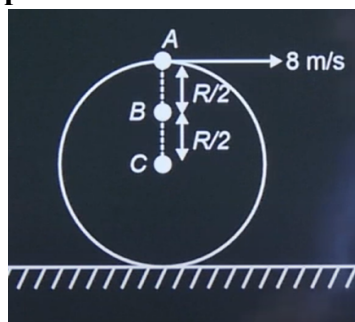


**JEE-Main-04-04-2025 (Memory Based)**

**[EVENING SHIFT]**

**Physics**

**Question:** A disc is performing pure rolling if speed of top point is 8 m/s. Find speed of point B.

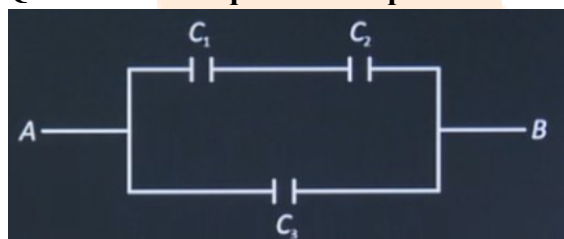


**Options:**

- (a) 2 m/s
- (b) 4 m/s
- (c) 6 m/s
- (d) 8 m/s

**Answer: (c)**

**Question:** The equivalent capacitance between A and B is

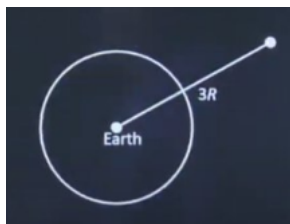


**Options:**

- (a)  $\frac{C_1 C_2 + C_2 C_3 + C_1 C_3}{C_2 + C_3}$
- (b)  $\frac{C_1 C_2 + C_1 C_3 + C_2 C_3}{C_1 + C_2}$
- (c)  $\frac{2C_1 C_2 + C_2 C_3}{C_2 + C_3}$
- (d)  $\frac{2C_2 C_3 + C_1 C_2}{C_1 + C_3}$

**Answer: (b)**

**Question:** A particle mass  $m$  is at a distance  $3R$  from the centre of Earth. Find minimum kinetic energy of particle to leave Earth's field ( $R$ : Radius of Earth)



**Options:**

- (a)  $\frac{mgR}{3}$   
 (b)  $3mgR$   
 (c)  $\frac{2}{3}mgR$   
 (d)  $\frac{mgR}{2}$

**Answer (a)**

**Question:** In a YDSE setup, the slits are separated by  $1.5 \text{ mm}$  and the distance between slits and screen is  $2 \text{ m}$ . On using light of wavelength  $400 \text{ nm}$ , it is observed that 20 Maximas of double slit experiment lie inside the central maxima of single slit diffraction. The width of each slit is \_\_\_\_\_  $\mu\text{m}$ .

**Answer: (150)**

**Question:** Relative permittivity and Relative permeability of a medium is

$\epsilon_r = \frac{1}{0.0885}$  and  $\mu_r = \frac{10}{\pi}$ . Find the ratio of speed of light in vacuum to the speed of light in the given medium

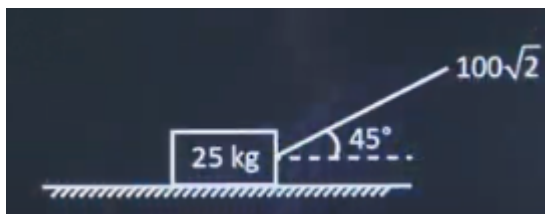
**Options:**

- (a) 6  
 (b) 3  
 (c) 4  
 (d) 2

**Answer: (a)**

**Question:** If the displacement of the block is  $5 \text{ m}$ , the work done by force applied is

(coefficient of friction between block and surface is  $\frac{1}{4}$ )



**Options:**

- (a)  $500\sqrt{2} \text{ J}$   
 (b)  $250 \text{ J}$

- (c) 100 J  
(d) 500 J

**Answer: (d)**

**Question:** A wave with angular frequency of 628 rad/sec is moving at 300 m/s. Find its wavelength

**Options:**

- (a) 1  
(b) 3  
(c) 5  
(d) 6

**Answer: (b)**

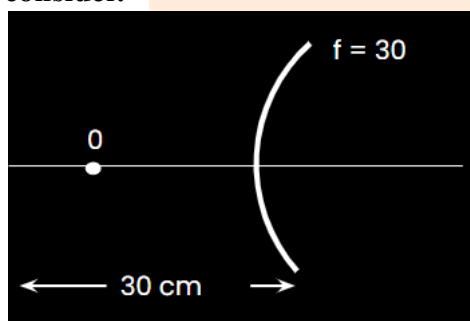
**Question:** The dimensional formula of the ratio of electrical dipole moment to the magnetic moment is  $M^P L^Q T^R A^S$ . Then P, Q, R and S are

**Options:**

- (a) 0, -1, 1, 0  
(b) 0, 1, -1, 0  
(c) 0, 1, 0, -1  
(d) 0, 1, 0, 1

**Answer: (a)**

**Question:** An object O is kept at 30 cm from convex mirror of focal length of  $f = 30$  cm as shown. Where to keep plane mirror so that image of plane mirror and convex mirror consider.



