### FOR 2017 ASPIRANTS

**MEDICAL AITS TEST-12**  
**DATE: 20 / 05 / 2017**  

**ANSWER KEY**

<table>
<thead>
<tr>
<th>PHYSICS</th>
<th>CHEMISTRY</th>
<th>BIOLOGY</th>
<th>GENERAL KNOWLEDGE</th>
</tr>
</thead>
</table>
1. (b)

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

$$\left| \vec{A} + \vec{B} \right| = n \left| \vec{A} + \vec{B} \right| \quad \text{(Given)}$$

Then, $\left| \vec{A} + \vec{B} \right|^2 = n^2 \left| \vec{A} - \vec{B} \right|^2$

$$A^2 + 2AB\cos \theta + B^2 = n^2 \left[ A^2 - 2AB\cos \theta + B^2 \right]$$

$$A^2 + 2A^2\cos \theta + A^2 = n^2 \left[ A^2 - 2A^2\cos \theta + A^2 \right]$$

$$\therefore \left| \vec{A} \right| = \left| \vec{B} \right|$$

$$2A^2 + 2A^2\cos \theta = n^2 \left[ 2A^2 - 2A^2\cos \theta \right]$$

$$(n^2 + 1)\cos \theta = (n^2 - 1)$$

$$\cos \theta = \left[ \frac{n^2 - 1}{n^2 + 1} \right]$$

$$\theta = \cos^{-1} \left[ \frac{n^2 - 1}{n^2 + 1} \right]$$

2. (b)

$$-S = ut_i - \frac{1}{2}gt_i^2 \quad \text{---(1)}$$

$$-S = -ut_s - \frac{1}{2}gt_s^2 \quad \text{---(2)}$$

$$-S = -\frac{1}{2}gt_2^2 \quad \text{---(3)}$$

$$-St_3 = ut_i t_s - \frac{1}{2}gt_i^2 t_s \quad \text{---(4)}$$

$$-St_1 = -ut_i t_s - \frac{1}{2}gt_3^2 t_i \quad \text{---(5)}$$

Adding, eqns. (4) and (5)

$$-S(t_1 + t_s) = -\frac{1}{2}gt_i^2( t_1 + t_s )$$

(or) $$S = +\frac{1}{2}gt_i^2 \quad \text{---(6)}$$

from eqns. (3) and (4),

$$\frac{1}{2}gt_3 t_i = \frac{1}{2}gt_2^2$$

$$t_2 = \sqrt{t_3 t_i}$$

3. (d)

Given that at any instant $t$

$$x = kt \quad \text{and} \quad y = kt - k\alpha t^2$$

If $ii$ be the initial velocity of projectile and $\alpha$ be the angle of projection, then
\[ x = (u \cos \alpha) t \]

\[ y = (u \sin \alpha) t - \frac{1}{2} gt^2 \]

Comparing above equations, with the given equation, we get; \( u \sin \alpha = k \) and \( g = 2k\alpha \)

If \( t_m \) be time taken to reach maximum height, then at max. height, \( v_y = 0 \)

i.e., \( v_y = \frac{dy}{dt} = k - 2\alpha t_m = 0 \)

\[ \therefore t_m = \frac{1}{2\alpha} \]

Hence, time of flight,
\[ T = 2t_m = 2 \left( \frac{1}{2\alpha} \right) = \frac{1}{\alpha} \]

Now, maximum height attained,
\[ H = \frac{(u \sin \alpha)^2}{g} = \frac{k^2}{4k\alpha} = \frac{k}{4\alpha} \]

4. (c) For speed \( v_i \), we have
\[
\tan \theta = \frac{v^2}{rg} = \frac{V^2}{20g}
\]

If \( v' = v + 10\% \) of \( v \)

\[ = 1.1v \]

then \( \tan \theta = \frac{v'^2}{r'g} \)
\[
\frac{v^2}{20g} = \frac{(1.1v)^2}{r'g}
\]

\[ \Rightarrow \frac{1}{20} = \frac{1.21}{r'} \]

\[ \Rightarrow r' = 20 \times 1.21 = 24.2m \]

5. (a)

Let \( v_r \) be the velocity of particle relative to hemisphere and \( v \) be the linear velocity of hemisphere at this moment. Then from conservation of linear momentum, we have

\[ 4mv = m(v_r \cos \theta - v) \]

(or) \( 5v = v_r \cos \theta \)

\[ \therefore v_r = \frac{5v}{\cos \theta} \]

\[ \therefore \omega = \frac{v_r}{R} = \frac{5v}{R \cos \theta} \]
6. (b) If the body strikes the sand floor with a velocity $v$ then,

$$Mgh = \frac{1}{2}Mv^2$$

With this velocity $v$, when body passes through the sand floor it comes to rest after travelling a distance $x$. Let ‘$f$’ be the resisting force acting on the body. Then the resultant force = $F-Mg$.

