ANSWERS

MATHEMATICS

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

PHYSICS

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

CHEMISTRY

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

INTELLIGENCE, LOGIC & REASONING

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

ENGLISH LANGUAGE & COMPREHENSION

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

EXPLANATIONS

1. If a, b ∈ R, a < b, then a < x < b

$\Leftrightarrow$ (x – a) (x – b) < 0,

Alternatively, $2 < x < 3$

$\Rightarrow$ $x - 2 > 0$ and $(x - 3) < 0$

$\Rightarrow$ (x – 2) and (x – 3) are of opposite sign

2. $Z^{69} = \left(\frac{\sqrt{3}+i}{2}\right)^{69}$

$= \left[\frac{1}{i}\left(\frac{-1+\sqrt{3}i}{2}\right)\right]^{69} = \left(\frac{w}{i}\right)^{69} = \frac{1}{i} = -i$

3. $|3z - 1| = 3\,|z - 2|,\ z = x + yi,\ x, y \in R$

$\sqrt{(3x-1)^2+(3y)^2} = 9x^2 + 9y^2 - 36x$

$\Leftrightarrow$ $30x = 35$

$\Rightarrow$ $x = \frac{7}{6}$

4. $(z + 1)(\bar{z} + 1) = (z + 1)\overline{(z+1)}$

$= |z + 1|^2$

5. When f(x) is divided by $x - \alpha$, the remainder $= f(\alpha)$

In this case, $\alpha = -2k$ and $f(x) = kx^2+1$

6. Since the coefficients of the equation one real, therefore, either both the roots are real or both are non real ; But

$4a + 2b + c = 0$

$\Rightarrow$ $a(2)^2 + b(2) + c = 0$

Hence 2 is a root of $ax^2 + bx + c = 0$

One root of the equation, $ax^2 + bx + c = 0$ is real.

$\therefore$ Both the roots of $ax^2 + bx + c = 0$ are real.

7. Given $x = 2 + \frac{1}{x}$

$\Rightarrow$ $x^2 - 2x - 1 = 0$

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

8. Given series is, $\frac{3}{(1\times 2)^2} + \frac{5}{(2\times 3)^2} + \frac{7}{(3\times 4)^2} + \ldots\ldots$

Its nth term $= \frac{3+(n-1)\times 2}{\{n(n+1)\}^2} = \frac{(n+1)^2 - n^2}{n^2(n+1)^2}$

$= \frac{1}{n^2} - \frac{1}{(n+1)^2}$

Sum of series $= \left(\frac{1}{1^2} - \frac{1}{2^2}\right) + \left(\frac{1}{2^2} - \frac{1}{3^2}\right) + \ldots\ldots + \left(\frac{1}{n^2} - \frac{1}{(n+1)^2}\right)$

9. Given sequence is, $2 + \frac{1}{3},\ 6 - \frac{1}{6},\ 10 + \frac{1}{12},\ 14 - \frac{1}{24}, \ldots\ldots$

Hence, the next term $= 18 + \frac{1}{18} = \frac{865}{48}$

10. $(666\ldots.6)^2 + (888\ldots\ldots8)$

$= (6 + 60 \ldots. + 600 \text{ upto n terms })^2 + (8 + 80 + 800 \ldots \text{ upto n terms})$

$= \left\{\frac{6(10^n - 1)}{10 - 1}\right\}^2 + \frac{8(10^n - 1)}{10 - 1}$

$= \frac{10^n - 1}{10 - 1}\left[\frac{36(10^n - 1)}{10 - 1} + 8\right] = \frac{4}{9}(10^{2n} - 1)$

11. ${}^nC_r$ is maximum for $r = \frac{n}{2}$ if n is even and for $r = \frac{n-1}{2}$ or $\frac{n+1}{2}$ where n is odd.

Now, ${}^{21}C_n = \frac{\lfloor 21}{\lfloor 21-n \lfloor n}$ is maximum, iff $\frac{21-1}{2}$,

i.e. when n = 10

12. We know, $\frac{{}^nC_r}{{}^nC_{r-1}} = \frac{n-r+1}{r}$

$\therefore$ ${}^nC_r \geq {}^nC_{r-1}$ only if $\left(\frac{n-r+1}{r}\right) \geq 1$

$\therefore$ $r = \frac{n}{2}$

13. We have two sets of parallel lines (inclusive of the parallelogram) each containing (n + 2) lines. A parallelogram is formed when a pair of parallel lines is selected from each set.

$\therefore$ Required number $= {}^{n+2}C_r \times {}^{n+2}C_r$

14. Let $(3\sqrt{3} - 5)^{2n+1} = f'$, a proper fraction, then

$(3\sqrt{3} + 5)^{2n+1} - (3\sqrt{3} - 5)^{2n+1} = p + f - f'$ must be an integer

$\Rightarrow$ $f = f'$

$\therefore$ $(p + f)\,f = (p + f)f'$

$= (3\sqrt{3} + 5)^{2n+1}\ (3\sqrt{3} - 5)^{2n+1}$

15. Let $(8+3\sqrt{7})^n = p + f$, where $p \in I$ and f is a proper fraction, and

let $(8-3\sqrt{7})^n = f'$, a proper fraction, as $0 < (8-3\sqrt{7}) < (8+3\sqrt{7})$,

Since $(8-3\sqrt{7})^n + (8-3\sqrt{7})^n = p + f + f'$ is an even integer.