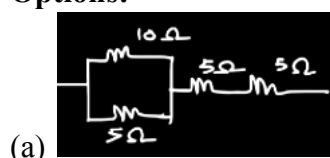
**Options:**

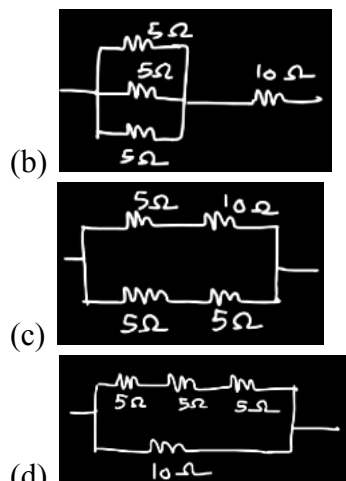
- (a) At 22.5 cm from o towards mirror  
(b) At 15 cm from o towards mirror  
(c) At 25 cm from o towards mirror  
(d) At 10 cm from o towards mirror

**Answer: (a)**

**Question:** If three 5 ohm resistance and one 10 ohm resistance are available. From the following network of resistors which combination give 6 ohm resistance.

**Options:**





Answer: (c)

**Question:** There is a spherical drop of liquid of radius  $R$  which is rotating about its own axis. The liquid evaporates till the radius becomes  $\frac{R}{2}$ . Find the ratio of  $\omega_1$  &  $\omega_2$ . The density remains same throughout in both the cases.

**Options:**

- (a)  $\frac{1}{32}$   
 (b)  $\frac{1}{16}$   
 (c)  $\frac{3}{16}$   
 (d)  $\frac{5}{8}$

Answer: (a)

**Question:** Two polarises  $P_1$  &  $P_2$  are aligned in such a way that intensity is zero.  $P_3$  polarised is inserted between  $P_1$  and  $P_2$  such that final transmitted ray will have the maximum intensity. Find angle between  $P_1$  and  $P_3$ .

**Options:**

- (a)  $\pi/4$   
 (b)  $\pi/2$   
 (c)  $\pi/3$   
 (d)  $\pi/8$

Answer: (a)

**Question:** Given below are two statements. One is labelled as Assertion (A) and the other is labeled as Reason (R).

**Assertion (A):** Plank's constant and linear momentum have same dimensions.

**Reason (R):** Bohr's angular momentum is integral multiple of  $\frac{h}{2\pi}$ .

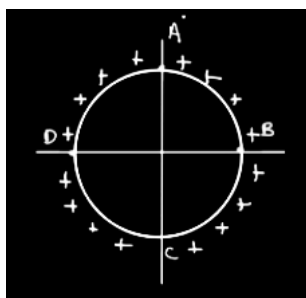
In the light of the above statements, choose the correct answer from the options given below:

**Options:**

- (a) (A) is false but (R) is true
- (b) (A) is true but (R) is false
- (c) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)
- (d) Both (A) and (R) are true but (R) is the correct explanation of (A)

**Answer: (a)**

**Question:** A uniformly charged ring having linear charge density  $\lambda$ . If electric field due charge on quadrant AB at the center of the ring is E. Find electric field at same point due arc ABC.

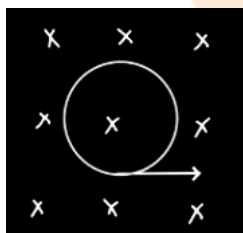


**Options:**

- (a)  $2E$
- (b)  $E$
- (c)  $\sqrt{2} E$
- (d)  $\sqrt{3} E$

**Answer: (c)**

**Question:** A charged particle of mass  $16 \mu\text{g}$  and charge  $1.6 \mu\text{C}$  gets a velocity in enters in a region of uniform and transverse magnetic field of  $6.28 \text{ T}$  Find time period of revolution of charged particle



**Options:**

- (a)  $0.02 \text{ sec}$
- (b)  $0.01 \text{ sec}$
- (c)  $10 \text{ sec}$
- (d)  $100 \text{ sec}$

**Answer: (b)**

**Question: Match the column.**

|    | Column-I          |     | Column-II            |
|----|-------------------|-----|----------------------|
| a. | Adiabatic process | (i) | $W \propto \Delta T$ |

|    |                    |       |                    |
|----|--------------------|-------|--------------------|
| b. | Isochoric process  | (ii)  | $W = 0$            |
| c. | Isobaric process   | (iii) | $\Delta U + W = 0$ |
| d. | Isothermal process | (iv)  | $\Delta U = 0$     |

**Options:**

- (a) a(ii), b(iii), c(i), d(iv)  
 (b) a(i), b(ii), c(iii), d(iv)  
 (c) a(iii), b(ii), c(i), d(iv)  
 (d) a(iii), b(ii), c(iv), d(ii)