Using work – energy theorem,

$$(F - Mg) x = \frac{1}{2}Mv^2 - 0$$

$$(F - Mg) x = Mgh$$

$$Fx = Mgh + Mg x$$

$$. \quad F = Mg \left(1 + \frac{h}{x}\right)$$

7. (a)

$$I_{AB} = (m_1)(0) + (m_2)(0) + m_3(CE)^2$$

$$= m_3 \left(\frac{d}{\sqrt{2}}\right)^2$$

$$= \frac{1}{2}md^2$$

8. (d)

Mass per unit length of the rod = $\frac{M}{L}$ mass of small length element AB,

$$dm = \left(\frac{M}{L}\right)Rd\theta$$

Potential at O due to this element,
\[ dV = G \frac{dm}{R} \]
\[ = \frac{-GM}{L} \frac{R}{R} d\theta \]
\[ = \frac{-GM}{L} d\theta \]
\[ \therefore V = \int dV = \frac{-GM}{L} \int_0^\pi d\theta = \frac{-\pi GM}{L} \]

9. (b) For the spring: \( F_1 = Kx_1 \)

or \( x_1 = \frac{F_1}{K} \)

\[ Y = \frac{F_1L}{Ax_2} \Rightarrow x_2 = \frac{F_2L}{AY} \]

Total extension = \( x_1 + x_2 \)

i.e., \( x = \frac{F_1 + F_2L}{K} \frac{1}{AY} \)

\[ = F \left[ \frac{1}{K} + \frac{L}{AY} \right] \left( : F_1 = F_2 = F \right) \]

\[ \therefore F = \left[ \frac{AYK}{AY + KL} \right] x \]

But Acceleration = \( \frac{\text{force}}{\text{mass}} = \left[ \frac{AYK}{AY + KL} \right] x \)

For SHM acceleration = \( \omega^2 \)

\[ \omega^2 = \frac{AYK}{m(AY + KL)} \]

\[ \therefore T = 2\pi \sqrt{\frac{m(AY + KL)}{AYK}} \]

10. (b) Speed of the water coming from the hole, \( v = \sqrt{\frac{2gh}{2}} \) where \( h \) denotes depth of the hole from the free surface of the water in tank.

The quantities of water flowing out per second from both holes are given to be same, therefore,

\( A_1v_1 = A_2v_2 \),

Where, \( A_1 \) and \( A_2 \) be the area of cross-sections of the hole 1 (i.e., square hole) and hole 2 (i.e., circular hole) and \( v_1 \) and \( v_2 \) be the speeds of water coming out from these holes.

\[ \therefore a^2 \sqrt{2gx} = \pi r^2 \sqrt{2g4x} \]

\[ a^2 = 2\pi^2 \]

\[ r^2 = \frac{a^2}{2\pi} \]

\[ r = \frac{a}{\sqrt{2\pi}} \]
11. (b) The rate of coolingness decreases with decrease in temperature difference between the body and surroundings

12. (a) For an adiabatic process $PV^\gamma = k$

$\gamma = \frac{3}{2}$ and $k = \text{const}$

$PV^{3/2} = K$

$log P + \frac{3}{2} \log V = \log K$

$\frac{\Delta P}{P} + \frac{3}{2} \frac{\Delta V}{V} = 0$

$\frac{\Delta V}{V} = \frac{-2}{3} \frac{\Delta P}{P}$

$\frac{\Delta V}{V} \times 100\% = \left( -\frac{2}{3} \right) \left( \frac{\Delta P}{P} \times 100\% \right)$

$= \left( -\frac{2}{3} \right) \left( \frac{2}{3} \right)$

$= -\frac{4}{9} \%$

$\therefore$ volume decreases by about $\frac{4}{9} \%$

13. (b) $y = A \cos^2 \left( \frac{t}{2} \right) \sin (1000t)$

$y = A \left[ \frac{1 + \cos t}{2} \right] \sin (1000t) \left[ \cos^2 \theta = \frac{1 + \cos 2\theta}{2} \right]$}

$y = \frac{A}{2} \sin (1000t) + \frac{A}{2} \sin (1000t) \cos t$

$y = \frac{A}{2} \sin (1000t) + \frac{A}{4} 2 \sin (1000t) \cos t$

$y = \frac{A}{2} \sin (1000t) + \frac{A}{4} \left[ \sin (1001t) + \sin (999t) \right]$

$y = \frac{A}{2} \sin (1000t) + \frac{A}{4} \sin (1001t) + \frac{A}{4} \sin (999t)$

