ANSWERS

MATHEMATICS

1. (b)	2. (d)	3. (a)	4. (c)	5. (b)	6. (a)	7. (c)	8. (a)	9. (d)	10. (c)
11. (d)	12. (c)	13. (c)	14. (c)	15. (b)	16. (b)	17. (d)	18. (b)	19. (a)	20. (b)
21. (c)	22. (c)	23. (b)	24. (c)	25. (d)	26. (d)	27. (d)	28. (c)	29. (b)	30. (c)
31. (a)	32. (c)	33. (b)	34. (a)	35. (c)	36. (d)	37. (a)	38. (c)	39. (a)	40. (d)
41. (d)	42. (b)	43. (b)	44. (b)	45. (d)					

PHYSICS

46. (d)	47. (d)	48. (c)	49. (c)	50. (b)	51. (a)	52. (c)	53. (c)	54. (b)	55. (d)
56. (c)	57. (d)	58. (d)	59. (a)	60. (c)	61. (c)	62. (b)	63. (a)	64. (b)	65. (b)
66. (d)	67. (b)	68. (b)	69. (c)	70. (a)	71. (c	72. (d)	73. (b)	74. (b)	75. (a)
76. (c)	77. (b)	78. (b)	79. (b)	80. (b)	81. (b)	82. (c)	83. (d)	84. (d)	85. (b)

CHEMISTRY

86. (a)	87. (c)	88. (d)	89. (d)	90. (a)	91. (a)	92. (b)	93. (a)	94. (c)	95. (c)
96. (c)	97. (b)	98. (a)	99. (c)	100. (d)	101. (a)	102. (a)	103. (c)	104. (c)	105. (b)
106. (d)	107. (c)	108. (b)	109. (a)	110. (d)	111. (a)	112. (c)	113. (a)	114. (b)	115. (a)
116. (c)	117. (c)	118. (a)	119. (a)	120. (a)	121. (d)	122. (a)	123. (d)	124. (c)	125. (b)

INTELLIGENCE, LOGIC & REASONING

126. (a)	127. (b)	128. (d)	129. (d)	130. (a)	131. (c)	132. (c)	133. (a)	134. (a)	135. (c)

ENGLISH LANGUAGE & COMPREHENSION

136. (c)	137. (b)	138. (b)	139. (c)	140. (a)	141. (c)	142. (a)	143. (c)	144. (d)	145. (a)
146. (b)	147. (d)	148. (b)	149. (c)	150. (d)					

EXPLANATIONS

1. $\frac{1}{\omega}\cdot\left[\frac{(\omega(a+b\omega+c\omega^2+d\omega^3)}{c+d\omega+a\omega+b\omega^2}\right]$

$= \frac{1}{\omega}\cdot\left[\frac{a\omega+b\omega^2+c+d\omega}{c+d\omega+a\omega+b\omega^2}\right]$

$= \omega^2.$

2. $\sqrt{2+\sqrt{3}}+\sqrt{2-\sqrt{3}} = \sqrt{\frac{4+2\sqrt{3}}{2}}+\sqrt{\frac{4-2\sqrt{3}}{2}}$

$= \frac{1}{\sqrt{2}}\sqrt{(\sqrt{3}+1)^2}\frac{1}{\sqrt{2}}\sqrt{(\sqrt{3}+1)^2}$

$= \frac{\sqrt{3}}{\sqrt{2}}$

3. $\frac{\sqrt{3}-1}{2\sqrt{2}-\sqrt{3}-1}$

$= \frac{\sqrt{3}-1}{2\sqrt{2}-\sqrt{3}+1}\cdot\frac{2\sqrt{2}+(\sqrt{3}+1)}{2\sqrt{2}+(\sqrt{3}+1)}$

$= \frac{2\sqrt{6}-2\sqrt{2}+2}{6-2\sqrt{3}} = \frac{\sqrt{6}-\sqrt{2}+1}{2-\sqrt{3}}\cdot\frac{2+\sqrt{3}}{2+\sqrt{3}}$

$= \sqrt{6}+\sqrt{4}+\sqrt{3}+\sqrt{2}$

4. $|z_1| = \sqrt{3^2+4^2} = 5$ and $|z_2| = \sqrt{4^2+3^2} = 5$

5. $x^2 - |x| - 2 = 0$

$\Rightarrow |x|^2 - |x| - 2 = 0$

$\Rightarrow |x| = \frac{1\pm\sqrt{1+8}}{2} = 2$

$\Rightarrow x = \pm 2$

6. $\alpha + \alpha^2 = \frac{3}{4}$

$\Rightarrow \alpha^3 + \alpha^6 + 3\alpha\alpha^2(\alpha + \alpha^2) = \frac{27}{64}$

$\Rightarrow \alpha^3 + (\alpha^3)^2 + 3(\alpha)^3(\alpha + \alpha^2) = \frac{27}{64}$

$\Rightarrow \frac{a}{8} + \frac{a^2}{64} + 3\frac{a}{8}\left(\frac{3}{4}\right) = \frac{27}{64} \quad [\alpha\alpha^2 = \frac{a}{8}]$

7. In this cone, the sum of the roots in zero,

$\Rightarrow -\frac{b}{a} = 0$

$\Rightarrow b = 0.$

8. Given, series sums to $\sum_{n=1}^{20} n^3 - \sum_{n=1}^{10} n^3$

9. If r is common ratio of the given G.P., then

$\frac{a}{c} = \frac{ar^4}{ar^2} = r^2$ and also $\frac{d}{b} = \frac{ar^3}{ar} = r^2.$