**Answer: (c)**

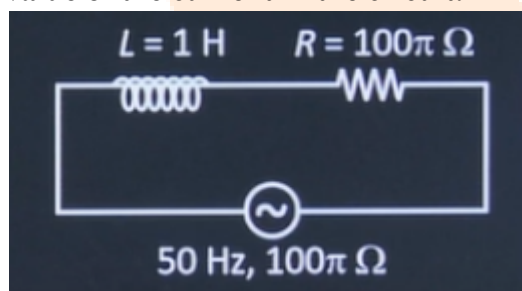
**Question:**  $n$  identical bulbs each takes power  $p$  when connected with main supply. If  $n$  bulbs are connected in series with main supply, then power will be

**Options:**

- (a)  $np$   
 (b)  $\frac{p}{n^2}$   
 (c)  $\frac{p}{n}$   
 (d)  $n^2p$

**Answer: (c)**

**Question:** An ac source of  $100\pi$  volt is connected to the given circuit. Find maximum value of the current in the circuit.

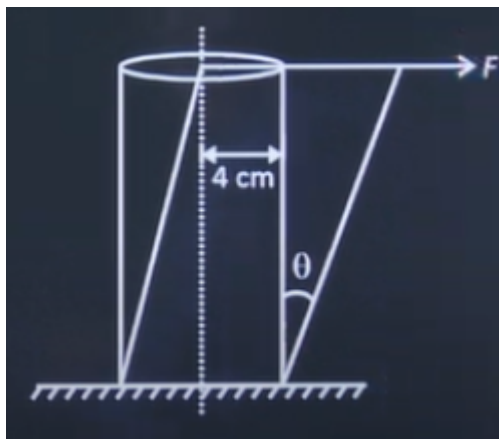


**Options:**

- (a)  $\frac{1}{\sqrt{2}}\text{ A}$   
 (b)  $1\text{ A}$   
 (c)  $\sqrt{3}\text{ A}$   
 (d)  $0.5\text{ A}$

**Answer: (b)**

**Question:** A force  $F = 10^5\text{ N}$  is applied on the cylinder as shown. If the shear modulus of the cylinder is  $10^{10}\text{ N/m}^2$  find  $\theta$ .



**Options:**

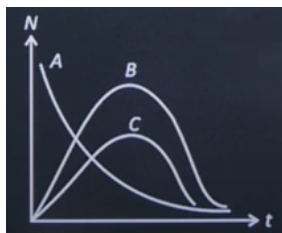
- (a)  $\pi/160$
- (b)  $1/160\pi$
- (c)  $1/16\pi$
- (d)  $\pi/16$

**Answer: (b)**

**Question:** In a successive nuclear decay, a sample of radioactive nuclei A decays into an unstable nuclei B which further disintegrates into a stable nuclei C. Which of the following graphs correctly represents the concentration of the nuclei as a function of time? (Assume concentration of B and C to be zero initially)

**Options:**

- (a)
- (b)
- (c)



(d)

Answer: (a)

**Question:** For n-type semi-conductor choose the correct option having correct statements

- (i)  $n_e \cdot n_n = n_i^2$
- (ii)  $n_e \cdot n_n \neq n_i^2$
- (iii) Pentavalent impurity
- (v) Additional are not generated
- (iv) Electrons are majority carriers

**Options:**

- (a) (ii), (iii), (iv)
- (b) (i), (iii), (iv), (v)
- (c) (i), (v) only
- (d) (i), (iii), (iv)

Answer: (b)

**Question:** Two adiabatic containers A and B have volume in the ratio 1: 2. The pressure and temperature for gas in A is 8 kPa and 1000 K, and the corresponding values for B is 7 kPa and 500 K. If the containers are connected by a thin pipe and gases are allowed to mix thoroughly, the final temperature of the mixture is 600 K. The final pressure in the vessel is

**Options:**

- (a) 7.6 kPa
- (b) 7.8 kPa
- (c) 7.4 kPa
- (d) 7.2 kPa

Answer: (d)

**JEE-Main-04-04-2025 (Memory Based)**

**[EVENING SHIFT]**

**Chemistry**

**Question:** Maximum IE and minimum IE of group 13 elements

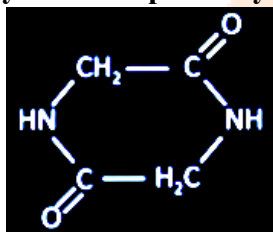
**Options:**

- (a) B, In
- (b) B, Tl
- (c) Al, In
- (d) Al, Tl

**Answer:** (a)

**Question:** x is peptide which is hydrolysed to 2 amino acids y and z, y when react with  $\text{HNO}_2$  gives lactic acid. z when heated gives cyclic structure as below:

y and z respectively are



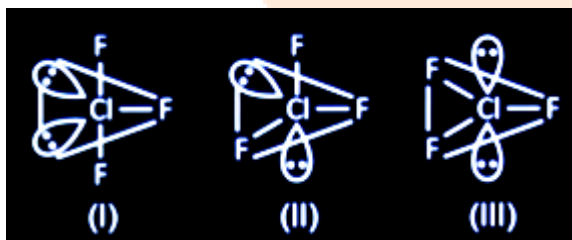
**Options:**

- (a) Alanine and Lysine
- (b) Alanine and Glycine
- (c) Glycine and Alanine
- (d) Valine and Glycine

**Answer:** (b)

**Question:** Statement-I:  $\text{ClF}_3$  has 3 possible structures

Statement-II: III is most stable structure due to least lp-bp repulsion.



