1. (4)  
As \( \mu = \frac{\text{velocity of light in vacuum}}{\text{velocity of light in medium}} \), hence \( \mu \) is dimensionless. Thus each term on the RHS of given equation should be dimensionless.

\[ \therefore \frac{B}{\lambda^2} \] is dimensionless, \( i.e., B \) should have dimensions of \( \lambda^2 \), \( i.e., \text{cm}^2, i.e., \text{area}. \)

2. (3)  
\[ P + \frac{1}{2} \rho v^2 + \rho gh = K \]
K has the same dimension as each one of the factors on the L.H.S. \( i.e., P, \frac{1}{2} \rho v^2 \) and \( \rho gh. \)

\[ \therefore \frac{[K]}{[P]} = [0] \]

3. (1)  
Moment of inertia (\( I \)) = \( mr^2 \)
\[ \therefore [I] = [ML^2] \]
Moment of force \( \tau = r \times \vec{F} \)
\[ \therefore [\tau] = [r][F] = [L][MLT^{-2}] \]
or \( [\tau] = [ML^2T^{-2}] \)
Moment of inertia and moment of a force do not have identical dimensions.

4. (4)  
In the expression \( U = \frac{A\sqrt{x}}{x^2 + B} \)
\( B \) must have the dimensions \( x^2 i.e., [L^2] \)
Dimensions of \( A = \frac{Ux^2}{\sqrt{x}} = \frac{[ML^2T^{-2}][L^2]}{[L^{3/2}]} \)
\[ = [ML^{1/2}T^{-2}] \]
\[ \therefore AB = [ML^{7/2}T^{-2}][L^2] = [ML^{11/2}T^{-2}] \]
5. \( A = \frac{a^2 b^3}{c \sqrt{d}} \)

\[
\frac{\Delta A}{A} \times 100 = \left[ 2 \left( \frac{\Delta a}{a} \right) + 3 \left( \frac{\Delta b}{b} \right) + \left( \frac{\Delta c}{c} \right) + \frac{1}{2} \left( \frac{\Delta d}{d} \right) \right] \times 100
\]

\[
= \left[ 2 \times 1 + 3 \times 3 + 1 \times 2 + \frac{1}{2} \times 2 \right] = 14\%
\]

6. \( \frac{A^2}{\text{Mass}(m)} = \text{K.E.} = \frac{1}{2} m v^2 \)

\[ A^2 = \frac{1}{2} m^2 v^2 \]

\[ \therefore A \text{ has the dimensions of } m v = [\text{MLT}^{-1}] \text{ which are the dimensions of impulse } (F \times t). \]

7. (1)

The power of exponent is always dimensionless

\[ [Bxt] = [\text{MLT}^0] \]

\[ [B] = \frac{1}{[xt]} = \frac{1}{[\text{MLT}]} = [\text{M}^0 \text{L}^{-1} \text{T}^{-1}] \]

Hence unit of \( B \) is \( \text{m}^1 \text{s}^{-1} \).

8. (3)

\[ V = (100 \pm 5)V \]

\[ I = (10 \pm 0.2)A \]

\[ R = \frac{V}{I} = \frac{100}{10} = 10 \text{ ohm} \]

\[ \frac{\Delta R}{R} = \pm \left( \frac{\Delta V}{V} + \frac{\Delta I}{I} \right) = \pm \left( \frac{5}{100} + \frac{0.2}{10} \right) = \pm \frac{7}{100} \]

\[ \frac{\Delta R}{R} \times 100 = \pm \frac{7}{100} \times 100 = \pm 7\% \]

9. (3)

\[ \frac{A}{B} = \frac{\text{force}}{\text{force}} = [\text{M}^0 \text{L}^0 \text{T}^0] \]

\[ Ct = \text{angle} \Rightarrow C = \frac{\text{angle}}{\text{time}} = \frac{1}{T} = [\text{T}^{-1}] \]

\[ Dx = \text{angle} \Rightarrow D = \frac{\text{angle}}{\text{distance}} = \frac{1}{L} = [\text{L}^{-1}] \]

\[ \therefore \frac{C}{D} = \frac{[\text{T}^{-1}]}{[\text{L}^{-1}]} = [\text{M}^0 \text{LT}^{-1}] \]
10. (2)
\[ V = IR = 2.33 \times 10.485 = 24.43005 = 24.4 \text{ volt with} \]
Least number of significant figures (3).