14. (a) $y = a \sin 2\pi \left( bt - cx \right)$

$y = a \sin \left( 2\pi bt - 2\pi ca \right)$

$\omega = 2\pi b$ and $k = 2\pi c$ and amplitude $A = a$

$\left( v_{\text{max}} \right)_{\text{particle}} = 2v_{\text{wave}}$

$A\omega = 2\frac{\omega}{k}$

$A = \frac{2}{k}$

$a = \frac{2}{2\pi c}$

$c = \frac{1}{\pi a}$
15. (b) \( \frac{I_1}{I_2} = \frac{4}{1} \); \( I_1 = 4 \) and \( I_2 = 1 \)

\[
\frac{I_{\text{max}}}{I_{\text{min}}} = \frac{(\sqrt{I_1} + \sqrt{I_2})^2}{(\sqrt{I_2} - \sqrt{I_1})^2} = \frac{9}{1} = 9
\]

\[
\beta_1 - \beta_2 = 10\log\left(\frac{I_{\text{max}}}{I_0}\right) - 10\log\left(\frac{I_{\text{min}}}{I_0}\right)
\]

\[
= 10 \log_{10}\left(\frac{I_{\text{max}}}{I_{\text{min}}}\right)
\]

\[
= 10 \log_{10} 9
\]

\[
= 20 \log_{10} 3
\]

16. (d) \( n = \frac{1}{2\ell} \sqrt{\frac{T}{\mu}} \)

\[
\frac{n_2}{n_1} = \frac{\ell_1}{\ell_2} \sqrt{\frac{T_2}{T_1}}
\]

\[
\frac{n_2}{n_1} = \frac{100}{60} \sqrt{\frac{144}{100}} = \frac{2}{1}
\]

17. (c) \( v_0 = 5\text{m/s}, \quad n = 165\text{Hz}, \quad v = 335\text{m/s}, \quad v_s = 5\text{m/s} \)

\[
n' = \left(\frac{v + v_0}{v - v_s}\right)(n)
\]

\[
= \left(\frac{335 + 5}{335 - 5}\right)(165)
\]

\[
= 170\text{Hz}
\]

Number of beats heard per second

\( = n' - n \)

\( = 170\text{Hz} - 165\text{Hz} \)

\( = 5\text{Hz} \)

18. (b) Writing the general expression for \( y \) in terms of \( x \) as

\[
y = \frac{1}{1+(x-vt)^2}
\]

at \( t=0 \), \( y = \frac{1}{1+x^2} \)

at \( t=2s \), \( y = \frac{1}{1+(x-2v)^2} \)

Comparing with the given equation, we get

\( 2v = 1 \Rightarrow v = 0.5\text{m/s} \)
19. (a) Use the equation: \( v^2 - u^2 = 2aS \)
   On smooth inclined plane: \( v^2 = (2g\sin \theta)S \rightarrow (1) \)
   On Rough inclined plane: \( \left( \frac{v}{n} \right)^2 = 2g(\sin \theta - \mu \cos \theta)S \rightarrow (2) \)

   Dividing the equations (1) and (2): \( n^2 = \frac{\sin \theta}{\sin \theta - \mu \cos \theta} \)

   On solving, we get \( \mu = \left( 1 - \frac{1}{n^2} \right) \tan \theta \)

20. (c) \( \frac{r}{R} = \sin \theta \) \hspace{1cm} (i)
    \( N\cos \theta = Mg \) \hspace{1cm} (ii)
    \( N\sin \theta = M\mu^2 \) \hspace{1cm} (iii)

   Dividing eqn. (iii) by eqn. (ii), we get:
   \( \tan \theta = \frac{\mu^2}{\cos \theta} = \frac{R\sin \theta \times \omega^2}{g} \)
   \( \sin \theta = \frac{R\sin \theta \times \omega^2}{g} \)
   \( \cos \theta = \frac{g}{R\cos \theta} \)

   \( \therefore \omega = \sqrt{\frac{g}{R\cos \theta}} \)

21. (a) As we have,
   \( V = \frac{q}{4\pi\varepsilon_0} \left[ 1 + \frac{1}{3} + \frac{1}{5} + \ldots \right] - \frac{q}{4\pi\varepsilon_0} \left[ \frac{1}{2} + \frac{1}{4} + \frac{1}{6} + \ldots \right] \)
   \( = \frac{q}{4\pi\varepsilon_0} \left[ 1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \ldots \right] \)
   \( = \frac{q}{4\pi\varepsilon_0} \log_2 \)

22. (b) As, \( q_1 + q_2 = Q \)

   Here, \( \frac{q_1}{4\pi r^2} = \frac{q_2}{4\pi R^2} \)

   \( \therefore q_1 = \frac{QR^2}{R^2 + r^2} \)

   And \( q_2 = \frac{QR^2}{R^2 + r^2} \)

