ANSWERS WITH DETAIL SOLUTIONS OF SAMPLE PAPER

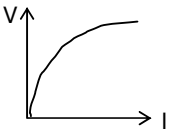
PHYSICS

1. **Ans:** 14.4 V.

2. **Ans:** 50 watt.

3. **Ans:** 55.55 cm **Reason:** Let AC = l
Current in the upper circuit
$i = \frac{E_1}{r_1 + R_{AB}} = \frac{10}{9+1} = 1A$
Now $E_2 = V_{AC}$ or 5 = (i) R_{AC}
$= (i)\left(\frac{R_{AB}}{100}\right)l = (1)\frac{(9)}{100}l$
$\therefore l = \frac{500}{9}cm = 55.55$ cm

4. **Ans:** 1 **Reason:** For incident electron
$\lambda_1 = \frac{h}{p} = \frac{h}{\sqrt{2Km}} = \frac{h}{\sqrt{2mVe}}$
and shortest wavelength of X-rays is $\lambda_2 = \frac{hc}{Ve}$
$\therefore \frac{\lambda_1}{\lambda_2} = \frac{1}{c}\sqrt{\left(\frac{V}{2}\right)\left(\frac{e}{m}\right)}$
substituting the values, we get $\frac{\lambda_1}{\lambda_2} = 1$

5. **Ans:**


6. **Ans:** 5.

7. **Ans:** 14.28% **Reason:** Initial angular momentum
$L = \frac{2}{5}Mr^2\left(\frac{V_0}{2r}\right) + MrV_0 = \frac{6}{5}MrV_0$ .....(1)
The angular momentum about A is $= \frac{2}{5}Mr^2\left(\frac{V}{r}\right) + MrV$
$= \frac{7}{5}MrV$ .....(2)
$V = \frac{6}{7}V_0 = \left[\frac{V_0 - \frac{6}{7}V_0}{V_0}\right]\times 100$
$= \frac{1}{7}\times 100 = 14.28\%$

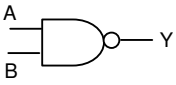
8. **Ans:** 2 : 1 **Reason:** $P = \frac{1}{3}\frac{mn}{V}C^2$ or $n = \frac{3PV}{mC^2}$
$\frac{n_1}{n_2} = \frac{2\times 2}{2} = \frac{2}{1}$

9. **Ans:** nRT **Reason:** Since temperature remains unchanged therefore $U_f = U_i$. So, $\Delta Q = \Delta W$. In the first step which is isochoric, $\Delta W = 0$. In second step, pressure $= \frac{P}{n}$. Volume V is increased from V to nV.
$\therefore W = \frac{P}{n}(nV - V) = PV\left(\frac{n-1}{n}\right) = RT(1 - n^{-1})$

10. **Ans.** If both A and R are true but R is not the correct explanation of A.

11. **Ans.** 2 cm. **Reason :**
$r = \frac{mv}{\sin\theta qB} = \frac{3\times 10^5}{1/2\times 10^8 \times 0.3} = 2cm$

12. **Ans.** $\frac{\omega L}{R}$. **Reason :** $Q = \omega L/R$

13. **Ans.** NAND. **Reason :** $Y = \overline{AB} =$


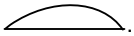
14. **Ans.** If both A and R are true and R is the correct explanation of A.

15. **Ans.** 6 :10. **Reason :** $r = R_0 A^{1/3}$

16. **Ans.** 5 m s^{-2} along Y-axis

17. **Ans.** It will go upward with speed 100 m/s. **Reason :** $m_1v_1 + m_2v_2 = (m_1 + m_2)v$

18. **Ans.** $\cot\alpha = 3$

19. **Ans.**  . **Reason :** Air streams have to cover a larger distance above the surface as compared to the air streams below the surface. So, velocity above the surface is large and consequently the pressure is less. On the other hand, velocity below the surface is small an consequently the pressure is large. This explains maximum upthrust in figure.

20. **Ans.** 8.1 m/s

21. **Ans.** 9.1 m/s

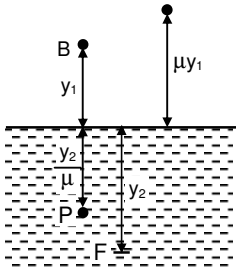
22. **Ans.** 10.2 m/s

23. **Ans.** Three. **Reason :** $y = \frac{4}{2}\left[2\cos^2\left(\frac{t}{2}\right)\right]\sin(1000\ t)$
or y = 2(1 + cos t) sin 1000 t, or y = 2 sin 1000 t + 2 sin 1000 t cos t, or y = 2 sin 1000 t + sin (1001 t) + sin (999 t). So, the given expression is a result of the superposition of three independent harmonic motions.

