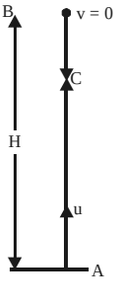
NEET TEST SERIES

SOLUTIONS PART TEST-1

PART A – PHYSICS

1. **(3)** Let body takes T sec to reach maximum height.
Then $v = u - gT$
$v = 0$, at highest point.



$$T = \frac{u}{g} \qquad ....(1)$$

Velocity attained by body in $(T - t)$ sec
$v = u - g(T - t)$

$$= u - gT + gt = u - g\frac{u}{g} + gt$$

or $v = gt$ ....(2)
$\therefore$ Distance travelled in last t sec of its ascent

$$S = (gt)t - \frac{1}{2}gt^2 = \frac{1}{2}gt^2$$

2. **(3)** Velocity of $P = (NP)\omega = (NM + MP)\omega$

$$= r(r + \sin\theta)\omega = v(1 + \sin\theta)$$

3. **(3)** $F = KR^{-n} = MR\omega^2 \Rightarrow \omega^2 = \frac{K}{M}R^{-(n+1)}$

or $\omega = K'R^{\frac{-(n+1)}{2}}$ [where $K' = \left(\frac{K}{M}\right)^{1/2}$, a constant]

$$\frac{2\pi}{T} \alpha\ R^{\frac{-(n+1)}{2}}$$

$$\therefore T\ \alpha\ R^{\frac{(n+1)}{2}}$$

4. **(1)** Electrical Permittivity, $\varepsilon_0 = \frac{1}{4\pi}\frac{q^2}{F r^2}$

$$\varepsilon_0 = \frac{c^2}{Nm^2} = \frac{[AT]^2}{[MLT^{-2}][L^2]} = [M^{-1}L^{-3}T^4A^2]$$

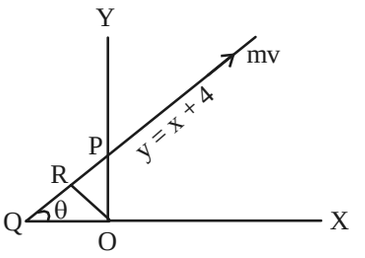
5. **(2)** $v^2 = u^2 + 2gh = (10)^2 + 2\times10\times19.5 = 490$
K.E. at the ground

$$= \frac{1}{2}mv^2 = \frac{1}{2}\times\frac{5}{1000}\times490 = \frac{49}{40}\ J$$

$$P.E. = mgh = \frac{5}{1000}\times10\times\left(\frac{-50}{100}\right) = -\frac{1}{40}\ J$$

$$\therefore \text{ Change in energy} = \frac{49}{40} - \left(-\frac{1}{40}\right) = \frac{50}{40} = 1.25J$$

6. **(1)**



$y = x + 4$ line has been shown in the figure. When $x = 0, y = 4$ So, $OP = 4$.
The slope of the line can be obtained by comparing with the equation of line $y = mx + c$
$m = \tan\theta = 1 \Rightarrow \theta = 45°$
$\angle OQP = \angle OPQ = 45°$
Length of the perpendicular drawn = OR

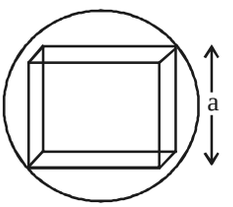
In ΔOPR, $\frac{OR}{OP} = \sin 45°$

$$\Rightarrow OR = OP\sin 45° = 4\times\frac{1}{\sqrt{2}} = \frac{4}{\sqrt{2}} = 2\sqrt{2}$$

Angular momentum of particle going along this line

$$= r \times mv = 2\sqrt{2}\times5\times3\sqrt{2} = 60 \text{ units}$$

7. **(1)** Here $a = \frac{2}{\sqrt{3}}R$



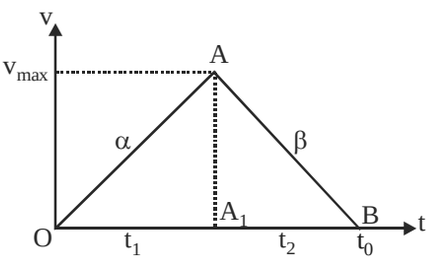
Now, $\frac{M}{M'} = \frac{\frac{4}{3}\pi R^3}{a^3}$

$$= \frac{\frac{4}{3}\pi R^3}{\left(\frac{2}{\sqrt{3}}R\right)^3} = \frac{\sqrt{3}}{2}\pi. \quad M' = \frac{2M}{\sqrt{3}\pi}$$

Moment of inertia of the cube about the given axis,

$$I = \frac{M'a^2}{6} = \frac{\frac{2M}{\sqrt{3}\pi}\times\left(\frac{2}{\sqrt{3}}R\right)^2}{6} = \frac{4MR^2}{9\sqrt{3}\pi}$$

8. **(4)**



In fig., $AA_1 = v_{max.} = \alpha t_1 = \beta t_2$

But $t = t_1 + t_2 = \frac{v_{max}}{\alpha} + \frac{v_{max}}{\beta}$

$= v_{max}\left(\frac{1}{\alpha} + \frac{1}{\beta}\right) = v_{max}\left(\frac{\alpha+\beta}{\alpha\beta}\right)$

or, $v_{max} = t\left(\frac{\alpha\beta}{\alpha+\beta}\right)$

9. (1) Coefficient of static friction,

$\mu_s = \tan 30° = \frac{1}{\sqrt{3}} = 0.577 \cong 0.6$

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

$4 = \frac{1}{2}a(4)^2 \Rightarrow a = \frac{1}{2} = 0.5$

[$\because$ s = 4m and t = 4s given]

$a = g\sin\theta - \mu_k(g)\cos\theta$

$\Rightarrow \mu_k = \frac{0.9}{\sqrt{3}} = 0.5$

10. (2) $v = \frac{3}{4}v_e$

$K.E. = \frac{1}{2}mv^2 = \frac{1}{2}m\left(\frac{3}{4}v_e\right)^2 = \frac{9}{32}mv_e^2$

$= \frac{9}{32}m\left(\frac{2GM}{R}\right)$

$K.E. = \frac{9}{16}\frac{GMm}{R}$; $P.E. = -\frac{GMm}{R}$

Total energy = K.E. + P.E. = $-\frac{7}{16}\frac{GMm}{R}$

Let the height above the surface of earth be h, then

$P.E. = -\frac{GMm}{h}$

$-\frac{7}{16}\frac{GMm}{R} = -\frac{GMm}{h} \quad \therefore \quad h = \frac{16R}{7}$

11. (1) Since, $T^2 = kr^3$

Differentiating the above equation

$\Rightarrow 2\frac{\Delta T}{T} = 3\frac{\Delta r}{r} \Rightarrow \frac{\Delta T}{T} = \frac{3}{2}\frac{\Delta r}{r}$

12. (1) Velocity of 50 kg. mass after 5 sec of projection

$v = u - gt = 100 - 9.8\times 5 = 51 m/s$

At this instant momentum of body is in upward direction

$p_{initial} = 50\times 51 = 2550\, kg\ m/s$

After breaking 20 kg piece travels upwards with 150 m/s let the speed of 30 kg mass is v

$p_{final} = 20\times 150 + 30\times v$

By the law of conservation of momentum

$p_{initial} = p_{final}$

$\Rightarrow 2550 = 20\times 150 + 30\times v \Rightarrow v = -15 m/s$

i.e. it moves in downward direction.

