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ULTIMATE TEST SERIES JEE-MAIN-2017

TEST - 02, 03-03-2017

[PHYSICS]

1. Answer (1)

2. Answer (4)

$$36 = \frac{\omega^2 - \frac{\omega^2}{4}}{2\alpha}$$

$$\theta = \frac{\frac{\omega^2}{4} - 0}{2\alpha}$$

$$\Rightarrow \frac{\theta}{36} = \frac{1}{3} \Rightarrow \theta = 12$$

3. Answer (2)

$$a = \frac{g \sin 90}{1+1} = \frac{g}{2}$$

4. Answer (4)

$$\frac{1}{2} \frac{ml^2}{3} \omega^2 = mgh$$

$$\Rightarrow h = \frac{l^2 \omega^2}{6g}$$

5. Answer (4)

$$m_1 \times d = m_2 \times x$$

6. Answer (3)

$$-\frac{2GM_1 m}{d} - \frac{2GM_2 m}{d} + \frac{1}{2} m V_e^2 = 0$$

$$\Rightarrow V_e = \sqrt{\frac{4G(M_1 + M_2)}{d}}$$

7. Answer (2)

8. Answer (1)

$$\left. \begin{array}{l} U = -2E \\ KE = E \end{array} \right\} \therefore \text{Total energy} = -E$$

\therefore Binding energy = E.

9. Answer (4)

$$\frac{GM}{x^2} = G \times \frac{4m}{(r-x)^2}$$

$$\Rightarrow x = \frac{r-x}{2} \Rightarrow x = \frac{r}{3}$$

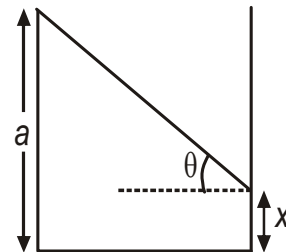
$$\therefore V = -\frac{3GM}{r} - \frac{3G \times 4m}{2r} = -\frac{9GM}{r}$$

10. Answer (2)

$$\sqrt{2gx} \times \sqrt{\frac{2h}{g}} = R$$

$$4hx = R^2.$$

11. Answer (2)



$$\frac{1}{2} \times a^2 \times (a-x) = \frac{a^3}{3}$$

$$3a - 3x = 2a$$

$$x = \frac{a}{3}$$

$$\tan \theta = \frac{\frac{2a}{3}}{a} = \frac{a_0}{g}$$

$$\Rightarrow a_0 = \frac{2g}{3}$$

12. Answer (2)

13. Answer (4)

$$a = \frac{g}{3}$$



$$\therefore a_{cm} = \frac{m\left(\frac{g}{3}\right) - 2m \times \frac{g}{3}}{3m} = -\frac{g}{9}$$

14. Answer (4)

$$0 = m(v_0 - v) - 2mV$$

$$v_0 - v = 2V \Rightarrow v = \frac{v_0}{3}$$

$$\therefore \text{Velocity of girl} = v_0 - \frac{v_0}{3} = \frac{2v_0}{3}$$

15. Answer (3)

$$I = \frac{MR^2}{2} - \left[\frac{3}{2} \times \frac{M}{4} \left(\frac{R}{2} \right)^2 \right] = \left(\frac{1}{2} - \frac{3}{32} \right) MR^2 = \frac{13}{32} MR^2$$

16. Answer (2)

$$u_1 = \frac{P}{m}, u_2 = 0, I = p - mv_1, I = mv_2$$

$$\Rightarrow v_1 = \frac{p - I}{m} \Rightarrow v_2 = \frac{I}{m}$$

$$\therefore e = \frac{\frac{I}{m} - \frac{p}{m} + \frac{I}{m}}{u_1} = \frac{2I - p}{p}$$

17. Answer (3)

18. Answer (4)

$$T = \left(\frac{M}{2} \right) \left(\frac{3I}{4} \right) \omega^2 = \frac{3}{8} mI \omega^2$$

19. Answer (3)

20. Answer (2)

21. Answer (1)

22. Answer (2)

$$F_2 = \frac{a_2}{a_1} \times F_1 = \frac{(15)^2}{(1.25)^2} \times 400 = 57600 \text{ N}$$