10. If the A.P. is, a + (a + d) + (a + 2d) . . . . .

Then $a + (p-1)d = q$

$a + (q-1)d = p$

$(-q)d = a - p$

$\Rightarrow d = -1$

$\therefore$ rth term $= a + (p-1) + (r-1)(-1)$

$= p + q - r.$

11. $^{x+5}P_{x+1} = \frac{11(n-1)^{x+3}P_n}{2}$

$= \frac{\lfloor x+5}{\lfloor x+5-(x+1)}$

$= \frac{11(x-1)}{2} \times \frac{\lfloor x+3}{\lfloor x+3-n}$

$= \frac{11(x-1)}{2} \times \frac{\lfloor x+3}{\lfloor 3}$

12. $^{47}C_4 + {}^{51}C_3 + {}^{50}C_3 + {}^{49}C_3 + {}^{48}C_3 + {}^{47}C_3$

$= (^{47}C_3 + {}^{47}C_4)\ {}^{48}C_3 + {}^{49}C_3 + {}^{50}C_3 + {}^{51}C_3$

$= {}^{48}C_4 + {}^{48}C_3 + {}^{49}C_3 + {}^{49}C_3 + {}^{50}C_3$

$+ {}^{51}C_3 \ldots = {}^{52}C_4.$

13. Total number of selection of the three balls out of nine = $^9C_3 = 84$.

Those selections which have no black ball are $^6C_3$ in number as there are six non-black balls.

14. Since the coin has tail on both the sides, therefore the even "a head" appears on any throw is impossible.

15. Let E be an event, then

P (E or not E) = P (E $\cup$ E')

= P(E) + P(E') = 1

16. Here, $(1 + x - 2x^2)^6$

$= 1 + 0, x + a_2 x^2 \ldots . a_{12}x^{12}$ ...(i)

Putting x = 1, –1 in equation (i), we get

$0 = 1 + a_1 + a_2 + \ldots . a_{12}$ ...(ii)

and $(-2)^6 = 1 - a_1 + a_2 - a$ ...+ a_{12} ...(iii)

Adding equations (ii) and (iii), we get

$2 = 1 + a_1 + a_4 \ldots . + a_{12}.$

17. $^nC_1\ x^{x-1}\ a = 240$ ...(1)

$^nC_2\ x^{x-2}\ a^2 = 720$ ...(2)

$^xC_3\ x^{n-3}\ a^3 = 1080$ ...(3)

Dividing (1) by (2), we get $\frac{2x}{(x-1)a} = \frac{1}{3}$ ...(4)

Dividing (2) by (3) , we get $\frac{3x}{(x-2)a} = \frac{2}{3}$

Dividing (4) and (5), we get $\frac{2(x-2)}{3(x-1)} = \frac{1}{2}$

18. Operate $R_2 - R_2 - \frac{1}{2}(R_1 + R_3)$ and use $\frac{a+c}{2} = b$;

it will be found that $R_2 = 0$.

20. Operate $C_3 \to C_3 - C_2$; $C_3 \to C_3 - C_2$, we get

$$\begin{vmatrix} 1 & 0 & 0 \\ x & 1 & 1 \\ \frac{x(x-1)}{2} & x & x+a \end{vmatrix} = 1\ (x + 1 - x) = 1$$

21. $f\left(\frac{\pi}{3}\right) = \begin{vmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{vmatrix} = (1-1) - (1-0) = -1$

22. Operate $R_1 \to R_2 \to R_3$; take out – (a + b + c) form R_1 and then operate $C_2 \to C_2 - C_1$, $C_3 \to C_3 - C_1$

Value of determinant is

$-(a + b + c)^3 = [-(a + b + c)]^3.$

23. $\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$

24. $f(x) = \sin\left(x + \frac{\pi}{6}\right) + \cos\left(x + \frac{\pi}{6}\right)$

$= \sqrt{2}\sin\left(x + \frac{\pi}{6} + \frac{\pi}{4}\right)$

which has a maximum value = $\sqrt{2}$, when

$x + \frac{\pi}{6} + \frac{\pi}{4} = \frac{\pi}{2}$

i.e., when $x = \frac{\pi}{2} - \frac{\pi}{4} - \frac{\pi}{6} = \frac{\pi}{12}$

25. $$\frac{1-\tan^2\left(\frac{\pi}{8}\right)}{1+\tan^2\left(\frac{\pi}{8}\right)} = \cos\left(\frac{2\pi}{8}\right) = \frac{1}{\sqrt{2}}$$