   \( \therefore \) Potential at common centre is
   \( V = \frac{1}{4\pi\varepsilon_0} \left[ \frac{q_1}{r} + \frac{q_2}{R} \right] \)
   \( = \frac{1}{4\pi\varepsilon_0} \left[ \frac{QR^2}{(R^2 + r^2)r} + \frac{QR^2}{(R^2 + r^2)R} \right] \)
\[
= \frac{1}{4\pi\varepsilon_0} \left( \frac{Qr^2}{(R^2 + r^2)r} + \frac{QR^2}{(R^2 + r^2)R} \right)
= \frac{1}{4\pi\varepsilon_0} \frac{Q(R+r)}{R^2 + r^2}
\]

23. (a) \( r_b - r_a = 1\text{mm} = 10^{-3}\text{m} \)

From \( C = \frac{4\pi\varepsilon_0 r_a r_b}{r_b - r_a} \)

\[
10^{-6} = \frac{1(r_b - 10^{-3})r_b}{9 \times 10^9 (10^{-3})}
\]

\( \Rightarrow r_b^2 = 9 \) or \( r_b = 3\text{m} \)

24. (c) \( R = \frac{V^2}{P} \) or \( R \propto V^2 \)

\[
R_1 = \frac{(200)^2}{(300)^2} = \frac{4}{9}
\]

When bulbs are connected in series, the current \( I \) is same through each. As \( P = I^2R \) or \( P \propto R \) (as \( I \) is same in series)

So, \( \frac{P_1}{P_2} = \frac{R_1}{R_2} = \frac{4}{9} \)

25. (b) \( \frac{\mu_0 i_1}{4\pi r} - \frac{\mu_0 i_2}{4\pi r} = 10\mu\text{T} \)

\( \frac{\mu_0 i_1}{4\pi r} + \frac{\mu_0 i_2}{4\pi r} = 30\mu\text{T} \)

On solving, \( i_1 = 20\text{A} \) and \( i_2 = 10\text{A} \).

so, \( \frac{i_1}{i_2} = 2 \)

26. (b) Consider a hypothetical ring of radius \( x \) and thickness \( dx \) of a disc as shown in figure.

![Diagram](image)

Charge on the ring, \( dq = \frac{q}{\pi r^2} (2\pi xd) \)

Current due to rotation of charge on ring is \( di = \frac{dq}{l/n} = n dq = \frac{q^2xdx}{r^2} \)

Magnetic field at the centre \( O \) due to current of ring element is

\[
dB = \frac{\mu_0 di}{2x} = \frac{\mu_0 nq2xdx}{r^2 (2x)} = \frac{\mu_0 nqdx}{r^2} (i)
\]
Total magnetic field induction due to current of whole disc is

\[ B = \frac{\mu_0 n q}{r^2} r = \frac{\mu_0 n q}{r} \] (on integrating equation (i))

27. (a) Here, \( \tan \theta = \frac{B_v}{B_h} \), or \( \tan \theta' = \frac{B_v}{B_h \cos x} \)

\[ \tan \theta' = \frac{1}{\cos x} \]

28. (b) From, \( T = 2\pi \sqrt{\frac{I}{MB}} \Rightarrow 4 = \sqrt{\frac{I}{MB}} \)

When it is cut into two equal parts in length, mass of each part becomes half

\[ I = \frac{(\text{mass})(\text{length})^2}{12} \]

\[ I' = \frac{\text{mass}}{2} \left( \frac{\text{length}'}{2} \right)^2 \]

\[ I' = \frac{1}{8}I \]

Effective magnetic moment of each piece becomes \( M' = \frac{1}{2}M \)

\[ T' = 2\pi \sqrt{\frac{I'}{M'B}} \]

\[ = 2\pi \left( \frac{1}{\sqrt{\frac{M}{2}B}} \right) \]

\[ = \frac{1}{2} \left( 2\pi \sqrt{\frac{1}{MB}} \right) \]

\[ = \frac{1}{2}T \]

\[ = 2 \text{ sec} \]

29. (b) As, \( \frac{Q}{t} = CV \) or \( i_d = C \left( \frac{V}{t} \right) \) where, \( i_d = \) displacement current.

\[ \frac{V}{t} = \frac{i_d}{C} = \frac{1.0}{10^{-6}} V/s \]

\[ = 10^6 V/s \]
30. (d) If \( I \) is the final intensity and \( I_0 \) is the initial intensity then
\[
I = \frac{I_0}{2} \left( \cos^2 30^\circ \right)^5
\]
\[
\frac{I}{I_0} = \frac{1}{2} \left( \frac{\sqrt{3}}{2} \right)^{10}
\]
\[
\frac{I}{I_0} = 0.12
\]

31. (c) Distance of 5th Bright fringe from central fringe
\[
x_{5b} = \frac{5\lambda D}{d} \rightarrow (1)
\]
Distance of 3rd dark fringe from central fringe,
\[
x_{3d} = \left( 3 - \frac{1}{2} \right) \frac{\lambda D}{d} = \frac{5 \lambda D}{2 d} \rightarrow (2)
\]
From equations (1) and (2), required distance
\[
x_{5b} - x_{3d} = \frac{5 \lambda D}{2 d}
\]
\[
= \frac{5 \times 10^{-7}}{1 \times 10^{-3}}
\]
\[
= 1.25 \text{ mm}
\]

