_3  120°

(69) **Answer :** (3)
Solution:





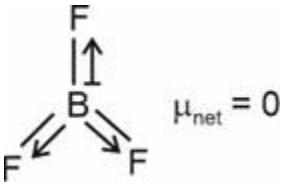
(70) **Answer :** (1)
Solution:



Number of s bonds = 16

(71) **Answer :** (4)
Hint:
Dipole moment (μ) is a vector quantity and its value depends on shape and bond moment of the molecule.
Solution:

•



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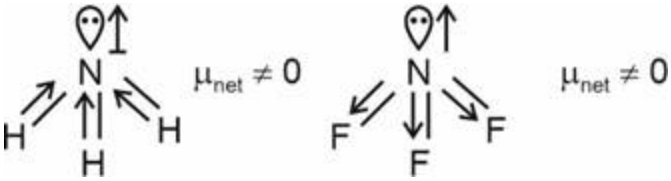
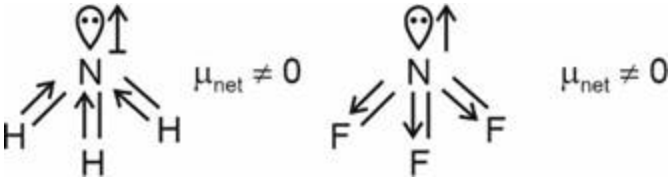


In case of NH_3, the orbital dipole is due to lone pair is in the same direction as the resultant dipole of N – H bonds.

∴ Dipole moment of NH_3 is greater than NF_3 molecule



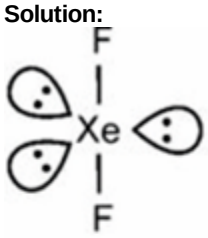
$\mu_{H_2O} > \mu_{NH_3}$

So, the correct order of dipole moment is

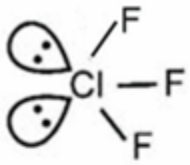
$\boxed{\mu_{H_2O} > \mu_{NH_3} > \mu_{NF_3} > \mu_{BF_3}}$

(72) Answer : (2)

Solution:



(XeF_2)
(linear)



(ClF_3)
(Bent-T-shape)

(SF_4)
See-saw shape

(XeO_3)
Pyramidal

(73) Answer : (2)

Solution:

I_3^- → Linear (planar)

ClF_3 → Bent T shape (planar)

BF_3 → Trigonal planar

XeO_3 → Pyramidal

B_2H_6 → non-planar

(74) Answer : (3)

Solution:

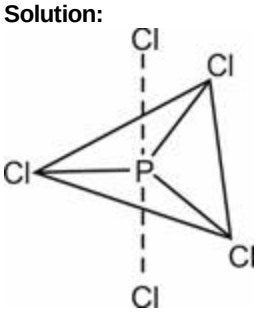
	Species	Number of lone pair around central atom
1.	SO_2	1
2.	$CHCl_3$	0
3.	IF_3	2
4.	XeF_2	3

(75) Answer : (4)

Solution:

Species	Configuration	HOMO
He_2^+	$\sigma 1s^2\sigma^* 1s^2$	σ^*
Li_2	$\sigma 1s^2\sigma^* 1s^2\sigma 2s^2$	σ
B_2	$\sigma 1s^2\sigma^* 1s^2\sigma 2s^2\sigma^* 2s^2, \pi 2p_x^1 \pi 2p_y^1$	π
F_2	$\sigma 1s^2\sigma^* 1s^2\sigma 2s^2\sigma^* 2s^2\sigma 2p_z^2 \pi 2p_x^2 \pi 2p_y^2 \pi^* 2p_x^2 \pi^* 2p_y^2$	π^*

(76) Answer : (2)
Solution:



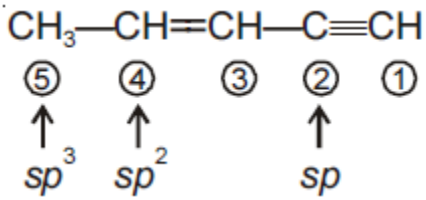
Each axial bond forms 90° bond angle with each equatorial bonds.