**Options:**

- (a) Statement-I is correct and statement-II is incorrect
- (b) Statement-I is incorrect and statement-II is correct
- (c) Both statement-I and II are correct
- (d) Both statement-I and II are incorrect

**Answer:** (a)

**Question:** Consider the following graph between Rate Constant (K) and  $1/T$ .

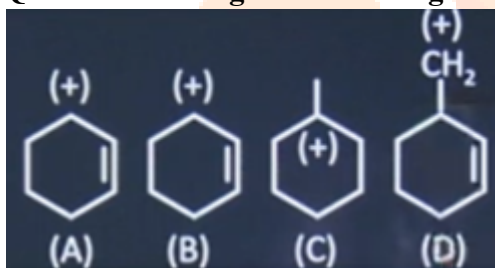


**Options:**

- (a)  $E_{a_1} > E_{a_2} > E_{a_3}$
- (b)  $E_{a_3} > E_{a_2} > E_{a_1}$
- (c)  $E_{a_3} > E_{a_1} > E_{a_2}$
- (d)  $E_{a_1} > E_{a_3} > E_{a_2}$

**Answer: (b)**

**Question:** Arrange the following carbocation in decreasing order of their stability



**Options:**

- (a) (A) > (B) > (C) > (D)
- (b) (A) > (C) > (B) > (D)
- (c) (C) > (A) > (B) > (D)
- (d) (B) > (C) > (A) > (D)

**Answer: (b)**

**Question: Statement-I:** Alcohol is prepared from alkyl halide in presence of aq. KOH by elimination

**Statement-II:** Alkenes are prepared from alkyl halide with alc. KOH by  $\beta$  - elimination

**Options:**

- (a) Statement-I and Statement-II are correct
- (b) Statement-I and Statement-II are incorrect
- (c) Statement-I is true and Statement-II is false
- (d) Statement-I is false and Statement-II is true

**Answer: (d)**

**Question:** A dipeptide 'x' on complete hydrolysis gives 'y' and 'z' y on treatment with aq  $\text{HNO}_2$  produces lactic acid on the other hand 'z' on heating gives the following molecule. Based on the information the given dipeptide is

**Options:**

- (a) Alanine - Glycine
- (b) Valine - Glycine

- (c) Valine - Leucine  
(d) Alanine - Alanine

**Answer: (a)**

**Question: Consider the following complex ions**

- (a)  $\text{Ni}(\text{CO})_4$  (b)  $[\text{Ni}(\text{CN})_6]^{2-}$   
(c)  $[\text{FeF}_6]^{3-}$  (d)  $[\text{CoF}_6]^{3-}$

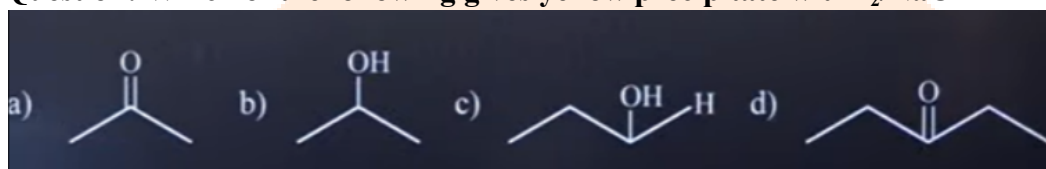
**Which of the following order is correct for their unpaired electrons**

**Options:**

- (a)  $c > d > a = b$   
(b)  $c > d > a > b$   
(c)  $a > b > c > d$   
(d)  $c > a > d > b$

**Answer: (a)**

**Question: Which of the following gives yellow precipitate with  $\text{I}_2/\text{NaOH}$**

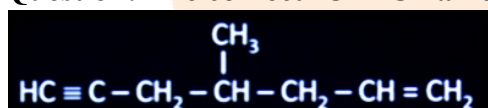


**Options:**

- (a) a & b  
(b) b & c  
(c) a & c  
(d) b & d

**Answer: (a)**

**Question: The correct IUPAC name of the following compound is**



**Options:**

- (a) 4-Hydroxyhept-1-en-6-yne  
(b) 4-Hydroxyhept-6-en-1-yne  
(c) 4-Hydroxyhept-1-yn-6-ene  
(d) 4-Hydroxyhept-6-yn-1-ene

**Answer: (a)**

**Question: Consider the following zero order reaction:**

**$\text{A} \rightarrow \text{Products}$**

**Half-life of the reaction is 1 hr if initial concentration of the reaction is 2 mol/L. Find the half-life of the reaction in minutes if the initial concentration of the reaction is 0.5 mol/L.**