32. (b) By using \( \frac{hc}{e} \left( \frac{1}{\lambda} - \frac{1}{\lambda_0} \right) = V_0 \)
\[
\frac{hc}{e} \left( \frac{1}{\lambda} - \frac{1}{\lambda_0} \right) = 4.8 \rightarrow (1)
\]
\[
\frac{hc}{e} \left( \frac{1}{2\lambda} - \frac{1}{\lambda_0} \right) = 1.6 \rightarrow (2)
\]
\[
\frac{(1)}{(2)} \Rightarrow \frac{\left( \frac{1}{\lambda} - \frac{1}{\lambda_0} \right)}{\left( \frac{1}{2\lambda} - \frac{1}{\lambda_0} \right)} = \frac{4.8}{1.6}
\]
\[
\Rightarrow \lambda_0 = 4\lambda
\]

33. (b) \[
\frac{1}{\lambda} = R \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right]
\]
\[
\frac{1}{\lambda} = R \left[ \frac{1}{4} - \frac{1}{9} \right]
\]
\[
\frac{1}{\lambda} = R \left[ \frac{5}{36} \right]
\]
\[
\lambda = \frac{36}{5R}
\]
\[ f = \frac{c}{\lambda} = \frac{c}{\left( \frac{36}{5R} \right)} = 5Rc \]

34. (c) \[ \frac{2}{3} N_0 = N_0 e^{-\lambda t_2} \rightarrow (1) \]
\[ \frac{1}{3} n_0 = N_0 e^{-\lambda t_1} \rightarrow (2) \]

Dividing equations (1) and (2)
\[ 2 = e^{(t_2-t_1)} \]
\[ \lambda (t_2-t_1) = \ln 2 \]
\[ t_2 - t_1 = \frac{\ln 2}{\lambda} = \frac{T}{2} = 20 \text{ min} \]

35. (c) \[ \beta = \frac{I_c}{I_B} \Rightarrow I_c = \beta I_b = 2 \times 10^{-3} \text{ A} \]
\[ V_{CE} = V_{CC} - I_c R_L \]
\[ 4 = 10 - (2 \times 10^{-3}) R_L \]
\[ R_L = 3k\Omega \]

36. (a) Modulation index, \[ \mu = \frac{A_{max} - A_{min}}{A_{max} + A_{min}} = \frac{25 - 5}{25 + 5} = \frac{2}{3} \]

37. (a) For dispersion without deviation,
\[ A = \left( \frac{\mu - 1}{\mu} \right) \]
\[ A' = \left( \frac{\mu' - 1}{\mu'} \right) \]
\[ \Rightarrow \frac{A'}{A} = \frac{(1.72 - 1)}{(1.54 - 1)} = 0.72 \]
\[ \Rightarrow A' = \frac{0.72 \times 0.54}{0.72} = 3^o \]

38. (a) Apparent depth (AD) = \[ \frac{t_1}{\mu_1} + \frac{t_2}{\mu_2} \]
\[ \therefore \frac{36}{7} = \frac{5}{5/3} + \frac{3}{\mu_2} \]
\[ \frac{3}{\mu_2} = \frac{36}{7} - 3 = \frac{15}{7} \]
\[ \therefore \mu_2 = \frac{7}{5} = 1.4 \]

39. (c) By using Kirchhoff's voltage low
\[ V_A - iR + E - L \frac{di}{dt} = V_B \]
\[ \Rightarrow V_B - V_A = 15 \text{ volt} \]

\[ A \xrightarrow{1\Omega} 15v \xrightarrow{5\text{ mtt}} B \]
40. (b) Motional enf across PQ
\[ V = BLv = 4(1)(2) = 8\text{volt} \]
This is the potential to which the capacitor is charged.
As \( q = CV \)
\[ \therefore q = (10 \times 10^{-6})(8) \]
\[ = 8 \times 10^{-5} \text{C} \]
\[ = 80 \mu\text{C} \]
As magnetic force on electron in the conducting rod PQ is towards Q, therefore, A is positively charged and B is negatively charged.
i.e., \( q_A = +80 \mu\text{C} \)
and \( q_B = -80 \mu\text{C} \)

41. (a) When roads are not properly banked, force of friction between tyres and road provides partially the necessary centripetal force. This cause wear and tear of tyres.