13. (4) Dimension of $a.t$ = dimension of velocity

$a.t = LT^{-1} \Rightarrow a = LT^{-2}$

Dimension of c = dimension of t

(two physical quantity of same dimension can only be added)

So, dimension of c = T

Dimension of $\frac{b}{t+c}$ = Dimension of v

$\frac{b}{T+T} = LT^{-1} \Rightarrow b.T^{-1} = LT^{-1} \Rightarrow b = L$

So, answer is LT^{-2}, L & T

14. (4) The particle is moving in circular path

From the figure, $mg = R\sin\theta$ …(i)

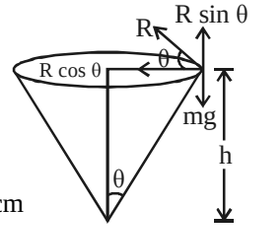
$\frac{mv^2}{r} = R\cos\theta$ … (ii)

From equations (i) and (ii) we get

$\tan\theta = \frac{rg}{v^2}$ but $\tan\theta = \frac{r}{h}$

$\therefore\ h = \frac{v^2}{g} = \frac{(0.5)^2}{10}$

$= 0.025\,m = 2.5$ cm



15. (3) For projectile A

Maximum height, $H_A = \frac{u_A^2\sin^2 45°}{2g}$

For projectile B

Maximum height, $H_B = \frac{u_B^2\sin^2\theta}{2g}$

As we know, $H_A = H_B$

$\frac{u_A^2\sin^2 45°}{2g} = \frac{u_B^2\sin^2\theta}{2g}$

$\frac{\sin^2\theta}{\sin^2 45°} = \frac{u_A^2}{u_B^2}$

$\sin^2\theta = \left(\frac{u_A}{u_B}\right)^2 \sin^2 45°$

$\sin^2\theta = \left(\frac{1}{\sqrt{2}}\right)^2\left(\frac{1}{\sqrt{2}}\right)^2 = \frac{1}{4}$

$\sin\theta = \frac{1}{2} \Rightarrow \theta = \sin^{-1}\left(\frac{1}{2}\right) = 30°$

16. (3) $F = \left(\frac{dM}{dt}\right)v = \alpha v^2 \qquad \left(\because \frac{dM}{dt} = \alpha v\right)$

$\therefore$ Retardation $= \frac{-F}{M} = -\frac{\alpha v^2}{M}$

17. (3) Kinetic energy $_{(\text{rotational})}$ $K_R = \frac{1}{2}I\omega^2$

Kinetic energy $_{(\text{translational})}$ $K_T = \frac{1}{2}Mv^2$

$(v = R\omega)$

M.I.$_{(\text{initial})}$ $I_{ring} = MR^2$; $\omega_{initial} = \omega$

M.I.$_{(\text{new})}$ $I'_{(\text{system})} = MR^2 + 2mR^2$

$\omega'_{(\text{system})} = \frac{M\omega}{M+2m}$

Solving we get loss in K.E.

$$= \frac{Mm}{(M+2m)}\omega^2R^2$$

18. (4) As we know, time period of a simple pendulum

$T = 2\pi\sqrt{\frac{L}{g}} \Rightarrow g = \frac{4\pi^2L}{T^2}$

The maximum percentage error in g

$\frac{\Delta g}{g}\times 100 = \frac{\Delta L}{L}\times 100 + 2\left(\frac{\Delta T}{T}\times 100\right)$

$= 2\% + 2(3\%) = 8\%$

19. (1) As particle is projected with some velocity therefore its initial kinetic energy will not be zero.

As it moves downward under gravity then its velocity increases with time $K.E. \propto v^2 \propto t^2\ (As\ v \propto t)$

So the graph between kinetic energy and time will be parabolic in nature.

20. (4) Given; speed = 10 m/s; radius r = 10 m

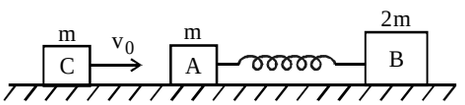
Angle made by the wire with the vertical

$\tan\theta = \frac{v^2}{rg} = \frac{10^2}{10\times 10} = 1$

$\Rightarrow \theta = 45° = \frac{\pi}{4}$

21. (4) When C strikes A

$\frac{1}{2}mv_0{}^2 = \frac{1}{2}mv'^2 + \frac{1}{2}kx_0{}^2$ (v' = velocity of A)



$kx_0{}^2 = m(v_0{}^2 - v'^2)$ ..... (i)

$\frac{1}{2}2mv'^2 = \frac{1}{2}kx_0{}^2$

(When A and B Block attains K.E.)

$\therefore \quad \frac{1}{2}kx_0{}^2 = mv'^2$ ..... (ii)

From (i) and (ii),

$kx_0{}^2 = mv_0{}^2 - mv'^2 = mv_0{}^2 - \frac{k}{2}x_0{}^2$

$\Rightarrow \quad kx_0{}^2 + \frac{k}{2}x_0{}^2 = mv_0{}^2$

$\frac{3}{2}kx_0{}^2 = mv_0{}^2 \ \therefore\ k = \frac{2}{3}m\frac{v_0{}^2}{x_0{}^2}$

22. (4) Let $X = [ML^{-1}T^{-1}]$

Then, $\frac{\Delta X}{X}\times 100 = \left(\frac{\Delta M}{M} + \frac{\Delta L}{L} + \frac{\Delta T}{T}\right)\times 100$

As we know, $\frac{\Delta M}{M} = 1\%, \frac{\Delta L}{L} = 1.5\%$ and $\frac{\Delta T}{T} = 3\%$

$= (1 + 1.5 + 3)\% = 5.5\%$.

23. (4) Acceleration of block while sliding down upper half = $g\sin\phi$;

Retardation of block while sliding down lower half = $-(g\sin\phi - \mu g\cos\phi)$

For the block to come to rest at the bottom, acceleration in I half = retardation in II half.

$g\sin\phi = -(g\sin\phi - \mu g\cos\phi)$

$\Rightarrow \mu = 2\tan\phi$

24. (3) Motion with constant momentum along a straight line. According to Newton's second law rate of change of momentum is directly proportional to force applied.

25. (4) As we know power $P = \frac{dw}{dt}$

$\Rightarrow \quad w = Pt = \frac{1}{2}mV^2$

So, $v = \sqrt{\frac{2Pt}{m}}$

Hence, acceleration $a = \frac{dV}{dt} = \sqrt{\frac{2P}{m}}\cdot\frac{1}{2\sqrt{t}}$

Therefore, force on the particle at time 't'

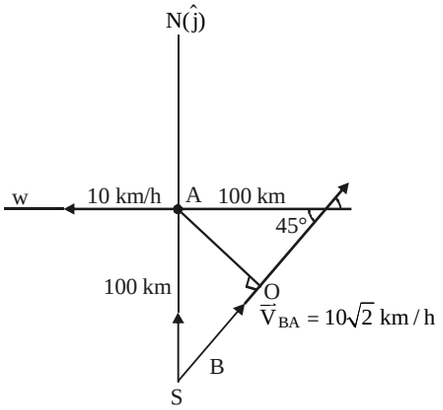
$$= ma = \sqrt{\frac{2Km^2}{m}}\cdot\frac{1}{2\sqrt{t}} = \sqrt{\frac{Km}{2t}} = \sqrt{\frac{mK}{2}}\ t^{-1/2}$$

26. (1) $\vec{V}_A = 10\left(-\hat{i}\right)$

$\vec{V}_B = 10\left(\hat{j}\right)$

$\vec{V}_{BA} = 10\,\hat{j} + 10\,\hat{i} = 10\sqrt{2}$ km / h

Distance OB = $100 \cos 45° = 50\sqrt{2}$ km



Time taken to each the shortest distance between

A and B $= \dfrac{OB}{\vec{V}_{BA}} = \dfrac{50\sqrt{2}}{10\sqrt{2}} = 5h$

27. (4) Given $F = 600 - (2\times10^5 t)$

The force is zero at time t, given by

$$0 = 600 - 2\times10^5 t$$

$$\Rightarrow \quad t = \frac{600}{2\times10^5} = 3\times10^{-3} \text{ seconds}$$

$$\therefore \text{ Impulse} = \int_0^t F dt = \int_0^{3\times10^{-3}} (600 - 2\times10^5 t)\, dt$$

$$= \left[600t - \frac{2\times10^5 t^2}{2}\right]_0^{3\times10^{-3}}$$

$$= 600\times3\times10^{-3} - 10^5(3\times10^{-3})^2$$

$$= 1.8 - 0.9 = 0.9 \text{Ns}$$

28. (2) $\dfrac{\text{Planck's constant}}{\text{Moment of inertia}} = \dfrac{\frac{2\pi I\omega}{n}}{I} \qquad \left[\text{As } \dfrac{nh}{2\pi} = I\omega\right]$

$$= \frac{2\pi I(2\pi f)}{nI} = \left(\frac{4\pi^2}{n}.f\right) = [T^{-1}]$$

29. (1) $g = g_p - R\omega^2 \cos^2\lambda$

$$= g_p - \omega^2 R\cos^2 60° = g_p - \frac{1}{4}R\omega^2$$

30. (2) Angular momentum, L = Iω

Rotational kinetic energy, $K = \dfrac{1}{2}I\omega^2$

$$\frac{L}{K} = \frac{I\omega}{\frac{1}{2}I\omega^2} = \frac{2}{\omega}$$

$$\therefore L = \frac{2K}{\omega}$$

$$\therefore \frac{L'}{L} = \frac{K'}{K}\times\frac{\omega}{\omega'} = \left(\frac{K}{2K}\right)\left(\frac{\omega}{2\omega}\right) \Rightarrow L' = \frac{L}{4}$$