**Options:**

- (a) 15  
(b) 35  
(c) 60  
(d) 55

Answer: (a)

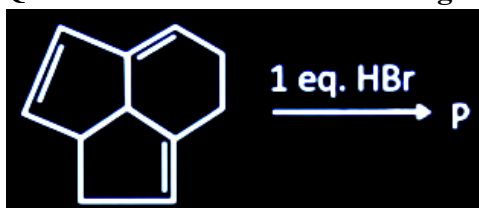
**Question:** The incorrect relationship in the following pair in relation to ionization enthalpies is

**Options:**

- (a)  $Mn^+ < Mn^{+2}$
- (b)  $Mn^{+2} < Fe^{+2}$
- (c)  $Fe^{+2} < Fe^{+3}$
- (d)  $Mn^+ < Cr^+$

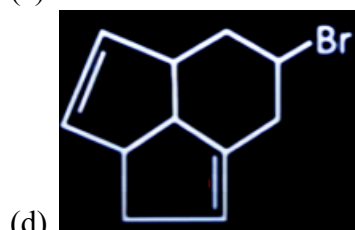
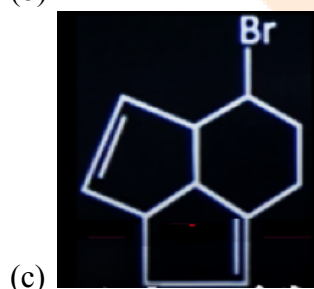
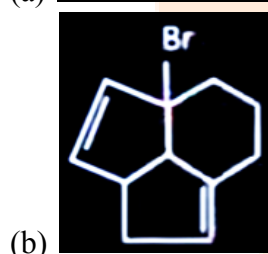
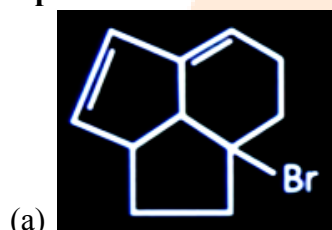
Answer: (c)

**Question:** Consider the following reaction,



Identify the major product of

**Options:**



Answer: (b)

**Question: Match the column**

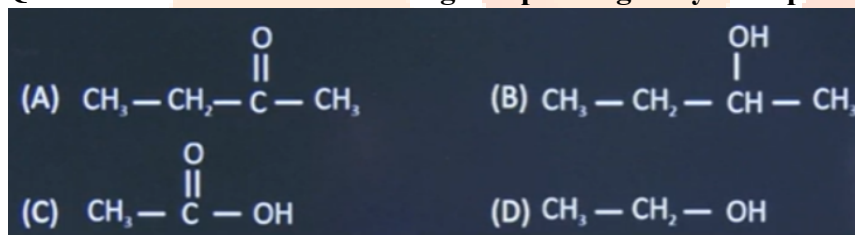
| List-I (Process) | List-II (Thermodynamic parameter) |
|------------------|-----------------------------------|
| (A) Adiabatic    | (1) $w = 0$                       |
| (B) Isobaric     | (2) $q = -w$                      |
| (C) Isochoric    | (3) $q = 0$                       |
| (D) Isothermal   | (4) $q = \Delta U + P\Delta V$    |

**Options:**

- (a) A-4, B-1, C-3, D-2
- (b) A-2, B-1, C-3, D-4
- (c) A-3, B-4, C-1, D-2
- (d) A-4, B-1, C-2, D-3

**Answer: (c)**

**Question: Which of the following compound gives yellow precipitate with NaOI?**



**Options:**

- (a) A, B & D
- (b) A only
- (c) A & C only
- (d) A & B only

**Answer: (a)**

**Question: Total number of electrons in chromium ( $Z = 24$ ) for which the value of azimuthal quantum number ( $l$ ) is 1 and 2**

**Answer: (17)**

**Question: If  $x$  mg of  $\text{Mg}(\text{OH})_2$  is added in 1 L of solution to make a solution with  $\text{pH} = 10$ , then find the value of  $x$ .**

**[Given: MW of  $\text{Mg}(\text{OH})_2 = 58 \text{ g/mol}$ ]**

**Assume  $\text{Mg}(\text{OH})_2$  dissociates completely in water.**

**Answer: (2.9)**

**Question:** The amount of Calcium Oxide produced when 150 kg of Limestone (75% pure) on strong heating is:

**Options:**

**Answer: (63)**



# JEE-Main-04-04-2025 (Memory Based)

## [EVENING SHIFT]

### Maths

**Question:**  $\cot^{-1}\left(\frac{7}{4}\right) + \cot^{-1}\left(\frac{19}{4}\right) + \cot^{-1}\left(\frac{39}{4}\right) + \dots \infty$

