

**JEE MAINS SAMPLE PAPER PHYSICS
SOLUTIONS AND ANSWER KEY**

1. a	2. b	3. a	4. b	5. a	6. a	7. a	8. c	9. c	10. b
11. a	12. a	13. a	14. b	15. b	16. a	17. a	18. c	19. a	20. d
21. a	22. a	23. b	24. c	25. a	26. c	27. b	28. d	29. d	30. a

1. Let $F \propto P^a V^b T^c$

$$\Rightarrow [F] = [P]^a [V]^b [T]^c$$

$$[F] = [ML^{-1}T^{-2}]^a [LT^{-1}]^b [T]^c$$

$$[MLT^{-2}] = [M^a L^{-a+b} T^{-2a-b+c}]$$

Comparing, $a = 1$,

$$-a + b = 1 \Rightarrow b = 2$$

$$-2a - b + c = -2 \Rightarrow -2 - 2 + c = -2 \Rightarrow c = 2$$

$$[F] = [P^1 V^2 T^2]$$

2. $\vec{u} = (\hat{i} + 2\hat{j}) \text{ ms}^{-1} \Rightarrow u_x = 1 \text{ v}_y = 2$

$$\Rightarrow \tan \theta = \frac{v_y}{u_x} = 2$$

$$\text{Range; } R = \frac{2v_x v_y}{g}$$

$$= \frac{2(1)(2)}{10}$$

$$= \frac{2}{5} \text{ m}$$

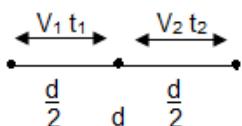
Trajectory,

$$y = x \tan \theta \left(1 - \frac{x}{R} \right)$$

$$y = 2x \left(1 - \frac{5x}{2} \right)$$

$$y = 2x - 5x^2$$

3. $V_{\text{avg}} = \frac{\text{Total displacement}}{\text{Total time}}$



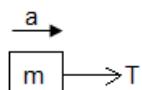
$$V = \frac{d}{\frac{d}{2V_1} + \frac{d}{2V_2}}$$

After some rearranging we get

$$\Rightarrow \frac{2}{V} = \frac{1}{V_1} + \frac{1}{V_2}$$

4. For the system $a = \frac{F}{2m}$

For the second block



$$T = ma$$

$$= m \times \frac{F}{2m}$$

$$= \frac{F}{2}$$

5. $F = \frac{mv_f - mv_i}{t}$

$$\frac{0.1(0) - 0.1(10)}{0.1}$$

$$= -10 \text{ N magnitude wise } F = 10 \text{ N}$$

6. $U_1 = \frac{1}{2}kx_1^2$

$$= \frac{1}{2} (240) \times (10 \times 10^{-2})^2$$

$$= 0.12 \text{ J}$$

$$U_1 = \frac{1}{2}kx_1^2$$

$$= \frac{1}{2} (240) \times (10 \times 10^{-2})^2$$

$$= 0.12 \text{ J}$$

$$U_1 - U_2 = 0$$

7. The radius is r_n and the velocity is v_n . The de-broglie wavelength is

$$\frac{\frac{r_n}{h}}{mv_n} = \frac{mv_n r_n}{h}$$

$$\text{But } mv_n r_n = \frac{n\hbar}{2\pi}$$

$$\text{Therefore, } \frac{\frac{r_n}{h}}{mv_n} = \frac{n}{2\pi}$$

8. $f = 30 \text{ cm}$

$$R_0 = 10 \text{ cm}$$

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

$$\frac{1}{30} = (n - 1) \left(\frac{1}{\infty} - \left(\frac{1}{-10} \right) \right)$$

$$\Rightarrow n - 1 = \frac{1}{3}$$

$$\Rightarrow n = \frac{4}{3} = 1.33$$



9. $E_k = \frac{1}{2} m u^2$

At the highest point of the trajectory,

$$U = mg H$$

$$= mg \times \frac{u^2 \sin^2 \theta}{2g}$$

$$= \frac{1}{2} m v^2 \sin^2 \theta$$

$$= E_k \sin^2 \theta$$

10. Initial energy $E_1 = (1)(-80) + 1(640) = 560 \text{ cal}$

Let the final state be completely liquid state (water)

$$E_f = mct$$

$$= (2)(1)t$$

$$\Rightarrow 2t = 560$$

$\Rightarrow t = 280^\circ\text{C}$. Water cannot exist at 280°C . Thus all steam has not condensed. The final temperature is thus 100°C .