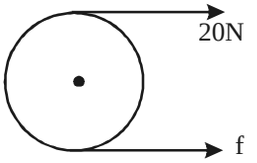
31. (1) Limiting friction between block and slab
$= \mu_s m_A g = 0.6\times10\times9.8 = 58.8$ N
But applied force on block A is 100 N. So the block will slip over a slab.
Now kinetic friction works between block and slab
$F_k = \mu_k m_A g = 0.4\times10\times9.8 = 39.2$ N
This kinetic friction helps to move the slab

$$\therefore \text{ Accleration of slab} = \frac{39.2}{m_B} = \frac{39.2}{40} = 0.98 \text{ m/s}^2$$

32. (1) Normal force would change momentum in y-direction while in x-direction no external force exist. Mechanical energy is lost because of friction.

33. (2) In 4.8000×10^4 number of significant figurers are 5 because power of 10 is not considered as significant figure whereas in 48000.50 number of significant figures are 7 because all the zero's between non zero digits and the zero's placed to the right of the numbers are significant.

34. (1) Let friction force = f



$F + f = ma$ …(i)
$(F - f)R = I\alpha$ …(ii)
From eq^{n}s. (i) and (ii),

$$2F = ma + \frac{I\alpha}{R}$$

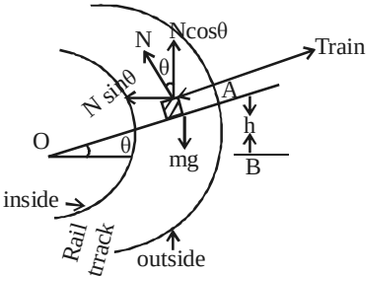
Use $\alpha = \dfrac{a}{R}$ (for pure rolling)

$$2F = ma + \frac{Ia}{R^2}$$

$$40 = 4a + \frac{0.02a}{(0.1)^2} \; ; \; a = \frac{40}{6} = 6.7 \text{ m/s}^2$$

35. (1) If the outside rail is h units higher than inside of rail track as shown in figure then

$N\cos\theta = mg$ …(i)



$$N\sin\theta = \frac{mv^2}{r} \qquad \ldots(ii)$$

$$\& \ \tan\theta = \frac{v^2}{rg} \qquad \ldots(iii)$$

Where θ is angle of banking of rail track, N is normal reaction exerted by rail track on rail.

It is clear from the equation (i) & (ii) that N cosθ balance the weight of the train & N sinθ provide the necessary centripetal force to turn.

If width of track is ℓ (OB) & h (AB) be height of outside of track from the inside, then

$$\tan\theta = \frac{h}{\ell} = \frac{v^2}{rg} \text{ or } h = \frac{v^2\ell}{rg} \qquad \ldots (iv)$$

So it is clear from the above analysis that if we increase the height of track from inside by h metre then resultant force on rail is provided by railway track & whose direction is inwards.

36. (2) Let the block compress the spring by x before stopping.
kinetic energy of the block = (P.E of compressed spring) + work done against friction.

$$\frac{1}{2}\times 2\times(4)^2 = \frac{1}{2}\times 10,000\times x^2 + 15\times x$$

$$10,000\,x^2 + 30x - 32 = 0$$

$$\Rightarrow 5000x^2 + 15x - 16 = 0$$

$$\therefore\ x = \frac{-15 \pm \sqrt{(15)^2 - 4\times(5000)(-16)}}{2\times 5000}$$

$$= 0.055\text{m} = 5.5\text{cm}.$$

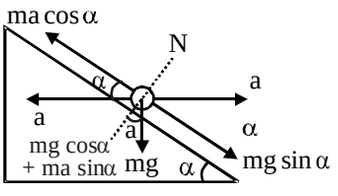
37. (4) No of divisions on main scale = N
No of divisions on vernier scale = $N + 1$
size of main scale division = a
Let size of vernier scale division be b
then we have

$$aN = b\,(N+1) \Rightarrow b = \frac{aN}{N+1}$$

Least count is $a - b = a - \frac{aN}{N+1}$

$$= a\left[\frac{N+1-N}{N+1}\right] = \frac{a}{N+1}$$

38. (3) From free body diagram,



For block to remain stationary,

$$mg\sin\alpha = ma\cos\alpha \Rightarrow a = g\tan\alpha$$

39. (1) $\frac{dv}{dt} = -2.5\sqrt{v}$

$$\Rightarrow \frac{dv}{\sqrt{v}} = -2.5\,dt$$

Integrating,

$$\int_{6.25}^{0} v^{-1/2}dv = -2.5\int_0^t dt$$

$$\Rightarrow \left[\frac{v^{+1/2}}{(1/2)}\right]_{6.25}^{0} = -2.5[t]_0^t$$

$$\Rightarrow -2(6.25)^{1/2} = -2.5t$$

$$\Rightarrow t = 2\text{ sec}$$

40. (2) True weight at equator, W = mg
Observed weight at equator,

$$W' = mg' = \frac{3}{5}mg$$

At equator, latitude $\lambda = 0$
Using the formula,

$$mg' = mg - mR\omega^2\cos^2\lambda$$

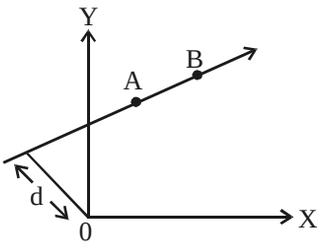
$$\frac{3}{5}mg = mg - mR\omega^2\cos^2 0 = mg - mR\omega^2$$

$$\Rightarrow mR\omega^2 = mg - \frac{3}{5}mg = \frac{2}{5}mg$$

$$\therefore\ \omega = \left(\frac{2}{5}\frac{g}{R}\right)^{1/2}$$

$$= \left(\frac{2\times 9.8}{5\times 6.4\times 10^6}\right)^{1/2} = 7.8\times 10^{-4}\,\text{rad/s}.$$

41. (1) Angular momentum = linear momentum × distance of line of action of linear momentum about the origin.



$L_A = P_A \times d$ and $L_B = P_B \times d$
As linear momenta are equal, therefore, $L_A = L_B$.

42. (1) Given: Mass of particle, $M = 10g = \frac{10}{1000}kg$

Radius of circle, R = 6.4 cm
Kinetic energy E of particle = 8×10^{-4}J
Acceleration a_t = ?

$$\frac{1}{2}mv^2 = E$$

$$\Rightarrow \frac{1}{2}\left(\frac{10}{1000}\right)v^2 = 8\times 10^{-4}$$

$$\Rightarrow v^2 = 16\times 10^{-2}$$

$$\Rightarrow v = 4\times 10^{-1} = 0.4\text{ m/s}$$

Now, using

$v^2 = u^2 + 2a_t s$ $\quad (s = 4\pi R)$

$$(0.4)^2 = 0^2 + 2a_t\left(4\times\frac{22}{7}\times\frac{6.4}{100}\right)$$

$$\Rightarrow \quad a_t = (0.4)^2 \times \frac{7\times100}{8\times22\times6.4} = 0.1\ \text{m/s}^2$$

43. (4) Quantities in option (1), (2) and (3) have same dimensions $[ML^{-1}T^{-2}]$.