11. (1)
Here \( \mathbf{A} = \mathbf{B} + \mathbf{C} \)
Let angle between \( \mathbf{B} \) and \( \mathbf{C} \) be \( \theta \). Then
\[ A^2 = B^2 + C^2 + 2BC \cos \theta \]
\[ (5)^2 = 4^2 + 3^2 + 2(4)(3) \cos \theta \]
Or \( 0 = 24 \cos \theta \), \( \theta = \frac{\pi}{2} \)
In the right angled triangle, let the angle between \( \mathbf{A} \) and \( \mathbf{C} \)
Be \( \alpha \).
\[ \therefore \cos \alpha = \frac{C}{A} = \frac{3}{5} \therefore \alpha = \cos^{-1} \left( \frac{3}{5} \right) \]

12. (2)
The two bodies will collide at the highest point if both cover the same vertical height in the same time. So \( \frac{v_1^2 \sin^2 30^\circ}{2g} = \frac{v_2^2}{2g} \) or \( \frac{v_2}{v_1} = \sin 30^\circ = \frac{1}{2} = 0.5 \)

13. (2)
Maximum acceleration is represented by maximum slope of velocity-time graph. It is for portion \( CD \) of graph.
Slope of \( CD = \frac{60 - 20}{40 - 30} = \frac{40}{10} = 4 \text{ m/s}^2 \)

14. (1)
\( t = ax^2 + bx \)
Differentiate the equation with respect to \( t \)
\[ 1 = 2ax \frac{dx}{dt} + b \frac{dx}{dt} \]
or \( 1 = 2axv + bv \left( As \frac{dx}{dt} = v \right) \)
or \( v = \frac{1}{2ax + b} \)
or \( \frac{dv}{dt} = \frac{-2a(dx/dt)}{(2ax + b)^2} = 2av \times v^2 \)
or Acceleration = \(-2av^3\)
15. (2)

\[ v = \alpha \sqrt{x} \]

or \( \frac{dx}{dt} = \alpha \sqrt{x} \) or \( \frac{dx}{\sqrt{x}} = \alpha dt \)

or \( \int \frac{dx}{\sqrt{x}} = \alpha \int dt \)

or \( 2x^{\frac{1}{2}} = \alpha t + C_1 \)

where \( C_1 \) is the constant of integration

Given : \( x = 0, t = 0 \)

\[ \therefore C_1 = 0 \]

\[ \therefore 2x^{\frac{1}{2}} = \alpha t \text{ or } x = \left( \frac{\alpha}{2} \right)^2 t^2 \text{ or } x \propto t^2 \]

16. (2)

Let \( v_w \) be the velocity of water and \( v_b \) be the velocity of motor boat in still water. If \( x \) is the distance covered, then as per question

\[ x = (v_b + v_w) \times 6 = (v_b - v_w) \times 10 \]

On solving, \( v_w = \frac{vb}{4} \)

\[ \therefore \left( v_b + \frac{v_b}{4} \right) \times 6 = 7.5vb \]

Time taken by motor boat to cross the same distance in still water is

\[ t = \frac{x}{v_b} = \frac{7.5v_b}{v_b} = 7.5 \text{ hours} \]

17. (3)

Time taken to cover \( n \) metres is given by

\[ n = \frac{1}{2} gt_n^2 \text{ or } t_n = \sqrt{\frac{2n}{g}} (\because u = 0) \]

Time taken to cover \((n+1)\) metres is given by

\[ t_{n+1} - t_n = \sqrt{\frac{2(n+1)}{g}} - \sqrt{\frac{2n}{g}} = \sqrt{\frac{2}{g} \left[ \sqrt{n+1} - \sqrt{n} \right]} \]

This gives ratio as:

\( \sqrt{1}, (\sqrt{2} - \sqrt{1}), (\sqrt{3} - \sqrt{2}), \ldots \), etc.
18. (3)

(e) \[ s = ut + \frac{1}{2} at^2 \]
Here, \( u = 0 \)
\[ \therefore x_1 = 0 + \frac{1}{2} a \times 10^2 = 50a \] ... (i)
\[ x_1 + x_2 = 0 + \frac{1}{2} a (10 + 10)^2 = 200a \]
\[ x_2 = 200a - x_1 = 200a - 50a \] (Using (i))
\[ \therefore x_2 = 150a \] ... (ii)
\[ x_1 + x_2 + x_3 = 0 + \frac{1}{2} a (10 + 10)^2 = 450a \]
\[ x_3 = 450a - x_1 - x_2 \]
\[ = 450a - 50a - 150a \] [Using (i) and (ii)]
\[ \therefore x_3 = 250a \]
Hence
\[ x_1 : x_2 : x_3 = 50a : 150a : 250a = 1 : 3 : 5 \]

19. (2)