26. $\cos\frac{\pi}{5}\ \cos\frac{2\pi}{5}\ \cos\frac{4\pi}{5}\ \cos\frac{8\pi}{5}$

$$= \frac{16\sin\theta\cos\theta\cos 2\theta\cos 8\theta}{16\sin\theta},$$

where $\theta = \frac{\pi}{5}$

$$= \frac{\sin 16\theta}{16\sin\theta} = \frac{\sin 15\theta}{16\sin\theta} = \frac{\sin(3\pi+\theta)}{16\sin\theta}$$

$$= \frac{-\sin\theta}{16\sin\theta}$$

27. $\tan 81° - \tan 63° - \tan 27° + \tan 9°$

$= \{\tan(90 - 9°) + \tan 90°\}$

$\quad - \{\tan(90 - 27°) + \tan 27°\}$

$= (\cot 9° + \tan 9°) - (\cot 27° + \tan 27°)$

$= 2\,\text{cosec}\ 18° - 2\,\text{cosec}\ 54°$

$$= \frac{2}{\sin 18°} - \frac{2}{\sin 54°} = \frac{2}{\sin 18°} - \frac{2}{\sin 36°}$$

$$= 8\left[\frac{\sqrt{5}+1-\sqrt{5}+1}{(\sqrt{5})^2-1^2}\right]$$

28. $D_f = (\frac{4}{3}, \infty)$ for R_f,

Let $y = \frac{1}{\sqrt{3x-4}}$

$\Rightarrow y > 0$

and $3x - 4 = \frac{1}{y^2}$

$\Rightarrow x = \frac{1}{3}\left(4 + \frac{1}{y^2}\right)$

x is real if $y^2 \neq 0$

i.e., if $y^2 > 0$

But $y > 0$, therefore $R_f = (0, \infty)$

29. $x^2 + x + 1 = \left(x+\frac{1}{2}\right)^2 + \frac{3}{4} \geq \frac{3}{4}$ for all $x \in R$

$D_f = R$

Also if $y = f(x)$, then

$$y = \sqrt{x^2+x+1} \geq \frac{\sqrt{3}}{4} \ \forall\ x \in R$$

Hence $R_f = \left[\frac{\sqrt{3}}{2}, \infty\right)$

30. Let $y = f(x)$

$\Rightarrow y = \sqrt{\frac{x}{1+x}} \Rightarrow y^2(1+x) = x$

and $y \geq 0$

31. $\sin^{-1}x$ is defined only if $-1 \leq x \leq 1$

Hence, $\sin^{-1}(2x+1)$ is defined only if

$-1 \leq 2x + 1 \leq 1$

i.e., if $-1 \leq x \leq 0$

32. $f(x) = 2x^3 - 3x^2 - 12x + 4$

$\Rightarrow f'(x) = 6x^2 - 6x - 12$

and $f''(x) = 12x - 6$

Now $f'(x) = 0$

$\therefore\ 6(x^2 - x - 2) = 0$

$\Rightarrow x = 2, -1$

At $x = 2$, $f''(x) > 0$ and at $x = -1$, $f''(x) < 0$.

Therefore f has a local maximum at $x = -1$ and local minima at $x = 2$.

33. Since, $\int\sqrt{x^2+1}dx$

$$= \frac{x}{2}\sqrt{x^2+1} + \frac{1}{2}\log(x + \sqrt{x^2+1})$$

$$\therefore \frac{d}{dx}\left(\frac{x}{2}\sqrt{x^2+1} + \frac{1}{2}\log(x + \sqrt{x^2+1})\right)$$

$$= \sqrt{x^2+1}$$

34. When $x \to 1^+$, $(x-1) \to 0^+$

$\Rightarrow \frac{1}{x-1} \to +\infty$ Hence

$2^{\frac{1}{x-1}} \to \infty \Rightarrow 2^{-2^{\frac{1}{x-1}}} \to 0$

35. Let ϵ be any positive number, however small,

then for any x in $|x - \frac{1}{2}| < \epsilon$

i.e., in $(\frac{1}{2} - \epsilon), \frac{1}{2} + \epsilon$

$|f(x) - f(\frac{1}{2})| = |x - \frac{1}{2}| < \epsilon$ if x is rational

and $|f(x) - f(\frac{1}{2})| = |1 - x\frac{1}{2}| = |\frac{1}{2} - x|$

$= |x - \frac{1}{2}| < \epsilon$ if x is rational

i.e., $|f(x) - f(\frac{1}{2})| < \epsilon$ for all $\epsilon (\frac{1}{2} - \epsilon, +\frac{1}{2}\ \epsilon)$

and hence f is continous at $x = \frac{1}{2}$.

36. $\int_a^b \frac{|x|}{x}dx = [|x|]_a^b = |b| - |a|$

37. $\int_a^{\sqrt{3}} \frac{1}{1+x^2}dx = \left[\tan^{-1}x\right]_a^{\sqrt{3}}$

$= \tan^{-1}\sqrt{3} - \tan^{-1}1 = \frac{\pi}{3} - \frac{\pi}{4}$

38. Given, $\frac{dx}{x} = \frac{y}{x}$

$\Rightarrow \frac{dx}{x} = \frac{dy}{y}$

$\log |x| = \log|y| + \log|c|, c \neq 0$

$|x| = |yc|$

$\Rightarrow y = \pm \frac{1}{c} x = kx$

39. $\int \frac{1}{f(x)} dx = (f(x))^2 + c$

$\Rightarrow \frac{1}{f(x)} = \frac{d}{dx} \left[\log (f(x))^2 + c\right]$

Now, $\frac{1}{f(x)} = \frac{2f'(x)}{f(x)}$

$\Rightarrow f'(x) = \frac{1}{2}$

$\therefore f(x) = \frac{1}{2} x + \alpha,$

where α is some constant.

40. $\frac{d^2y}{dx^2} = e^{-2x}$

Integrating we get, $\frac{dy}{dx} = \frac{e^{-2x}}{-2} + c,$

Again integrating, $y = \frac{e^{-2x}}{(-2)(-2)} + cx + d$

or $y = \frac{1}{4} e^{-2x} + cx + d$

where c and d are constants.