Therefore, (p + 1) is even

16. $A = [aij]_{n \times n}$ is a diagonal matrix iff all non-diagonal entries are 0, i.e. iff aij = 0 for $i \neq j$

17. For AX = B has a unique solution only if det A $\neq 0$

18. $A^2 + I = 0$

$\Rightarrow A^2 = -1$

and for A $\begin{bmatrix} i & 0 \\ 0 & -1 \end{bmatrix}$, $A^2 = \begin{bmatrix} i & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} i & 0 \\ 0 & -e \end{bmatrix}$

$= \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$

19. $\frac{3+\cos 76°\cot 16°}{\cot 76° + \cot 16°}$

$= \frac{3\sin 76°\sin 16° + \cos 76°\cos 16°}{\cos 76°\sin 16° + \sin 76\cos 16°}$

$= \frac{2\sin 76°\sin 16° + \cos(76° - 16°)}{\sin(76° + 16°)}$

$= \frac{\cos 60° - \cos 92° + \cos 60°}{\sin 92°}$

$= \frac{1 - \cos 92°}{\sin 92°} = \tan 46°$

20. Given $(\tan^{-1}x)^2 + (\cot^{-1}x)^2 = \frac{5\pi^2}{8}$

$\Rightarrow (\tan^{-1}x + \cot^{-1}x)^2 - 2\tan^{-1}x\cot^{-1}x = \frac{5\pi^2}{8}$

$\Rightarrow \frac{\pi^2}{2} - 2\tan^{-1}x\left(\frac{\pi}{2} - \tan^{-1}x\right) = \frac{5\pi^2}{8}$

$\Rightarrow 2t^2 - \pi t - \frac{3\pi^2}{8} = 0$, where $t = \tan^{-1}x$

$\Rightarrow t = \frac{3\pi}{4}, -\frac{\pi}{4} \Rightarrow \tan^{-1}x = \frac{3\pi}{4}, -\frac{\pi}{4}$

$\Rightarrow x = \tan\frac{3\pi}{4}, \tan\left(-\frac{\pi}{4}\right)$

$\Rightarrow x = -1$

21. $\cos^2 x = \tan^2 y = \sec^2 y - 1 = \cot^2 z - 1$

$\Rightarrow (1 + \cos^2 x) = \frac{\tan^2 x}{1 - \tan^2 x}$

$\Rightarrow 1 + 1 - \sin^2 x = \frac{\sin^2 x}{\cos^2 x - \sin^2 x}$

$\Rightarrow (2 - \sin^2 x)(1 - 2\sin^2 x) = \sin^2 x$

$\Rightarrow \sin^2 x = \frac{6 - 2\sqrt{5}}{4} = \frac{4(\sqrt{5}-1)^2}{4} = 4\sin^2 18°$

$\Rightarrow \sin x = \pm 2\sin 18°$

22. $\cot(\alpha + \beta) = 0$

$\Rightarrow \cos(\alpha + \beta) = 0$

$\Rightarrow (\alpha + \beta) = (2n + 1)\frac{\pi}{2} = n\pi + \frac{\pi}{2}$

23. First find tan 2α, then tan 4α and then tan (4α – β)

$\tan 4\alpha = \frac{120}{119}$

$\tan(4\alpha - \beta) = \frac{\frac{120}{119} - \frac{1}{239}}{1 + \frac{120}{119}\cdot\frac{1}{239}} = 1$

24. $4\{x\} = x + [x]$

$\Rightarrow 4(x - [x]) = x + [x]$

$\Rightarrow 3x = 5[x]$

$\Rightarrow [x] = \frac{3x}{5}$,

which is satisfied only by $x = \frac{5}{3}, 0$

25. Here, $D_g = [-\sqrt{3}, \sqrt{3}]$ and $D_f = \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

Also $R_f = R$

$\Rightarrow R_f\ R_g = \psi$, therefore, gof is defined

and D_g of $= \{x \in D_f : f(x) \in D_g\}$

$= x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

$\tan x \in (-\sqrt{3}, \sqrt{3}) = \left(-\frac{\pi}{3}, \frac{\pi}{3}\right)$

26. Since, R.H.S. lies in $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$, therefore given statement is valid only, if

$-\frac{\pi}{2} < 3\tan^{-1}x < \frac{\pi}{2}$

i.e., if $-\frac{\pi}{6} < \tan^{-1} x < \frac{\pi}{6}$

i.e., if $\tan\left(-\frac{\pi}{6}\right) < x < \tan\left(\frac{\pi}{6}\right)$

i.e. if $-\frac{1}{\sqrt{3}} < x < \frac{1}{\sqrt{3}}$

27. Given equation is ,

$$\tan^{-1}\left(\frac{x-1}{x-2}\right) + \tan^{-1}\left(\frac{x+1}{x+2}\right) = \frac{\pi}{4}$$

$$\Rightarrow \quad \frac{x-1}{x-2} = \tan\left\{\frac{\pi}{4} - \tan^{-1}\left(\frac{x+1}{x+2}\right)\right\}$$

$$= \frac{1-\left(\frac{x+1}{x+2}\right)}{1+\left(\frac{x+1}{x+2}\right)} = \frac{1}{2x+3}$$

$$\Rightarrow \quad 2x^2 = 1$$

$$\Rightarrow \quad x = \pm\frac{1}{\sqrt{2}}$$

28. First, we note that y is defined only when $\frac{\pi^2}{9} - x^2 \geq 0$

i.e., when $|x| \leq \frac{\pi}{3}$

i.e., when $-\frac{\pi}{3} \leq x \frac{\pi}{3}$

For $-\frac{\pi}{3} \leq x \leq \frac{\pi}{3}$, $\frac{\pi^2}{9} - x^2$ takes values in $[0, \frac{\pi^2}{9}]$ and hence $\sqrt{\frac{\pi^2}{9} - x^2}$ takes values in $[0, \frac{\pi}{3}]$ so, y takes values in $\left[0, \frac{1}{\sqrt{3}}\right]$