(77) Answer : (3)
Solution:
According to VSEPR theory repulsive interaction decrease in the order lp – lp > lp – bp > bp – bp

(78) Answer : (2)
Solution:

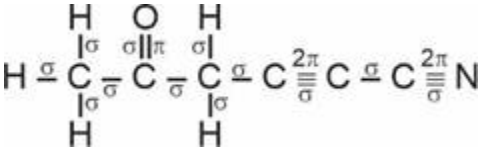
BF_3	sp^2
H_2O	sp^3
SF_6	sp^3d^2
$BeCl_2$	sp

(79) Answer : (2)
Solution:



(80) Answer : (3)
Hint:
In PCl_5, the axial bond pairs suffer more repulsive interaction from the equatorial bond pairs.
Solution:
• In PCl_5, three P — Cl bonds lie in one plane and make an angle of 120° with each other; these bonds are called equatorial bonds. The remaining two P — Cl bonds make an angle of 90° with the plane. These bonds are called axial bonds.
• As the axial bond pair suffer more repulsive interaction from the equatorial bond pairs, therefore axial bonds have been found to be slightly longer.

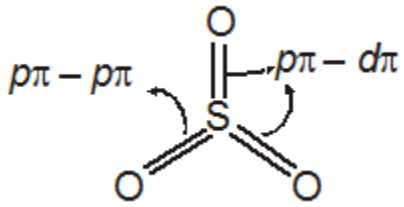
(81) Answer : (2)
Hint:
In multiple bonds, only one bond is σ and the remaining bonds are π bonds.
Solution:



∴ Number of σ bonds = 12
And number of π bonds = 5

(82) **Answer :** (1)
Solution:
The number of hybrid orbitals formed are same as the number of atomic orbitals that get hybridised.

(83) **Answer :** (3)
Solution:



Sulphur is sp^2 hybridised and has available *d* orbitals. SO_3 has two $p\pi - d\pi$ bonds.

(84) **Answer :** (1)
Hint:
For O_2, the order of energy of the molecular orbitals is

$\sigma 1s < \sigma^*1s < \sigma 2s, < \sigma^* 2s, < \sigma 2p_z < \begin{cases} \pi 2p_x \\ \pi 2p_y \end{cases} < \begin{cases} \pi^* 2p_x \\ \pi^* 2p_y \end{cases} < \sigma^* 2p_z$

Solution:
Molecular orbital configuration of O_2 is

$(\sigma 1s)^2, (\sigma^*1s)^2, (\sigma 2s)^2, (\sigma^*2s)^2, (\sigma 2p_z)^2, \begin{cases} \pi(2p_x)^2 \\ \pi(2p_y)^2 \end{cases} \begin{cases} (\pi^* 2p_x)^1 \\ (\pi^* 2p_y)^1 \end{cases}$

So, the electron is removed from π*orbital

(85) **Answer :** (4)
Solution:
• $O_2^{2-} \Rightarrow \sigma 1\, s^2 < \sigma^* 1\, s^2 < \sigma 2s^2 < \sigma^* 2\, s^2$
$< \sigma 2p_z^2 < \left(\pi 2p_x^2 = \pi 2p_y^2\right) < \pi^* 2p_x^2 = \pi^* 2p_y^2$
• Bond order in $O_2^{2-} = \frac{1}{2}[10-8] = 1$
• It has no unpaired electron so it is diamagnetic in nature

(86) **Answer :** (3)
Hint:
Orbitals which are perpendicular to each other will not form bond.
Solution:
p_x and p_y are perpendicular to each other, hence there will be no bond formation.