**Options:**

(a)  $\cot^{-1}(2)$

(b)  $\cot^{-1}\left(\frac{1}{2}\right)$

(c)  $\cot^{-1}\left(\frac{1}{3}\right)$

(d)  $\cot^{-1}(3)$

**Answer: (b)**

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

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

$$S_n = \sum_{r=1}^n T_r = \tan^{-1}\left(n + \frac{1}{2}\right) - \tan^{-1}\left(\frac{1}{2}\right)$$

$$S_n = \tan^{-1}(\infty) - \tan^{-1}\left(\frac{1}{2}\right) = \frac{\pi}{2} - \tan^{-1}\left(\frac{1}{2}\right)$$

$$= \cot^{-1}\left(\frac{1}{2}\right)$$

**Question:**  $\sum_{k=1}^n \left(\alpha^k + \frac{1}{\alpha^k}\right)^2 = 20$ ,  $\alpha$  is one of the root of  $x^2 + x + 1 = 0$  then  $n = ?$

**Answer: (n = 20)**

$$x^2 + x + 21 = 0 < \frac{w}{w^2}$$

$$x = \frac{-1 \pm \sqrt{1-4}}{2}$$

$$x = -\frac{1 \pm \sqrt{3}i}{2}$$

$$w^3 = 1$$

$$1 + w + w^2 = 0$$

$$w + w^2 = -1$$

$$\sum \left( w^k + \frac{1}{w^k} \right)^2 = 20$$

$$\sum_{k=1}^n \left( w^{2k} + \frac{1}{w^{2k}} + 2 \right) = 20$$

$$\sum_{k=1}^n (w^{2k} + w^k + 2) = 20$$

|                 |                 |
|-----------------|-----------------|
| $(w^2 + w + 2)$ | $w^4 + w^2 + 2$ |
| $-1$            | $w + w^2$       |
| $\Rightarrow 1$ | $-1 + 2$        |

$$n = 20$$

**Question:** Let  $L_1 : \frac{x-1}{3} = \frac{y}{4} = \frac{z}{5}$  and  $L_2 : \frac{x-p}{2} = \frac{y}{3} = \frac{z}{4}$ . If the shortest distance between  $L_1$  and  $L_2$  is  $\frac{1}{\sqrt{6}}$ . Then possible value of p is

**Options:**

- (a) 3
- (b) 2
- (c) 5
- (d) 7

**Answer:**  $(\sqrt{6})$

$$L_1 = \frac{x-1}{3} = \frac{y}{4} = \frac{x}{5}, L_2 = \frac{x-p}{2} = \frac{y}{3} = \frac{z}{4}$$

$$\begin{vmatrix} 1-p & 0 & 0 \\ 3 & 4 & 5 \\ 2 & 3 & 4 \end{vmatrix} = \frac{1}{\sqrt{6}}$$

$$\begin{vmatrix} 1-p & 0 & 0 \\ 3 & 4 & 5 \\ 2 & 3 & 4 \end{vmatrix} = \frac{1}{\sqrt{6}}$$

$$(3\hat{i} + 4\hat{j} + 5\hat{k}) \times (2\hat{i} + 3\hat{j} + 4\hat{k})$$

$$\hat{i} \quad \hat{j} \quad \hat{k}$$

$$3 \quad 4 \quad 5$$

$$2 \quad 3 \quad 4$$

$$= \hat{i}(1) - \hat{j}(2) + \hat{k}(1)$$

$$|\bar{b}_1 \times \bar{b}_2| = \sqrt{1+1+4}$$

$$\sqrt{6}$$

**Question:** Let the mean & variance of observation 2, 3, 3, 4, 5, 7, a, b is 4 and 2, then mean deviation about mode of the observation is

**Answer:** (1)

$$\sigma^2 = 2$$

$$\frac{2+3+3+4+5+7+a+b}{8} = 4$$

$$24 + a + b = 32$$

$$a + b = 8$$

$$\frac{2^2+3^2+3^2+4^2+5^2+7^2+a^2+b^2}{8} - 4^2 = 2$$

$$\frac{38+25+49+a^2+b^2}{8} = 18$$

$$a^2 + b^2 = 144 - 112$$

$$a^2 + b^2 = 32$$

$$2, 3, 3, 4, 4, 4, 5, 7$$

$$\text{mode} = 4$$

$$di : xi - m$$

$$di 2, 1, 1, 0, 0, 0, 1, 3$$

$$\bar{x} = \frac{8}{8} = 1$$

**Question:** If the sum of first 20 terms of series

$$\frac{4.1}{4 + 3.1^2 + 1^4} + \frac{4.2}{4 + 3.2^2 + 2^4} + \frac{4.3}{4 + 3.3^2 + 3^4} + \frac{4.4^5}{4 + 4.4^2 + 4^4} + \dots \text{ is } \frac{m}{n},$$