29. When $x = 1$ $(x-1) \to 0$, $\Rightarrow \frac{1}{x-1} \to -\infty$

Hence $\frac{1}{2^{x-1}} \to 0$,

$$\Rightarrow \quad 2^{-2^{\frac{1}{x}-1}} \to 2^{\circ} = 1$$

30. $$\underset{x\to\frac{\pi}{4}}{\text{Lt}} \frac{2\sqrt{2} - (\sin x + \cos x)^3}{1 - \sin 2x}$$

$$= \underset{x\to 0}{\text{Lt}} \frac{2\sqrt{2}(1-\cos^2 h)}{2\sin^2 h}$$

$$= \underset{h\to 0}{\text{Lt}} \frac{\sqrt{2}\,(1-\cosh)}{\sin^2 h}(1 + \cos h + \cos^2 h)$$

$$= \underset{h\to 0}{\text{Lt}} \frac{\sqrt{2}}{1+\cos h}[1 + \cos h + \cos^2 h]$$

31. $\sin^{-1} x^n = 0$, $\sin^{-1} y^n = \phi$, we obtain,

$x^n = \sin\theta$,

$y^n = \sin\phi$, $\frac{\pi}{2} \leq 0, \phi \leq \frac{\pi}{2}$

$$\sqrt{1-\sin^2\theta} + \sqrt{1-\sin^2\phi} = a(\sin\theta - \sin\phi)$$

$$\Rightarrow \sin^{-1} x^n - \sin^{-1} y^n = 2\cot^{-1} a$$

Differentiate with respect to x we get

$$\frac{1}{\sqrt{1-x^{2n}}} n x^{n-1} - \frac{1}{\sqrt{1-y^{2n}}} n y^{n-1}\frac{dy}{dx} = 0$$

33. $$\underset{h\to 0}{\text{Lt}} \frac{f(x+h) - f(x-h)}{h}$$

$$= \underset{h\to 0}{\text{Lt}} \frac{\{f(x+h) - f(x)\} - \{f(x-h) - f(x)\}}{h}$$

$$= \underset{h\to 0}{\text{Lt}} \frac{f(x+h) - f(x)}{h} + \underset{h\to 0}{\text{Lt}} \frac{f(x-h) - f(x)}{-h}$$

$$= f'(x) + f'(x) = 2f'(x)$$

34. Let $\tan\frac{x}{2} = t$, then

$$dx = \frac{2t}{1+t^2}$$

$$\sin x = \frac{2t}{1+t^2}, \text{ and } \cos x = \frac{1-t^2}{1+t^2}$$

36. Put $\sin x - \cos x = t$, then

$(\sin x + \cos x)dx = dt$

and $(\sin x - \cos x)^2 = t^2 = 1$

$\Rightarrow$ $1 - 2\sin 2x = t^2$

37. Since $\int_2^4 3 - f(x)\,dx = 7$ therefore,

$$\int_2^4 3\,dx - \int_2^4 f(x)\,dx = 7$$

$$\Rightarrow \int_2^4 f(x)\,dx = \int_2^4 3dx - 7$$

$$\Rightarrow \int_2^4 f(x)\,dx = 6 - 7 = -1$$

Hence $\int_{-1}^4 f(x)\,dx = 4$

$$\Rightarrow \int_{-1}^2 f(x)\,dx + \int_2^4 f(x)\,dx = 4$$

38. $I = \int_0^a x\, f(x)\,dx$, then

$$I = \int_0^a (a-x)\, f(a-x)\,dx$$

$$\Rightarrow I = \int_0^a a(fa-x)\,dx - \int_0^a x\,f(a-x)\,dx$$

$$\Rightarrow I = \int_0^a a\,f(x)\,dx - \int_0^a x\,f(x)\,dx$$

$$\Rightarrow 2I = a\int_0^a fx\,dx$$

39. Required Area = $\frac{1}{2}|\vec{a} \times \vec{b}|$

40. $\vec{a} \cdot \vec{b} = |\vec{a}|\ |\vec{b}|$

$\Rightarrow \quad |\vec{a}|\ |\vec{b}| \cos\theta = |\vec{a}|\ |\vec{b}|$

$\Rightarrow \quad \cos\theta = 1$

$\Rightarrow \quad \theta = 0$

$\Rightarrow \quad \vec{a}$ and $\vec{b}$ are like parallel.

41. $\vec{a} \cdot \vec{b} = -|\vec{a}|\ |\vec{b}|$

$\Rightarrow \quad |\vec{a}|\ |\vec{b}| \cos\theta = -|\vec{a}|\ |\vec{b}|$

42. $\hat{a}.(\hat{a}+\hat{b}) = \hat{a}.\hat{a}+\hat{a}.\hat{b} = 1+\hat{a}.\hat{b}$ and $\hat{b}.(\hat{a}+\hat{b})$

$\hat{b}.\hat{a}+\hat{b}\hat{b} = \hat{a}.\hat{b}+1$

so $\hat{a}+\hat{b}$ will make equal angles will $\hat{a}$ and $\hat{b}$

43. $(\hat{a}+\hat{b}) \times (\hat{a}\times\hat{b}) = (\hat{a}.\hat{b}\times\hat{b}\hat{b})\ \hat{a}\ (\hat{a}.\hat{a}+\hat{b}.\hat{a})\hat{b}$

$= (\hat{a}.\hat{b}+1)\ (\hat{a}-\hat{b})$

= a scalar multiple of $\hat{a}-\hat{b}$

44. Given vectors are coplaner if $\begin{vmatrix} 1 & 1 & m+1 \\ 1 & 1 & m \\ 1 & -1 & m \end{vmatrix} = 0$

45. $\hat{i} \times (\vec{x} \times \hat{i}) + \hat{j} \times (\vec{x} \times \hat{j}) + \hat{k}(\vec{x} \times \hat{k})$