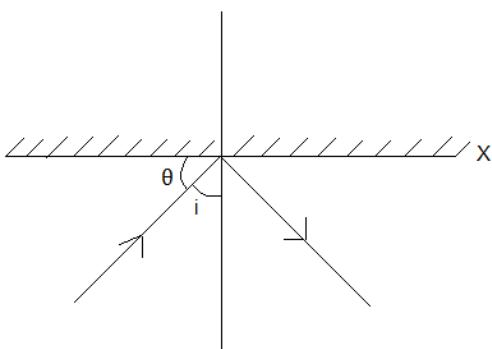
11. The following is the reflection diagram.

$$\vec{r}_i = \frac{1}{2} (\hat{i} + \sqrt{3}\hat{j})$$

$$\tan \theta = \frac{\frac{\sqrt{3}}{2}}{\frac{1}{2}} = \sqrt{3}$$

$$\Rightarrow \theta = 60^\circ$$

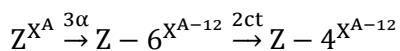
$$i = 30^\circ$$



12. For every α particle emission neutrons and protons both decrease by two and for every positron emission proton number decreases by 1.

Initial neutron number: $A - Z$

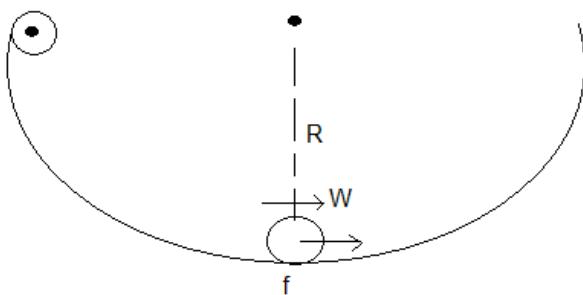
Initial proton number: Z



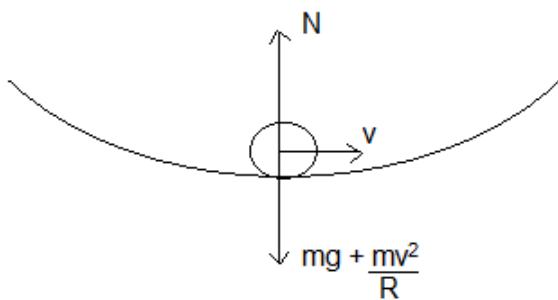
Number of neutrons is $A - 12 - (Z - 4) = A - Z - 8$

Number of protons is $Z - 4$

13.



The forces acting at the lower most point are,



Where ; $v = R$

$$k_i + U_i + W_{NC} = k_f + U_f$$

$$0 + mgR + 0 = \frac{1}{2} \times \frac{1}{2} m R^2 \times \left(\frac{v}{R}\right)^2 + 0$$