(87) **Answer :** (3)
Hint:
N_2(Diamagnetic) = $\sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2\, \sigma^* 2s^2\, \pi 2p_x^2 \equiv \pi 2p_y^2\, \sigma 2p_z^2$

O_2 (Paramagnetic) = $\sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2\, \sigma^* 2s^2\, \sigma 2p_z^2\, \pi 2p_x^2 \equiv \pi 2p_y^2 \pi^* 2p_x^1 \pi^* 2p_y^1$

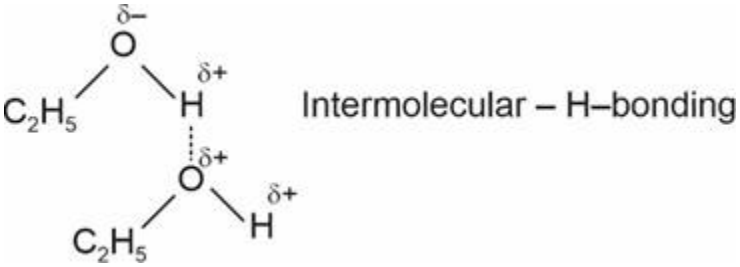
Solution:
N_2^+(Paramagnetic) = $\sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2\, \sigma^* 2s^2\, \pi 2p_x^2 \equiv \pi 2p_y^2\, \sigma 2p_z^1$

C_2^-(Paramagnetic) = $\sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2\, \sigma^* 2s^2\, \pi 2p_x^2 \equiv \pi 2p_y^2\, \sigma 2p_z^1$

O_2^+(Paramagnetic) = $\sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2\, \sigma^* 2s^2\, \sigma 2p_z^2\, \pi 2p_x^2 \equiv \pi 2p_y^2 \pi^* 2p_x^1$

C_2^{2-}(Diamagnetic) = $\sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2\, \sigma^* 2s^2\, \pi 2p_x^2 \equiv \pi 2p_y^2 \sigma 2p_z^2$

(88) Answer : (3)
Hint:
Two ethanol molecules can join with each other by hydrogen bonding.
Solution:



(89) Answer : (2)
Solution:
O-Nitrophenol exhibits intramolecular hydrogen bonding.

(90) Answer : (1)
Solution:
The magnitude of H-bonding depends on physical state of the compound. It is maximum in the solid state and minimum in gaseous state.

BOTANY

(91) Answer : (2)
Solution:
Pellicle is composed of protein.

(92) Answer : (3)
Solution:
Deuteromycetes are commonly known as imperfect fungi.
Sexual or perfect stage is absent in deuteromycetes.

(93) Answer : (2)
Solution:
Diatoms are chief producers in the ocean. They have left behind large amount of cell wall deposits in their habitat, this accumulation over billions of years is referred to as 'Diatomaceous earth'.

(94) Answer : (2)
Solution:
The fungi constitute a unique kingdom of heterotrophic organisms.

(95) Answer : (2)
Solution:
Paramoecium possesses cilia as their locomotory structure.

(96) Answer : (2)
Solution:
In diatoms, cell wall form two thin overlapping shells, which fit together as in a soap box.

(97) Answer : (1)
Solution:
Halophiles are archaebacteria that can survive in extremely salty areas.

(98) Answer : (1)
Solution:
All the prokaryotes are grouped in kingdom Monera of five kingdom classification.
M. W. Beijerinek called the fluid extract of the infected tobacco plant as *Contagium vivum fluidum*.

(99) Answer : (2)
Solution:
Aseptate and coenocytic mycelium is present in the members of class Phycomycetes.

(100) Answer : (3)
Solution:

Prions consisting of abnormally folded protein can cause certain neurological disorders which are bovine spongiform encephalopathy in cattle and Cr-Jacob disease in humans.

(101) Answer : (4)
Solution:
Mode of nutrition in kingdom Monera can be autotrophic or heterotrophic.
Autotrophic mode of nutrition includes chemoautotrophic and photoautotrophic, and heterotrophic mode of nutrition includes saprophytic and parasitic.