42. (c) the value of \( g \) at any place is given by the relation,
\[ g' = g - \omega^2 R \cos^2 \lambda \]
When \( \lambda \) is angle of latitude and \( \omega \) is the angular velocity of earth. If earth suddenly stops rotating, then \( \omega = 0 \).
\[ \therefore g' = g \quad \text{i.e., the value of } g \text{ will be same at all places.} \]

43. (a) When earth shrinks it angular momentum remains constant
\[ \text{i.e. } L = I\omega = \frac{2}{5}MR^2 \times \frac{2\pi}{T} = \text{constant} \]
\[ \therefore T \propto R^2 \]
It means if size of the earth changes then its moment of inertia changes.
In the problem radius becomes half so time period (Length of the day) will becomes 1/4 of the present value i.e. \( 24/4 = 6 \text{hr} \).

44. (d) Spring constant \( \propto \frac{1}{\text{length of spring}} \)
\[ \Rightarrow k' = nk \]
Also, spring constant depends on the material and the properties of the spring.

45. (a) work done \( = \frac{1}{2} \times \text{stress} \times \text{strain} = \frac{1}{2} \times Y \times (\text{strain})^2 \)
Since, elasticity of steel is more than copper, hence more work has to be done in order to stretch the steel.

46. (c) With increase in temperature surface tension of the liquid decreases and angle of contact also decreases.

47. (a) The fundamental frequency of an open organ pipe is \( n = \frac{v}{2\ell} \). As temperature increases, both \( v \) and \( \ell \) increases but \( v \) increases more rapidly than \( \ell \).
Hence, the fundamental frequency increases as the temperature increase.

48. (d) \( v_{\text{rms}} > v_{\text{mp}} \)
49. (d) If an electric fan is switched on in a closed room, the air will be heated because due to motion of the fan, the speed of air molecules will increase. In fact, we feel cold due to evaporation of our sweat.

50. (a) It is quite clear that the colored spectrum is seen due to diffraction of while light on passing through fine slits made by fine threads in the muslin cloth.

51. (d) Electric potential of a charged conductors depends not only on the amount of charge and volume but also on the shape of the conductor. Hence, if their shapes are different, they may have different electric potential.

52. (a) sensitivity \( \propto \frac{1}{\text{potential gradient}} \propto (\text{length of wise}) \)

53. (d) When a charged particle is moving in a circular path in a magnetic field, the magnitude of velocity does not change but direction of velocity changes every moment. Hence velocity is changing, so momentum \((m\vec{v})\) is also changing.

54. (d) In general, the field due to a magnet is non-uniform. Therefore, it exerts both force and torque on the nails which will translate the nails before striking to north pole of magnet with their induced south poles and vice versa.

55. (c) The manner in which the two coils are oriented determines the coefficient of coupling between them.

\[ M = K\sqrt{L_1L_2} \]

When the two coils are wound on each other, the coefficient of coupling is maximum and hence mutual inductance between the coils is maximum.

56. (d) When a metal piece falls from a certain height then eddy currents are produced in it due to earth’s magnetic field. Eddy currents oppose the motion of the Piece. Hence metal piece falls with a smaller acceleration (as compared of g). But no eddy currents are produced in non-metal piece. Hence it drops with acceleration due to gravity. Therefore, non-metal piece will reach the earth’s surface earlier.

57. (d) On increasing the intensity of incident light, the current in photoelectric cell will increase. The energy of the photons \((h\nu)\) will, however, not increase with increase in intensity, and hence the kinetic energy of the emitted electrons will not increase.

58. (a) We know that an electrons is very light particle as compared to an alpha particle. Hence electron can not scatter the \(\alpha\)-particle at large angles, according to law of conservation of momentum. On the other hand, mass of nucleus is comparable with the mass of \(\alpha\)-particle, hence only the nucleus of atom is responsible for scattering of \(\alpha\)-particles.

59. (b) Intrinsic Pentavalent N-type
Semiconductor + Impurity \(\Rightarrow\) semiconductor
(neutral) (Neutral) (Neutral)

60. (a) Explosion is due to internal forces. As no external force is involved, the vertical downward motion of centre of mass is not affected.

CHEMISTRY
61. (d) 
   i-factor for C₆H₁₂O₆ is 1 (Minimum)

62. (c) 
   2nd excited state → n = 3
   Angular momentum = \( \frac{\hbar n}{2\pi} \)

63. (b) 

64. (a) 
   \( \text{C}_6\text{H}_5\text{I} \xrightarrow{\text{NaOH}} \text{No reaction} \)

65. (c) 
   \( \text{CH}_3 - \text{C} \equiv \text{N} \)
   \( \text{sp}^3 \quad \text{sp} \)

66. (a) 

67. (a) 

68. (a) 

69. (a) 
   \[ M + (x + y) \text{NH}_3 \rightarrow M^+ (\text{NH}_3)_x + \text{e}^- (\text{NH}_3)_y \]
   Solved ammoniated electrons

70. (c) 

71. (a) 
   \( \text{Zn}^{(s)} \) has greatest oxidation potential.