$$mgR = \frac{3}{4} mv^2 \Rightarrow v^2 = \frac{4gR}{3}$$

$$N = mg + \frac{mv^2}{R}$$

$$= mg + \frac{m}{R} \times \frac{4}{3} g R$$

$$= \frac{7}{3} mg$$

14. The acceleration is ; $a = \frac{qE}{m}$

Also, $v = u + at$

$$v = 0 + \frac{qE}{m} t$$

$$v = \frac{qE}{m} t$$

The kinetic energy is

$$k = \frac{1}{2} mv^2$$

$$= \frac{1}{2} \times m \left(\frac{qEt}{m} \right)^2$$

$$= \frac{q^2 E^2 t^2}{2m}$$

15. Motorcyclist listens to two apparent frequencies police car:

$$f_1 = f_{01} \left(\frac{330+v}{330} \right)$$

$$= 165 \left(\frac{330+v}{330} \right)$$

$$= \left(\frac{330+v}{2} \right)$$

Since no beats are present,

$$f_1 = f_2$$

$$\frac{330-v}{2} = \frac{330+v}{2}$$

$$\Rightarrow v = 22 \text{ ms}^{-1}$$

16. Since the voltage across the resistor is 40V, we have

$$20i = 40 \Rightarrow i = 2A$$

Applying KVL to the loop

$$-40 - 10R - 20 + 100 = 0$$

$$\Rightarrow R = 4\Omega$$

17. The intensity at a point on the screen where the path difference is Δx is given by

$$I = I_0 \cos^2\left(\frac{\pi}{\lambda} \times \Delta x\right)$$

$$I = I_0 \cos^2\left(\frac{\pi}{\lambda} \times \frac{\lambda}{6}\right)$$

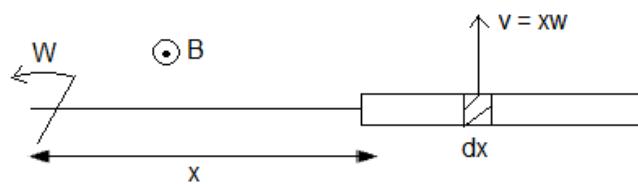
$$\Rightarrow \frac{I}{I_0} = \frac{3}{4}$$

18. The emf induced in the element is ,

$$d\epsilon = B dx v$$

$$\int d\epsilon = B \int_{2l}^{3l} x dx$$

$$\epsilon = \frac{5B l^2}{2}$$



19. The initial angular velocity is $\omega_0 = 300 \times \frac{\pi}{30}$

$$= 10 \text{ rad s}^{-1}$$

We have,

$$\omega^2 = \omega_0^2 + 2\alpha^2$$

$$0 = (10\pi)^2 - 2\alpha (25 \times 2\pi)$$

$$\Rightarrow \alpha = \pi$$

Also,

$$T = I \alpha$$

$$= \frac{10}{\pi} \times \pi$$

$$= 10 \text{ Nm}$$

20. Using the expression for the reactances, we have

$$X_L = 2\pi f L$$

$$= 2 \times \pi \times 50 \times \frac{200}{\pi} \times 10^{-3}$$

$$= 20 \Omega$$

$$X_C = \frac{1}{2\pi f C} = \frac{10^3}{2 \cdot 50}$$

$$= 10 \Omega$$

$$R = 10 \Omega$$

$$\text{We have } \tan \phi = \frac{X_L - X_C}{R}$$

$$= \frac{20 - 10}{10}$$

$$= 1$$

$$\Rightarrow \phi = \frac{\pi}{4}$$

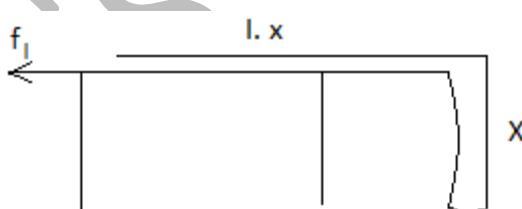
$$21. R = \frac{mV}{qB} = \frac{p}{qB}$$

Since p remains the same for both

$$R_{e^-} = \frac{p}{e_B} R_p = \frac{p}{e_B}$$

$$\therefore R_{e^-} = R_p$$

22.



Chain has a mass ' m ' and length ' l '. Let a maximum length x of the chain project over the table. The length of the chain on the table is $\frac{l}{2} - x$. Then the pulling force due to the length x should be balanced by the limiting friction acting to the left.

$$\frac{m}{l}xg = \mu \frac{m}{l}(\frac{l}{2} - x)g$$

$$x = \frac{\mu R}{1 + \mu}$$

$$= \frac{0.25l}{1.25}$$

$$= 0.2l$$

Therefore, it is 20%.