24. **Ans.** $\frac{S_1+S_2}{S_1-S_2}$. **Reason :** Distance as estimated by the bird, $S_1 = y_1 + \frac{y_2}{\mu}$. Distance as estimated by the fish, $S_2 = y_2 + \mu y_1$.

Now $\frac{S_1}{S_2} = \frac{y_2+\mu y_1}{y_1+\frac{y_2}{\mu}}$

or $\frac{S_2}{S_1} = \frac{\mu y_2+\mu^2 y_1}{\mu y_1+y_2}$ or $\mu = \frac{S_2}{S_1}$.



25. **Ans.** 25 : 4. **Reason :** $\frac{I_{max}}{I_{min}} = \left(\frac{a_1+a_2}{a_1-a_2}\right)^2 = \frac{49}{9}$

$\Rightarrow \frac{a_1+a_2}{a_1-a_2} = \frac{7}{3}$. $a_1 = 5$ and $a_2 = 2$.

$\frac{I_1}{I_2} = \left(\frac{a_1}{a_2}\right)^2 = \left(\frac{5}{2}\right)^2 = \frac{25}{4}$

26. **Ans.** $3P_1V_1$. **Reason :** Work done = $3P_1V_1$

27. **Ans.** 99°C, 37°C. **Reason :**

$n = \frac{1-T_2}{T_1} \Rightarrow 2n = \frac{T_1-(T_2-62)}{T_1}$

28. **Ans.** $\frac{2}{3}\lambda m$. **Reason :** $\lambda_m \times T$ = Const. (Wein's displacement Law)

29. **Ans.** $\frac{mgR}{B^2l^2}$

30. **Ans.** All the remaining three.

CHEMISTRY

31. **Ans:** 72. **Reason:**

$\frac{r_x}{r_{H_2}} = \sqrt{M_{H_2}/M_x}, \frac{1}{6} = \sqrt{\frac{2}{M_x}}, M_x = 72$

32. **Ans:** 2a pm. **Reason:** Length of the edge of NaCl unit cell = 2 × distance between Na^+ and Cl^-.

33. **Ans:** y will be doubled but z will remain same. **Reason:** When intensity is doubled, number of electrons emitted per second is also doubled but average energy of photoelectrons emitted remains the same.

34. **Ans:** close to 125 ml but not exceed 125 ml. **Reason:** For non-ideal solution, 100 ml + 25 ml is nearly 125 ml but not exactly 125 ml.

35. **Ans:** – 25 kJ. **Reason:** $\Delta H = H_P - H_R$.

36. **Ans:** 4. **Reason:** At eqm. $\underset{a}{A} + \underset{a}{B} \rightleftharpoons \underset{2a}{C} + \underset{2a}{D}$

$K = \frac{2a \times 2a}{a \times a} = 4$.

37. **Ans.** +57.27 kJ/mol **Reason :** $H^+ + OH^- \rightarrow H_2O$; $\Delta H = -13.7 \times 4.18$ kJ.

38. **Ans.** 25mL acid + 25mL alkali **Reason :** 25 Meq. of acid and 25 Meq. of alkali reacts to give $\frac{13.7\times25}{1000}$ kcal heat

39. **Ans.** CH_4 **Reason :** Best fuel is CH_4 as its calorific value = $\frac{890}{16}$ = 55.63 kJ.

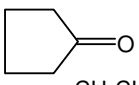
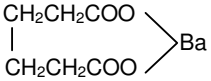
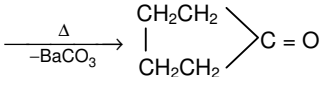
40. **Ans:** $CH_3C \equiv CH + 2\,HBr \rightarrow$ **Reason:** $CH_3C \equiv CH + 2HBr \rightarrow CH_3C(Br)_2\,CH_3$

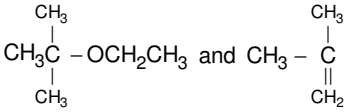
41. **Ans:** $CH_3 —(CH_2)_3 —O— CH_2 — CH_3$ **Reason:** $CH_3CH_2CH = CH_2 \xrightarrow{HBr} CH_3CH_2CH_2\ CH_2Br \xrightarrow{C_2H_5ONa} CH_3CH_2CH_2CH_2\ OCH_2CH_3$

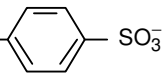
42. **Ans:** MgO. **Reason:** Lattice energy increases as the charge on the ions increases. Thus MgO with +2 charge on Mg and -2 charge on O has the highest lattice energy.