where m, n are co-primes, then m + n is equal to

**Options:**

(a) 422

(b) 423

(c) 420

(d) 421

**Answer:** (d)

$$a_n = \frac{4n}{4+3n^2+n^4}$$

$$a_n = \frac{4n}{n^2+4n^2+4-n^2} = \frac{4n}{(n^2+2)^2-n^2}$$

$$a_n = \frac{4n}{(n^2+n+2)(n^2-n+2)}$$

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

$$a_n = 2 \left[ \frac{1}{n^2-n+2} - \frac{1}{n^2+n+2} \right]$$

$$\left[ S_n = 2 \left[ \frac{1}{2} - \frac{1}{n^2+n+2} \right] \right]$$

put  $n = 20$

Ans = 421

**Question:** Let the three sides of a triangle ABC is given by vectors

$2\hat{i} - \hat{j} + \hat{k}$ ,  $\hat{i} - 3\hat{j} - 5\hat{k}$  &  $3\hat{i} - 4\hat{j} - 4\hat{k}$ , let G be the centroid of

triangle ABC. Then  $6 \left( |\vec{AG}|^2 + |\vec{BG}|^2 + |\vec{CG}|^2 \right)$  is \_\_\_\_\_

**Answer:** (164)

$$\vec{AB} = (2\hat{i} - \hat{j} + \hat{k})$$

$$\vec{BC} = \hat{i} - 3\hat{j} - 5\hat{k}$$

$$\vec{CA} = 3\hat{i} - 4\hat{j} - 4\hat{k}$$

$$G; \left( 2, -\frac{8}{3}, -\frac{8}{3} \right)$$

$$|GA| = \sqrt{0 + \frac{25}{9} + \frac{121}{9}}$$

$$|GA|^2 = \frac{146}{9}$$

$$|GB|^2 = 1^2 + \frac{1}{9} + \frac{49}{9}$$

$$= \frac{9+1+49}{9}$$

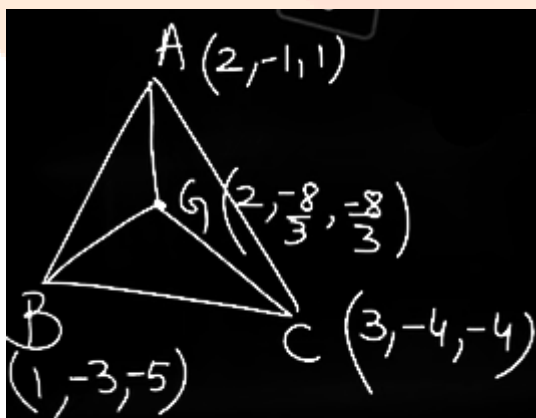
$$\frac{59}{9}$$

$$|GL|^2 = 1^2 + \frac{16}{9} + \frac{16}{9}$$

$$= \frac{9+32}{9} = \frac{41}{9}$$

$$\therefore 6 \left( \frac{146}{9} + \frac{59}{9} + \frac{41}{9} \right)$$

$$= 164$$



**Question:** Consider two sets A & B containing three numbers in A.P. Let the sum and the product of the elements of A be 36 and p respectively and the sum and the product

of B be 36 and q respectively. Let d & D be the common difference of AP's in A & B

respectively such that  $D = d + 3, d > 0$ . If  $\frac{p+q}{p-q} = \frac{19}{5}$  then p - q = ?

Answer: (= 6, -20.4)

$$A\{12 - d, 12, 12 + d\}$$

$$B\{12 - D, 12, 12 + D\}$$

$$p = (12 - d)12(12 + d)$$

$$q = (12 - D)12(12 + D)$$

$$\left[ \frac{p}{q} = \frac{(12-d)(12+d)}{(12-D)(12+D)} = \frac{144-d^2}{144+D^2} \right] = \frac{12}{7}$$

$$\frac{p+q}{p-q} = \frac{19}{5}$$

$$\frac{p+q+p-q}{p+1-(p-q)} = \frac{19+5}{19-5}$$

$$\frac{2p}{2q} = \frac{24}{14}$$

$$\frac{p}{q} = \frac{12}{7}$$

$$7(144) - 7d^2 = 12(144) - 12D^2$$

$$12D^2 - 7d^2 = 144(5)$$

$$12(d^2 + 9 + 6d) - 7d^2 - (144)5$$

$$5d^2 + 72d + 108 - 720 = 0$$

$$\begin{aligned}
 D &= d + 3 \\
 &= 6 + 3 = 9 \\
 p &= (12 - d)12(12 + s) \\
 &= (12 - 6)12(12 + 6) = 6 \times 12 \times 18 = 1206 \\
 q &= (12 - D)12(12 + D) \\
 &= (12 - 9)12(12 + 9) = 3 \times 12 \times 21 = 756 \\
 \therefore p - q &= 1206 - 756 = 450 \\
 5d^2 + 72d - 612 &= 0 \\
 \Rightarrow d &= \frac{-72 \pm \sqrt{72^2 + 4 \times 5 \times 612}}{2 \times 5} \\
 &= \frac{-72 \pm \sqrt{17424}}{10} \\
 &= \frac{-72 \pm 132}{10} \\
 &= \frac{60}{10}, -\frac{204}{10} \\
 &= 6, -20.4
 \end{aligned}$$