(b) \[ S \] be the total distance travelled by body. If \( t_1 \) is the time taken to cover first one-third distance, then
\[ t_1 = \frac{S}{v_1} = \frac{S}{3v_1} \]
Let \( t_2 \) be the time taken by body for each part of remaining journey as described in question. Then
\[ \frac{2S}{3} = v_2t_2 + v_3t_2 \]
or, \[ t_2 = \frac{2S}{3(v_2 + v_3)} \]
Average velocity = \[ \frac{\text{total displacement}}{\text{total time}} = \frac{S}{t_1 + 2t_2} \]
= \[ \frac{S}{3v_1 + \frac{4S}{3v_1 + v_2 + v_3}} \]
\[ = \frac{3v_1(v_2 + v_3)}{v_2 + v_3 + 4v_1} \]

20. (3)

When the drunkard walks 8 steps forward and 6 steps backward, the displacement in the first 14 steps = \( 8m - 6m = 2m \)
Time taken by drunkard to cover first 10m for journey
\[ = \frac{14}{2} \times 10 = 70s \]
If the drunkard takes 8 steps more, he will fall in to the pit, so the time taken by the last 8 steps = 8 s
Total time taken = 70 s + 8 s = 78 s
21. Refer figure. The boatman can cross the river along the shortest possible path if the resultant velocity $\vec{v}$ is along $OC$. It will be so if the boatman goes along $OB$. Then

$$v = \sqrt{v_b^2 - v_c^2} = \sqrt{10^2 - 6^2} = 8\text{ km h}^{-1}$$

Time taken to cross the river,

$$t = \frac{1\text{ km}}{8\text{ km h}^{-1}} = \frac{1}{8}\text{ h}$$

22. (d) Here, $\vec{A} = 2\hat{i} + 3\hat{j} + \hat{k}$

$$\vec{B} = -3\hat{i} + 6\hat{k}$$

Let $\theta$ be the angle between the vectors $\vec{A}$ and $\vec{B}$.

$$\cos \theta = \frac{\vec{A} \cdot \vec{B}}{|A||B|} = \frac{2(-3) + 3 	imes 0 + 1 	imes 6}{\sqrt{14} \times \sqrt{45}} = 0$$

$$\therefore \theta = 90^\circ$$

23. Using $v^2 - u^2 = 2as$

According to given problem

$$v'^2 - (20)^2 = 2a \frac{x}{2}$$

and

$$(30)^2 - v'^2 = 2a \frac{x}{2}$$

Equating equations (i) and (ii), we get

$$(v')^2 - (20)^2 = (30)^2 - (v')^2$$

or

$$2(v')^2 = (30)^2 + (20)^2$$

$$v' = \sqrt{\frac{(30)^2 + (20)^2}{2}} = \sqrt{\frac{900 + 400}{2}} = \sqrt{650}$$

$$= 25.5 \text{ m s}^{-1}$$
24. (4)

Maximum height, \( H_{\text{max}} = \frac{u^2 \sin^2 \theta}{2g} \)

Horizontal range, \( R = \frac{u^2 \sin 2\theta}{g} \)

According to given problem

\[
\begin{align*}
H_{\text{max}} &= \frac{R}{2} \\
u^2 \sin^2 \theta &= \frac{u^2 \sin 2\theta}{2g} \\
u^2 \sin^2 \theta &= \frac{2u^2 \sin \theta \cos \theta}{2g} \\
\frac{\sin \theta}{\cos \theta} &= \frac{2}{\sqrt{5}} \quad ; \quad \cos \theta = \frac{1}{\sqrt{5}} \\
\therefore \quad R &= \frac{2u^2 \sin \theta \cos \theta}{g} \\
&= \frac{2u^2 \times \frac{2}{\sqrt{5}} \times \frac{1}{\sqrt{5}}}{g} = \frac{4u^2}{5g} 
\end{align*}
\]

25. (2)

\[ \tan \alpha = \frac{b \sin \theta}{a + b \cos \theta} \quad \text{...(i)} \]

where \( \alpha \) is the angle made by the vector \((\tilde{a} + \tilde{b})\) with \( \tilde{a} \).

Similarly, \( \tan \beta = \frac{b \sin \theta}{a - b \cos \theta} \quad \text{...(ii)} \)

where \( \beta \) is the angle made by the vector \((\tilde{a} - \tilde{b})\) with \( \tilde{a} \).

Note that the angle between \( \tilde{a} \) and \((-\tilde{b})\) is \((180^\circ - \theta)\).