41. $\underset{n\to\infty}{Lt} \sum_{r=1}^{n} \frac{n}{n^2 + r^2} = \underset{n\to\infty}{Lt} \sum_{r=1}^{n} \frac{1}{1 + \left(\frac{r}{n}\right)^2}$

$= \underset{n\to\infty}{Lt} \frac{1}{n} \sum_{r=1}^{n} f\left(\frac{r}{n}\right)$

where $f(x) = \frac{1}{1+n^2}$

$= \underset{h\to 0}{Lt} \sum_{r=1}^{n} (0 + rh)$

$= \int_0^1 \frac{1}{1+x^2} dx.$

42. $\begin{vmatrix} -12 & 0 & \alpha \\ 0 & 3 & -1 \\ 2 & 1 & -15 \end{vmatrix} = 546$

43. The two given vectors include an actual angle if

their dot product > 0

i.e., if $2(1 + m) + (-m)(-2m) + 3m \cdot 1 > 0$

i.e., $m < -2$ or $m > -\frac{1}{2}$

44. $\frac{\vec{a}.(\vec{b}\times\vec{c})}{(\vec{c}\times\vec{a}).\vec{b}} + \frac{\vec{b}.(\vec{a}\times\vec{c})}{\vec{c}.(\vec{a}\times\vec{b})} = \frac{[\vec{a}\vec{b}\vec{c}]}{[\vec{c}\vec{a}\vec{b}]} + \frac{[\vec{b}\vec{a}\vec{c}]}{[\vec{c}\vec{a}\vec{b}]}$

$\frac{[\vec{a}\vec{b}\vec{c}]}{[\vec{a}\vec{b}\vec{c}]} + \frac{-[\vec{a}\vec{b}\vec{c}]}{[\vec{a}\vec{b}\vec{c}]} = 0$

45. Since, $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}$ and $\vec{b} = 4\hat{i} - 4\hat{j} + 7\hat{k}$

$\therefore$ Length required $= \frac{\vec{a}.\vec{b}}{|\vec{b}|}$

46. Amplitude, A = 0.06 m

Frequency, f = 15 Hz

Maximum velocity of the body,

$v_m = \omega A$

$= (2\pi f) A$

$= 2 \times 3.14 \times 15 \times 0.06$

$= 5.65$ m/s

Maximum acceleration of the body

$a_m = \omega^2 A$

$= (2\pi f)^2 A = 4\pi^2 f^2 A$

$= 4 \times (3.14)^2 \times 15^2 \times 0.06$

$= 5.32 \times 10^2$ m/s^2

47. Potential difference V = 100 V

Kinetic energy of the electron

$= |eV| \times 1.6 \times 10^{-19}$ J

Thus, kinetic energy of the electron accelerated in a potential difference of 100 V

$= 1.6 \times 10^{-19} \times 100$

$= 1.6 \times 10^{-17}$ joules

48. Equation of motion is

$y = 0.3 \sin(314t - 1.57x)$ ...(i)

Standard equation of standing wave is

$y = A \sin(\omega t - kx)$ ...(ii)

Now comparing the given equation (i) with the standard equation (ii), we get

$\omega = 314$ and $k = 1.57$

$\therefore$ Velocity of wave, $v = \frac{\omega}{k} = \frac{314}{1.57} = 200$ unit

49. Frequency of wave, $\nu = 1000$ Hz
Number of successive nodes = 6
Total distance between six successive nodes = 85 cm
From the relation between distance of nodes and wavelength of the wave

$$s = 85 = \frac{(n-1)\lambda}{2} = \frac{(6-1)\lambda}{2} = \frac{5\lambda}{2}$$

where, λ = wavelength of wave

$$\therefore \quad \lambda = \frac{2\times 85}{5} = 34 \text{ cm} = 0.34 \text{ m}$$

Hence, speed of sound in the gas = $\nu\lambda$
$= 1000 \times 0.34 = 340$ m/s

50. Amplitude of the particle = A
Potential energy of the particle at a displacement y from the mean position,

$$\text{P.E.} = \frac{1}{2}ky^2$$

Its kinetic energy, $\text{K.E.} = \frac{1}{2}k(A^2 - y^2)$

Since, K. E. = P. E.

$$\therefore \quad \frac{1}{2}k(A^2 - y^2) = \frac{1}{2}ky^2$$

or $A^2 - y^2 = y^2$

or $2y^2 = A^2$

or $y = \frac{A}{\sqrt{2}}$

$= 0.707\, A \approx 0.71\, A$

51. Current, i = 2A, time, t = 6 min = 360 sec
work done, W = 1000 J
Charge flowing in the circuit,

$$q = it$$
$$= 2 \times 360 = 720 \text{ C}$$

Hence, e.m.f. in the circuit,

$$E = \frac{W}{q} = \frac{1000}{720} = 1.38 \text{ V}$$

52. Length of the column, l = 20 cm = 0.2 m
Frequency of the tuning fork, ν = 250 Hz
Frequency of a tuning fork,

$$\nu = 250 = \frac{v}{4l}$$

$$\therefore \quad v = 250 \times 4 \times 0.2 = 200 \text{ m/s}$$

53. Length of rod, l = 2 m
Cross-sectional area, $A = 50 \text{ mm}^2$
$= 50 \times 10^{-6} \text{ m}^2$
Change in the length, $\Delta l = 0.5$ mm
$= 0.5 \times 10^{-3}$ m
Mass hung at lower end, m = 250 kg
Force acting on the rod,

$$F = mg = 250 \times 9.8 = 2450 \text{ N}$$

$$\therefore \quad y = \frac{F.L}{A.\Delta L} = \frac{2.450\times 2}{50\times 10^{-6}\times 6.5\times 10^{-3}}$$
$$= 19.6 \times 10^{10} \text{ N/m}^2$$