72. (b) 
   \[ q = 0 \implies \Delta U = W \]
   \[ \Rightarrow n \epsilon \Delta T = W \]
   \[ \Rightarrow 1 \times 20 \times (T - 300) = -3000 \]
   \[ \Rightarrow T - 300 = -150 \]
   \[ \Rightarrow T = 150 \text{K} \]

73. (c) 

74. (c) 

75. (a) 
   Smog is formed by the action of sunlight on unsaturated hydrocarbons and nitrogen oxides. Smog mainly contains higher concentration of peroxyacetyl nitrate (PAN) formed by the reaction of \( \text{NO}_2, \text{O}_3 \) and unsaturated hydrocarbons.
   \[ \text{NO}_2 \xrightarrow{hv} \text{NO} + \text{O} \]
   \[ \text{O} + \text{O}_2 \rightleftharpoons \text{O}_3 \]
   \[ \text{NO} + \text{O}_3 + \text{Unsatd.HC} \rightarrow \text{PAN} \]

76. (b) 

77. (c) 
   The movement forwards anode shows that sol is negative. For coagulation of negative sol, cation with higher charge is more effective.

78. (d) 
   Unit of Rate constant is \( \text{s}^{-1} \), hence
Rate = k\([N_2O_5]\)
\[[O_2] = 0.1\text{M} \Rightarrow [NaO_2] = 1 - 2 \times 0.1 = 0.8\)
Rate = \(3 \times 10^{-4} \times 0.8\)

\[\frac{1}{4} \frac{d[NO_2]}{dt} = 3 \times 10^{-4} \times 0.8\]
\[\frac{d[NO_2]}{dt} = 9.6 \times 10^{-4}\]

79. (c)
\[\text{CH}_3\text{CH}_2\text{COOH} \xrightarrow{\text{NH}_3} \text{CH}_3\text{CH}_2\text{COONH}_4 \xrightarrow{\Delta} \text{CH}_3\text{CH}_2\text{CONH}_2 \xrightarrow{\text{KOH/Br}_2} \text{CH}_3\text{CH}_2\text{NH}_2\]

80. (c)

81. (b) Aldol condensation giving cinnamaldehyde.

82. (b)
\[\text{CH}_3\text{CH}_2\text{CH}_2\text{Br} \xrightarrow{\text{aq.NaOH}} \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \xrightarrow{\text{Al}_2\text{O}_3} \text{CH}_3\text{CH} = \text{CH}_2 \xrightarrow{\text{Cl}_2/\text{H}_2\text{O}} \text{CH}_3 - \text{CH} - \text{CH}_2\]

83. (b)
\[\text{NH}_4\text{Cl} \rightarrow \text{salt of SA and WB (acidic)}\]
\[\text{KHSO}_4 \rightarrow \text{amphoteric salt having acidic Hydrogen (acidic)}\]
\[\text{NaCN} \rightarrow \text{salt of WA and SB (Basic)}\]
\[\text{KNO}_3 \rightarrow \text{salt of SA and SB (Neutral)}\]

84. (a)
\[2\text{HI}(g) \rightleftharpoons \text{H}_2(g) + \text{I}_2(g)\]
\[t = 0 \quad a \quad o \quad o\]
At eqb
\[\frac{a}{2} \quad \frac{a}{4} \quad \frac{a}{4}\]
\(K_{eq} = \frac{a \times a / 4}{a / 2} = \frac{1}{4} = 0.25\)

85. (d)
86. (d)
87. (b) to remove Na$_2$S and NaCN formed during fusion.
88. (b)

89. (b)
SO₂Cl₂ + 2H₂O → H₂SO₄ + 2HCl
m.moles of SO₂Cl₂ = 25 × 0.2 = 5
m.moles of H⁺ = 2 × 5 + 2 × 5 = 20
m.moles of Ba(OH)₂ required = \frac{20}{2} = 10
Volume of Ba(OH)₂ required = \frac{10}{0.2} = 50ml

90. (a)
Moles of O₂ = \frac{67.2}{22.4} = 3
Mass of O₂ = 3 × 32g = 96g
Mass of O₁ formed = 96 × \frac{15}{100} = 14.4g

91. (c)

92. (c)

CH₃NH₂ + COCl₂ → CH₃NCO + 2HCl

93. (d)
Oxidation state of S varies from -2 to +6.

94. (c)
\frac{V}{22.4} × 2 = \frac{100}{1000} × 0.5 \Rightarrow V = 0.56L
\uparrow \quad \uparrow
\begin{bmatrix}
\text{Moles of O₂} \\
\text{n-factor}
\end{bmatrix}

95. (b) Concentration of H₂SO₄ increases due to consumption of H₂O during electrolysis.