Adding (i) and (ii), we get

\[
\begin{align*}
\tan \alpha + \tan \beta &= \frac{b \sin \theta}{a + b \cos \theta} + \frac{b \sin \theta}{a - b \cos \theta} \\
&= \frac{ab \sin \theta - b^2 \sin \theta \cos \theta + ab \sin \theta + b^2 \sin \theta \cos \theta}{(a + b \cos \theta)(a - b \cos \theta)} \\
&= \frac{2ab \sin \theta}{(a^2 - b^2 \cos^2 \theta)}
\end{align*}
\]
26. (4) The cannon ball will have same horizontal range for angle of projection $\theta$ and $(90^\circ - \theta)$. So

$$H_1 = \frac{u^2 \sin^2 \theta}{2g} \quad \text{and} \quad H_2 = \frac{u^2 \sin^2 (90^\circ - \theta)}{2g} = \frac{u^2 \cos^2 \theta}{2g}$$

$$\therefore H_1 H_2 = \frac{1}{4} \left( \frac{u^2 \sin \theta \cos \theta}{g} \right)^2 = \frac{1}{4} \times \frac{R^2}{4} \quad \therefore R = 4 \sqrt{H_1 H_2}$$

27. (1) (a) If $y$ is the maximum length of chain which can hang outside the table without sliding, then for equilibrium of the chain, the weight of hanging part must be balanced by force of friction on the portion on the table:

$$W = f_L \quad \text{..(i)}$$

But from figure

$$W = \frac{M}{L} y g \quad \text{and} \quad R = W' = \frac{M}{L} (L - y) g$$

so that $f_L = \mu R = \mu \frac{M}{L} (L - y) g$

Substituting these values of $W$ and $f_L$ in eqn. (i), we get

$$\frac{M}{L} y g = \mu \frac{M}{L} (L - y) g$$

On simplification we get $y = \left( \frac{\mu L}{1 + \mu} \right)$

28. (3) Various forces acting on the ball are shown in figure.

Using Laxi's theorem, according to figure,

$$\frac{T_1}{\sin 150^\circ} = \frac{T_2}{\sin 120^\circ} = \frac{10}{\sin 90^\circ}$$

$$\frac{T_1}{\sin 30^\circ} = \frac{T_2}{\sin 60^\circ} = \frac{10}{1}$$

$T_1 = 10 \sin 30^\circ = 10 \times 0.5 = 5 \text{ N}$

and $T_2 = 10 \sin 60^\circ = 10 \times \frac{\sqrt{3}}{2} = 5\sqrt{3} \text{ N}$
29. (2)

**Common acceleration of the system,**

\[ a = \frac{14 \text{ N}}{4 \text{ kg} + 2 \text{ kg} + 1 \text{ kg}} = \frac{14}{7} \text{ ms}^{-2} = 2 \text{ ms}^{-2} \]

Let \( R \) be the contact force between 4 kg and 2 kg blocks.
The free body diagram of 4 kg block is as shown in the figure.

The equation of motion is

\[ 14 - R = 4a \]
\[ R = 14 - 4 \times 2 = 6 \text{ N} \]

30. (1)

On smooth inclined plane, the acceleration of body down the plane = \( g \sin \theta \). For rough inclined plane, the downward acceleration of body = \( g \sin \theta - \mu g \cos \theta \): Let \( l \) be length of inclined plane, then

\[ l = \frac{1}{2} (g \sin \theta)^2 \]

And \( l = \frac{1}{2} (g \sin \theta - \mu g \cos \theta) (nt)^2 \)

\[ \therefore \frac{1}{2} (g \sin \theta)^2 = \frac{1}{2} (g \sin \theta - \mu g \cos \theta) (nt)^2 \]

\[ \sin \theta = (\sin \theta - \mu \cos \theta) n^2 \]

\[ = n^2 \sin \theta - \mu n^2 \cos \theta \]

or \( \mu n^2 \cos \theta = (n^2 - 1) \sin \theta \)

or \( \mu = \frac{(n^2 - 1) \sin \theta}{n^2 \cos \theta} \)

or \( \mu = \tan \theta \left(1 - \frac{1}{n^2}\right) \)

31. (4)

Let \( AC = l \), \( AO = a \) and \( OC = y \)

\[ \rho = a^2 + y^2 \]

Differentiating it with respect to time, we have

\[ 2l \frac{dl}{dt} = 2y \frac{dy}{dt} \]

\[ \therefore \frac{dl}{dt} = \frac{y}{\cos \theta} \frac{dy}{dt} = \frac{v}{\cos \theta} \]

\[ \left[ \therefore \frac{dl}{dt} = v \right] \]
32. (1) Let \( f \) be the force of friction between the two blocks. Let \( a \) be the acceleration of the two blocks to the left. The free body diagram of two blocks is shown in the figure.

\[
\begin{array}{c}
\begin{array}{c}
\text{2 kg} \\
\uparrow
\end{array}
\end{array}
\quad
\begin{array}{c}
\begin{array}{c}
\text{2 N} \\
\downarrow
\end{array}
\end{array}
\quad
\begin{array}{c}
\begin{array}{c}
\text{4 kg} \\
\uparrow
\end{array}
\end{array}
\quad
\begin{array}{c}
\begin{array}{c}
f \\
\downarrow
\end{array}
\end{array}
\quad
\begin{array}{c}
\begin{array}{c}
20 \text{ N} \\
\downarrow
\end{array}
\end{array}
\end{array}
\]