44. (3) At equilibrium : $\dfrac{dU(x)}{dx} = 0$

$$\Rightarrow \frac{-12a}{x^{11}} = \frac{-6b}{x^5} \Rightarrow x = \left(\frac{2a}{b}\right)^{\frac{1}{6}}$$

$$\therefore\ U_{\text{at equilibrium}} = \frac{a}{\left(\frac{2a}{b}\right)^2} - \frac{b}{\left(\frac{2a}{b}\right)} = -\frac{b^2}{4a} \text{ and } U_{(x=\infty)} = 0$$

$$\therefore\ D = 0 - \left(-\frac{b^2}{4a}\right) = \frac{b^2}{4a}$$

45. (1) From $F = \dfrac{R}{t^2}v(t) \Rightarrow m\dfrac{dv}{dt} = \dfrac{R}{t^2}v(t)$

Integrating both sides $\int \dfrac{dv}{v} = \int \dfrac{Rdt}{mt^2}$

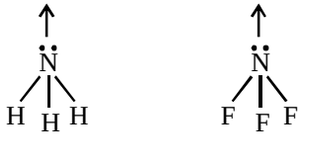
$$\ln v = -\frac{R}{mt}$$

$$\therefore \ln v \propto \frac{1}{t}$$

PART B – CHEMISTRY

46. (3) Energy of an electron at infinite distance from the nucleus is zero. As an electron approaches the nucleus, the electron attraction increases and hence the energy of electron decreases and thus becomes negative. Thus as the value of *n* decreases, *i.e.* lower the orbit is, more negative is the energy of the electron in it.

47. (1) In NH_3 the atomic dipole (orbital dipole due to lone pair) and bond dipole are in the same direction, whereas in NF_3 these are in opposite directions so in the former case, they are added up whereas in the latter case net result is reduction of dipole moment. It has been shown in the following figure :



48. (2) Angular momentum $mvr = n\dfrac{h}{2\pi} = \dfrac{h}{2\pi}$ (For first orbit)

or, $mv = \dfrac{h}{2\pi r} = \dfrac{h}{\text{circumference}} = \dfrac{h}{\lambda}$ $\quad \left(\lambda = \dfrac{h}{mv}\right)$

Hence, λ = circumference

49. (2) $\underset{a(1-x)}{PCl_5} \rightleftharpoons \underset{ax}{PCl_3} + \underset{ax}{Cl_2}$

$a = 2, x = 0.4, V = 2$ L

$$\therefore\ \left[PCl_5\right] = \frac{2(1-0.4)}{2} = 0.6\ \text{mol L}^{-1}$$

$$\left[PCl_3\right] = \left[Cl_2\right] = \frac{2\times0.4}{2} = 0.4\ \text{mol L}^{-1}$$

$$\therefore\ K_c = \frac{0.4\times0.4}{0.6} = 0.267$$

50. (4) BF_4^- hybridisation sp^3, tetrahedral structure. NH_4^+ hybridisation sp^3, tetrahedral structure.

51. (2) As volume is constant hence work done in this process is zero hence heat supplied is equal to change in internal energy.

52. (3) In a reversible process the work done is greater than in irreversible process. Hence the heat absorbed in reversible process would be greater than in the latter case. So

$$T_f(\text{rev.}) < T_f(\text{irr.})$$

53. (1)

Fe_2O_3	+	3CO	$\rightarrow$	2Fe	+	$3CO_2$
1 vol.		3 vol.		2 vol.		3 vol.
1 mol.		3 mol.		2 mol.		3 mol.

($\because$ vol% = mol%)

One gram mole of any gas occupies 22.4 litre at NTP. 1 mole of Fe_2O_3 requires 3 moles of CO for its reduction i.e., 1 mol of Fe_2O_3 requires 3×22.4 litre or 67.2 dm^3 CO to get itself reduced.

54. (4) $\underset{2(78)}{2C_6H_6} + \underset{15(32)}{15O_2(g)} \rightarrow 12CO_2(g) + 6H_2O(g)$

$\because$ 156 gm of benzene required oxygen = 15×22.4 litre

$$\therefore \text{1 gm of benzene required oxygen} = \frac{15\times22.4}{156}\text{ litre}$$

$\therefore$ 39 gm of Benzene required oxygen

$$= \frac{15\times22.4\times39}{156} = 84.0\ \text{litres}$$

55. (1)

56. (4) HCl is stronger acid than CH_3COOH and Cl^- is a stronger base than $CH_3COOH_2^+$ and is the conjugate base of HCl.

$$\underset{\text{acid}_1}{HCl} + CH_3COOH \rightleftharpoons \underset{\text{base}_1}{Cl^-} + \underset{\text{acid}_2}{CH_3COOH_2^+}$$

57. (1) Given $n_{CO} = n_{N_2}$

$P_{CO} + P_{N_2} = 1$ atm

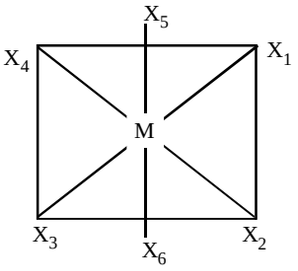
Partial pressure of a gas = mole fraction of gas × total pressure

$$\therefore \ P_{N_2} = \frac{n_{N_2}}{n_{CO} + n_{N_2}} \times 1 = \frac{n_{N_2}}{2n_{N_2}} \times 1 = \frac{1}{2} = 0.5 \text{ atm.}$$

58. (3) Strong base has higher tendency to accept the proton. Increasing order of base and hence the order of accepting tendency of proton is

$I^- < HS^- < NH_3 < RNH_2$

59. (1)



Thus here bond angles between

$X_4 - M - X_2 = 180°$

$X_1 - M - X_3 = 180°$

$X_5 - M - X_6 = 180°$

60. (3) I represents Li, II represents K, III represents Br, IV represents I, V represents He. So, amongst these, II represents most reactive metal and V represents least reactive non-metal.

61. (1) $\Delta G° = \Delta H° - T\Delta S°$

For a spontaneous reaction $\Delta G° < 0$

$$\text{or } \Delta H° - T\Delta S° < 0 \Rightarrow \ T > \frac{\Delta H°}{\Delta S°}$$

$$\Rightarrow \ T > \frac{179.1 \times 10^3}{160.2} > 1117.9\text{K} \approx 1118\text{K}$$

62. (2)

63. (2) $_5B = 1s^2, 2s^2, 2p_x^1 p_y^0 p_z^0$; n = 2, l = 1, m = –1

64. (2) **Given:** Equilibrium constant (K_1) for the reaction

$$HI(g) \underset{}{\overset{K_1}{\rightleftharpoons}} \frac{1}{2}H_2(g) + \frac{1}{2}I_2(g); \ K_1 = 8; \qquad \text{.....(i)}$$

To find equilibrium constant for the following reaction :

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g); \ K_2 = ? \qquad \text{.....(ii)}$$

For this multiply (i) by 2, we get

$$2HI(g) \rightleftharpoons H_2(g) + I_2(g); \ K_1 = 8^2 = 64 \qquad \text{.....(iii)}$$

[**Note:** When the equation for an equilibrium is multiplied by a factor, the equilibrium constant must be raised to the power equal to the factor]

Now reverse equation (iii), we get

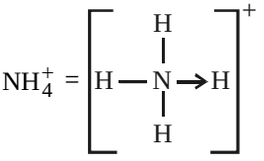
$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g); K = \frac{1}{64} \qquad \text{.....(iv)}$$

[**Note:** For a reversible reaction, the equilibrium constant of the backward reaction is inverse of the equilibrium constant for the forward reaction.]

Equation (iv) is the same as the required equation (ii), thus K_2 for equation (ii) is $\frac{1}{64}$ i.e. option (b) is correct.