23. For the open tube

$$f_0 = \frac{v}{2l}$$

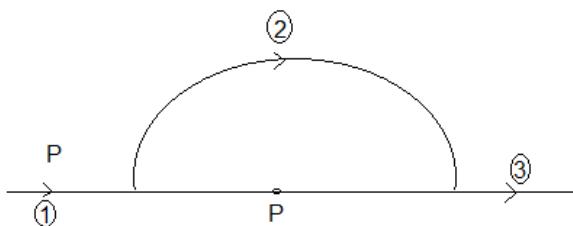
For the closed tube

$$f_0^1 = \frac{v}{4\left(\frac{l}{2}\right)} = f_0$$

24. At P, $\frac{B}{l} = 0$

$$\frac{B}{l} = 0$$

$$B_2 = \frac{\mu_0 i}{4R} = \frac{\mu_0 \pi i}{4\pi R}$$



25. A and B are axial points

$$|V_A| = |V_B| = \frac{kp}{r^2} \cos 0^\circ$$

$$= \frac{kp}{r^2}$$

C and D are equatorial points. Thus,

$$V_C = V_D = \frac{kp}{r^2} \cos 90^\circ$$

$$= 0$$

$$26. \phi = \frac{\pi}{3}$$

$$V_{rms} = \frac{100}{\sqrt{2}}$$

$$i_{rms} = \frac{100}{\sqrt{2}}$$

$$P_{avg} = V_{rms} i_{rms} \cos \phi$$

$$= \frac{100}{\sqrt{2}} \times \frac{100}{\sqrt{2}} \times \frac{1}{2}$$

$$= 2500 \text{ W}$$

$$27. \phi = 8t^2 - 4t + 1$$

We have

$$\epsilon = -\frac{d\phi}{dt}$$

$$= -16t + 4$$

$$\epsilon|_{t=0.1s} = -1.6 + 4$$

$$= 2.4 \text{ V}$$

$$i = \frac{\epsilon}{R}$$

$$= \frac{2.4}{10}$$

$$= 0.24 \text{ A}$$

28. Using dimensional analysis, we have

$$\left[\frac{L}{R} \right] = [T] \Rightarrow \left[\frac{R}{L} \right] = [T^{-1}]$$

$$[RC] = [T] \Rightarrow \left[\frac{1}{RC} \right] = [T^{-1}]$$

$$\left[\frac{1}{\sqrt{LC}} \right] = [T^{-1}]$$

$$\text{Only } [RCL] \neq [T^{-1}]$$

29. We can write the following truth table from the graph

A	B	C
0	0	0
1	1	1
0	1	0
1	0	0

This truth table belongs to the AND gate

30. 15 years is three half lives

$$\text{Thus, } N = \frac{N_0}{2^3} = \frac{N_0}{8}$$

CHEMISTRY
SOLUTION AND ANSWER KEY

31.b	32. d	33.c	34.c	35.b	36.d	37.b	38.c	39.b	40.d
41.a	42.c	43.c	44.b	45.b	46.c	47.c	48.a	49.d	50.d
51.d	52.d	53.c	54.c	55.b	56.c	57.c	58.d	59.c	60.c

31. (b)

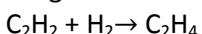
Sol: Conceptual

32. (d)

Sol: $\text{CaC}_2 + 2\text{H}_2\text{O} \rightarrow \text{C}_2\text{H}_2 + \text{Ca}(\text{OH})_2$

or 64g ----- 26g

64kg ----- 26kg



26kg ----- 28kg

\therefore 64kg of CaC_2 gives 28kg of ethylene or polyethylene

33. (c)

Sol: EWG increases reactivity towards nucleophilic substitution, EDG decreases reactivity towards nucleophilic substitution.

34. (c)

Sol: $\text{C}_2\text{H}_5\text{OH} + \text{SOCl}_2 \xrightarrow{\text{pyridine}} \text{C}_2\text{H}_5\text{Cl} + \text{SO}_2 + \text{HCl}$

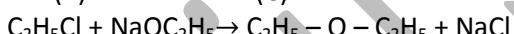
(A)

(B)



(X)

(C)

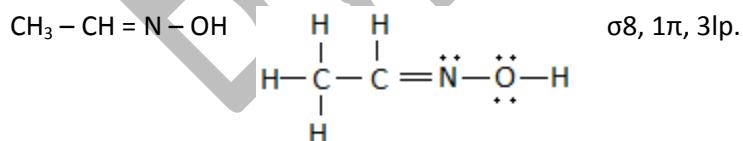


(B) (C)

35. (b)

36. (d)

Sol:



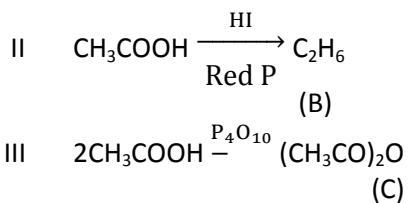
37. (b)

Sol: Acidity α - I effect

38. (c)