Their equations of motion are
\[ f - 2 = 2a \]  
\[ 20 - f = 4a \]  
\[ (i) \]
\[ (ii) \]

Solving (i) and (ii), we get \( f = 8 \text{ N} \)

Maximum force of friction,
\[ f_{\text{max}} = \mu mg = \frac{1}{2} \times 2 \times 10 = 10 \text{ N} \]

As the blocks move together, \( f < f_{\text{max}} \)
\[ \therefore f = 8 \text{ N}. \]

33. (3) Acceleration of the rope, \( a = \frac{(F/M)}{y} \) \[ (i) \]

Now, considering the motion of the part \( AB \) of the rope (which has mass \( (M/L)y \)) and acceleration given by eq.(i) assuming that tension at \( B \) is \( T \).
\[ F - T = \left( \frac{M}{L} \right) y \times a \quad \text{or} \quad F - T = \frac{M}{L} y \times \frac{F}{M} = \frac{F y}{L} \]
\[ \text{or} \quad T = F - \frac{F y}{L} = F \left( 1 - \frac{y}{L} \right) \]

34. (2) Just before the string is cut, force on the spring pulling up \( kx = 3mg \)

After string is cut, free body diagram of block \( A \) is as shown in figure (i).
\[ \therefore 2ma_A = 3mg - 2mg \]
\[ \text{or} \quad a_A = \frac{mg}{2m} = \frac{g}{2} \]

Free body diagram of block \( B \) as shown in figure (ii).
\[ \therefore ma_B = mg \quad \text{or} \quad a_B = g \]
35. **(4)**

Change of momentum of one bullet

\[ = m(v - u) \]

\[ = 0.03 \times \{50 - (-30)\} \]

\[ = 2.4 \text{ kg m s}^{-1} \]

Average force = rate of change of momentum of 200 bullets

\[ = 200 \times 2.4 = 480 \text{ N} \]

36. **(3)**

![Diagram](image)

In case A, the acceleration of mass \( m \) is

\[ a = \frac{(2m - m)g}{m + 2m} = \frac{g}{3} \]

In case B, the acceleration of mass \( m \) is

\[ a' = \frac{2mg - mg}{m} = g \]

\[ \therefore \frac{a}{a'} = \frac{1}{3} \]

37. **(3)**

If \( T \) is the tension in the rope, then the force exerted by the boy on the rope is equal to the force exerted by the rope on the boy. Let \( R \) be the normal reaction between the boy and the frame.

![Diagram](image)

Refer to the free body diagram of boy

\[ T + R = 40g \] ...(i)

Refer to the free body diagram of frame

\[ T = R + 360g \] ...(ii)

Adding (i) and (ii), we get,

\[ 2T = 400g \] or \[ T = 200g \]

38. **(4)**

If \( m \) is the mass of block \( A \) and \( a \) is its acceleration then

fictitious force that presses the cart block = \( ma \)

\[ \therefore \text{ The upward frictional force, } F = \mu ma \]

The block \( A \) will not fall so long as \( F \geq mg \)

\[ \mu ma \geq mg \text{ or } a \geq \frac{g}{\mu} \]

\[ \therefore \text{ Minimum value of } a = \frac{g}{\mu} \]
39. (1) 

The incline is given an acceleration \( a \). Acceleration of the block is to the right. Pseudo acceleration \( a \) acts on the block to the left. As it is clear from figure, the block will remain stationary, when

\[
\text{ma} \cos \alpha = mg \sin \alpha
\]

\[
a = \frac{g \sin \alpha}{\cos \alpha} = g \tan \alpha
\]

40. (1) 

\[
a = \frac{40g \sin 30^\circ - 30g \sin 30^\circ}{70}
\]

\[
= \frac{50}{70} \text{ m/s}^2
\]

\[
= 0.7 \text{ m/s}^2
\]

41. (3) 

In Uniform circular motion, magnitude of velocity (speed) is constant, but direction of velocity changes

42. (3) 

\[
v = \sqrt{rg \tan \theta} \]

\[
= \sqrt{(10 \sqrt{3} \text{ m})(10 \text{ m/s}^2) \tan 30^\circ}
\]

\[
= 10 \text{ m/s}
\]

\[
= (10) \left( \frac{18}{5} \right) \text{ km/hr}
\]

\[
= 36 \text{ km/hr}
\]