65. (2) Bond structure of molecules are :

$HCl = H^+ - Cl^-$

$NH_4^+ =$ 

$Cl^- =$

$H_2O_2 = H - O - O - H$

hence, clearly NH_4^+ ion contains all the three types of bonds.

66. (1) When pressure is low '*b*' can be neglected, thus

$$\left(P + \frac{a}{V^2}\right)V = RT$$

$$PV + \frac{a}{V} = RT$$

$$PV = RT - \frac{a}{V}$$

$$\frac{PV}{RT} = \frac{RT}{RT} - \frac{a}{VRT}$$

$$Z = \frac{PV}{RT} = 1 - \frac{a}{VRT}$$

67. (1) IV^{th} group needs higher S^{2-} ion concentration. In presence of HCl, the dissociation of H_2S decreases hence produces less amount of sulphide ions due to common ion effect, thus HCl decreases the solubility of H_2S which is sufficient to precipitate II^{nd} group radical.

68. (4) No. of moles $= \frac{\text{weight}}{\text{mol. wt.}} = \frac{50}{342} = 0.14$ mole

69. (1) 1 ppm = 1 mg / 1 litre (for liquids)

4 ppm = 4 mg / 1 litre

1 litre contains 4 mg of fluoride ions

10 ml contains $\frac{4}{1000} \times 10 = 0.04$ mg

$$\text{Number of moles of fluoride} = \frac{0.04\text{g}}{19\text{g/mol}}$$

$$= 2.10 \times 10^{-3}$$

70. (1) Bond order in N_2 and O_2^{2+} is 3 (calculated by energy level diagram)

71. (3) van der Waal's equation,

$$\left(P+\frac{a}{V^2}\right)(V-b)=RT;$$

Here $\left(P+\frac{a}{V^2}\right)$ represents the intermolecular forces.

72. (4) $MX \rightleftharpoons \underset{s}{M^+} + \underset{s}{X^-}$ (Where s is the solubility)

Then $K_{sp} = s^2$ or $s=\sqrt{K_{sp}}$

Similarly for MX_2 ¾ ® $\underset{s}{M^{2+}} + \underset{2s}{2X^-}$

$$K_{sp} = s\times(2s)^2 = 4s^3 \quad \text{or} \quad s=\left[\frac{K_{sp}}{4}\right]^{\frac{1}{3}}$$

and for $M_3X \rightleftharpoons \underset{3s}{3M^+} + \underset{s}{X^{-3}}$

$$K_{sp} = (3s)^3\times s = 27s^4 \quad \text{or} \quad s=\left[\frac{K_{sp}}{27}\right]^{\frac{1}{4}}$$

From the given values of K_{sp} for MX, MX_2 and M_3X, we can find the solubilities of these salts at temperature, T.

Solubility of $MX = \sqrt{4\times10^{-8}} = 2\times10^{-4}$

Solubility of $MX_2 = \left\{\frac{3.2\times10^{-14}}{4}\right\}^{\frac{1}{3}}$

or $\left\{\frac{32}{4}\times10^{-15}\right\}^{\frac{1}{3}}$

$= \{8\times10^{-15}\}^{\frac{1}{3}}$ or 2×10^{-5}

Solubility of $M_3X = \left\{\frac{2.7\times10^{-15}}{27}\right\}^{\frac{1}{4}}$

$= \{10^{-16}\}^{\frac{1}{4}}$ or 10^{-4}

Thus the solubilities are in the order $MX > M_3X > MX_2$ i.e the correct answer is (d).

73. (3) $\lambda=\frac{h}{p}=\frac{6.6\times10^{-34}}{3.3\times10^{-24}}=2\times10^{-10}m=2\text{Å}$

74. (2) Along the period, I.P. generally increases but not regularly. Be and B are exceptions. First I.P. increases in moving from left to right in a period, but I.P. of B is lower than Be.

75. (1) Given weight of empty glass vessel = 50 g
Weight of vessel filled with liquid = 144 g
∴ Weight of liquid = 144 – 50 = 94 g.
Volume of liquid = Mass/density = 94/0.47
= 200 ml = 200×10^{-3} L.
Given, pressure of ideal gas = 760 mm Hg = 1 atm
Temperature = 300 K
R = 0.0821 L atm K^{-1} mol^{-1}
Mass of ideal gas = 50.5 – 50 = 0.5 g
According to ideal gas equation,

$$PV = nRT = \frac{w}{M}RT$$

$$1\times200\times10^{-3}=\frac{0.5}{M}\times0.0821\times300$$

$$M=\frac{0.5\times0.0821\times300}{200\times10^{-3}}=61.575$$

76. (3) Number of moles, temperature and volume are same.

77. (1) $H_2O(l)\rightarrow H_2O(g)$
ΔH_{vap} = 40.79 kJ/mol
$\Delta H = \Delta U + \Delta n_g RT$
$\Rightarrow$ 40.79 kJ/mol = ΔU + (1) (8.314 JK^{-1} mol^{-1}) (373 K)

$$\Rightarrow \Delta U = \left(40.79\text{ kJ/mol}-\frac{8.314\times373}{1000}\text{kJ/mol}\right)$$

$$= (40.79-3.10)\text{ kJ/mol}$$

$$= 37.69\ \frac{\text{kJ}}{\text{mol}}$$

Internal energy change for 36 g of water

$$=37.69\frac{\text{kJ}}{\text{mol}}\times\frac{36\text{g}}{18\text{g/mol}}$$

ΔU = 75.38 kJ

78. (4) In NF_3 D.M. due to lone pair and F act in opposite direction and cancel each other while in NH_3 it acts in one direction only Hence D.M. of NH_3 is more than NF_3.

79. (2) $\underset{S}{Cr(OH)_3(s)} \rightleftharpoons \underset{S}{Cr^{3+}(aq.)} + \underset{3S}{3OH^-(aq.)}$

$(S)\ (3S)^3 = K_{sp}$

$27S^4 = K_{sp}$

$$S=\left(\frac{K_{sp}}{27}\right)^{1/4}=\left(\frac{1.6\times10^{-30}}{27}\right)^{1/4}$$

80. (4) This reaction shows the formation of H_2O, and the X_2 represents the enthalpy of formation of H_2O because as the definition suggests that the enthalpy of formation is the heat evolved or absorbed when one mole of a substance is formed from its constituent atoms.

81. (2) $PCl_5 \rightleftharpoons PCl_3 + Cl_2$
Moles at equilibrium

$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$

Mole fraction at equilibrium

$\frac{1}{3}$ $\frac{1}{3}$ $\frac{1}{3}$

Partial pressure at equilibrium

$\frac{P}{3}$ $\frac{P}{3}$ $\frac{P}{3}$

$$K_p = \frac{\frac{P}{3}\times\frac{P}{3}}{P/3} = \frac{P}{3};\ P = 3\,K_p$$

82. (4) $\frac{C_P}{C_V} = \frac{\frac{5}{2}R}{\frac{3}{2}R} = \frac{5}{3} = 1.67$

83. (4) Energy = $N_A h\nu$

$495.5 = 6.023 \times 10^{23} \times 6.6 \times 10^{-34} \times \nu$

$$\nu = \frac{495.5\times10^3}{6.023\times10^{23}\times6.6\times10^{-34}} = 12.4\times10^{14}$$

$= 1.24 \times 10^{15}\ s^{-1}$.

84. (1) $K_1 = \frac{Ni(CO)_4}{[CO_2]^2}$; $K_2 = \frac{[CO]^2}{[CO_2]}$

$$K = \frac{[Ni(CO)_4]}{[CO]^4}$$

$$K = \frac{[Ni(CO)_4]}{[CO_2]^2} \times \left(\frac{[CO_2]}{[CO]^2}\right)^2$$

$$K = \frac{K_1}{K_2^2}$$

85. (1) In a period on moving from left to right ionic radii decreases.