23. Answer (4)

$$B = 20 - 16 = 4 \text{ N}$$

$$\therefore \text{So weight read} = 36 + 4 = 40 \text{ N}$$

24. Answer (2)

$$\frac{1}{2} mv_o^2 = \frac{GMm}{R+h} = 0$$

25. Answer (2)

26. Answer (4)

27. Answer (2)

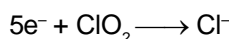
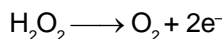
28. Answer (2)

29. Answer (3)

30. Answer (4)

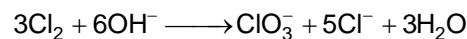
[CHEMISTRY]

31. Answer (3)



$$1 \text{ mol of ClO}_2 = \frac{5}{2} \text{ mole of H}_2\text{O}_2$$

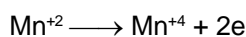
32. Answer (3)



33. Answer (3)



34. Answer (2)



$$n\text{-factor} = 2$$

35. Answer (2)

$$\rho = \frac{PM}{RT}$$

36. Answer (1)

$$\frac{v_2}{v_1} = \sqrt{\frac{1200}{300}} \times 0.3 = 0.6 \text{ ms}^{-1}$$

37. Answer (2)

Fact

38. Answer (3)

$$n = \frac{PV}{RT} = \frac{1.56 \times 10}{0.082 \times 317} = 0.6 \text{ mol}$$

$$\text{Let } {}^n\text{C}_x\text{H}_8 = a$$

$${}^n\text{C}_x\text{H}_{12} = (0.6 - a)$$

Total mass of C in mixture

$$= 12ax + 12(.6 - a)x = 7.2x$$

$$\% \text{ of C in mixture} = \frac{7.2x}{41.4} \times 100 = 87\%$$

$$\text{or } \frac{720x}{41.4} = 87 \quad \text{or } x = 5$$

39. Answer (3)

Slope of the adiabatic curve $\propto \gamma$

$$\text{He } (\gamma = 1.66), \text{O}_2 (\gamma = 1.44)$$

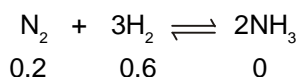
40. Answer (1)

$$W = -2.303 nRT \log \frac{P_1}{P_2}$$

$$= -2.303 \times 1 \times 8.314 \times 273 \log \frac{1}{0.1} = -5.227 \text{ kJ}$$

$$q = -W = +5.227 \text{ kJ}$$

41. Answer (1)



$$0.2 - x \quad 0.6 - 3x \quad 2x$$

$$0.4 = \frac{x}{0.2} \Rightarrow x = 0.08$$

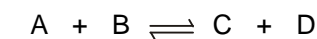
$$\frac{V_f}{V_i} = \frac{0.8 - 2x}{0.8} = \frac{4}{5}$$

42. Answer (2)

$$\alpha = \frac{46 - 38.3}{38.3} = 0.2$$

$$2\alpha = 2 \times .2 = 0.4$$

43. Answer (2)



$$4 \quad 4 \quad 0 \quad 0$$

$$4 - x \quad 4 - x \quad x \quad x$$

$$x = 2$$

$$K = \frac{2 \times 2}{2 \times 2} = 1$$

44. Answer (4)

$$\begin{array}{c} 2\text{HI} \\ (2-2\alpha) \end{array} \quad \begin{array}{c} \square \\ \alpha \end{array} \quad \begin{array}{c} \text{H}_2 \\ \alpha \end{array} + \begin{array}{c} \text{I}_2 \\ \alpha \end{array} \quad \left| K = \frac{0.5 \times 0.5}{(2 - 2 \times 0.5)^2} = 0.25 \right.$$

45. Answer (1)

Fact

46. Answer (1)

$$[\text{NH}_4^+] = [\text{NH}_2^-] = \sqrt{K\text{NH}_3} = 10^{-15} \text{ M}$$

$$1 \text{ mm}^3 \text{ solution contains} = 6.02 \times 10^{23} \times 10^{-15} \times 10^{-6} = 602$$