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

**Question:** Let the matrix  $A$  satisfy  $A^n = A^{n-2} + A^2 - I$  for  $n \geq 3$  then the sum of all the elements of  $A^{50}$  is \_\_\_\_\_

**Answer: (53)**

$$\begin{aligned}
 A^2 &= \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix} \\
 A^2 &= \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix} \\
 A^2 - I &= \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \end{bmatrix} \\
 A^4 &= \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix} \\
 A^4 &= \begin{bmatrix} 1 & 0 & 0 \\ 1+1 & 1 & 0 \\ 1+1 & 0 & 1 \end{bmatrix} \\
 A^6 &= \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 2 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix} \\
 A^6 &= \begin{bmatrix} 1 & 0 & 0 \\ 2+1 & 1 & 0 \\ 2+1 & 0 & 1 \end{bmatrix} \\
 A^3 &= A + A^2 - I \\
 A^4 &= A^2 + A^2 - I \\
 A^5 &= A^3 + A^2 - I \\
 A^{50} &= A^{48} + A^2 - I \\
 &\Rightarrow \begin{bmatrix} 1 & 0 & 0 \\ 24 & 1 & 0 \\ 24 & 0 & 1 \end{bmatrix} + \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \end{bmatrix} \\
 &= \begin{bmatrix} 1 & 0 & 0 \\ 25 & 1 & 0 \\ 25 & 0 & 1 \end{bmatrix} \\
 \therefore \text{Sum of all elements} &= 53
 \end{aligned}$$

**Question:** Let  $A = \{-3, -2, -1, 0, 1, 2, 3\}$  and  $xRy \Rightarrow 2x - y \in \{0, 1\}$ . If  $l$  is number of elements in given relation,  $m$  and  $n$  are minimum number of elements to be added to make it reflexive and symmetric respectively. Then  $l + m + n$  equals to

**Answer: (17)**

$$A = \{-3, -2, -1, 0, 1, 2, 3\}$$

$$xRy \Rightarrow 2x - y \in \{0, 1\}$$

$$2x - y = 0 \quad 2x - y = 1$$

$$x \ y \quad x \ y$$

$$-1 \ -2 \quad -1 \ -3$$

$$0 \ 0 \quad 0 \ -3$$

$$1 \ 2 \quad 1 \ 1$$

$$2 \ 3$$

Relation

$$\{(-1, 2), (0, 0), (1, 2), (-1, 3), (0, -1), (1, 1), (2, 3)\}$$

$$l = \text{no. of cells in } R = 7$$

$$\text{Reflexive} = (-3, -3), (2, -2), (-1, -1), (2, 2), (3, 3) : 5 \text{ cells required}$$

$$\text{Symmetric} = (-2, -1), (2, 1), (-3, -1), (-1, 0), (3, 2) : 5 \text{ cells required}$$

$$l + m + n = 7 + 5 + 5 = 17$$

**Question:** Let  $f(x)$  and  $g(x)$  satisfies the functional equation  $2g(x) + 3g(1/x) = x$  and  $2f$

$$(x) + 3f(1/x) = x^2 + 5. \text{ If } \alpha = \int_1^2 f(x)dx \text{ and } \beta = \int_1^2 f(x)dx \text{ is equal to}$$

**Options:**

$$(a) \frac{27 + 6\ell n_2}{10}$$

$$(b) \frac{27 - 6\ell n_2}{10}$$

$$(c) \frac{3}{5} \ell n_2$$

$$(d) \frac{3}{5} \ell n_2 + \frac{7}{30}$$

**Answer:** (a)

**Question:** If  $12 \cdot {}^{15}C_1 + 22 \cdot {}^{15}C_2 + \dots + 152 \cdot {}^{15}C_{15}$  is equal to  $2n \times 3m \times 5k$ , then  $m + n + k$  is equal to

**Answer:**  $(2^{17} \cdot 3 \cdot 5)$

$$\begin{aligned}
 & \sum_{r=1}^{15} r^2 \cdot {}^{15}C_r \\
 & \Rightarrow 15 \sum_{r=1}^{15} r \cdot {}^{14}C_{r-1} \\
 & \Rightarrow 15 \sum_{r=1}^{15} (r-1+1) \cdot {}^{14}C_{r-1} \\
 & = 15 \sum_{r=1}^{15} (r-1) {}^{14}C_{r-1} + 15 \sum_{r=1}^{15} {}^{14}C_{r-1} \\
 & = 15 \sum_{r=0}^{14} r \cdot {}^{14}C_r + 15 \cdot 2^{14} \\
 & = 15 \cdot 14 \cdot \sum {}^{13}C_{r-1} + 15 \cdot 2^{14} \\
 & = 15 \cdot 14 \cdot 2^{13} + 15 \cdot 2^{14} \\
 & = 15 \cdot 2^{13} (14 + 2) = 15 \cdot 2^{13} \cdot 16 \\
 & = 2^{17} \cdot 3 \cdot 5
 \end{aligned}$$