(i) So order of cationic radii is
$Cr^{2+} > Mn^{2+} > Fe^{2+} > Ni^{2+}$ and

(ii) Sc > Ti > Cr > Mn (correct order of atomic radii)

(iii) For unpaired electrons

Mn^{2+} (Five) > Ni^{2+} (Two)

< Co^{2+} (Three) < Fe^{2+} (Four)

(iv) For unpaired electrons

Fe^{2+} (Four) > Co^{2+} (Three)

> Ni^{2+} (Two) > Cu^{2+} (One)

86. (1) Process is isothermal reversible expansion, hence
$\Delta U = 0$, therefore $q = -W$.
Since $q = +208$ J, $W = -208$ J

87. (1) K_w at 25°C = 1×10^{-14}
At 25ºC
$K_w = [H^+]\,[OH^-] = 10^{-14}$
At 100°C (given)
$K_w = [H^+]\,[OH^-] = 55 \times 10^{-14}$
$\because$ for a neutral solution
$[H^+] = [OH^-]$
$\therefore\ [H^+]^2 = 55 \times 10^{-14}$
or $[H^+] = (55 \times 10^{-14})^{1/2}$
$\because$ pH = – log $[H^+]$
On taking log on both side
$-\log [H^+] = -\log (55 \times 10^{-14})^{1/2}$

$$pH = -\frac{1}{2}\log 55 + 7\log 10$$

$pH = -0.87 + 7$
$= 6.13$

88. (4) N_2^+ is paramagnetic
$\sigma 1s^2,\ \sigma^*1s^2, \sigma^*2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^1$

89. (3) The correct order of acidic strength of the given species in

$$\underset{(iv)}{HSO_3F} > \underset{(ii)}{H_3O^+} > \underset{(iii)}{HSO_4^-} > \underset{(i)}{HCO_3^-}$$

or (i) < (iii) < (ii) < (iv)
It corresponds to choice (c) which is the correct answer.

90. (4) Critical temperature of water is higher than O_2 because H_2O molecule has dipole moment which is due to its V-shape.

PART C – BIOLOGY

91. (1) All cells arise from pre-existing cells by a process of cell division. Cell division is the phenomenon of production of daughter cell from parent cell. It occurs continuously in plants and only up to a certain age in animals. The continuous growth in plants termed "unique", while in animals, cells divide up to a certain stage.

92. (3) Growth and reproduction are mutually exclusive events in majority of the higher animals and plants. Growth may be defined as a positive change in size, often over a period of time. Reproduction leads to production of progenies, possessing features more or less similar to those of parents.

93. (3) The term biodiversity is used for the variety and variability among all forms of living organisms like plants, animals, and micro-organisms present in a given region under natural conditions. Biodiversity can be defined as the totality of genes, species and ecosystem of a region. India is very rich in biodiversity.

94. (2) The diatom shells accumulating up at the bottom of oceans over millions of years formed deposits called diatomaceous earth. These deposits may be thousand metres thick with as many as five million diatom shells in each cubic centimetre. This diatomaceous earth is used in many small and large scale industries.

95. (1) Diversification in plant life appeared due to long periods of evolutionary changes. Algae and bryophytes have thalloid plant body with no differentiation into root, stem and leaves. They had no vascular tissues but later in pteridophytes vascular tissues (xylem and phloem) developed and plant body became differentiated into root, stem and leaves. But the vascular tissues lack vessels and companion cells and they reproduce by spores. In gymnosperms, seed habit developed but the seeds are not enclosed inside fruit.

In angiosperms vessels companion cells and flowers are present and seeds are enclosed inside fruits. Thus the path of evolution is from algae to bryophytes to pteridophytes to gymnosperms and finally to angiosperm.

96. (1) Haeckel created the kingdom Protista to include all unicellular eukaryotic micro-organisms. They have a typical eukaryotic structure with membrane bound organelles and nucleus.

97. (3) Chrysophytes are a group of diatoms, golden algae (desmids) and golden brown photosynthetic microscopic protists. Their body is covered by a transparent siliceous shell.

98. (4) Deuteromycetes is commonly known as fungi imperfecti due to absence of perfect sexual stage. They are classified by the colour and structure of the conidia. Since most of the conidia structures look like ascomycetes type, they are believed to be derived from ascos which does not have the ability to reproduce sexually.

99. (3) Nearly 50% of total carbon dioxide fixation or photosynthesis of world is carried out by algae. Photosynthesis by algae releases oxygen in the immediate aquatic environment. It is essential for respiration of aquatic life. Algae are primary producers of food in large bodies of fresh, brackish and sea water.

100. (2) In gymnosperms, the pollen grains and the megaspores are haploid and develop as a result of meiosis in the respective mother cells. The functional megaspore forms the embryo sac. The endosperm is formed prior to fertilization, hence is haploid.

101. (1) A body cavity refers to any internal space, or a series of spaces present inside body, whereas coelom or true body cavity generally refers to a large fluid-filled space (cavity) lying between the outer body wall and the inner digestive tube. In acoelomates, no body cavity or coelom is present. Embryonic mesoderm remains as a solid layer, space between endoderm (gut wall) and ectoderm (body wall) is filled with mesenchyme and muscle fibres. In pseudocoelomates, body space is a pseudocoelom or false coelom. In coelomates or eucoelomates, body space is a true coelum, enclosed by mesoderm on both sides. Aschelminthes are pseudocoelomates. Molluscs and insects are coelomates while flatworms are acoelomates.

102. (4) Taxonomic hierarchy is the sequence of arrangements of taxonomic categories in a descending order during the classification of organisms. Each category of taxonomic hierarchy refers to as a unit of classification.

103. (3) A family is a subdivision of an order consisting of a group of related genera which in turn are composed of groups of related species. Families are characterized on the basis of vegetative and reproductive parts of the plants species. Suffix added in families of both plants and animals may be –aceae or –ae.

104. (3) Herbarium is the store house of dead, dried, pressed and preserved plant specimens on paper sheets, called herbarium sheets. The sheets, along with description of plant specimen, are arranged according to standard system of classification, and are stored for future use. All sheets carry labels having information about date and place of collection, English, local and botanical names, family and collector's name etc. The herbarium sheets can be used as a quick reference for taxonomic studies.

105. (1) Animals display four different grades of organization. (i) Protoplasmic grade found in protozoans. (ii) Cellular grade is the characteristic of sponges and mesozoans in a sponge, cells exhibit division of labour for performing specialized functions. (iii) Tissue grade is of two types : Cell-tissue grade is seen in coelenterates as there are cells not only specialized for different functions but also certain similar cells gather together to form tissue as well. Tissue-organ grade appears in flatworms (Platyhelminthes) with arrangement of tissues to form organs. (iv) In organ system level of organisation, organs are joined in a system to perform basic functions. It is found in higher invertebrates and all vertebrates.

106. (3) Phyllode is the flattened petiole or rachis of a leaf which carries out the function of photosynthesis (e.g., *Parkinsonia*, *Acacia*). In these plants, lamina is either absent or reduced, to reduce the transpiring area. In Asparagus, cladode type of stem modification can be seen. Cladodes are slightly flattened, fleshy, straight or curved pointed structures which develop in clusters in the axils of scale leaves.

107. (4) The capsomere is a subunit of the capsid, an outer covering of protein that protects the genetic material of a virus. Capsomeres self-assemble to form the capsid.

108. (4) Viruses are obligate intracellular parasite which can reproduce only by invading and taking over other cells as they lack the cellular machinary for self reproduction. Viruses have either DNA or RNA as the genetic material. Viruses having RNA as the genetic material are known as Retroviruses.

109. (2) The correct labeling in the figures of bacterial cell and *Nostoc* are - A- cell wall, B - cell membranes, C - DNA, D-heterocysts, E - mucilaginous sheath.

110. (3) Deuteromycetes is commonly known as fungi imperfecti. Once the sexual stage of members of deuteromycetes was discovered they were often moved to ascomycetes and basidiomycetes.

111. (4) Phylogenetic system of classification indicates the evolutionary as well as genetic relationships among organisms. It is based on fossil record, biochemical, anatomical, morphological, embryological, physiological, genetics, karyotype and other studies.