43. (2) 

\[
kx = m\omega^2 (\ell + x)
\]

\[
kx - m\omega^2 x = m\omega^2 \ell
\]

\[
x = \frac{m\omega^2 \ell}{k - m\omega^2}
\]
44. \( \alpha = \omega \frac{d\omega}{d\theta} \)
\[ = \left( \theta^2 + 20 \right) \frac{d}{d\theta} \left( \theta^2 + 20 \right) \]
\[ = \left( \theta^2 + 20 \right) (20 + 2) \]
\[ \alpha_{at \theta = 1 \text{ rad}} = (1 + 2) (2 + 2) \]
\[ = 12 \text{ rad/s}^2 \]

45. (1)

Acute angle

46. (2)

Molarity = \( \frac{10 \times \text{d}(\text{m / m})\%}{\text{Molarmassofsolute}} \)
\[ = \frac{10 \times 98 \times 1.96}{98} = 19.6 \text{ M} \]

Normality of \( \text{H}_2\text{SO}_4 = 2 \times \text{Molarity} = 2 \times 19.6 = 39.2 \text{ N} \)

47. (2)

10 mg per mL \( \Rightarrow \) 10 g per litre
\[ = \frac{10}{40} \text{ M} = 0.25 \text{ M} \]

Use, \( M_1 V_1 = M_R V_R \); \( M_1 = 0.5 \text{ M}, V_1 = 300 \text{ ml}, M_2 = 0.25 \text{ M}, V_R = 300 \text{ ml} + V_2 \)

So on solving, the Volume of water added is 300 ml.

48. (2)

Down the group ionization enthalpy decreases.

49. (3)

Higher the s-character, higher is the electronegativity.

50. (2)

Number of atoms = \( 3 \times \text{ Number of moles } \times \text{ Avogadro Number} \)
\[ = 3 \times 0.1 \times 6.02 \times 10^{23} = 1.806 \times 10^{23} \]

51. (4)

\[ \text{Molarity} = \frac{\text{Moles}}{V \text{ in mL}} = \frac{\left( 6.02 \times 10^{20} \right) / \left( 6.02 \times 10^{21} \right)}{(100) / (1000)} = 0.01 \]

52. (1)

53. (1)
54. (4) \[
\text{MgCO}_3 \xrightarrow{24 + 12 + 48} \text{MgO} + \text{CO}_2 \quad \text{\scriptsize \(= 84\)} \quad \text{\scriptsize \(= 20\)}
\]
\[
40 \text{ g MgO} = 84 \text{ g MgCO}_3
\]
\[
\text{MgO} = \frac{84 \times 8}{40} = 16.8
\]
\[
\% \text{purity of MgCO}_3 = \frac{16.8 \times 100}{20} = 84\%
\]

55. (3) a (van der Walls' constant) is a measure of attractive force. Larger the value of a greater the liquefaction.

\[
n_{H_2} = \frac{pV}{RT} = \frac{20000}{RT}
\]

56. (4) \[
n_{He} = \frac{pV}{RT} = \frac{20000}{RT}
\]
\[
\therefore n_{H_2} + n_{He} = \frac{40000}{RT}
\]
Total volume = 300 mL
\[
p = \frac{n}{V} = \frac{40000}{RT}
\]
Total volume = 300 mL
\[
p = \frac{n}{V} = \frac{40000 \cdot RT}{RT \times 300}
\]
\[
= \frac{400}{3} = 133.33 \text{Torr}
\]

57. (3) Let 100 g of iron be kept in air and x g be oxidized (rusted)
\[
4 \text{Fe} + 3 \text{O}_2 \rightarrow 2 \text{Fe}_2 \text{O}_3
\]
For \(4 \times 56\) g Fe, increase in weight = \(3 \times 32\) g
\[
= \frac{3 \times 32 \times x}{4 \times 56} = 0.428 x \text{ gram}
\]
For x g Fe, increase in weight
For 100 g iron, total increase in weight \(0.428x = 4.28\) (given)
\[
x = \frac{4.28}{0.428} = 10
\]

58. (3) \[
m = \frac{n_B}{w_A (\text{kg})} = \frac{0.01}{0.60} \times \frac{1}{0.3} = 5.55 \times 10^{-4}
\]
59. (2)
\[
\frac{r_{ii}}{r_{0i}} = \sqrt{\frac{32}{2}} = 4
\]
\[
r_{ii} = 4r_{0i} = 4 \times 4 \times \frac{4}{32} \text{ mol H}_2 = \frac{4 \times 4 \times 2}{32} \text{ g H}_2 = 1 \text{ g}
\]

60. (3)

61. (3)
Order of difference of energy \( E_2 - E_1 > E_3 - E_2 > E_4 - E_2 > ... \)
So, \( E_6 - E_5 > E_5 - E_3 > E_4 - E_3 > E_6 - E_5 \)