47. Answer (1)

$$[\text{H}^+]_{\text{mix}} = \sqrt{1.8 \times 10^{-4} \times 0.1 + 3.1 \times 10^{-4} \times 0.1} = \sqrt{4.9 \times 10^{-5}} = 7 \times 10^{-3}$$

48. Answer (3)

$$\text{Buffer capacity} = \frac{2}{3.4 - 2.9} = 4$$

49. Answer (4)

$$\text{pH} = -\log_{10}(2 \times 0.05) = 1$$

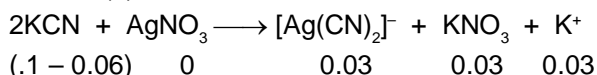
50. Answer (2)

Fact

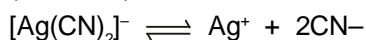
51. Answer (4)

$$\Delta H = -20.6 - 8.8 = -29.4 \text{ J}$$

52. Answer (2)



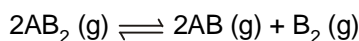
$$(1 - 0.06) \quad 0 \quad 0.03 \quad 0.03 \quad 0.03$$



$$(0.03 - a) \quad a \quad (0.04 + a)$$

$$K_c = \frac{a \times (0.04)^2}{0.03} = 4 \times 10^{-19} [0.03 - a \approx a \text{ as } K_c = 4 \times 10^{-19}]$$

53. Answer (1)



$$2 - 2x \quad 2x \quad x$$

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

54. Answer (1)

$$\text{Number of meq of H}^+ = 10 \times 1 + 20 \times 2 = 50$$

$$\text{Number of meq of OH}^- = 30 \times 1 = 30$$

$$\text{Number of meq of H}^+ \text{ left} = 50 - 30 = 20$$

55. Answer (3)

56. Answer (3)

Fact

57. Answer (2)

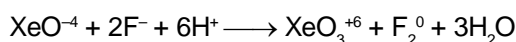
58. Answer (3)

59. Answer (2)

$$V_{\text{rms}} \propto \sqrt{T}$$

$$\text{Collision frequency} \propto \sqrt{T}$$

60. Answer (1)



[MATHEMATICS]

61. Answer (3)

$$\text{Here product of roots} = \frac{(m^2 + 1)^2}{m^2 + 1} = m^2 + 1 \geq 1$$

$$\therefore b = \text{least value of product of roots} = 1$$

$$\text{and sum of roots} = -\frac{(-3)}{m^2 + 1} = \frac{3}{m^2 + 1}$$

\therefore Greatest value of sum of roots is possible if $m^2 + 1$ is minimum and its minimum value = 1.

$$\therefore \text{Greatest value of sum of roots} = \frac{3}{1} = 3 = c$$

(given)

$$\therefore \text{1st term, } a = b + 2 = 1 + 2 = 3$$

$$\text{and c.r., } r = 2c^{-1} = \frac{2}{3} = \frac{2}{3} < 1$$

$$\therefore S_\infty = \frac{a}{1-r} = \frac{3}{1-\frac{2}{3}} = 9.$$

62. Answer (1)

A.M. \geq G.M.

$$\frac{\frac{a}{b} + \frac{b}{c} + \frac{c}{a}}{3} \geq (1)^{1/3}$$

$$\Rightarrow \frac{a}{b} + \frac{b}{c} + \frac{c}{a} \geq 3$$

63. Answer (2)

$$\frac{S_n}{S_n^1} = \frac{\frac{n}{2}[2a_1 + (n-1)d_1]}{\frac{n}{2}[2a_2 + (n-1)d_2]}$$

$$= \frac{7n+1}{4n+17}$$

$$\frac{a_1 + \left(\frac{n-1}{2}\right)d_1}{a_2 + \left(\frac{n-1}{2}\right)d_2} = \frac{7n+1}{4n+17}$$

 Put $n = 19$

$$\text{Required ratio} = \frac{134}{93}$$

 \therefore They are in G.P.