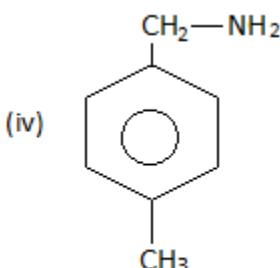
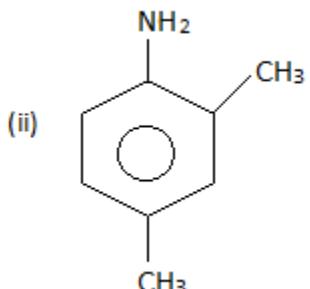
Sol: I $(\text{CH}_3\text{COO})_2\text{Ca} \xrightarrow{\Delta} \text{CH}_3\text{COCH}_3$





39. (b)

Sol:



Are primary amines

40. Ans: (d)

Sol: Rate = K $[N_2O_5]$

$$2.4 \times 10^{-5} = 3 \times 10^{-5} \times [N_2O_5]$$

$$[N_2O_5] = \frac{2.4 \times 10^{-5}}{3 \times 10^{-5}} = 0.8 \text{ mol/L}$$

41. Ans: (a)

$$\text{Sol: } d = \frac{\sqrt{3}}{2} a \Rightarrow a = \frac{2}{\sqrt{3}} d = \frac{2}{1.732} \times 365.9 = 422.5 \text{ pm}$$

For bcc, $Z = 2$

$$\int = \frac{z \times m}{a^3 \times N_A \times 10^{-30}} = \frac{2 \times 23}{(422.5)^3 \times (6.02 \times 10^{23}) \times 10^{-30}}$$

$$= 1.51 \text{ g/cm}^3$$

42. (c)

$$\text{Sol: } \Delta H = \Delta u + \Delta n RT$$

$\Delta H = 30 \text{ Kcal}$



(l) (v)



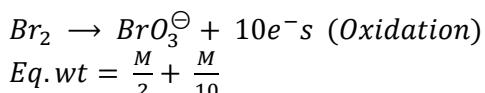
$$\Rightarrow 30 = \Delta U + 3 \times 2 \times 500 \times 10^{-3}$$

All = 27Kcal

ΔS = 27 kJ/mol

43.Ans: (c)

Sol: $Br_2 + 2e^- \rightarrow 2Br^\ominus$ (reduction)



44. (b)

$$\text{Sol: } K_{\text{AgCl}} = K_{\text{AgCl solution}} - K_{\text{H}_2\text{O}} \\ \equiv 1.86 \times 10^{-6} - 6 \times 10^{-8} \equiv 1.8 \times 10^{-6} \text{ ohm}^{-1} \text{ cm}^{-1}$$

$$\Lambda_{\text{AgCl}}^0 = \frac{K \times 1000}{S}$$

$$S = \frac{K \times 1000}{\Lambda_{\text{AgCl}}^0} = \frac{1.86 \times 10^{-6} \times 1000}{137.2} = 1.31 \times 10^{-5} \text{ M}$$

45. (b)

Sol:

46. (c)

Sol: Ionisation energy = -(energy of the 1st orbit)

$$\begin{aligned} \text{Energy of 1}^{\text{st}} \text{ orbit of Li}^{+2} &= -13.6 \times 9 \\ &= -122.4 \text{ ev} \end{aligned}$$

$$\text{Ionisation energy of Li}^{+2} = -(-122.4) = 122.4 \text{ ev}$$

47.(C)

$$\text{Sol: } K_a = K_{a_1} \times K_{a_2} = 1 \times 10^{-5} \times 5 \times 10^{-10} = 5 \times 10^{-15}$$

48.(a)

$$\text{Sol: } \frac{P_1 d_1}{T_1} = \frac{P_2 d_2}{T_2}$$

49.(d)

Sol: $[Ni(CN)_4]^{2-}$ is with dsp^2 hybridization and $\mu = 0$

$[Ni(CN)_4]$ is with sp^3 hybridization and $\mu = 0$ BM

$[Cu(NH_3)_4]^{2+}$ is with dsp^2 hybridization with $\mu = 1.732$ BM

$[Pd(Cl)_4]^{2-}$ is with dsp^2 hybridization with $\mu = 0$ BM

50.Ans(d)

Sol: boiling point of $NH_3 > PH_3$ due intermolecular hydrogen bonding

51. Ans(d)

Sol: Acidic nature of hydrides increases from H_2O to H_2Te

52. Ans(d)

Sol: conceptual

53. Ans(c)

Sol: it is an application of micro cosmic salt

54. Ans:(c)

Sol: Conceptual

55. Ans(b)

Sol: acidic nature of oxides increases in a period from left to right

56. Ans(c)

Sol: Dichromate salts react with hydrogen peroxide in acid medium and gives blue colour

57. Ans (c)

Sol. 50,000

58. Ans (d)

Sol: Since it is obtained by condensation polymersation of only one type of monomer i.e., caprolactam.