54. Distance between two parallel wires,
$r = 10$ cm $= 0.1$ m
Current in each wire, $i_1 = i_2 = 10$ amp.
Length of wire, l = 1 m
Force on the wire per meter length,

$$F = \frac{\mu_0 i_1 i_2 \times l}{2\pi r} \text{ (where } \mu_0 = 4\pi \times 10^{-7})$$
$$= \frac{4\pi\times 10^{-7}\times 10\times 10\times 1}{2\times\pi\times 0.1}$$
$$= 2 \times 10^{-4} \text{ N}$$

55. Resistance of wire at 30°C, $R_{30°C} = 3.1\Omega$
Resistance of wire at 100°C, $R_{100°C} = 4.5\ \Omega$
Temperature coefficient of resistance,

$$\alpha = \frac{R_{100} - R_{30}}{R_{30}\times\Delta t}$$
$$= \frac{4.5 - 3.1}{3.1\times(100° - 30°)}$$
$$= \frac{1.4}{217} = 0.00640°\text{C}^{-1}$$

56. Current across 30 resistor is 0.8 A.
Current through the parallel resistance of 6 Ω

$$= \frac{0.8\times 3}{6} = 0.4 \text{ A}$$

$\therefore$ Total current across 4 Ω = 0.8 + 0.4 = 1.2 A
Now potential drop across 4 Ω resistor
$= 4 \times 1.2 = 4.8$ V

57. When the pole of a bar magnet is pointing in the north direction, the magnetic lines pass through the magnet and the null point lie on the equatorial-line of the bar magnet.

58. e.m.f. of first battery, $E_1 = 4$ V
e.m.f. of second battery, $E_2 = 8$ V
Internal resistance of first battery, $r_1 = 1\ \Omega$
Internal resistance of second battery, $r_2 = 2\ \Omega$
Circuit resistance, $R = 9\ \Omega$
From the Kirchhoff's current law, we have

$$-4 - ir_1 - iR - ir_2 + 8 = 0$$

$$\therefore \quad -4 - (i \times 1) - (i \times 9) - (i \times 2) + 8 = 0$$

or $-12i = -4$

or $i = \frac{4}{12} = \frac{1}{3}$ A

Now potential difference across PQ,

$$V_{PQ} = i \times R = \frac{1}{3} \times 9 = 3 \text{ V}$$

59. Mass of the bullet, m = 30

g = 0.03 kg.

Initial velocity u = 120 m/s

Distance travelled by the bullet,

s = 12 cm = 0.12 m

Relation for the final velocity is given by

$$v^2 = u^2 + 2as$$

$\therefore$ $v^2 - u^2 = 2as$

or $0 - (120)^2 = 2 \times a \times 0.12$

or $a = -\frac{14400}{0.24} = -60000 \text{ m/s}^2$

(minus sign represents retardation of bullet)

Hence, resistance exerted by the block,

$F = ma = 0.03 \times 60000 = 1800$ N

60. Magnetic moment of bar magnet, $M = 220A \text{ m}^2$

Magnetic field intensity, H = 025 N/A–m

Angle of deflection, $\theta = 30°$

Couple required to deflect the magnet

$= M H \sin \theta$

$= 200 \times 0.25 \times \sin 30°$

$= 25$ Nm

61. Magnetic moment of each magnet,

$M_1 = M_2 = M$

Since two magnetic moments are placed perpendicular to each other, hence,

net magnetic moment

$$= \sqrt{M_1^2 + M_2^2} = \sqrt{2M^2} = \sqrt{2}\,M$$

62. Distance between two atoms = 3.7 Å

$\therefore$ Atomic radius, $r = \frac{d}{2} = \frac{3.7}{2} = 1.85$ Å

Now, atomic radius, $r = \frac{\sqrt{3}}{4} \times a$

where, a = lattice parameter

$\therefore$ $1.85 = \frac{\sqrt{3}}{4} \times a$

or $a = \frac{4 \times 1.85}{\sqrt{3}} = 4.27 \text{ Å} \approx 4.3 \text{ Å}$

63. When the waves which oscillates perpendicularly to the direction of propagation are known as the transverse waves and also the transverse waves can be produced in solids those which are having some rigidity. As we know that the gases do not have any rigidity. Therefore, transverse waves can not be produced in gases.

64. Displacement, $x = a_0 + a_1 t + a_2 t^2$

Velocity of the particle,

$$v = \frac{dx}{dt} = \frac{d(a_0 + a_1 t + a_2 t^2)}{dt}$$

$$= a_1 + 2a_2 t$$

$\therefore$ Acceleration of the particle,

$$a = \frac{dv}{dt} = \frac{d(a_1 + 2a_2 t)}{dt}$$

$\therefore$ $a = 2a_2$

65. Because of air resistance is taken into consideration so the horizontal velocity of the bomb is decreased, while the aeroplane is moving with constant speed. Now it is clear that bomb will fall on the earth behind the aeroplane.

66. The elements which have incomplete outer cell of electrons e.g. boron, gallium, aluminium in a p-type semi-conductor. Hence, the elements boron gallium and aluminium all are used in p-type semiconductor.