(102) Answer : (2)
Solution:
Coccus-spherical shaped bacteria.

(103) Answer : (3)
Solution:
The mycelium of deuteromycetes is septate and branched.

(104) Answer : (4)
Solution:
Puccinia is a parasitic fungus and causes wheat rust.

(105) Answer : (4)
Solution:
According to the five kingdom classification by R. H. Whittaker, both autotrophic and heterotrophic mode of nutrition is found in the kingdom Monera and Protista.

(106) Answer : (3)
Solution:
Bladderwort and the venus fly trap are the examples of insectivorous plants, whereas *Cuscuta* is a parasitic plant.

(107) Answer : (4)
Hint:
Ustilago is a smut fungi.
Solution:
Ustilago belongs to Basidiomycetes. *Neurospora* is an example of Ascomycetes. *Albugo* is an example of Phycomycetes. *Alternaria* is an example of deuteromycetes.

(108) Answer : (4)
Solution:
Whittaker never used `response to external stimulus', to group organisms into five kingdoms.

(109) Answer : (3)
Solution:
Mycoplasma are parasitic to animals also.

(110) Answer : (2)
Solution:
Fungi $\rightarrow$ Nuclear membrane is present in all members.
Animalia $\rightarrow$ Organ system level of body organisation.
Monera $\rightarrow$ Non-cellulosic cell wall.

(111) Answer : (1)
Solution:
All protozoans are heterotrophs and live as predators or parasites. They are believed to be primitive relatives of animals.

(112) Answer : (4)
Solution:
Rhizopus is commonly called as bread mould.

(113) Answer : (2)
Hint:
There are organisms which can fix atmospheric nitrogen in specialised cells called heterocysts.
Solution:
Heterocysts are present in Cyanobacteria or BGA.

(114) Answer : (4)
Solution:
Infectious spore - like stage is present in the life cycle of *Plasmodium*.

(115) Answer : (3)
Solution:

Double stranded DNA is present in bacteriophage.

(116) Answer : (2)
Hint:
Yeast–unicellular fungi
Solution:
Cell wall of fungi are composed of chitin and polysaccharide.
Most fungi are heterotrophic and absorb soluble organic matter.

(117) Answer : (4)
Solution:
Sleeping sickness causing organism is *Trypanosoma.*

(118) Answer : (2)
Hint:
No virus contains both RNA and DNA.
Solution:
Viruses are obligate parasites.

(119) Answer : (3)
Solution:
Mycoplasma is a eubacteria.

(120) Answer : (1)
Solution:
Cyanobacteria are gram negative photosynthetic bacteria being the most primitive organisms to have oxygenic photosynthesis.

(121) Answer : (2)
Solution:
Nostoc is a N_2 fixing cyanobacterium.

(122) Answer : (3)
Solution:
Agaricus lacks sex organs.

(123) Answer : (4)
Solution:
Neurospora belongs to Ascomycetes and *Alternaria* belongs to Deuteromycetes. Members of Deuteromycetes do not perform sexual reproduction.

(124) Answer : (4)
Solution:
Members of phycomycetes are found in aquatic habitats, moist and damp places, as obligate parasite on plants and on decaying wood.

(125) Answer : (4)
Solution:
Heterotrophs are most abundant

(126) Answer : (3)
Hint:
Protozoans are heterotrophic. Some protists, like euglenoids, do not have cell wall.
Solution:
Spores formed in the sporangium are dispersed by air currents. Dinoflagellates are mostly marine.

(127) Answer : (3)
Solution:
Ustilago – smut fungus
Puccinia – rust fungus

(128) Answer : (2)
Hint:
Agaricus is a member of Basidiomycetes.
Solution:
In *Agaricus*, the dikaryotic structure ultimately gives rise to basidium in which karyogamy and meiosis take place.