59. Ans (c)

Sol: Conceptual

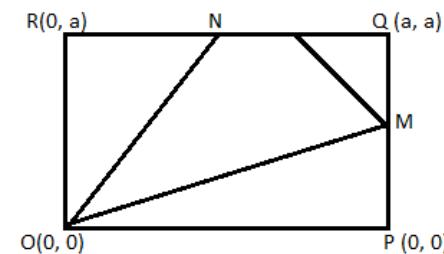
60. Ans (c)

Sol: Oxides of sulphur and nitrogen with dust and smoke combine with condensed water vapors and forms smog.

MATHEMATICS
SOLUTION AND ANSWER KEY

61. b	62. c	63. b	64. c	65. b	66. a	67. d	68. a	69. c	70. a
71. b	72. d	73. d	74. a	75. b	76. a	77. c	78. c	79. c	80. a
81. c	82. d	83. d	84. b	85. a	86. b	87. a	88. d	89. c	90. c

61. Sol: (b)



$$M = \left(a, \frac{a}{2} \right), \quad N = \left(\frac{a}{2}, a \right)$$

$$\text{Area } \Delta OMN = \frac{1}{2} \begin{vmatrix} 0 & 0 & 1 \\ a & a/2 & 1 \\ a/2 & a & 1 \end{vmatrix} = \frac{3a^2}{8}, \text{ Area of square} = a^2$$

$$\therefore \text{Ratio is } a^2 : \frac{3a^2}{8} \Rightarrow 8 : 3$$

62. Sol: (c)

The line $5x - 2y + 6 = 0$ cuts y-axis at $Q(0, 3)$. Clearly PQ is the length of the tangent drawn from Q on the circle

$$x^2 + y^2 + 6x + 6y = 2 \Rightarrow PQ = \sqrt{0 + 9 + 6 \times 0 + 6 \times 3 - 2} = 5$$

63. Sol: (b)

Equation of tangent of slope m is $y = mx + \frac{1}{m}$ which passes through $(1, 4) \Rightarrow m^2 - 4m + 1 = 0$

$$\tan\theta = \left| \frac{m_1 - m_2}{1 + m_1 m_2} \right| \Rightarrow \tan\theta = \frac{\sqrt{(m_1 + m_2)^2 - 4m_1 m_2}}{1 + m_1 m_2} \Rightarrow \tan\theta = \frac{\sqrt{16 - 4}}{2} = \sqrt{3}$$

$$\therefore \theta = 60^\circ$$

64. Sol: (c)

$$\text{Sum of 100 items} = 49 \times 100 = 4900$$

$$\text{Sum of items} = 60 + 70 + 80 = 210$$

$$\text{Sum of items replaced} = 40 + 20 + 50 = 110$$

$$\therefore \text{New sum} = 4900 - 110 + 210 = 5000$$

$$\therefore \text{Correct mean} = \frac{5000}{100} = 50$$

65. Sol: (b)

Equation of the pair of Asymptotes is $3x^2 - y^2 + k = 0$ But passes through origin

$$\Rightarrow k = 0$$

$$\therefore \text{Asymptotes are } 3x^2 - y^2 = 0$$

$$\therefore \text{Angle } \alpha \text{ between them } \alpha = 2 \tan^{-1} \left\{ \frac{2\sqrt{0+3}}{3-1} \right\}$$

$$\therefore \alpha = \frac{2\pi}{3}$$

66. Sol: (a)

$$\overset{\circ}{P} \rightarrow (\sim \vee r) \text{ is F} \Rightarrow \overset{\circ}{P} \text{ is T, } \sim \vee r \text{ is F}$$

$$\Rightarrow \overset{\circ}{P} \text{ is T, } \sim \text{ is F, } r \text{ is F}$$

$$\Rightarrow \overset{\circ}{P} \text{ is T, } \sim \text{ is T, } r \text{ is F}$$

$$67. (d) \quad Lt_{x \rightarrow 0} \frac{(1 - \cos x)(1 + \cos x + \cos^2 x)}{\sin 3x \cdot \sin 5x} = \frac{3/2}{3.5} = \frac{1}{10}$$