112. (4) Isogamous and anisogamous type of reproduction are found in *Chlamydomonas*. Fusion of flagellated gametes of similar size is called isogamous whereas fusion of two gametes of different size is called anisogamous.

113. (3) In bryophytes, sex organs are of two types, male antheridium and female archegonium. They are multicellular and jacketed, i.e., covered by jacket of sterile cells.

114. (1) Radial symmetry is found in coelenterates, ctenophores and echinoderms. The right and left, or the dorsal and ventral sides, in such symmetry are not differentiated. This type of symmetry is advantageous to sessile (attached) animals as they can feed from all directions.

115. (4) Phylum arthropoda is the most numerous phyla of all living organisms, both in number of species and in number of individuals.

116. (2) Lampreys and Hag fish (*Myxine*) are unusual, jawless fish that comprise the order Cyclostomata, so named because of the circular shape of the mouth. The brains of lampreys and hagfishes differ a lot, but they also show a large number of similarities, as do all craniate brains.

117. (2) *Laminaria* (kelp) and *Fucus* (rock weed) are the examples of brown algae. Brown algae are the common name of phaeophyceae. They are found primarily in marine habitats and show great variation in size and form.

118. (1) Pyrenoids are the rounded bodies found in the chloroplast of green algae and are the centres of conversion of glucose to starch and also collection of starch.

119. (4) Pteridophytes are classified into four classes : Psilopsida (Psilotum), Lycopsida (*Selaginella*, *Lycopodium*), Sphenopsida (*Equisetum*) and Pteropsida (*Dryopteris*, *Pteris*, *Adiantum*).

120. (4) Crocodile belongs to class Reptilia. Reptiles have usually three chambered heart but crocodile have four-chambered heart.

121. (2) *Ascaris* belongs to nematode phylum which is a non - segmented roundworms / threadworms/ pinworms. Nereis is a genus of polychaete worms. It possesses setae and parapodia for locomotion. *Hirudinaria*, also known as cattle leech, belongs to annelida phylum. It acts as a parasite on cattle.

122. (1) Medusa and polyp are the stages in the life cycle of cnidarians. Medusa is a sexual free swimming form and polyp is asexual form. The jellyfish have both a medusa and polyp stage in their life cycle, but the sea anemones do not have the medusa stage and spend the life cycle as polyps.

123. (2) Algae are a simple, non-flowering, and typically aquatic plant of a large assemblage that includes the seaweeds and many single-celled forms. Example - *Chlamydomonas*.

Fungi is a diverse group of eukaryotic single-celled or multinucleate organisms comprising the mushrooms, moulds, mildews, smuts, rusts, and yeasts. Example - *Rhizopus*.

Angiosperms comprises those that have flowers and produce seeds enclosed within a carpel, including herbaceous plants, shrubs, grasses, and most trees. Example - *Solanum tuberosum*.

Pteridophytes are the vascular plants (those having xylem and phloem tissues). They include the highly diverse true ferns and other graceful, primarily forest-dwelling plants. Example - *Equisetum*.

Gymnosperms are seed-bearing vascular plants in which the ovules or seeds are not enclosed in an ovary. Example - *Cycas*.

124. (4) Algae are eukaryotic organisms that have no roots stems or leaves but do have chlorophyll and other pigments for carrying out photosynthesis

125. (2) Mosses are non-vascular plants which means they cannot transport water and nutrients to the aerial parts of the plant.

126. (1) Diaphragm is a membrane that separates thoracic cavity from abdominal cavity. It is present only in mammals. All other chordates do not have diaphragm as their body cavity is not divided into thoracic and abdominal cavities.

127. (2) *Pheretima* belongs to phylum annelida . Annelida is a group commonly referred to as segmented worms, and they are found worldwide from the deepest marine sediments to the soils in our city parks and yards.

128. (2) Tap root or primary roots develop from the radicle. It forms lateral branches or secondary roots which are further branched to form tertiary roots. This type of root system is seen in the mustard plant.

129. (3) In some plants, roots arise from lower nodes of stem and enter the soil and become stronger. Such roots are called shift roots. They protect the plant against winds, e.g., sugarcane, maize, screwpine.

130. (2) Underground stems are non green stems that may take part in perennation, store food or help in vegetative propagation. Underground stems of potato, ginger, turmeric, zaminkand, *Colocasia* are modified stem to store food in them.

131. (1) Lateral meristem divides only periclinally or radially and is responsible for increase in girth or diameter. It includes vascular cambium and cork-cambium.

132. (2) Axillary buds are present in the axils of leaves and are capable of forming a branch or a flower.

133. (2) In roots, the protoxylem lies towards periphery and metaxylem lies towards the centre. Such arrangement of primary xylem is called exarch.

134. (2) The seed coat is the outermost covering of a dicotyledonous seed. The seed coat has two layers, the outer testa and the inner tegmen. The hilum is a scar on the seed coat through which the developing

seeds were attached to the fruit. Above the hilum is a small pore called the micropyle. Within the seed coat, is the embryo, consisting of an embryonal axis and two cotyledons.

135. (1) Xylem vessels become dead and lose their protoplasm due to deposition of lignified secondary wall. Mature sieve tube elements are living cells without nucleus.

136. (1) Dorsiventral leaves are commonly horizontal in orientation with distinct upper (adaxial) and lower (abaxial) surfaces. Xylem lies towards the upper (adaxial) side of leaf while phloem lies towards the lower (abaxial) side of leaf.

137. (2) Fluid mosaic model is the most recent and widely accepted model of a biomembrane which was proposed by Singer and Nicolson in 1972. Fluid mosaic model describes cell membrane as quasifluid, i.e., 'protein icebergs in a sea of liquids'. According to this model, there is a bilayer of lipid molecules (phospholipid) with globular protein molecules (2 types- integral and peripheral) and sterols which are arranged in different manner in different regions of the plasma membrane.

138. (1) Cytoplasm of eukaryotic animal cells contains two cylindrical, rod-shaped, microtubular structures, called centrioles, near the nucleus. Centrioles lack limiting membrane and DNA or RNA and form a spindle of microtubules. Though centrioles have not been found to contain DNA, yet they are capable of forming new centrioles with the help of massules or pericentriolar satellites which function as nucleating centres.

139. (4) Tomato and tobacco both belong to the family Solanaceae. Solanaceae has some identifying characteristics-bicarpellary, syncarpous superior ovary, axile plancentation, fruit is berry or capsule.

140. (1) Botanical name of banana is *Musa paradisica*.

141. (3)

142. (2) Pericycle in roots is active in the formation of root branches or lateral roots.

143. (3) Heartwood differs from sapwood in having dead and non-conducting elements. In old trees, the inner region that comprises dead elements with highly lignified walls is called heartwood. Heartwood does not conduct water but gives mechanical support to the stem. On the other hand, the peripheral region, which is lighter in colour are called sapwood. It is involved in the conduction of water and minerals from root to leaf.

144. (2) Vascular cambium is located between the xylem and the phloem in the stem and roots of a vascular plant, and is the source of both the secondary xylem growth (inwards, towards the pith) and the secondary phloem growth (outwards).

145. (1) In mango and coconut, the fruit is known as drupe. Drupe develops from monocarpellary superior ovaries.

In mango, the pericarp is differentiated into an outer thin epicarp, middle fleshy edible mesocarp and an inner stony hard endocarp. In coconut, the mesocarp is represented by the fibrous part.

146. (4) The aleurone layer is the outermost layer of the endosperm, followed by the inner starchy endosperm. This layer of cells is sometimes referred to as the peripheral endosperm. It lies between the pericarp and the hyaline layer of the endosperm.

147. (2) The first formed primary xylem elements are called protoxylem and the later formed primary xylem is called metaxylem. Phloem fibres (bast fibres) are made up of sclerenchymatous cells.

148. (1) Vascular bundles (VBs) is a strand of conducting vessels in the stem or leaves of a plant, typically with phloem on the outside and xylem on the inside. In the given figures A, B and C the types of vascular bundles are respectively radial, conjoint closed and conjoint open. When xylem and phloem are arranged in the radius of the plant in alternative manner then it is called radial vascular bundle. Radial VBs are always closed and present in all types of roots. In conjoint vascular bundle, xylem and phloem are situated at the same radius of vascular bundles. Such VBs are common in stems and leaves.