$= (\hat{i}.\hat{i})\vec{x} - (\hat{i}.\vec{x})\hat{i} + (\hat{j}.\hat{j})\vec{x} - (\hat{j}.\vec{x})\hat{j} + (\hat{k}.\hat{k})\ x - (\hat{k}.\vec{x}).\hat{k}$

$= 3\vec{x} - \vec{x} = 2\vec{x}$

46. Given, mass of the rockets, m = 5000 kg ; exhaust speed, v = 800 m/s

acceleration, a = 20 m/s²

Let $\frac{\Delta m}{\Delta t}$ is amount of gas per second,

Force = m(a + g)

$\frac{\Delta mu}{\Delta t} = m(a+g)$

$\frac{\Delta m}{\Delta t} \times 800 = m\ (a+g)$

$= 5000\ (10 + 20) = 5000 \times 30$

$\therefore \quad \frac{\Delta m}{\Delta t} = \frac{5000 \times 30}{800} = 187.5$ kg/sec

47. From the conservation of linear momentum, we have

$m_1v_1 + m_2v_2 = (m_1 + m_2)v$

$10 \times 10 + 5 \times 0 = (10 + 5)v$

$15v = 100$

$v = \frac{20}{3}$ m/s

48. Given, $m = 6 \times 10^{24}$,

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

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

Using the relation, we have

$F = mr\omega^2$

$= (6 \times 10^{24})\ (1.5 \times 10^{11})\ (2 \times 10^{-7})^2$

$= 36 \times 10^{21}$ N

49. Given, mass of the boy, m = 40 kg, energy in one bread = 21 kJ = 21 × 10³ J = 21000 J

efficiency of the boy = 28%; gravitational acceleration = 9.8 m/s²

When the efficiency of boy is 28%, then actual energy is consumed by the boy is given by

$0.28 \times 21000 = 5880J$ ...(i)

The energy consumed by the boy in climbing h metre is given by

$mgh = 40 \times 9.8 \times h$

$= 392\ h$ ... (ii)

Now after equating these two values of energies from equations (i) and (ii), we get

$392\ h = 5880$

$\therefore \quad h = \frac{5880}{392} = 15$ m

50. Acceleration due to gravity at a height

$g_h = \frac{g_e}{2}$

(where g_e is acceleration due to gravity at the surface of the earth)

Radius of earth R = 6400 km

Acceleration due to gravity at a height is given by

$g_h = g_e\left(1 - \frac{2h}{R}\right)$

or $\quad \frac{g_e}{2} = g_e\left(1 - \frac{2h}{R}\right)$

(where h is the height from the surface of earth)

or $\quad \frac{1}{2} = 1 - \frac{2h}{6400}$

or $\quad \frac{h}{3200} = 1 - \frac{1}{2} = 0.5$

$h = 3200 \times 0.5$

$= 1600$ km

51. Given, $F = Kr^{-5/2}$

But $F = \frac{dU}{dr}$

$$-\frac{dU}{dr} = Kr^{-5/2}$$

$$\frac{dU}{dr} = Kr^{-5/2}$$

$$dU = -Kr^{-5/2}dr$$

$$U = \frac{2}{3}Kr^{-3/2}$$

$$U \propto r^{-3/2}$$

52. Angular momentum,

$$L = pR_o = (mv_o)\,R_o$$

$$= m\left(\sqrt{\frac{GM}{R_o}}\right)R_o \quad \left[\because v_o = \sqrt{\frac{GM}{R_o}}\right]$$

$\therefore$ $L = m\sqrt{GMR_o}$

53. As we know that, $P = \frac{4T}{r}$

and $V = \frac{4}{3}\pi r^3$

Thus $PV = \left(\frac{4T}{r}\right)\frac{4}{3}\pi r^3 = \frac{16\pi Tr^2}{3}$

$$P\,V \propto r^2$$

54. Given, mass of the body, m = 200 gm = 0.2 kg, height, h = 200 m, g = 10 m/s²

$\therefore$ Potential energy of the body is given by

$$\Delta U_p = mgh$$

$$= 0.2 \times 10 \times 200 = 400J$$

55. Velocity at the top = 200 cos 60° = 100 m/s

Now applying the law of conservation of linear momentum we find that the particles going upwards and downwards should have equal momentum.

Thus, the initial momentum of the composite particle is transferred to the third particle.

$\Rightarrow$ $m \times 100 = \frac{m}{3} \times v$

Hence, $v = 300$ m/s

56. Moment of inertia, $I = \frac{1}{2}mR^2$

$$= \frac{1}{2} \times 0.5 \times (0.1)^2$$

$$= 2.5 \times 10^{-3}\ \text{kg m}^2$$

57. Given, initial velocity u = 0, distance travelled, s = 120 cm = 1.2 m,

number of second, n = 8

$\therefore$ The distance travelled by the body is given by

$$s_n = ut + \frac{a}{2}(2n-1)$$

$$1.2 = 0 + \frac{a}{2}(2 \times 8 - 1)$$

$$1.2 = \frac{15a}{2}$$

$\therefore$ $a = \frac{1.2 \times 2}{15} = 0.16\ \text{m/s}^2$

58. Given, depth of lake = 200 m, decrease in volume of ball = 0.1 %

$\therefore$ Bulk modulus is given by

$$B = \frac{\Delta p}{\frac{\Delta V}{V}} = \frac{h\rho g}{\frac{0.1}{100}} = \frac{200 \times 10^3 \times 9.8}{\frac{1}{1000}}$$

$$= 200 \times 10^3 \times 9.8 \times 10^3$$

$$= 19.6 \times 10^8\ \text{N/m}^2$$

59. Given, height of the fall = 500 m, specific heat of water, c = 4.2 kJ/kg,

$\therefore$ Potential energy = Heat increased in water

$$mgh = mc\,\Delta\theta$$

$$\Delta\theta = \frac{gh}{c} = \frac{9.8 \times 500}{4.2 \times 10^3} = 1.16°C$$

60. Frequency of closed organ pipe is half that of open organ pipe

$$n_{close} = \frac{n_{open}}{2}$$

When open pipe is dipped in water upto half its length, then it will behave like a close pipe of half length.