67. A third electrode known as the grid is introduced between the anode and cathode electrodes in a triode valve for controlling the electrons which are emitted by the cathode. Therefore, grid controls the current in the plate circuits.

68. When the bus takes a turn, the passengers tends to maintain their direction of motion forward (inertia of motion). Therefore, the passengers are thrown outwards while bus taking a turn.

69. It gives a high outputs when both inputs are low. It is abbreviation of NOT OR NOR gates is the opposite or OR gate therefore, NOR gate gives high output when both inputs are low.

70. The infra-red photons consist of less energy in comparison with visible light because of their frequency is less than that of visible light. Therefore, the option (a) is not true.

71. When α particle is emitted from the nucleus, then mass number is reduced by 4 unit and atomic number is reduced by 2 unit. When β-particle is emitted from the nucleus, then atomic number is increased by one unit but mass number remains same. When γ-particle are emitted from the nucleus then there is not change in atomic number and mass number. Therefore, first of all $\perp$ β-particle is emitted out, then 1-α-particle is emitted out and then γ-particle.

72. Focal length of red light = f_R

Focal length of violet light = f_v

The relation for the focal length is given by

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

or $$\frac{1}{f} \propto \mu$$

or $$f \propto \frac{1}{\mu} \text{ because } f_V < f_R$$

Then $$\mu_R < \mu_V$$

73. In the fission reaction of one $_{92}U^{235}$ nucleus a large amount of energy is released which is about 200 MeV.

When 50 kg. of U = 235 undergoes a fission, it will release a very high energy rate of 4×10^{15} joule. Hence, it causes a very large scale destruction called as holocaust.

74. Ramsdens' eye piece contains two plane convex lenses of equal focal lengths. These two lenses are separated by a distance of $\frac{2f}{3}$.

Hence, focal length of field lens and eye lens are same, so $f_1 = f_2$

and these are separated by $\frac{2f}{3}$.

75. According to Hugen's principle, every point on the wave front may be regarded as a source of secondary waves. While in photoelectric, light consists of particles (bundle of photons). Therefore, theory discovered by Hugen's could not explain the photoelectric effect.

76. Weight of the block = 2 kN

Distance, d = 10 m

Angle of inclination $\alpha = 15°$

Force of resistance due to inclination while block of wood is pulled upon a smooth plane surface

$$F = W \sin \alpha = 2 \sin 15°$$
$$= 2 \times 0.2588 = 0.5176 \text{ kN}$$

$\therefore$ Work done, $W = F.d$

$$= 0.5176 \times 10$$
$$= 5.17 \text{ kJ}$$

77. e.m.f. of the cell, E = 2 V

Internal resistance of the cell, r = 0.1 Ω

External resistance, R = 3.9 Ω

Voltage across the cell,

$$V = E - ir$$
$$= E - \left(\frac{E}{R+r}\right)r$$
$$= 2 - \left[\frac{2}{3.9+0.1} \times 0.1\right]$$
$$= 2 - 0.05 = 1.95 \text{ V}$$

78. Mass of the earth $M_e = 6 \times 10^{24}$ kg.

Angular velocity of the earth,

$$\omega = 2 \times 10^{-7} \text{ rad/sec}$$

Radius of circular orbit,

$$r = 1.5 \times 10^8 \text{ km} = 1.5 \times 10^{11} \text{ m}$$

Force exerted on the earth

$$= M_e r\omega^2$$
$$= (6 \times 10^{24}) \times (1.5 \times 10^{11}) \times (2 \times 10^{-7})^2$$
$$= 36 \times 10^{21} \text{ N}$$

79. Mass of ball, m = 150, g = 0.15 kg

Acceleration of the ball, a = 20 m/s^2

Time interval, dt = 0.1 sec

Force on the moving ball,

$$F = ma = 0.15 \times 20 = 3 \text{ N}$$

$\therefore$ Impulsive force = F $\times$ dt = 3 $\times$ 0.1 = 0.3 Ns

80. Heat added to the system, $\Delta Q = 110$ J

Internal energy, $\Delta U = 40$ J

External work done, $\Delta W = \Delta Q - \Delta U$

$$= 110 - 40 = 70 \text{ J}$$

81. The atoms of a paramagnetic material consists of a small magnetic moment because of spin motion of electrons.

This moment is either due to non-cancellation of the spin of two electrons or due to the spin of magnetic moment of last unpaired electron. Hence, the moment of a single atom is not zero in paramagnetism.

82. Luminous efficiency of the lamp = 4 lumen/watt
Luminous intensity, I = 30 candela
From the law of photometry, luminous flux

$$F = 4\pi I = 4 \times \frac{22}{7} \times 30$$

$$= 377.14 \text{ lumen} \approx 377 \text{ lumen}$$

$$\therefore \text{ Power of the lamp} = \frac{\text{luminous flux}}{\text{luminous efficiency}}$$

$$= \frac{377}{4} \approx 94 \text{ W}$$

83. $\vec{C} = \vec{A} + \vec{B}$
Above equation gives,

$$C^2 = A^2 + B^2 + 2AB\cos\theta$$

But $C^2 = A^2 + B^2$

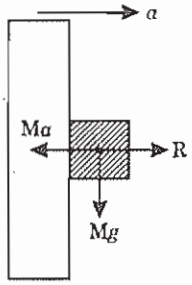
$\therefore$ $2AB \cos\theta = 0$

or $\cos\theta = 0$

Hence, $\theta = 90°$

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

84. Forces on M are shown in the given diagram, we get



$R = Ma$

$F = \mu R = \mu Ma$

As M does not fall, hence

$Mg \leq F$

$Mg \leq \mu Ma$

$\mu Ma \geq Mg$

Thus, $\mu \geq \frac{g}{a}$

85. Horizontal velocity of the packet = u
Vertical velocity of the packet = $\sqrt{2gh}$
Final velocity = $\sqrt{u^2 + 2gh}$