Sol:

$$68. (a) \quad x^2 + y^2 = 1 \quad \Rightarrow 2x + 2y \frac{dy}{dx} = 0$$

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

$$69. (c) \quad \frac{dy}{dx} = m = 3x^2 - 4x = 12 - 8 = 4$$

$$AT = \left| \frac{y_1 \sqrt{1+m^2}}{m} \right| = \frac{4 \cdot \sqrt{17}}{4} = \sqrt{17}$$

$$70. (a) \quad a \cos x + \frac{1}{3} \cdot 3 \cos 3x = 0 \quad \text{for } x = \frac{\pi}{3}$$

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

$$a = 2$$

71. (b) Let $f(x) = ax^3 + bx^2 + cx$
 $f(0) = 0 = f(1) \Rightarrow a + b + c = 0$

72. (d) $\int e^x \left(\frac{x+2}{x+3} + \frac{1}{(x+3)^2} \right) dx = e^x \cdot \left(\frac{x+2}{x+3} \right) + C$

73. (d) $f(x) = \log \left(\frac{2 - \sin x}{2 + \sin x} \right)$ is an odd function

$$\therefore \int_{-\pi/2}^{\pi/2} f(x) dx = 0$$

74. (a) Area = 4

75. (b) $y = vx \Rightarrow \sin^{-1} \left(\frac{y}{x} \right) = \log x$
 $\Rightarrow y = x = e^{\pi/2}$

76. Sol: (a)

$$\bar{a} \cdot \bar{b} > 0 \Rightarrow 2\lambda^2 - 3\lambda + 1 > 0 \Rightarrow \lambda < \frac{1}{2} \text{ or } \lambda > 1 \quad \dots \dots (1)$$

$$\bar{b} \cdot i < 0, \bar{b} \cdot j < 0, \bar{b} \cdot k < 0 \Rightarrow \lambda < 0 \quad \dots \dots (2)$$

From (1) and (2), $\lambda \in (-\infty, 0)$

77. Sol: (c)

$$\begin{aligned} [\bar{U}, \bar{V}, \bar{W}] &= \bar{U} \cdot (\bar{V} \times \bar{W}) = \bar{U} \cdot (3i - 7j - k) \\ &= |\bar{U}| |3i - 7j - k| \cos \theta \\ &= \sqrt{59} \cos \theta \\ \therefore \text{Maximum value of } [\bar{U}, \bar{V}, \bar{W}] &= \sqrt{59}. \quad (\because \cos \theta \leq 1) \end{aligned}$$

78. Sol: (c)

$$\begin{aligned} \text{Equation of the plane is } 3(x-1) + (y-1) + 4(z-1) &= 0 \\ \Rightarrow 3x + 4y - 7 &= 0 \end{aligned}$$

$$\therefore \text{Dist. from origin} = \frac{|-7|}{\sqrt{3^2 + 4^2}} = \frac{7}{5}$$

79. Sol: (c)

Let P be the required point on AB. Let P divides AB in the ratio $\lambda : 1$

$$P = \left(\frac{11\lambda - 9}{\lambda + 1}, \frac{4}{\lambda + 1}, \frac{5 - \lambda}{\lambda + 1} \right), OP \perp AB \Rightarrow 20 \left(\frac{11\lambda - 9}{\lambda + 1} \right) - 4 \left(\frac{4}{\lambda + 1} \right) - 6 \left(\frac{5 - \lambda}{\lambda + 1} \right) = 0$$

$$\therefore \lambda = 1 \Rightarrow P = (1, 2, 2)$$

80. Sol: (a)

$$\begin{vmatrix} 3 & -2 & 1 \\ 4 & -3 & 4 \\ 2 & -1 & m \end{vmatrix} = 0 \Rightarrow m = -2$$

81. Sol: (c)

$$\begin{aligned} n(S) &= 3^5 = 243 \\ n(E) &= 3({}^5C_2 \cdot {}^3C_2 \cdot {}^3C_1) + 3({}^5C_1 \cdot {}^4C_1 \cdot {}^3C_3) = 150 \\ P(E) &= \frac{n(E)}{n(S)} = \frac{50}{81} \end{aligned}$$