62. (2)
Orbital angular momentum
\[
= \sqrt{l(l+1)} \times \frac{h}{2\pi} = \sqrt{l(l+1)} \times \frac{h}{2\pi} \\
= \sqrt{2} \times \frac{h}{2\pi} = \frac{h}{\sqrt{2\pi}}
\]
(For \( p, l = 1 \))

63. (1)

64. (3)
\[ 5s^1 \rightarrow n = 5, l = 0, m = 0, s = + \frac{1}{2} \]
Valence electron is

65. (1)
\[ \lambda = \frac{h}{mv}; \text{KE} = \frac{1}{2}mv^2 \quad \Rightarrow \quad \text{KE} = \frac{h^2}{2ml^2} \]
For \( h \) and \( \lambda \) being constant,
\[ \text{KE} \propto \frac{1}{m} \]

66. (4)
No. of spectral lines \( = \sum \Delta n = \sum (6-3) = \sum 3 = 3 + 2 + 1 = 6 \). There is no line in Balmer series as the electron comes to 3rd shell

67. (2)
Spherical nodes for \( 3p_z n - l - 1 = 3 - 1 - 1 = 1 \)
Angular nodes for \( 3p_z = l = 1 \)
Nodal planes for \( 3p_z = l = 1 \)
68. (4)
\[ r_n = 0.529 \times \frac{n^2}{Z} \text{ Å} \]
\[ n^2 = \frac{8.46 \times 1}{0.529} \]
\[ = 2n^2 = 2 \times \frac{8.46}{0.529} = 32 \]
Electrons

69. (2)
Though 'b' and 'd' have the same electronic configuration in valence shell, yet 'b' is smaller in size.

70. (4)

71. (1)
The species are isoelectronic. Higher the charge of nucleus, smaller the size.

72. (2)
Negative ion O\(^-\) repels the incoming electron.

73. (4)
All pairs show diagonal relation.

74. (3)
Acidic character of oxides increase with increase in ionization energy.

75. (3)
\( \text{SF}_4 \) and I\(^3\) and PCl\(_5\) are sp\(^3\)d-hybridised. In general PCl\(_5\)\( (g) \) is considered sp\(^3\)d. In solid state, PCl\(_5\) exists as \((\text{PCl}_4)^+ (\text{PCl}_6)^-\) with sp\(^3\) and sp\(^3\)d\(^2\)-hybridizations respectively. SbCl\(_5^2-\) has 5σ bonds and one lone pair. It is sp\(^3\)d\(^2\)-hybridised.

76. (1)
In \( \text{SF}_4 \), sulphur atom is sp\(^3\) d-hybridised with two axial and two equatorial F-atoms and one lone pair on equatorial position.

77. (4)
Highest product of charges of ions

78. (1)
Radii of cations, Si\(^{4+}\) < Al\(^{3+}\) < Mg\(^{2+}\) < Na\(^+\). So, the covalent character of chloride are a sper the choice (a) according to Fajan's rule.

79. (1)
80. \( (4) \)
\[
pV \over RT = z, \quad z < 1
\]

81. \( (2) \)
\[
\therefore \quad {pV \over RT} < 1
\]

at STP
\[
{p \over RT} = {1 \over 0.0821 \times 273} = {1 \over 22.4}
\]
\[
\therefore \quad {V_n \over 22.4} < 1
\]

82. \( (1) \)
\[
pV = nRT
\]
\[
n \propto T^{-1}
\]
\[
{n_2 \over n_1} = \frac{T_1}{T_2} = \frac{300}{400} = \frac{3}{4}
\]

83. \( (3) \)
\[
\frac{u(H_2)}{u(O_3)} = \sqrt{\frac{50 \times 32}{2 \times 800}} = 1
\]

84. \( (1) \)
\[
p = \frac{dRT}{m}
\]
\[
\frac{p_1}{p_2} = \frac{d_1T_1m_2}{d_2T_2m_1} = \frac{1 \times 2 \times 28}{2 \times 1 \times 28} = 1
\]

85. \( (4) \)

86. \( (2) \)
If atomic weight of metal M is A, for \( \text{M}_3\text{O}_4 \)
\[
\frac{16 \times 4}{16 \times 4 + 3A} \times 100 = 27.6 \Rightarrow A = 56
\]

2nd oxide:
\[
M = \frac{70}{56} = 1.25, \quad O = \frac{30}{16} = 1.875
\]

Moles of M : O = 1.25 : 1.875 = 1 : 1.5 = 2 : 3

Formula if \( \text{M}_2\text{O}_3 \)

87. \( (4) \)
Cr \((Z = 24)\): \(1s^22s^22p^63s^23p^63d^44s^1\)

Total electrons in \( _1^1 \), i.e., p-subshell = 6 + 6 = 12

Total electrons in \( _2^2 \), i.e., d-subshell = 5.
88. (3)
Ionisation energy of Be (Z = 4, electronic configuration $1s^22s^2$) is greater than that of B (Z = 5, EC $1s^22s^22p^1$). IE of N (Z = 7, EC $1s^22s^22p^32p^12p^1$) is greater than that of O (Z = 8, EC $1s^22s^22p^42p^22p^1$).