(129) Answer : (3)
Solution:

All viruses have genetic material. Viruses can have either DNA or RNA as genetic material. Some viruses have envelope such as HIV.

(130) Answer : (3)
Solution:
Aristotle divided animals into two groups, those which had red blood and those that did not.

(131) Answer : (3)
Hint:
Lichens do not grow in polluted areas.
Solution:
Lichens are mutually useful association between algae and fungi. Algae prepare food for fungi and fungi provide shelter and absorb mineral nutrients and water for its partner.

(132) Answer : (3)
Solution:
Claviceps belongs to class ascomycetes which shows dikaryotic phase.

(133) Answer : (3)
Solution:
In the members of Zygomycetes, sexual reproduction produces a resting diploid spore called zygospore.

(134) Answer : (2)
Solution:
The protist that forms an aggregation called plasmodium is slime mould.

(135) Answer : (4)
Solution:
Chysophytes, euglenoids, dinoflagellates and slime moulds all belong to kingdom protista.

ZOOLOGY

(136) Answer : (4)
Solution:

So, 100 ml of blood transport → 15 ml of O_2 (strenous condition)
1000 ml of blood transport → 150 ml of O_2

(137) Answer : (1)
Solution:
Asthma is difficulty in breathing causing wheezing due to inflammation of bronchi and bronchioles. Emphysema is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased.

(138) Answer : (2)
Solution:
Systemic arteries have oxygenated blood having pO_2 95 mm Hg and pCO_2 40 mm Hg.

Respiratory Gas	Atmospheric Air	Aleboli	Blood (Deoxygenated)	Blood (Oxygenated)	Tissue
O_2	159	104	40	95	40
CO_2	0.3	40	45	40	45

(139) Answer : (1)
Solution:
'X' is carbonic anhydrase. RBCs contain a very high concentration of this enzyme and minute quantities of the same is present in the plasma too. Zinc is a co-factor for this enzyme. It belongs to class IV of enzymes.

(140) Answer : (3)

Solution:
Emphysema leads to reduced respiratory surface. Lung fibrosis is seen in occupational respiratory disorders.
Lungs are not muscular structure.

(141) Answer : (3)
Solution:
The opening between the right atrium and the right ventricle is guarded by a valve formed of three muscular flaps or cusps, the tricuspid valve; whereas a bicuspid or mitral valve guards the opening between the left atrium and the left ventricle. Amphibians and reptiles (except crocodiles) have a 3-chambered heart with two atria and a single ventricle, whereas crocodiles, birds and mammals possess a 4-chambered heart with two atria and two ventricles.

(142) Answer : (2)
Solution:
Nearly 20 – 25 per cent of CO_2 is transported by RBCs whereas 70 per cent of it is carried as bicarbonate through plasma and about 7 per cent of CO_2 is carried in a dissolved state through plasma. Thus, the total amount of CO_2 carried through blood plasma will be equal to around 77%.

(143) Answer : (4)
Hint:
Think about basement membrane
Solution:
At the tissue site where pCO_2 is high due to catabolism, CO_2 diffuses into RBCs and forms HCO_3^- and H^+ in presence of enzyme carbonic anhydrase. Diffusion membrane is formed by two cellular layers and an acellular basement substance in between them.

(144) Answer : (3)
Solution:
In the tissues, where low pO_2, high pCO_2, high H^+ concentration (low pH) and higher temperature exist, the conditions are favourable for dissociation of oxygen from the oxyhaemoglobin.

(145) Answer : (3)
Solution:
Increase in pCO_2 and H^+ concentration activates the central chemoreceptors that signal the rhythm centre to make necessary adjustments.

(146) Answer : (3)
Hint:
Medulla oblongata contains respiratory rhythm centre.
Solution:
Pneumotaxic centre present in the pons region of the brain can moderate the functions of the respiratory rhythm centre. Neural signals from this centre can reduce the duration of inspiration and thereby alter the respiratory rate.