64. Answer (1)

$$\text{Here } \frac{a^2 + b^2}{2} \geq (a^2 b^2)^{\frac{1}{2}}$$

$$\Rightarrow a^2 + b^2 \geq 2ab \quad \dots(1)$$

$$b^2 + c^2 \geq 2bc \quad \dots(2)$$

$$\text{and } c^2 + a^2 \geq 2ca \quad \dots(3)$$

Adding (1), (2) and (3), we get

$$2(a^2 + b^2 + c^2) \geq 2(ab + bc + ca)$$

$$\Rightarrow 1 \geq \frac{ab + bc + ca}{a^2 + b^2 + c^2} \Rightarrow \frac{ab + bc + ca}{a^2 + b^2 + c^2} \leq 1 \quad \dots(4)$$

 Also, $a < b + c$ (for any Δ)

$$\Rightarrow a \cdot a < a(b + c) \quad [\because a > 0]$$

$$\Rightarrow a^2 < ab + ca \quad \dots(5)$$

$$\text{Similarly, } b^2 < b(c + a) \Rightarrow b^2 < bc + ab \quad \dots(6)$$

$$\text{and } c^2 < c(a + b) \Rightarrow c^2 < ca + bc \quad \dots(7)$$

By [(5), (6) & (7)]

$$a^2 + b^2 + c^2 < 2(ab + bc + ca)$$

$$\Rightarrow \frac{1}{2} < \frac{ab + bc + ca}{a^2 + b^2 + c^2} \quad \dots(8)$$

$$\therefore \text{ From (4) and (8) } \frac{1}{2} < \frac{ab + bc + ca}{a^2 + b^2 + c^2} \leq 1.$$

65. Answer (1)

From given expression,

$$(15x)^2 + (5y)^2 + (3z)^2 - 15x \cdot 5y - 5y \cdot 3z - 15x \cdot 3z = 0$$

$$\Rightarrow (15x - 5y)^2 + (5y - 3z)^2 + (3z - 15x)^2 = 0$$

$$\therefore 15x = 5y = 3z$$

$$\Rightarrow \frac{x}{15} = \frac{y}{5} = \frac{z}{3} = k, \text{ say}$$

$$\therefore x = \frac{k}{15}, y = \frac{k}{5}, z = \frac{k}{3}$$

$$\therefore x + z = \frac{k}{15} + \frac{k}{3} = \frac{k + 5k}{15} = \frac{6k}{15} = \frac{2k}{5} = 2y$$

 $\Rightarrow x, y, z$ are in A.P.

66. Answer (1)

 Order of letter are ELMOUV 601th word will be VELMOU

67. Answer (1)

 Let a, b, c, d represent 4 persons and x_1, x_2, x_3, x_4, x_5 denote the number of vacant seats on either side of the persons as shown below

$$x_1(a)x_2(b)x_3(c)x_4(d)x_5$$

$$\text{We have } x_1 + x_2 + x_3 + x_4 + x_5 = 12 - 4 = 8$$

 where $x_1, x_5 \geq 0$ and $x_2, x_3, x_4 \geq 1$

$$x_2 - 1 \geq 0, x_3 - 1 \geq 0, x_4 - 1 \geq 0$$

$$\text{Let } x_2 - 1 = p, x_3 - 1 = q, x_4 - 1 = r$$

$$\Rightarrow x_2 = p + 1, x_3 = q + 1, x_4 = r + 1$$

 so that $p \geq 0, q \geq 0, r \geq 0$

$$\therefore x_1 + p + 1 + q + 1 + r + 1 + x_5 = 8$$

$$\Rightarrow x_1 + p + q + r + x_5 = 5 \quad \dots(i)$$

 where each of $x_1, p, q, r, x_5 \geq 0$
 \therefore Number of non-negative integral solutions of equation (1)

$$= {}^{5+5-1}C_{5-1} = {}^9C_4.$$

Also 4 persons can be arranged amongst themselves in 4! ways.

 \therefore Required number of seating arrangements

$$= 4! \times {}^9C_4 = 4! \times \frac{9!}{4! \times 5!} = \frac{9 \cdot 8 \cdot 7 \cdot 6 \cdot 5!}{5!} = 3024.$$

68. Answer (1)

 Let the 4 persons be given a, b, c, d things respectively.