Frequency of pipe is inversely proportional to its length.

$\therefore$ New frequency, $n' = 2 \times \frac{n_{open}}{2} = n_{open}$

$\Rightarrow$ frequency remains same. or $f = f'$

61. Given, frequency f = 500 Hz, velocity v = 350 m/s, phase ϕ = 60°

By the formula, $\lambda = \frac{v}{f} = \frac{350}{500} = 0.7$ m

Also we know that $\Delta x = \Delta\phi\frac{\lambda}{2\pi}$

$$= 60 \times \frac{\pi}{180} \times \frac{0.7}{2\pi}$$

$$\approx 0.12\ \text{metre} \approx 12\ \text{cm}$$

62. From de-Broglie theory the wavelength

$$\lambda = \frac{\text{Plancks constant}}{\text{Momentum}}$$

hence, if m momentum is doubled, then de-Broglie will be halved.

63. Given, frequency of wave, n = 100 Hz,

distance $= \frac{\lambda}{2} = 10$ cm

$\Rightarrow \lambda = 20$ cm

From the formula, we have

$$v = n\lambda = 100 \times 20$$
$$= 2000 \text{ cm/sec} = 20 \text{ m/s}$$

64. Given, velocity of source, $v' = 40$ km/hr, actual frequency of sound, $\nu = 2000$ Hz,

velocity of sound, $v = 1220$ km/hr

From the Doppler's effect, when the source is travelling towards the observer, then apparent frequency is given by

$$\nu' = \left(\frac{v}{v - v'}\right) \times \nu$$
$$= \frac{1220}{(1220 - 40)} \times 2000$$
$$= 2067.77 \text{ Hz} \approx 2068 \text{ Hz}$$

65. Given, magnitude of the first vector, $\vec{A} = 3$, magnitude of the second vector, $\vec{B} = 5$ and angle between them, $\theta = 60°$

The dot products of two vectors is given by

$$\vec{A}.\vec{B} = A\ B \cos\theta$$
$$= 3 \times 5 \cos 60°$$
$$= 15 \times 0.5 = 7.5$$

66. As we know, Torque = force × distance

Hence, dimensions of torque

= dimensions of force × dimensions of distance

$= [MLT^{-2}]\,[L] = [ML^2T^{-2}]$

67. Given, length of the rod, $l = 20$ cm = 0.2 m, frequency, $\nu = 4000$ Hz,

∴ Length of the rod, $L = 0.2 = \frac{\lambda}{2}$

or $\lambda = 02 \times 2 = 0.4$ m

Hence, the velocity of sound in gas is given by

$$v = \nu \times \lambda$$
$$= 4000 \times 0.4$$
$$= 1600 \text{ m/s}$$

68. Given, critical angle, C = 30°

According to law of total internal reflection,

$$\frac{\text{Velocity of light in medium}}{\text{Velocity of light in air}} = \sin C$$

$$\frac{\text{Velocity of light in medium}}{\text{Velocity of light in air}} = \sin 30°$$

Thus, velocity of light in medium

= velocity of light in air × 0.5

$= (3 \times 10^8) \times 0.5 = 1.5 \times 10^8$ m/s

69. Given, mass of the planet.

$M_p = \frac{M_e}{9}$ (where M_e is the mass of earth)

Radius of the planet,

$R_p = \frac{R_e}{2}$ (where R_e is the radius of the earth)

Weight of body on the earth, $w_e = 450$ N

According the law of gravitation the weight of the body (or force of gravity)

$$w = \frac{GMm}{R^2} \propto \frac{M}{R^2}$$

Hence, $\frac{w_e}{w_p} = \frac{M_e}{M_p} \times \left(\frac{R_p}{R_e}\right)^2$

(where w_p is the weight on the planet)

or $\frac{450}{w_p} = \frac{M_e}{\frac{M_e}{9}} \times \left(\frac{\frac{R_e}{2}}{R_e}\right)^2$

$$w_p = \frac{450 \times 4}{9} = 200 \text{ N}$$

70. Let the temperature of the mixture be θ

∴ Heat given by oxygen

$= nC_v(T_1 - \theta)$

$= \frac{16}{32}\left(\frac{5R}{2}\right)(37° - \theta)$

Heat received by nitrogen

$= nC_v(\theta - T_2)$

$= \frac{14}{28}\left(\frac{5R}{2}\right)(\theta - 27°)$

But $\frac{16}{32}\left(\frac{5R}{2}\right)(37° - \theta) = \frac{14}{28}\left(\frac{5R}{2}\right)(\theta - 27°)$

Thus $37° - \theta = \theta - 27°$

$2\theta = 64°$

$\theta = 32°$ C

71. In the system, where $\Delta Q = 0$ it means no heat enters or leaves in a system during the process. This process is called *adiabatic process.*

72. If constant pressure, $\frac{V'}{V} = \frac{T'}{T}$

$$\frac{2V}{V} = \frac{T'}{T}$$

$$T' = 2T$$

$$\Delta T = T' - T$$

$$= 2T - T = T$$

$$\Delta U = \mu C_v \Delta T$$

$$1\left(\frac{R}{\gamma-1}\right)T = \frac{RT}{\gamma-1} = \frac{PV}{\gamma-1}$$