(147) Answer : (4)
Solution:
In certain industries, especially those involving grinding or stone-breaking, so much dust is produced that the defense mechanism of the body cannot fully cope with the situation. Long exposure can give rise to inflammation leading to fibrosis (proliferation of fibrous tissues) and thus causing serious lung damage. Workers in such industries should wear protective masks.

(148) Answer : (3)
Solution:
The pO_2 in systemic vein is 40 mmHg and pCO_2 in aorta is 40 mmHg.

Respiratory Gas	Atmospheric Air	Alveoli	Blood (Deoxygenated)	Blood (Oxygenated)	Tissues
O_2	159	104	40	95	40
CO_2	0.3	40	45	40	45

(149) Answer : (1)

Solution:
Nearly, 20-25 per cent of CO_2 is transported by RBCs as carbamino-haemoglobin whereas 70 per cent of it is carried as bicarbonate. About 7 per cent of CO_2 is carried in a dissolved state through plasma. CO binds to Hb and forms carboxy-haemoglobin.

(150) Answer : (1)
Solution:
Solubility of CO_2 is 20-25 per cent higher than that of O_2. Lymphocytes (20-25 per cent) are of two major types – 'B' and 'T' Lymphocytes.
Normal respiratory rate of a healthy adult human is 12-16 times/minute.
Neutrophils make up 60-65 per cent of the total WBCs. Basophils constitute 0.5 – 1% of all WBCs.
Based on ABO blood grouping, we have 4 blood groups *i.e.*, A, B, AB and O.

(151) Answer : (2)
Solution:
Simple spirometer cannot measure RV and the pulmonary capacities which include RV in them.
Residual Volume (RV): Volume of air remaining in the lungs even after a forcible expiration. This averages 1100 mL to 1200 mL.
Functional Residual Capacity (FRC): Volume of air that will remain in the lungs after a normal expiration. This includes ERV+RV.
Vital Capacity (VC): The maximum volume of air a person can breathe in after a forced expiration. This includes ERV, TV and IRV.
Total Lung Capacity (TLC): Total volume of air accommodated in the lungs at the end of a forced inspiration. This includes RV, ERV, TV and IRV or VC+RV.

(152) Answer : (2)
Hint:
Haemoglobin has a quaternary structure.
Solution:
Adult human haemoglobin consists of 4 subunits-2α subunits and 2β subunits that can carry a maximum of four molecules of oxygen.

(153) Answer : (3)
Solution:
Body compensates for low oxygen availability by increasing red blood cells' production.

(154) Answer : (2)
Solution:
Total volume of air accommodated in the lungs at the end of a forced inspiration is called total lung capacity. It includes RV + ERV + TV + IRV.
EC = TV + ERV; IC = TV + IRV; FRC = ERV + RV

(155) Answer : (4)
Hint:
Can be measured by a spirometer
Solution:
• Vital capacity is the maximum volume of air a person can breathe in after a forced expiration.
• Functional residual capacity is the volume of air that will remain in the lungs after a normal expiration.
• Total lung capacity is the total volume of air accommodated in the lungs at the end of a forced inspiration.

(156) Answer : (4)
Solution:
• FRC = ERV + RV
• Value of FRC does not include TV
• TLC = VC + RV
• VC = IRV + TV + ERV
• IC = IRV + TV

(157) Answer : (1)
Solution:

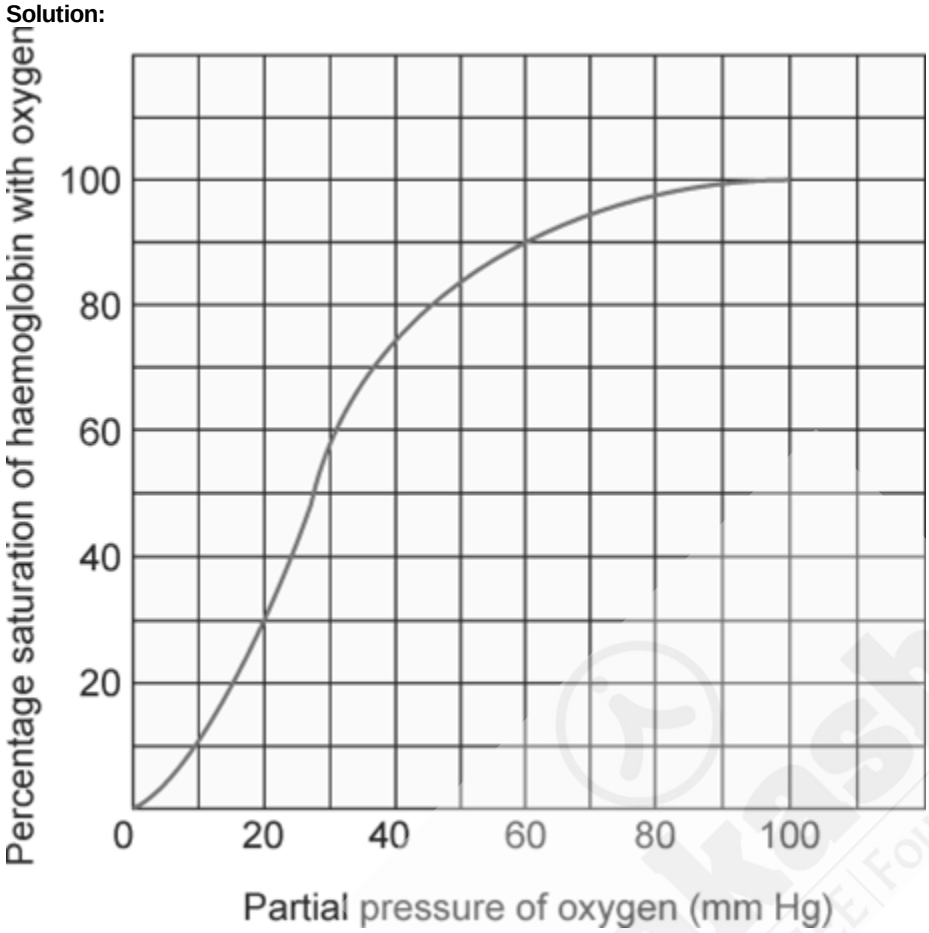
Vital capacity	– 4100-4600 mL
Respiratory minute volume	– 6000-8000 mL
Total lung capacity	– 5100-5800 mL
Expiratory reserve volume	– 1000-1100 mL

(158) Answer : (4)
Solution:

End of T-wave marks the end of ventricular systole. So, joint diastole starts after T-wave and ends with initiation of atrial systole that starts during P-wave. So, joint diastole is present between T-wave and P-wave of ECG of two adjacent cardiac cycles.

(159) Answer : (2)

Solution:



(160) Answer : (2)

Solution:

SAN is known as the pacemaker of the human heart.

(161) Answer : (3)

Solution:

Heart is mesodermal in origin .

(162) Answer : (1)

Solution:

The openings of the right and the left ventricles into the pulmonary artery and aorta respectively are guarded by the semilunar valves.

(163) Answer : (1)

Solution:

Neurophils and monocytes are the phagocytic cells.

(164) Answer : (1)

Solution:

Annelids and most chordates have a closed circulatory system, in which the blood pumped by the heart is always circulated through a closed network of blood vessels. This circulatory pattern is considered to be more advantageous, as the fluid flow can be more precisely regulated.

(165) Answer : (2)

Solution:

In pulmonary circulation, deoxygenated blood moves from the heart to lungs for oxygenation and then returns the oxygenated blood back to the heart.

A unique vascular connection exists between the digestive tract and liver which is called the hepatic portal system.

Renal portal system is absent in humans.