86. The correct order of dipole moment of HF, H_2S and H_2O is
$HF < H_2S < H_2O$

87. The heat exchanged in a reaction at constant temperature and pressure is known as enthalpy.

88. According to Aufbau principle the orbitals of lower energy are filled first followed by higher energy orbitals. Hence, the correct explanation is $1s^2, 2s^2 2p^6$.

89. A mole of any substance is related to number of particles, volume of gaseous substance and mass of a substance.

90. The alkane is not obtained by hydroxylation of ethyne because it produce aldehyde.

$$HC \equiv CH + H_2O \xrightarrow{H_2SO_4} CH_3CHO$$

91. According to Bronsted theory an acid is a substance that donates proton and a base is a substance that accept protons. Hence, base is proton acceptor.

92. A mixture of sodium benzoate and sodalime reacts on heating to produce benzene.

$$C_6H_5\boxed{COONa + NaO}H \xrightarrow[\text{Heat}]{CaO} \underset{\text{Benzene}}{C_6H_6} + Na_2CO_3$$

93. Wavelength $= \frac{h}{mv}$

$$= \frac{6.6 \times 10^{-34}}{10^{-3} \times 100} = 6.6 \times 10^{-33} \text{ m}$$

94. The Baeyer's reagent is alkaline $KMnO_4$ solution which is used for detection of unsaturation.

$$\underset{\text{olefin unsaturated}}{\begin{matrix}CH_2\\ \|\\ CH_2\end{matrix}} + O + H_2O \xrightarrow[\text{solution}]{\text{alk. } KMnO_4} \underset{\text{saturated}}{\begin{matrix}CH_2OH\\ |\\ CH_2OH\end{matrix}}$$

95. $[_{19}K^{40}]^{-1}$ has 20 electrons because the atomic number of K is 19 and it has 1 more electron.
$\therefore$ Number of electrons = 19 + 1 = 20.

96. The empirical formula of compound is CH_2O.
Hence empirical formula mass

$$= 12 + 2 + 16 = 30.$$

Molecular weight = 180

$$\text{We know, } n = \frac{\text{molecular weight}}{\text{empirical weight}}$$

$$= \frac{180}{30} = 6$$

Molecular formula = $(\text{empirical formula})_n$

$$= (CH_2O)_6 = C_6H_{12}O_6$$

97. $\therefore$ 100 kg sample of impure lime stone contains pure $CaCO_3$ = 95 kg
$\therefore$ 200 kg sample of impure lime stone contains

$$= \frac{95 \times 200}{100} = 190 \text{ kg}$$

$CaCO_3 \longrightarrow CaO + CO_2$

Since 100 kg $CaCO_3$ produce CaO = 56 kg
$\therefore$ 190 kg $CaCO_3$ produce CaO

$$= \frac{56 \times 190}{100} = 106.4 \text{ kg}$$

99. Let the oxidation state of Cr in $K_2Cr_2O_7$ = x

$\therefore$ $(2 \times 1) + (2 \times x) + 7(-2) = 0$

or $2 + 2x + (-14) = 0$

or $2x = 14 - 2 = 12$

or $x = +6$

101. Sodium reacts rapidly with water but copper is least reactive with water. Therefore, the reactivity of metals with water is

Na > Mg > Zn > Fe > Cu

Most reactive $\xrightarrow{\text{decreasing reactivity}}$ Least reactive

102. Magnalium is an alloy containing 95% aluminium and 5% magnesium. It is used to make light instruments.

103. Graphite is good conductor of heat and electricity due to the presence of free electrons in graphite crystal. The fourth valence electron of each carbon atom is free to move.

104. The hydrocarbons having the highest boiling point will have the maximum number of carbon atoms in its molecules. Here, hydrocarbon C has the highest boiling point of –0.6°C, therefore, it have the maximum number of carbon atoms in its molecule.

105. Here, V_1 = 10 litres, P_1 = 1 atm.,

$T_1 = 27°C + 273° = 300K$

V_2 = 5 litres, P_2 = 1 atm.,

Now, $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\therefore$ $\frac{1\times10}{300} = \frac{1\times5}{T_2}$

or $T_2 = \frac{1\times5\times300}{10} = 150\ K$

106. The bond formed by one sided sharing of electrons are known as coordinate bond. All the above SO_3, H_2SO_4 and O_3 have coordinate bonds.

107. The isomerism exhibited is metamerism. This is exhibited by the members of same homologous series due to different alkyl groups, attached to functional group.

108. The oxidation takes place as below :

$CH_3CH_2OH \xrightarrow[-2HCl]{Cl_2} CH_3CHO \xrightarrow[-3HCl]{3Cl_2} CCl_3CHO.$

Thus, the oxidation product is CCl_3CHO.

110. $4HNO_3 + P_4O_{10} \longrightarrow 4HPO_3 + 2N_2O_5$

Hence, X is N_2O_5.