 Then $a + b + c + d = 16$,

 where $a, b, c, d \geq 3 \quad \dots(1)$

$$\Rightarrow a - 3 \geq 0, b - 3 \geq 0, c - 3 \geq 0, d - 3 \geq 0$$

$$\text{Put } a - 3 = x, b - 3 = y, c - 3 = z, d - 3 = t$$

$$\Rightarrow a = 3 + x, b = 3 + y, c = 3 + z, d = 3 + t$$

$$\therefore \text{ from (1) } 3 + x + 3 + y + 3 + z + 3 + t = 16$$

$$\Rightarrow x + y + z + t = 4, x, y, z, t \geq 0$$

 \therefore Required number = number of ways of distributing 4 identical things among 4 persons when each person can get zero or more things

$$= {}^{4+4-1}C_{4-1} = {}^7C_3 = \frac{7!}{3! \times 4!} = \frac{7 \cdot 6 \cdot 5 \cdot 4!}{6 \cdot 4!} = 35$$

69. Answer (2)

$$4n + 2 = 2(2n + 1)$$

Number of divisors of the form $4n + 2$ is

$$1 \times 4 \times 4 \times 6 = 96$$

but $n \in N$, So required number = $96 - 1 = 95$

70. Answer (2)

Twenty pearls \equiv 10 pearls of one colour and 10 pearls of another colour.

Step-1: First arrange pearls of same colour in

$$\text{necklace in } \frac{1}{2}(10-1)! = \frac{1}{2} \times 9!.$$

Step-2: Now arrange pearls of another colour in between the arranged 10 pearls in $10!$ ways.

$$\therefore \text{ Required number of ways} = \frac{1}{2} \times 9! \times 10!$$

$$= \frac{1}{2} \times 9! \times 10 \times 9! = 5 \times (9!)^2$$

71. Answer (1)

Let one real root be α and other root be purely imaginary as $i\beta$.

Now α and $i\beta$ are the roots of equation

$$x^2 + ax + b = 0$$

$$\therefore \alpha + i\beta = -a \quad \dots(1)$$

$$\text{and } \alpha i\beta = b \quad \dots(2)$$

Now from (1) $\overline{\alpha + i\beta} = -\bar{a}$

$$\Rightarrow \alpha - i\beta = -\bar{a} \quad \dots(3)$$

Adding (1) and (3)

$$2\alpha = -a - \bar{a} = -(a + \bar{a}) \quad \dots(4)$$

Subtracting (3) from (1)

$$2i\beta = -a + \bar{a} = -(a - \bar{a}) \quad \dots(5)$$

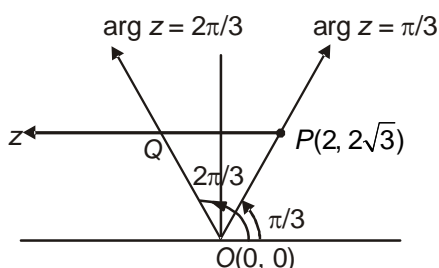
Multiplying (4) and (5)

$$4i\alpha\beta = (a^2 - \bar{a}^2)$$

$$\Rightarrow 4b = a^2 - \bar{a}^2 \text{ [from (3)]}$$

72. Answer (1)

The rays represented by these equations are drawn in the following figure:



In the above figure, ΔOPQ is equilateral

$$\text{Whose one side } OP = \sqrt{(2-0)^2 + (2\sqrt{3}-0)^2} = 4$$

\therefore Area of bounded region as ΔOPQ

$$= \frac{\sqrt{3}}{4} \times (\text{side})^2 = \frac{\sqrt{3}}{4} \times 16 = 4\sqrt{3} \text{ sq. units}$$