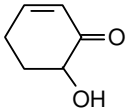
43. **Ans:** If both A and R are true and R is the correct explanation of A

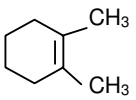
44. **Ans:** HCl is strong acid and C_2H_5OH is weak base **Reason:** Weak base reacts with strong acid.

45. **Ans:**  **Reason:** 


46. **Ans:** 

47. **Ans:** 

48. **Ans:** 

49. **Ans:** 

50. **Ans:** $LiAlH_4$ **Reason:** $LiAlH_4$ reduces esters and aldehydes to alcohol.

51. **Ans:** salicylic acid, salol, aspirin and oil of winter – green

52. **Ans:** hydrogen bonds

53. **Ans:** both A and R are true and R is the correct explanation of A. **Reason:** Due to the presence of $-NH_2$ group in amides there is stronger H-bonding between the amide molecules than between the acid molecules.

54. **Ans:** C > Be > B > Li. **Reason:** The four elements (Li, Be, B and C) belong to the 2nd period. As we go form Li → Be, IE_1 increases due to smaller size and increased nuclear charge. The IE_1 of B is however, lower than that of Be because in B a 2p – electron is to be removed while in Be a 2s – electron is to be removed. The IE_1 of C is however, higher than those of B and Be due to increased nuclear charge. Thus, the overall order is : C > Be > B > Li.

55. **Ans:** 1 cm^3 of the solution liberates 30 cm^3 of O_2 at STP.

56. **Ans:** Cs > Rb > K > Na > Li. **Reason:** As the IE decreases, the frequency of light emitted goes on increasing.

57. **Ans:** Glass bottle. **Reason:** Glass reacts with HF.

58. **Ans:** 2, 3-dimethyl 2-butene. **Reason:** The reaction passes through the more stable carbocation. .

59. **Ans:** Bakelite. **Reason:** It is also an example of condensation polymer. .

60. **Ans:** Fluorine. **Reason:** F is the strongest oxidising agent. .

MATHEMATICS

61. **Ans.** a+b **Reason:** Mid point of hypoteneous is the circumcentre. So $R = \frac{c}{2}$. $r = (s-c)\tan\frac{c}{2}$

$= (s-c)\tan\pi/4 = s - c.$

$2(R+r) = 2s - 2c + c = 2s - c = a + b$

62. **Ans.** (1, -2) **Reason:** a, b, c are in H.P. $\Rightarrow \frac{1}{a},\frac{1}{b},\frac{1}{c}$ are in A.P. $\Rightarrow \frac{1}{a}+\frac{1}{c}=\frac{2}{b}$. The given line is $\frac{x}{a}+\frac{y}{b}+\frac{1}{c}=0$

$\Rightarrow \frac{x}{a}+\frac{y}{b}+\left(\frac{2}{b}-\frac{1}{a}\right)=0 \Rightarrow \frac{1}{a}(x-1)+\frac{1}{b}(y+2)=0$

Solving x - 1 = 0 and y + 2 = 0, point of intersection is (1, -2).

63. **Ans.** $\frac{-2}{3}$ **Reason:** Sum of the roots = $-\frac{2}{\alpha}$ and product of the roots = $\frac{3a}{a}$ = 3. Given $-\frac{2}{a}$ = 3 $\Rightarrow$ a = -2/3.

64. **Ans.** $(14)^4$ **Reason:** We know that adj (adj A) = $|A|^{n-2}$ A if $|A| \neq 0$

Provided order of A is n.