111. Mg does not decomposed cold water due to the formation of $Mg(OH)_2$.

112. $CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$

Hence, acetylene is formed.

113. Methyl orange is the most suitable indicator used for titrating Na_2CO_3 solution with HCl. It produces pink colour in strong acidic solution.

$\therefore$ Equivalent weight $= \frac{\text{molecular weight}}{2}$

$= \frac{200}{2} = 100$

Here, volume of 100 ml = 0.1 litre

We know strength

= normality × volume × equivalent weight

= 0.1 × 0.1 × 100 = 1 gm

115. Calcium formate on heating produce

$(HCOO)_2Ca \xrightarrow{Heat} CaCO_3 + HCHO$

formaldehyde

116. $C_6H_5CH_3 \xrightarrow{2CrO_2Cl_2} C_6H_5CH(OCrOHCl_2)_2$

Toluene $\xrightarrow{H_2O} C_6H_5CHO$

Benzaldehyde

This reaction is known as Etard reaction.

117. CF_3COOH is the strongest acid due to greatest – I effect of fluorine atom among chlorine and methyl.

118. CO_2 has a linear structure. Its dipole moment is zero. In CO_2 the hybridisation of carbon is sp. $O = C = O$

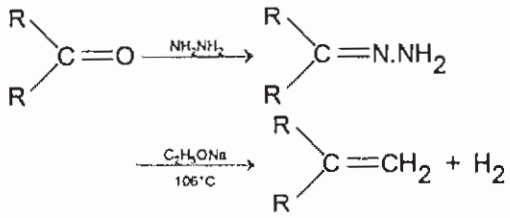
119. On heating crystals of potassium ferrocyanide with conc. H_2SO_4 following reaction takes place

$K_4Fe(CN)_6 + 6H_2SO_4 + 6H_2O \longrightarrow 2K_2SO_4 + 3(NH_4)_2SO_4 + 6CO$

Hence, carbon monoxide gas is evolved.

120. For an ideal gas Joule-Thomson coefficient is zero. Because van der Waal's forces of attraction are negligible and there is no expenditure of energy in overcoming these forces of attraction.

121. A ketone can be converted into hydrocarbon by Wolff Kishner reaction.



123.

Element	Percentage	Percentage At. wt.	Ratio
C	92.31	$\frac{92.31}{12} = 7.7$	1
H	7.69	$\frac{7.69}{1} = 7.69$	1

Empirical formula = CH

Empirical formula weight = 12 + 1 = 13

Value of 'n' = Molecular weight

$$\text{Empirical formula weight} = \frac{78}{13} = 6$$

$\because$ Molecular formula = empirical formula × n

$(CH) \times 6 = C_6H_6$

124. Average life of radium = 1.44 × half life

$= 1.44 \times 1580$

$= 2.275 \times 10^3$ years

125. In lake test of Al^{3+} ion, there is formation of coloured floating lake. It is due to the fact that $Al(OH)_2$, a solid surface absorbed litmus colour hence appears as "coloured floating lake".

126. As per the question, A is the sister of B and C whereas D is the father or mother of A, B and C. Therefore, D is the mother of B.

127. According to question, B and C are husband and wife. A and D are the sisters of B and C respectively. Therefore, D is the sister-in-law of B.

128. As per the question Mona is the grand-daughter of Sumitra and Kavita is the sister of Sumitra. Therefore, Kavita is grand-mother of Mona.

129. As argument and disagreement are the synonym. In the same way thought and thinking are also synonyms. Therefore, option (*d*) is correct.

130. The football is kicked by player same as cigar is smoked by smoker. Therefore, option (*a*) is correct.

131. Given : $1 + x + x^2 + x^3 = 40$

$x = 3$. will satisfy, the equation

i.e. $1 + 3 + (3)^2 + (3)^3 = 40$

or $1 + 3 + 9 + 27 = 40$

132. Solving, $7 \times \frac{0.8}{4} + 24 - 2 = 7 \times 0.2 + 22$

$= 1.4 + 22 = 23.4.$

133. Solving, $\frac{0.0028 \times 1.5}{0.0056} = \frac{0.0042}{0.0056} = 0.75$

134. 1 2 3 5 7 11 13 17 19

+1 +1 +2 +2 +4 +2 +4 +2

Therefore, the next number will be 19.

135. This series shows that all number in increasing order. Therefore, number in blank space will be 13.

136. It is true that the selection of books by the readers generally reveal their temperament and character. Option 'c' is correct.

137. The most suitable title of the passage is "books are man's abiding friends". Option 'b' is correct.

138. According to passage, the statement—'We have sometimes to be patient with a book at it may bore us' is not true because a book having good knowledge and informations may sometimes bore but it may worth something. Option 'b' is correct.

139. The opposite meaning of adversity is prosperity.

140. According to passage a good book can be included among the best friends of mankind because it gives a good company and sometimes good suggestions. Option 'a' is correct.

144. 'Each' (a distributive pronoun) always takes singular form of verb like 'is'.

145. 'Has' is used to a singular subject without affecting the number of the verb.

146. 'Are' is used for two or more singular subjects.

147. 'Minor' means smaller or less important but 'major' means greater or full age. Therefore, 'd' is correct antonym.

148. 'Former' means first of the two things but 'latter' means second of the two things. Therefore, 'b' is correct antonym.

149. 'His' is a singular possessive adjectives, used with neither.

150. 'Who' is used as an interrogative pronoun.