89. (2)

90. (1)

91. NCERT. Pg No. 32,33,34

92. NCERT. Pg No. 38

93. NCERT. Pg No. 35

94. NCERT. Pg No. 33

95. NCERT. Pg No. 20

96. Spore mother cell undergoes meiosis to produce spore

97. NCERT. Pg No. 30

98. NCERT. Pg No. 4,5

99. NCERT. Pg No. 32

100. NCERT. Pg No. 20

101. NCERT. Pg No. 30

102. The sequence of stages are
Protonema $\rightarrow$ Gametophore $\rightarrow$ Gamete $\rightarrow$ Embryo $\rightarrow$ Sporophyte

structure containing sex organs

103. “ORDER” ends with ale

104. NCERT. Pg No. 11 Table 1.1

105. NCERT. Pg No. 24
106. Bacteria divides once in 30 mins
   Given duration is 12 hrs = 720 mins
   No. of generation = \( \frac{720}{30} = 24 \)
   Thus \( 2^{24} \) bacteria formed after 12 hours

107. NCERT. Pg No. 42
   Funaria is a bryophyte.

108. NCERT. Pg No. 26

109. NCERT. Pg No. 27

110. NCERT. Pg No. 23, 24

111. NCERT. Pg No. 24

112. NCERT. Pg No. 23

113. NCERT. Pg No. 19, 23, 18

114. NCERT. Pg No. 23, 24

115. NCERT. Pg No. 12

116. NCERT. Pg No. 22, 23

117. NCERT. Pg No. 17

118. NCERT. Pg No. 22

119. NCERT. Pg No. 24

120. NCERT. Pg No. 20, 21

121. NCERT. Pg No. 24

122. NCERT. Pg No. 23, 24

123. NCERT. Pg No. 23

124. NCERT. Pg No. 35, 36

125. NCERT. Pg No. 27

126. Sperm mother cell is a part of gametophytic body, thus haploid, rest all are diploid
127. NCERT. Pg No. 20
128. NCERT. Pg No. 32
129. NCERT. Pg No. 22

130. Mesosomes are the invaginations of plasma membrane

131. Plasmids are double stranded; circular DNA.

132. NCERT. Pg No. 26

133. NCERT. Pg No. 35, 36

134. NCERT. Pg No. 42

135. NCERT. Pg No. 33

136. (1) 
Crocodiles have 4 chambered heart. Fishes heart pumps deoxygenated blood. Both vertebrates and in vertebrates have heart

137. (2) 
Ornithorhynchus, Hemidactylus, Neophrn and struthio are oviparous.

138. (2)

139. (1) 
Devil fish – Octopus (Mullusca) 
Cuttle fish – Sepia (“) 
Silver fish – Lepisma (Arthropoda)

140. (1) 
Monocytes – WBC – Phagocytosis 
Heparin is secreted by mast cell & Basophils.

141. (3) 
9n Echinoderms anus is dorsally located

142. (2)

143. (2) 
Fasciola has protonephridia for excretion

144. (4)

145. (4)
Fasciola shows blind sac pattern

Osteichthyes have swim bladder not chondrichthyes.

Reptiles, Aves and mammals have amniotic egg.

Ctenophores are called sea walnuts porifera shows cellular level of organization. Arthropoda is the largest phylum. Cnidarians have chidocytes.

Mollusc show organ system level of organisation. Bilaterally symmetrical, Eucoelomate, triploblastic oviparous.

Aschelminthes are endoparasiles, pseudowelomates and triploblastic

Echinoderms lack exoskeleton. Digestion occurs inside the body. They are exclusively marine

Locust – Arthropoda
Brittle star – Echinoderm
Ctenoplana – Ctenophora

Osculum – exhalent pore
163. (4)
Cnidocytes are found in chidaria not ctenophore

164. (3)

165. (2)

166. (2)

167. (3)
In cockroach, each ovary made of 8 ovarioles larval stage is called nymph. They are uricotelic

168. (4)

169. (3)

170. (3)

171. (2)

172. (3)

173. (3)
Abdomen has 6 ganglia. Each eye has 2000 ommatidia. Cockroach has 10 pairs of spiracles.

174. (4)

175. (4)

176. (3)
Adipose tissue is a good insulator and energy reservoir.

177. (1)
Ciliated epithelium, cartilage are avascular

178. (3)
Ventriculus is part of midget and hepatic caecae is at junction of foregut of midgut

179. (2)

180. (3)