73. According to Stefan's law the total radiant energy.

$$Q = CA\sigma T^4 t$$

$$R \propto T^4$$

Hence, $\frac{Q_2}{Q_1} = \left(\frac{T_2}{T_1}\right)^4$ ...(i)

$\because \frac{Q_2}{Q_1} = 2$ and $T_1 = 727 + 273 = 1000$ K

From equation (i), $2 = \left(\frac{T_2}{1000}\right)^4$

$$2^{1/4} = \frac{T_2}{1000}$$

$$T_2 = 1000 \times (2)^{1/4}$$

$$= 1000 \times 1.19 = 1190 \text{ K}$$

74. Gain in kinetic energy = work

But work = Fs cos θ

$$= (q E) (y) \cos 0 = qEy$$

75. Let four capacitors are connected in parallel capacitance of each capacitor = C

$$C = 25 \times 10^{-6} \text{ farad}$$

$$V = 200 \text{ volt}$$

∴ Charge on each capacitor,

$$Q = CV$$

$$= 25 \times 10^{-6} \times 200$$

$$= 5 \times 10^{-3} \text{ coulomb}$$

76. The power of heater is given by,

$$P = \frac{V^2}{R} = \frac{(110)^2}{10}$$

$$= \frac{12100}{10} = 1210 \text{ W}$$

77. As we know, $dW = \int_0^{\theta} MH\sin\theta\, d\theta$

$$= [MH(-\cos\theta)]_0^{\theta}$$

$$= MH(1 - \cos\theta)$$

$$= MH(1 - \cos\theta)$$

78. Heat produced is resistance of wire

$$= 20\ \Omega \text{ voltage}$$

$$V = 210 \text{ V}$$

$\Rightarrow$ Heat produced, $H = \frac{V^2}{R} \times t = \frac{(210)^2}{20} \times 1$

∴ Heat required for ice to melt = mL

But $\frac{(210)^2}{20} \times 1 = mL$

$$\frac{(210)^2 \times 1}{20} = m \times 80 \times 4.2$$

Hence, $m = \frac{(210)^2}{20 \times 80 \times 4.2}$

$$= 6.56 \text{ g/s}$$

79. The internal resistance are connected in parallel so the equivalent resistance is

$$r_{eq} = \frac{1\times 1}{1+1} = \frac{1}{2} = 0.5$$

Now, current passing through R is

$$i = \frac{E}{R+r} = \frac{2}{0.5+0.5} = 2 \text{ amp}$$

Power is given by

$$P = i^2 R = (2)^2 \times 0.5$$

$$= 4 \times 0.5 = 2 \text{ W}$$

80. For a thin prism, deviation $D = (\mu - l)A$

When the prism is placed in air, then

$$D_a = ({}^a\mu_g - 1)A$$

$$= \left(\frac{3}{2} - 1\right)A = \frac{A}{2} \quad ...(i)$$

When the prism is dipped in water, then

$$D_w = ({}^w\mu_g - 1)A = \left[\frac{{}^a\mu_g}{{}^a\mu_w} - 1\right]A$$

$$= \left(\frac{\frac{3}{2}}{\frac{4}{3}} - 1\right)A = \left(\frac{9}{8} - 1\right)A$$

$$= \frac{A}{8} \quad ...(ii)$$

Therefore, $\frac{D_w}{D_a} = \frac{\frac{A}{8}}{\frac{A}{2}} = \frac{1}{4}$

81. According to Bohr's theory, velocity of the electron in the innermost orbit is highest.

82. Limit of resolution of telescope

$$= 122\frac{\lambda}{d} = \frac{122 \times 6000 \times 10^{-10}}{5} \text{ radian}$$

$$= \frac{1.22 \times 6 \times 10^{-7}}{5} \times \frac{180}{\pi} \times 60 \times 60 \text{ sec}$$

$= 0.03$ second

83. As we know, energy of photo electrons,

$$E = h\nu = \frac{hc}{\lambda}$$

$$E = \frac{(6.6 \times 10^{-34})(3 \times 10^{8})}{(5000 \times 10^{-10})}$$

$$= \frac{19.8 \times 10^{-19}}{5} \text{ joule}$$

$$= \frac{19.8 \times 10^{-19}}{5 \times 1.6 \times 10^{-19}} \text{ eV}$$

$$= \frac{19.8}{8} = 2.48 \text{ eV}$$

Now, $$h\nu = \phi + \frac{1}{2} mv^2_{max}$$

$$\Rightarrow \quad \frac{1}{2} mv^2_{max} = h\nu - \phi$$

$$= 2.48 - 1.9 = 0.58 \text{ eV}$$

84. Radius R of a nucleus changes with nucleon number A of the nucleus as

$$R = 1.3 \times 10^{-15} A^{1/3} \text{ m}$$

Hence, $$\frac{R_2}{R_1} = \frac{A_2^{1/3}}{A_1^{1/3}}$$

$$\Rightarrow \quad \frac{R_2}{R_1} = \left(\frac{32}{4}\right)^{1/3} = (8)^{1/3}$$

$$\Rightarrow \quad \frac{R_2}{R_1} = 2$$

Therefore, radius of sulphur nucleus is larger than that of helium by factor of 2.

85. Given, $\alpha = 0.95$, $\Delta I_E = 100$ mA

$$\frac{\Delta I_c}{\Delta I_E} = 0.95$$

$$\frac{\Delta I_c}{100} = 0.95$$

$$\Delta I_c = 100 \times 0.95$$

$$= 95 \text{ mA}$$

86. In the structure of graphite, electrons are spread out between the structure. In graphite carbon atom is sp^2 hybridised and has a delocalised π-electron cloud.