73. Answer (1)

Let $z = r\cos\theta + ir\sin\theta$

So that $|z| = r \neq 0$ and $\arg z = \theta$

$$\therefore \frac{z}{|z|} = \frac{r(\cos\theta + i\sin\theta)}{r} = \cos\theta + i\sin\theta$$

$$\Rightarrow \frac{z}{|z|} - 1 = (\cos\theta - 1) + i\sin\theta$$

$$\Rightarrow \left| \frac{z}{|z|} - 1 \right| = \sqrt{(\cos\theta - 1)^2 + \sin^2\theta} = \sqrt{2 - 2\cos\theta}$$

$$= \sqrt{4\sin^2\frac{\theta}{2}} = 2 \left| \sin\frac{\theta}{2} \right|$$

$$\Rightarrow \left| \frac{z}{|z|} - 1 \right| = 2 \left| \sin\frac{\theta}{2} \right| \leq 2 \left| \frac{\theta}{2} \right| = |\theta|$$

$$[\because \sin\theta \leq \theta \Rightarrow |\sin\theta| \leq |\theta|]$$

$$\Rightarrow \left| \frac{z}{|z|} - 1 \right| \leq |\arg z|$$

74. Answer (1)

Since $\cos\alpha + i\sin\alpha$ is the root of the given equation,

we have $\sum_{k=0}^n p_k (\cos\alpha + i\sin\alpha)^{n-k} = 0$ [where $p_0 = 1$]

$$\Rightarrow (\cos\alpha + i\sin\alpha)^n \sum_{k=0}^n p_k (\cos\alpha + i\sin\alpha)^{-k} = 0$$

$$\Rightarrow \sum_{k=0}^n p_k (\cos\alpha k - i\sin\alpha k) = 0$$

$$\Rightarrow \sum_{k=0}^n p_k \sin k\alpha = 0$$

$$\Rightarrow 0 + p_1 \sin\alpha + p_2 \sin 2\alpha + \dots + p_n \sin n\alpha = 0.$$

75. Answer (1)

By $c_1 \rightarrow c_1 + c_2 + c_3$

$$= \begin{vmatrix} x + (1 + \omega + \omega^2) & \omega & \omega^2 \\ \omega + x + \omega^2 + 1 & x + \omega^2 & 1 \\ \omega^2 + 1 + x + \omega & 1 & x + \omega \end{vmatrix}$$

$$= \begin{vmatrix} x & \omega & \omega^2 \\ x & x + \omega^2 & 1 \\ x & 1 & x + \omega \end{vmatrix} \quad [\because 1 + \omega + \omega^2 = 0]$$

$$= x(x^2 + x\omega + \omega^2 x + 1 - 1) - x(\omega x + \omega^2 - \omega^2)$$

$$+ x(\omega - \omega^2 x - \omega)$$

$$= x(x^2 - x) - x^2(\omega + \omega^2) = x^3 - x^2 + x^2 = x^3.$$

76. Answer (2)

$$(1 + x^3 + 3x^2 + 3x)^{10} = (1 + x)^{30}$$

$$\text{Largest binomial coeff.} = {}^{30}C_{15}$$

77. Answer (3)

$$3^{51} = 3 \cdot 3^{50} = 3 \cdot (3^2)^{25} = 3(1+8)^{25}$$

$$= 3[1 + {}^{25}C_1 \cdot 8 + {}^{25}C_2 \cdot 8^2 + \dots + {}^{25}C_{25} \cdot 8^{25}]$$

$$= 3 + 3 \cdot 8[{}^{25}C_1 + {}^{25}C_2 \cdot 8 + \dots + {}^{25}C_{25} \cdot 8^{24}]$$

$$= 3 + 24K, \text{ where } K = {}^{25}C_1 + {}^{25}C_2 \cdot 8 + \dots + {}^{25}C_{25} \cdot 8^{24}$$

$$= \text{an integer.}$$

$\therefore 3^{51}$ when divided by 24 leaves the remainder 3.

78. Answer (3)

$$\text{Given, } (1 + ax)^n = 1 + 8x + 24x^2 + \dots$$

$$\Rightarrow 1 + n(ax) + \frac{n(n-1)}{2!} a^2 x^2 + \dots = 1 + 8x + 24x^2 + \dots$$