96. (b)
2C(s) + 3H₂(\text{g}) → C₂H₆(\text{g}) \Delta H₁ = -85
3C(s) + 4H₂(\text{g}) → C₂H₈(\text{g}) \Delta H₂ = -104
(C - C) \rightarrow x \quad (C - H) \rightarrow y
(i) \quad 2 \times 718 + 3 \times 436 - 1 \times x - 6 \times y = -85
\Rightarrow x + 6y = (2 \times 718 + 3 \times 436 + 85)
(ii) 3 \times 718 + 4 \times 436 - 2 \times x - 8 \times y = -104
\Rightarrow 2x + 8y = (3 \times 718 + 4 \times 436 + 104)
(x = 345, y = 414)

97. (d)
CHCl₃ + HNO₃ → Cl₃CNO₂

98. (d)

99. (c)

100. (b)

101. (a)

102. (b) Color is due to charge transfer spectra.

103. (b)
\ln k_{eq} = \frac{-\Delta H°}{RT} + \frac{\Delta S°}{R}
104. (a) The two glucose units of maltose are linked through $\alpha$-glycosidic linkage between C-1 of one glucose unit and C-4 of other unit.

106. (b) Benzophenone does not have $\alpha$-hydrogen.

107. (c) Electron affinity of Cl is more than F.

108. (c) SO$_2$ is acting as oxidizing agent.

110. (b) Higher boiling point is due to H-bond.

111. (d) Tertiary alkyl halide is more reactive.

115. (c) Change in color is due to redox reaction between alcohol and K$_2$Cr$_2$O$_7$.

117. (c) It has $(4n+2)$ electrons (pi) in cyclic conjugation.

119. (d) Increasing T results in increase in $k_w$. Hence, $[H^+]$ increases, so pH decreases.

120. (b) xz plane acts as Nodal plane for $3d_{xy}$.

**BIOLOGY**

121. (c) *Xanthomonas oryzae* causes Bacterial blight of nice

122. (b)

123. (d)

124. (d) *Gammae-Marchantia*

125. (c)

126. (a)

127. (d)

128. (b)

129. (b)

130. (c) Methaemoglobinemia- blood disorder in which abnormal amount of mathemoglobin is produced

131. (b) In some plants like Oenthre, there are only two mitotic divisions giving of four nucleate embryo sac (lacking the three antipodal cells and one polar nuclei).

132. (b) $\frac{17+13}{(109+101)+(17+13)} \times 100 = \frac{30}{(210)(30)} = 12.5$

133. (d)

134. (c)

135. (d)

136. (d)

137. (d)

138. (b)

(a) Usually occur in fat rich plant cells

(c) Through glyoxylate cycle are involved in conversion of Acetyl CoA into carbohydrates.

139. (b)

140. (d)

141. (3) Cholera is an infectious disease caused by bacterium Vibrio cholera and can be treated by antibiotics

142. (2) This enzyme catalyses the hydrolysis of chitin which is a polysaccharide having glycosidic bonds. It also inhibits the enzyme which catalyses the digestion of amylose which is also a polysaccharide which also has glycosidic bonds

143. (4)
We need to find \( q \) where \( q^2 = 2 \times 2pq \).

Thus, \( q^2 = 4pq \). Hence \( q^2 = 4(1-q)q \) since \( p + q = 1 \).

Thus, \( 4q^2 = 4q - 4q^2 \). Hence \( 5q^2 = 4q \). Thus \( q = 4/5 = 0.8 \).

This enzyme catalyses the hydrolysis of chitin which is a polysaccharide having glycosidic bonds. It also inhibits the enzyme which catalyses the digestion of amylose which is also a polysaccharide which also has glycosidic bonds.

The recognition site of PvuII is on rop region.

Diaphragm is also present in crocodiles. Corpus callosum is absent in marsupials.

Discoblastula is formed as a result of discoidal cleavage. eg. Bony fishes, reptile, birds & prototherian mammals.

Chorionic Villous sampling is a procedure to obtain chorionic villous from placenta for the purpose of diagnosis. It can be done transabdominally or transcervically with the help of ultrasonography. It can be safely done during 10\(^{th}\) – 12\(^{th}\) week of pregnancy.

Basedow’s disease or Grave’s disease is a hyperthyroidic disease. Hashimoto’s disease is an autoimmune disorder which causes hypothyroidism.

Melatonin is an anti-FSH and anti-LH hormone secreted by pineal gland.

Both intracellular and extra cellular digestion is found in Cnidarians and Ctenophorans. In the list given Cnidarians are Physalia, Meandrina, Pennatula, Adamsia, Gorgonia and Ctenophorans are Pleurobrachia & Ctenoplana.

A- aqueous chamber, B- cornea, C- ciliary body, D- iris, E- yellow spot, F- blind spot, G- optic nerve, H- choroid layer, I- sclera, J- retina.

R : This type of karyotype has fewer metacentric chromosomes and is considered to be relatively advanced feature.
165. (a)
166. (c)
167. (d)
168. (b)
169. (a)
170. (c)