87. First of all the technique of electroplating was given by Faraday.

88. Vitamins are essential for body for normal growth and health. There are two types of vitamins fat soluble and water soluble. Fat soluble vitamins are stored in the body while water soluble can't stored. Therefore, water soluble vitamins like vitamin B-complex and vitamin C are required daily.

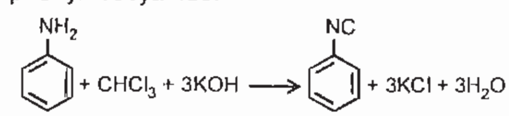
89. Primary amine and carbon disulphide on heating with mercuric chloride produce isothiocyanate. This reaction is known as mustard oil reaction.

$$R{-}NH_2 + CS_2 + HgCl_2 \xrightarrow{\text{Heat}} R{-}NCS + 2HCl + HgS$$

alkyl isothiocyanate
(smell of mustard oil)

90. Hydrogen have + 1 and –1 oxidation state. This is the correct statement regarding hydrogen.

91. Aniline, chloroform and KOH reacts to produce phenyl isocyanide.



Aniline Phenyl isocyanide

This reaction is known as carbylamine reaction.

92. Aromatic hydrocarbons although contains double bond but they do not undergo addition reactions. They undergo electrophilic substitution reaction like nitration, sulphonation, halogenation etc. It is due to the presence of π electron clouds above and below the plane of aromatic hydrocarbon, the ring serves as a source of electrons therefore an electrophile attack the ring.

93. We know that, atomic number (z)

= number of proton = number of electron

89 = 89 = 89

Mass number (A) = number of proton + number of neutron

$\therefore$ Number of neutron = mass number – number of proton

$= 231 - 89 = 142$

∴ Number of proton = 89, and
Number of neutron = 142
Number of electron = 89

94. He_2 cannot be formed because He is a monoatomic gas and it can be represented as He. After removing one electron it becomes He^{+} and after removing both the electrons it becomes He^{+2}.

95. Some crystals have permanent alignment of dipoles even in the absence of electric field. When electric field is applied, then the direction of polarisation of ions is altered. Such crystals are known as ferroelectric.

The ferroelectric crystals are $BaTiO_3$ and sodium potassium tartarate.

96. In this reaction substitution takes place. Therefore, it is substitution reaction.

97. Synthesis of ammonia by Habers' process takes place at high pressure, low temperature and in presence of a catalyst.

98. We know that $\frac{V_1}{V_2} = \frac{T_1}{T_2}$

Here, $V_1 = 0.2$ litre, $T_1 = 0°C$, $T_2 = 273°C$, $V_2 = ?$

$$\therefore \quad V_2 = \frac{T_2 V_1}{T_1} = \frac{0.2 \times 546}{273}$$

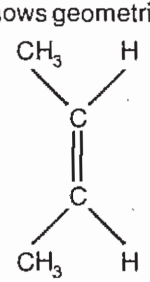
$$= 0.4 \text{ lit}$$

99. In gas equation PV = nRT, P and V represent pressure and volume of one mole of gas, respectively and n is the number of moles of gas. Hence, the incorrect statement is n is the number of molecules of gas.

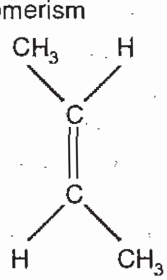
100. Geometrical isomerism is the isomerism shown by isomers having same structural formula but different spatial arrangements of atoms or groups about

>C = C<, > C = N–, –N = N– bonds.

Hence, 2-butene, $CH_3 - CH = CH - CH_3$ shows geometrical isomerism



cis-2-butene



trans-2-butene

101. First law of thermodynamics states that energy can neither be created nor destroyed or the total energy of universe is constant.

i.e., $\Delta E = Q + W$.

102. Cyanide and isocyanide both have same molecular formula but different structural formula.

$R - C \equiv N$ $R - N \equiv C$

Alkyl cyanide   Alkyl isocyanide

They differ due to the different functional groups.

103. We know that the configuration of Fe is as follows

$_{26}Fe : 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^6, 4s^2$

$Fe^{+2} : 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^6$

104. $C + O_2 \longrightarrow CO_2$

∵ 12 gm carbon requires O_2 = 22.4 lit

∴ 1000 gm carbon requires O_2

$$= 22.4 \times \frac{1000}{12}$$

$$= 1866.67 \text{ lit}$$

∵ O_2 is 1/5th part of air

∴ Volume of air = 5 × Volume of O_2

= 5 × 1866.67

= 9333.35 litre

105.

	A	+	B	⇌	2C
Initial moles	2		3		0
equilibrium moles	(2 – x)		(3 – x)		2x

Suppose volume of container is V litre.

$$\therefore \quad K_c = \frac{[C]^2}{[A][B]} = \frac{(2x/V)^2}{[(2-x)/V][(3-x)/V]}$$

$$\text{or} \quad 4 = \frac{4x^2}{(2-x)(3-x)}$$

$$\therefore \quad x = 12$$

∴ Moles of carbon at equilibrium

= 2x = 2 × 12 = 2.4

106. Heavy water is D_2O, it is deuterium oxide. It is used as moderator in nuclear reactors.

107. The alkylation or acylation of aromatic hydrocarbon is presence of anhydrous $AlCl_3$ is known as Friedel craft's reaction.

108. $F_2C = CF_2$ is a monomer of Teflon.

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

Ethyl alcohol   Chloral

110. Semi-conductors are those solids which are perfect insulators at absolute zero but conduct electric current at room temperature. Silicon (Si) and Germanium (Ge) are semi-conductors.

111. The electronegative character of halogens is

$$F > Cl > Br > I$$

Therefore, F is the most electronegative atom among halogens.