Comparing, we get

$$na = 8 \Rightarrow a = \frac{8}{n}$$

$$\text{and } \frac{n(n-1)}{2!} a^2 = 24 \Rightarrow \frac{n(n-1)}{2} \times \frac{64}{n^2} = 24$$

$$\Rightarrow \frac{(n-1)}{n} = \frac{24}{32} = \frac{3}{4} \Rightarrow 1 - \frac{1}{n} = \frac{3}{4}$$

$$\Rightarrow 1 - \frac{3}{4} = \frac{1}{n}$$

$$\therefore n = 4$$

$$\therefore a = \frac{8}{n} = \frac{8}{4} = 2$$

$$\therefore \frac{a-n}{a+n} = \frac{2-4}{2+4} = -\frac{2}{6} = -\frac{1}{3}$$

79. Answer (3)

$$\text{Here } t_{r+1} = {}^{15}C_r \cdot 3^{\frac{15-r}{5}} \cdot 2^{\frac{r}{3}}$$

which will be rational if $3 - \frac{r}{5}$ and $\frac{r}{3}$ are integers

Also, $0 \leq r \leq 15$

$\therefore r$ must be a multiple of (l.c.m. of 3 and 5)

$\Rightarrow r$ must be multiple of 15

$\therefore r = 0, 15$

\therefore Sum of rational terms

$$= {}^{15}C_0 \cdot 3^3 \cdot 2^0 + {}^{15}C_{15} \cdot 3^0 \cdot 2^5 = 1 \cdot 27 \cdot 1 + 1 \cdot 1 \cdot 32 = 59$$

80. Answer (3)

$$\text{Given expression} = (1+x)^{2m} \cdot \left(\frac{x}{1-x}\right)^{-2m}$$

$$= \frac{1}{x^{2m}} [(1+x)(1-x)]^{2m} = \frac{1}{x^{2m}} \cdot (1-x^2)^{2m}$$

$$\text{Here, } t_{r+1} = \frac{1}{x^{2m}} \cdot {}^{2m}C_r \cdot (1)^{2m-r} \cdot (-x^2)^r$$

$$= \frac{1}{x^{2m}} \cdot {}^{2m}C_r \cdot 1 \cdot (-1)^r \cdot x^{2r}$$

$$= {}^{2m}C_r \cdot (-1)^r \cdot x^{2r-2m}$$

For the term independent of x , $2r - 2m = 0$

$$\Rightarrow \boxed{r = m}$$

\therefore Term independent of $x = (-1)^m \cdot {}^{2m}C_m$

81. Answer (1)

Here determinant of order 2 will be of the form given below.

$$\begin{vmatrix} \square & \square \\ \square & \square \end{vmatrix}$$

and each of the four places can be filled up by 0 or 1 in 2 ways.

so that $n(S) = 2 \times 2 \times 2 \times 2 = 16$

Let E be the event of getting non-negative determinants.

Then E^c be the event of getting negative determinants.

But negative determinants of the second order that can be made with 0, 1 are

$$\begin{vmatrix} 0 & 1 \\ 1 & 0 \end{vmatrix}, \begin{vmatrix} 0 & 1 \\ 1 & 1 \end{vmatrix}, \begin{vmatrix} 1 & 1 \\ 1 & 0 \end{vmatrix}$$

$$\therefore P(E^c) = \frac{n(E^c)}{n(S)} = \frac{3}{16}$$

$$\therefore P(E) = 1 - P(E^c) = 1 - \frac{3}{16} = \frac{13}{16}$$

82. Answer (3)

$P(E_n)$ = probability of the die showing $n = kn$

$$\therefore P(E_1) + P(E_2) + \dots + P(E_n) = 1$$

$$\Rightarrow k(1+2+3+4+5+6) = 1$$

$$\Rightarrow k = \frac{1}{\left(\frac{6 \cdot 7}{2}\right)} = \frac{1}{21}$$

$$\therefore P(E_3) = k \cdot 3 = \frac{1}{21} \times 3 = \frac{1}{7}$$

83. Answer (1)

$$n(E) = {}^3C_2 \times 2 \times \frac{10!}{3!3!4!}$$

$$P(E) = \frac{8}{11}$$

84. Answer (2)

$$Z = \frac{3 + 2i \sin \theta}{1 - 2i \sin \theta}$$

$$= \frac{3 - 4 \sin^2 \theta}{1 + 2 \sin^2 \theta} + i \frac{8 \sin \theta}{1 + 4 \sin^2 \theta}, Z \text{ is parallell}$$

$$\Rightarrow \sin \theta = 0$$

$$\theta = n\pi, n \in \mathbb{Z}$$

85. Answer (3)

As there are three letters alike out of six letters and the three others are different.