82. Sol: (d)

$$P(W) = \frac{1}{6}, \quad P(L) = \frac{5}{6}$$

$$P(A) = \frac{1}{6} + \left(\frac{5}{6}\right)^2 \cdot \frac{1}{6} + \left(\frac{5}{6}\right)^4 \cdot \frac{1}{6} + \dots = \frac{6}{11}$$

83. Sol: (d)

$$\begin{aligned} \text{Sol: } & (x^2 + (x^6 - 1)^{1/2})^5 + (x^2 - (x^6 - 1)^{1/2})^5 \\ & = 2 ({}^5C_0 (x^2)^5 + {}^5C_2 (x^2)^3 (x^6 - 1) + {}^5C_4 x^2 (x^6 - 1)^2) \end{aligned}$$

Here last term is of 14 degree.

$$\begin{aligned} 84. \text{ Sol. (b)} |z| &= \left| z - \frac{4}{2} + \frac{4}{2} \right| \\ &\leq \left| z - \frac{4}{2} \right| + \left| \frac{4}{2} \right| \\ &= \left| z - \frac{4}{2} \right| + \frac{4}{|2|} \\ &|z| \leq 2 + \frac{4}{|2|} \\ &|z|^2 \cdot 2|2| \leq 4 \\ &|z|^2 - 2|2| + 1 \leq 5 \\ &\Rightarrow |z| \leq \sqrt{5} + 1 \end{aligned}$$

$$85. \text{ Ans. (a)} \quad \begin{vmatrix} 1 & \log_x y & \log_x z \\ \log_y x & 1 & \log_y z \\ \log_z x & \log_z y & 1 \end{vmatrix}$$

$$= (1 - \log_z y \log_y z) - \log_x y (\log_y x - \log_z x \log_y z)$$

$$+ \log_x z (\log_y x \log_z y - \log_z x)$$

$$= (1 - 1) - (1 - \log_x y \log_y x) + (\log_x z \log_z x - 1) = 0$$

{Since $\log_x y \cdot \log_y x = 1$ } .

86. Sol: (b)

Last digit is zero and the remaining from digits are 1,2,4,5. Number of arrangements = $4! = 24$

87. Sol: (a)

$$x - \frac{2}{x-1} = 1 - \frac{2}{x-1} \dots\dots\dots (1)$$

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

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

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

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

But when $x = 1$ (1) is not divined \therefore No root

88. Sol: (d)

$$\begin{aligned} & \tan 9^\circ - \tan 27^\circ - \tan 63^\circ + \tan 81^\circ \\ &= \tan 9^\circ + \cot 9^\circ - (\tan 27^\circ + \cot 27^\circ) \\ &= \frac{1}{\sin 9^\circ \cos 9^\circ} - \frac{1}{\sin 27^\circ \cos 27^\circ} \\ &= \frac{2[\sin 54^\circ - \sin 18^\circ]}{\sin 18^\circ \sin 54^\circ} = 4 \end{aligned}$$

89. Sol: (c)

$$2^{78} + 2^3 \cdot 2^{75} = 8(2^5)^{15} = 8(1+31)^{15} = 8\{ {}^{15}C_0 + {}^{15}C_1 31 + \dots + {}^{15}C_{15}(31)^{15} \}$$

2^{78} = 8 + an integer multiple of 31

$$\frac{2^{78}}{31} = \frac{8}{31} + \text{an integer}$$

90. Sol: (c) $|z_1 + z_2|^2 = |z_1 - z_2|^2$

$$\Rightarrow z_1 \cdot \bar{z}_2 + \bar{z}_1 z_2 = 0$$

$$i.e. z_1 \cdot \bar{z}_2 + \overline{z_1 \cdot \bar{z}_2} = 0$$

$$\Rightarrow \operatorname{Re}(z_1 \cdot \bar{z}_2) = 0$$

$$\text{Let } z_1 = r_1 e^{i\theta_1}, z_2 = r_2 e^{i\theta_2}$$

$$\Rightarrow \operatorname{Re} z_1 \cdot \bar{z}_2 = r_1 r_2 e^{i(\theta_1 - \theta_2)} = 0$$

$$\Rightarrow \operatorname{can}(\theta_1 - \theta_2) = 0$$

$$\Rightarrow \theta_1 - \theta_2 = \pm \frac{\pi}{2}$$