$\therefore$ adj (adj A) = |A| A (as n = 3)

$\therefore$ det (adj (Adj A)) = $|A|^3$ det A = $|A|^4$

But $|A| = \begin{bmatrix} 1 & 2 & -1 \\ -1 & 1 & 2 \\ 2 & -1 & 1 \end{bmatrix} = 14$

$\therefore$ det (adj (adj A)) = $(14)^4$

65. **Ans.** $e^{2/\pi}$ **Reason:** $\lim_{x\to a}\left(2-\frac{x}{a}\right)^{\tan\frac{\pi x}{2a}} = e^{\lim_{x\to a}\left(2-\frac{x}{a}-1\right)\tan\frac{\pi x}{2a}}$

$e^{\lim_{x\to a}\left(1-\frac{x}{a}\right)\tan\frac{\pi x}{2a}} = e^{\lim_{x\to a}\frac{\left(1-\frac{x}{a}\right)}{\cot\left(\frac{\pi x}{2a}\right)}} = e^{2/\pi}$

66. **Ans.** continuous but not differentiable **Reason:** L.H.D = -1 and R.H.D = 1. So f(x) is not differentiable at x = 0 but continuous at x = 0.

67. **Ans.** y+2z = 6 **Reason:** Let the plane be ax + by + cz + d = 0, ---(1)

The yz-plane is x = 0

or 1.x + 0.y + 0.z = 0 ---(2)

Since (1) and (2) are perpendicular to each other, we have a.1 + b.0+ c.0 = 0, i.e. a = 0

$\therefore$ The plane (1) reduces to by + cz + d = 0

Now since it passes through (1, -2, 4) and (3, -4, 5), we get -2b+4c+d = 0 and -4b + 5c+d = 0

giving $\frac{b}{-1}=\frac{c}{-2}=\frac{d}{6}$.

Thus the plane is y + 2z = 6.

68. **Ans.** $-\frac{10}{7}$

69. **Ans.** $|\vec{r}-(3\hat{i}+6\hat{j}-4\hat{k})| = 4$

70. **Ans.** $\frac{3\pi^2}{512}$ **Reason:** Let $I = \int_0^{\pi} x\sin^6 x\cos^4 x dx$

$= \int_0^{\pi}(\pi-x)\sin^6(\pi-x)\cos^4(\pi-x)dx$

$= \int_0^{\pi}(\pi-x)\sin^6 x\cos^4 x dx = \pi\int_0^{\pi}\sin^6 x\cos^4 x dx - I$

$\Rightarrow 2I = \pi.2.\int_0^{\pi/2}\sin^6 x\cos^4 x dx$. $\therefore I = \frac{3\pi^2}{512}$.

71. **Ans.** 18 **Reason:** Since | sin x | is a periodic function of period π,

$\therefore \int_{\pi}^{10\pi}|\sin x|dx = 9\int_{\pi}^{\pi}|\sin x|dx$

$= 9\int_{\pi}^{\pi} \sin x dx$ [$\because \sin x > 0$ in $(0, \pi)$]

$= -9[\cos x]_0^{\pi} = -9(-1-1) = 18.$

72. **Ans.** 1 **Reason:** $\tan\alpha \tan 2\alpha$ ..... $\tan(2n-1)\alpha$
$= \tan\alpha \tan 2\alpha$ ..... $\tan(\pi/2\alpha - 1)\alpha$.
$= \tan\alpha \tan 2\alpha$ .... $\cot\alpha = 1$.

73. **Ans.** 6 **Reason:** Any point at a distance r from $(\sqrt{3}, 2)$ is $(\sqrt{3} + r\cos\pi/6, 2 + r\sin\pi/6) = (\sqrt{3} + \frac{\sqrt{3}}{2}r, 2 + \frac{r}{2})$

Since it is on the given line then r = 6. so PQ = 6.

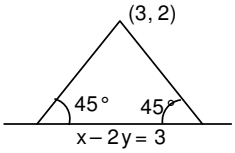
74. **Ans.** $3x - y = 7$ **Reason:** Let the slope of the line be m

$$\tan 45° = \left|\frac{\frac{1}{2} - m}{1 + \frac{1}{2}m}\right| = \left|\frac{1-2m}{2+m}\right|$$

$\Rightarrow \frac{1-2m}{2+m} = \pm 1 \Rightarrow 1 - 2m = \pm(2 + m) \Rightarrow m = 3, -1/3$

Eqn. of lines are $y - 2 = 3(x-3)$ i.e. $3x - y = 7$

And $y - 2 = -\frac{1}{3}(x - 3)$ i.e. $x + 3y = 9$.