Selections can be made in the following ways:

- (i) All different ${}^4C_4 = 1$
 - (ii) 2 alike, 2 different ${}^1C_1 \times {}^3C_2 = 3$
 - (iii) 3 alike and 1 different ${}^1C_1 \cdot {}^3C_1 = 3$
- \therefore Total number of ways of selections
 $= 1 + 3 + 3 = 7$.

86. Answer (1)

We have $n(n+1) = n^2 + n < n^2 + n + n + 1 \forall n \geq 2$

$$\Rightarrow n(n+1) < (n+1)^2$$

$$\Rightarrow \sqrt{n(n+1)} < (n+1) \forall n \geq 2 \quad \dots(1)$$

\Rightarrow Statement-2 is true.

Also from (1)

$$\sqrt{n} < \sqrt{n+1}$$

$$\Rightarrow \frac{1}{\sqrt{n}} > \frac{1}{\sqrt{n+1}}, n \geq 2$$

$$\therefore \frac{1}{\sqrt{1}} > \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}} > \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}} > \frac{1}{\sqrt{4}}, \dots \forall n \geq 2$$

Adding all of them, we get

$$\frac{1}{\sqrt{1}} + \frac{1}{\sqrt{2}} + \frac{1}{\sqrt{3}} + \dots + \frac{1}{\sqrt{n}} > \frac{n}{\sqrt{n}}$$

\therefore Statement-1 is also true and statement-2 is the correct explanation for statment-1.

87. Answer (4)

Variance of first n even natural numbers

$$= \left[\frac{1}{n} \sum x_i^2 \right] - \left(\frac{\sum x_i}{n} \right)^2$$

$$= \frac{1}{n} [2^2 + 4^2 + 6^2 + \dots + \text{to } n \text{ terms}]$$

$$- \left(\frac{2 + 4 + 6 + \dots + \text{to } n \text{ terms}}{n} \right)^2$$

$$= \frac{1}{n} \times 2^2 (1^2 + 2^2 + 3^2 + \dots + \text{to } n \text{ terms})$$

$$- \left[\frac{2(1+2+3+\dots+n)}{n} \right]^2$$

$$= \frac{1}{n} \times 4 \times \frac{n(n+1)(2n+1)}{6} - \left[\frac{2n(n+1)}{n2} \right]^2$$

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

$$= \frac{(n+1)}{3} [2(2n+1) - 3(n+1)]$$

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

\therefore Statement-1 is false.

But statement-2 is true.

88. Answer (2)

For unique solution

$$\begin{vmatrix} a & b \\ c & d \end{vmatrix} \neq 0$$

where $a, b, c, d \in \{0, 1\}$

\therefore Total number of cases = $2 \times 2 \times 2 \times 2 = 16$

Since each of a, b, c or d can take any one of two values 0 or 1.

Favourable number of cases = 6 (either $ad = 1, bc = 0$, or $ad = 0, bc = 1$)

\therefore Probability that system of equations has unique

$$\text{solution} = \frac{6}{16} = \frac{3}{8} \Rightarrow \text{statment-1 is true.}$$

Since $x = 0, y = 0$ satisfy both the equations.

\Rightarrow The system has atleast one solution.

\therefore Statement-2 is also correct, but it is not the correct explanation for statement-1.

89. Answer (4)

Sum to n terms of AP is

$$S_n = \frac{n}{2} [2a + (n-1)d] = na + \frac{n}{2} (n-1)d$$

$$= na + n^2 \cdot \frac{d}{2} - n \cdot \frac{d}{2} = n \left(a - \frac{d}{2} \right) + \left(\frac{d}{2} \right) n^2$$

which is of the form $pn^2 + qn$

Hence statment-2 is true.

\therefore Statment-1 is false

90. Answer (1)

Since coefficient of x^r in $(1-x)^{-n} = {}^{n+r-1}C_r$

\therefore Coefficient of x^n in $(1-x)^{-2}$

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

\therefore Statment-2 is correct and statement-1 is also correct and statement-2 is the correct explanation for statement-1.