149. (3) Annual ring is a ring in the cross section of the stem or root of a temperate woody plant, produced by one year's growth. Trees at sea do not have annual rings because there is no marked climatic variation. In climates with well-marked alternations of seasons (either cold and warm or wet and dry), the wood cells produced when water is easily available and growth is rapid (generally corresponding to the spring or wet season) are often noticeably larger and have thinner walls than those produced later in the season when the supply of water has diminished and growth is slower. There is thus a sharp contrast between the small, thick-walled late-season wood cells produced one year, and the large, thin-walled cells of the spring wood of the following year results. Where the climate is uniform and growth continuous, as in wet, tropical forests, there is usually little or no gross visible contrast between the annual rings, although differences exist. When rings are conspicuous, they may be counted in order to obtain a reasonably accurate approximation of the age of the tree. They are also reflective (by their range of thickness) of the climatic and environmental factors that influence growth rates.

150. (3) Mast cell are a cell found in connective tissue that contains numerous basophilic granules and release substances such as heparin and histamine in response to injury or inflammation of tissues.

151. (4) Basement membrane is a thin extracellular supporting layer that separates a layer of epithelial cells from the underlying lamina propria and is composed of the basal lamina and reticular lamina

152. (3) Elastic cartilage or yellow cartilage is a type of cartilage present in the outer ear, Eustachian tube and epiglottis. It contains elastic fibre networks and collagen fibres. The principal protein is in elastic cartilage is elastin.

153. (2) An energy dependent process, in which ATP is utilised is called an active transport.
e.g., Na^+ / K^+ Pump.

154. (1) RBC (red blood cell) of the human is the best material for the study of structure of cell membrane. Chemical studies on the RBC cell membrane enabled the scientists to infer the possible structure of plasma membrane. The plasma membrane of the RBC consists of a complex, well-ordered group of lipids and proteins stretched over the outer surface of the cell in the form of a lipid bilayer punctuated by penetrating or attached proteins. This membrane has numerous properties that arise in part from specialized interactions between specific membrane proteins or lipids, or both.

155. (1) Golgi apparatus principally performs the function of packaging material to be delivered either to the intra – cellular targets or secreted outside the cell.

156. (2) In B–DNA, one turn of the helix has about 10 nucleotides on each strand of DNA. A turn occupies a distance of about 3.4 nm (34Å or 3.4×10^{-9} m) so that adjacent nucleotides or their bases are separated by a space of about 0.34 nm (0.34×10^{-9} m or 3.4 Å).

157. (4) Homeostasis is the regulation by an organism of the chemical composition of its body fluids and other aspects of its internal environment so that physiological processes can proceed at optimum rates.

158. (4) During anaphase of mitosis, each chromosome arranged at metaphase plate is split and two daughter chromatids are formed. Centromeres split and chromatids move to opposite poles. During anaphase I of meiosis I, the homologous chromosomes separate, while sister chromatids remain associated at their centromeres. Anaphase II of meiosis II begins with simultaneous splitting of the centromere of each chromosome allowing them to move towards opposite poles of the cell.

159. (4) Spermathecae are present in sixth, seventh, eighth and ninth segments of the earthworm. They store the sperms received from another earthworm during copulation.

160. (1) The frog never drinks water but absorbs it through the skin. The skin is always maintained in a moist condition.

161. (2) Basal body is a short cylindrical array of microtubules. It is formed from a centriole and associated with the formation of cilia and flagella. It is located at the base of eukaryotic cilia and flagella, which is a continuation of the 9 outer-axonemal microtubule doublets, but with the addition of a C tubule to form a centriole-like triplet. Basal bodies may be self-replicating and serve as a nucleating centre for axonemal assembly, which are anchored in the cytoplasm by rootlets.

162. (1) Satellite is a small chromosomal segment separated from the main body of the chromosome by a secondary constriction. In humans, it is usually associated with the short arm of an acrocentric chromosome. They play a vital role in the formation of the nucleolus after cell division. In humans, chromosomes number 13, 14, 15, 21 and 22 are examples of SAT (satellite) chromosomes.

163. (1) The special membranous structure formed by the extension of prokaryotic plasma membrane is known as mesosome while polysome is structure formed by combination of many ribosomes.
SER is the major site of synthesis of lipids. The site of protein synthesis is RER.

164. (1) Metacentric chromosomes have the centromere in the centre, such that both sections are of equal length. Human chromosome 1 and 3 are metacentric.
Sub metacentric chromosomes are a chromosome with the centromere so placed that it divides the chromosome into two arms of strikingly unequal length.
Acrocentric chromosomes have a centromere which is located almost near the tip leading to one very long and one very short section. Human chromosomes 13, 15, 21, and 22 are acrocentric.
Telocentric chromosomes have centromere which is located at the terminal end. Telomeres may extend from both ends of the chromosome. Humans do not possess telocentric chromosomes.

165. (1) Lysosomes are membrane-enclosed organelles and consist of hydrolytic enzymes which are capable of breaking down all types of biological polymers (like proteins, nucleic acids, carbohydrates, and lipids). If lysosomes get ruptured in a cell, the cell dies due to release of hydrolytic enzymes which destroys the cells.

166. (1) The only definitive characteristic listed is the presence or absence of a nucleus.

167. (4) Glutamic acid and aspartic acid are acidic amino acid because they bear one amino acid group and two carboxylic group. Lysine is a basic amino acid.

168. (4) Phospholipids are composed of phosphate group and one or more fatty acids. They have hydrophilic (polar) phosphate group and long hydrophobic (non-polar) hydrocarbon 'tails'. The phospholipids readily form membrane like structure in water.

169. (3) Feedback inhibition of enzymes is affected by end product. Feedback inhibition occurs when the end product of a reaction interferes with the enzyme that helped produce it. The inhibitor does this by binding to a second active binding site that's different from the one attached to the initial reactant. The enzyme then changes its shape and can't catalyze the reaction anymore. This type of inhibition is done as a regulatory mechanism to meet the metabolic needs of the cell or organisms.

170. (2) Interphase is the longest phase of the mitotic cycle, lasting for more than 95% of the duration of cell cycle. It has three sub-phases : G_1, S and G_2. Interphase is the most suitable period to carry out FISH for detecting and locating gene mutations & chromosome abnormalities.

171. (2) Metaphase is the best stage to count the number of chromosomes and study their morphology.

172. (2) Crossing over is exchange of chromosomes segments between non-sister chromatids of homologous pair. It brings about gene recombination and also produces genetic variation. The chromatids are the unit of crossing over.

173. (3) Amino acids are the building blocks of proteins. Amino acid can be classified on the basis of characteristics of their side chains.

174. (3) Options (1), (2) and (4) are wrong.

(1) Inulin is a polymer of fructose.

(2) Starch forms helical secondary structure.

(4) Glycogen is glucosan homopolysaccharide which is the major reserve food of animals, fungi and some bacteria.

175. (1) The catalytic efficiency of two different enzymes can be compared by the Km value. Km is the Michaelis-Menten constant. It is the substrate concentration at which an enzyme attains half its maximal velocity.

176. (2) Crossing over leads to recombination between homologous chromosomes. Recombination is the rearrangement of genetic information within and among DNA molecules.

177. (3) The figure A represents late anaphase while figure B represent prophase stage of mitosis.

178. (1) In meiosis, the daughter cells differ from the parent cell as well as amongst themselves due to segregation, independent assortment and crossing over.

179. (3) The correct sequence of the events in the meiosis is: III, II, I, IV.

180. (1) With the increase in substrate concentration, the velocity of the enzymatic reactions rises at first. The reaction ultimately reaches a maximum velocity which is not exceeded by any further rise in concentration of the substrate. This is because the enzyme molecules are fewer than the substrate molecules and after saturation of these molecules there are no free enzyme molecules to bind with the additional substrate molecules.