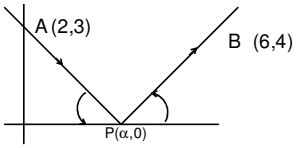


75. **Ans.** (26/7, 0)**Reason:** Slope of AP is $\frac{3}{2-\alpha}$.

And slope of BP = $\frac{4}{6-\alpha}$

$0 - \frac{4}{6-\alpha} = \frac{3}{2-\alpha} - 0 \Rightarrow -8 + 4\alpha = 18 - 3\alpha$

$\Rightarrow 7\alpha = 26 \Rightarrow \alpha = \frac{26}{7}$. Point $\left(\frac{26}{7}, 0\right)$



76. **Ans.** $\left(\frac{-3}{2}, \frac{1}{2}\right)$ **Reason:** Eqn of a line passing through centre and perpendicular to $x - y + 2 = 0$ is $x + y + 1 = 0$ solving both the equation the required point is (-3/2, ½)

77. **Ans.** $3x^2 + 4y^2 = 48$. **Reason:** Co-ordinate of foci are $(\pm 2, 0)$

And Latus rectum = $\frac{2b^2}{a} = 6 \Rightarrow b^2 = 3a$

So $b^2 = a^2(1 - e^2) \Rightarrow 3a = a^2 - 2^2$
$\Rightarrow a^2 - 3a - 4 = 0 \Rightarrow (a - 4)(a + 1) = 0$
$\Rightarrow a = 4, -1$ But a cannot be –ve so a = 4, $b^2 = 3a = 12$.

Eqn of ellipse is $\frac{x^2}{16} + \frac{y^2}{12} = 1$ $3x^2 + 4y^2 = 48$.

78. **Ans.** $(-\infty, -1]$ **Reason:** f(x) to be defined
$1 - x > 0$ and $x^2 - 1 \geq 0 \Rightarrow x < 1$ and $(x - 1)(x + 1) \geq 0$
$\Rightarrow x < 1$ and ($x \leq -1$ or $x > 1$)
$\Rightarrow x \leq -1$ so domain is $(-\infty, -1]$

79. **Ans.** $e^{d/b}$ **Reason:** $\lim_{x\to\infty}\left(1 + \frac{1}{a+bx}\right)^{c+dx}$

$= e^{\lim_{x\to\infty}\frac{c+dx}{a+bx}} = e^{d/b}$

80. **Ans.** only one real root **Reason:** $f(x) = x + e^x$, $f'(x) = 1 + e^x > 0$ so
f(x) is increasing for all $x \in R$
But f(x) = 0 has only one real root since
$f(-\infty) = -\infty$ and $f(\infty) = +\infty$.

81. **Ans.** (1, 2) **Reason:** $f'(x) = e^x(x-1)(x-2) < 0$
$\Rightarrow (x-1)(x-2) < 0 \Rightarrow 1 < x < 2$

82. **Ans.** $3\pi/4$

83. **Ans.** both A and R are true and R is the correct explanation of A **Reason:**. Any plane || to $3x - 4y + 5z - 6 = 0$ is $3x - 4y + 5z + K = 0$. It passes through (0, 0, 0).
$\therefore K = 0$.
$\therefore$ Plane is $3x - 4y + 5z = 0$

84. **Ans.** $x.e^{\tan^{-1}y} = \tan^{-1}y$

Reason: $(1 + y^2)dx + (x - e^{-\tan^{-1}y})dy = 0$
$\Rightarrow \frac{dx}{dy} + \frac{1}{1+y^2}x = \frac{1}{1+y^2}.e^{-\tan^{-1}y}$

I.F = $e^{\frac{dy}{1+y^2}} = e^{\tan^{-1}y}$

Soln. is $x\,e^{\tan^{-1}y} = \int \frac{dy}{1+y^2} + c = \tan^{-1}y + c$

Since it passes through origin, c = 0
Hence equation of curve is $x.e^{\tan^{-1}y} = \tan^{-1}y$

85. **Ans.** None**Reason:** $v = u - at \Rightarrow a = \frac{22-12}{5} = 2\ m/s^2$

$s = ut - \frac{1}{2}at^2 = (22 \times 13) - \frac{1}{2} \times 2 \times 13^2$
$= 268 - 169 = 99m$.

86. **Ans.** 3/8

87. **Ans.** 1/e

88. **Ans.** $\pi/4$

89. **Ans.** 1/8

90. **Ans.** Equal