Among alkali metals the electropositive character increases in the order

$$Li < Na < K < Rb < Cs$$

Therefore, LiF is the most stable compound.

112. We know the molecular weight,

$$m = \frac{100 \times K_f \times w}{\Delta T_f \times W}$$

where K_f = molecular depression constant
= 50.2°C per 100 gm
w = weight of compound = 0.750 gm,
ΔT_f = lowering of freezing point of solvent
= 0.502°C and
W = weight of solvent = 25 gm

$$\therefore \quad m = \frac{100 \times 50.2 \times 0.750}{0.502 \times 25} = 300$$

113. Iodoethane reacts with sodium in presence of dry ether as

$$C_2H_5\boxed{I + 2Na + I}C_2H_5 \xrightarrow[-2NaI]{\text{dry ether}} C_2H_5 - C_2H_5$$

Butane

114. The gas is expanded isothermally. Therefore, T is constant.

Hence, $\Delta T = 0$

When ΔT is zero, then ΔE is also zero.

115. $C_6H_5CH_2Cl + NaOH \rightarrow NaCl + C_6H_5\ CH_2OH$

Benzyl chloride Benzyl alcohol

$NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$

white ppt.

Therefore, compound A is identified as benzyl chloride.

116. $CH_3 - CH = NOH \xrightarrow[(-HCl)]{P_2O_5} CH_3C \equiv N$

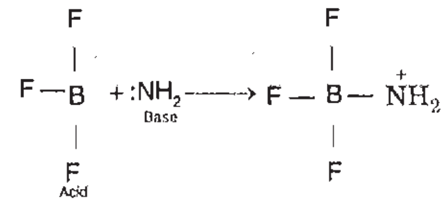
Acetaldoxime Methyl cyanide

Hence, acetaldoxime dehydrate with P_2O_5 to produce methyl cyanide.

117. In presence of nickel catalyst, hydrogen gas is used for hydrogenation of oils.

118. BF_3 is known as Lewis acid.

According to Lewis definition, an acid is a substance that can accept an electron pair.



BF_3 accepts a lone pair of electron therefore it is Lewis acid.

119. Picric acid is 2,4, 6-trinitrophenol. Therefore, it does not have any —COOH group.

120. The electronic configuration of bromine atom is

$$1s^2,\ 2s^2\ 2p^6,\ 3s^2\ 3p^6\ 3d^{10},\ 4s^2\ 4p^5$$

Hence, total number of electrons in p-orbitals

$$= 6 + 6 + 5 = 17.$$

121. We know that $CaCO_3 \xrightarrow{\text{Heat}} CaO + CO_2$

100 gm 22.4 lit at STP

$\because$ 100 gm $CaCO_3$ 22.4 lit CO_2 at STP

$$\therefore \text{ 20 gm } CaCO_3 \text{ produce } CO_2 = \frac{22.4 \times 20}{100}$$

$$= 4.48 \text{ lit}$$

122. Plaster of Paris is $CaSO_4 \cdot \frac{1}{2}H_2O$

123. We know that $PV = nRT$

$$\therefore \quad P = \frac{nRT}{V} = \frac{2 \times 0.0821 \times 546}{44.8}$$

$$= 2.00 \text{ atm.}$$

124. $CH_3COOH \xrightarrow{Br_2/P} BrCH_2COOH \xrightarrow{KCN}$

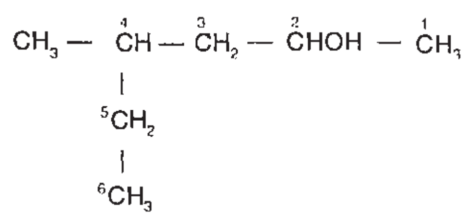
$NC—CH_2COOH \xrightarrow{H_2O}$

$HOOCCH_2COOH$

Malonic acid

Therefore, malonic acid is formed.

125. The IUPAC name of



This is 4-methyl-2-hexanol.

129. In the given series, each successive number is obtained by adding 110 to the previous number.

125 → 235 → 345 → 455 (+110, +110, +110)

Therefore, the next number will be

345 + 110 = 455

130. In the given series, each successive number is obtained by adding 23, 24 and 25 to the previous number respectively

138 → 161 → 185 → 210 → 236 (+23, +24, +25, +26)

Therefore, the next number will be 210 + 26 = 236

131. In the set of five alphabets, the middle one is different with remaining four. Therefore, the series will be as follows.

ccdcc, ddcdd, ccdcc, ddcdd.

132. In the set of three alphabets, is in repairing itself continously. Therefore, complete series' will be as follows.

klmnklmnklmn

133. Given, $m + \frac{1}{m} = 4.$

Therefore, $\left(m + \frac{1}{m}\right)^2 = (4)^2$

As we know, $(a + b)^2 = a^2 + b^2 + 2ab$

$$m^2 + \frac{1}{m^2} + 2m \times \frac{1}{m} = 16$$

$$m^2 + \frac{1}{m^2} = 16 - 2 = 14$$

134. As we know, Area (A) = 25 hectares

= 25 × 10,000

= 2,50,000 meter

Speed (v) = 10 km/hr.

∴ Side of Square = $\sqrt{\text{Area}}$

= $\sqrt{250,000}$

= 500 metre

Distance for which the boy will run

= 4 × 500

= 2000 m = 2 km.

∴ Time taken by the boy

$= \frac{\text{Distance}}{\text{Speed}} = \frac{2}{10}$ hr.

135. Given,

Price of $\frac{17}{18}$ of the article = Rs. 850

Price of 1 of the article = $850 \times \frac{18}{17}$ = ₹ 900

Price of $\frac{3}{5}$ of the article = $900 \times \frac{3}{5}$ = ₹ 540