(166) Answer : (2)

Solution:

During coagulation of blood, an enzyme complex thrombokinase helps in the conversion of prothrombin (present in plasma) into thrombin.

Thrombin further helps in the conversion of inactive fibrinogens into fibrins which form network of threads.

Renin is secreted by JG cells in response to fall in glomerular blood flow, which converts angiotensinogen in blood to angiotensin-I.

Epinephrine or adrenaline is secreted by adrenal medulla in response to stress of any kind and during emergency situation.

(167) Answer : (1)

Solution:

Blood is considered as a fluid connective tissue as its matrix (plasma) does not have any fibres. A healthy individual has 12-16 gms of haemoglobin in every 100 mL of blood. RBCs have an average life span of 120 days after which they are destroyed in the spleen (graveyard of RBCs). Spleen also has a large reservoir of erythrocytes.

(168) Answer : (2)

Solution:

Heart beat rate of a healthy adult human is 72 times/min in his resting state.

(169) Answer : (1)

Solution:

RBCs are formed in the red bone marrow of adults.

In humans, the mature RBCs are enucleated and biconcave disc shaped.

Absence of nucleus provides more space for oxygen binding pigment haemoglobin and biconcave shape increases the total surface area for exchange of gases.

(170) Answer : (3)

Solution:

Fishes have a 2-chambered heart with an atrium and a ventricle. Amphibians and reptiles (except crocodile) have 3-chambered heart with 2 atria and a single ventricle, whereas, birds and mammals possess a 4-chambered heart with two atria and two ventricles.

(171) Answer : (2)

Solution:

Basophils secrete histamine, serotonin, heparin, *etc*., and are involved in inflammatory reactions.

(172) Answer : (3)

Solution:

The first heart sound (lub) is associated with the closure of the tricuspid and bicuspid valves whereas the second heart sound (dub) is associated with the closure of the semilunar valves.

(173) Answer : (3)

Solution:

Neural signals from the sympathetic nerves (part of ANS) can increase the heart rate, the strength of ventricular contraction and thereby the cardiac output. Adrenal medullary hormones (Epinephrine and Nor epinephrine) can also increase the cardiac output.

(174) Answer : (4)

Solution:

The SAN generates action potentials which stimulate both atria to undergo simultaneous contraction. The action potential is conducted to the ventricular side by AVN and AV bundles. Removal of AVN will cause contraction of both atria and ventricles at the same time.

(175) Answer : (2)

Hint:

These blood vessels carry deoxygenated blood.

Solution:

Blood must pass through pulmonary circulation in order to flow from right atrium to left atrium.

(176) Answer : (1)

Solution:

Cardiovascular centre is present in medulla oblongata.

(177) Answer : (4)

Solution:

Heart failure means the state of heart when it is not pumping blood effectively enough to meet the needs of body.

Heart attack is when the heart muscle is suddenly damaged by an inadequate blood supply.

(178) Answer : (3)

Hint:

Pacemaker maintains rhythmic contractility of heart.

Solution:

Artificial pacemaker is required when there is a damage to nodal tissue of heart like in case of heart attack. This device sends out small electrical current to stimulate heart to contract thus maintaining rhythm of cardiac activity.

(179) Answer : (4)

Solution:

Both blood and lymph are fluid connective tissues which come in the category of specialised connective tissues.

(180) Answer : (3)

Solution:

Hint: Antibody produced against Rh antigen.

Sol.: When an Rh –ve mother becomes pregnant with Rh +ve foetus in her first pregnancy, foetal blood may be exposed to maternal blood during delivery and mother starts producing antibodies against Rh antigen. In her subsequent pregnancies, if the foetus is Rh +ve, Rh antibodies from mother's blood pass into the blood of the foetus and destroy the foetal RBCs, leading to severe anaemia and jaundice to the baby. This can be avoided by administering anti-Rh antibodies to the mother immediately after the delivery of first Rh positive child.