

**SUBJECT: SCIENCE I**

**MAX. MARKS: 40**

**SOLUTIONS**

**CLASS: X**

**DURATION: 2 Hrs.**

**Q.1 A Write the correct alternative (1 marks each)**

**4M**

- i. (C) Concave lens
- ii. (B)  $m = -1$
- iii. (D) Electric Generator
- iv. (C) Bromine
- v. (A) Solar photovoltaic cells

**Q.1 B Answer the following: (1 mark each)**

**4M**

- i. (i)-(b), (ii)-(c)

- ii.  $\text{BaSO}_4$  : White

Lead iodide forms yellow precipitate & Barium sulphate forms white precipitate

- iii. Low refractive index.

- iv. 400

- v. True

**Q.2 A Give scientific reasons. (Any two) (2 marks each)**

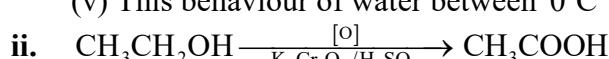
**4M**

- i. (i) Electric bulb works on the principle of heating effect electric of current.  
(ii) The solenoid type coil of bulb has high resistivity. Hence, it can be heated by passing current through it.  
(iii) The melting point of tungsten is very high. So, when the tungsten filament is heated at very high temperature, it does not melt.  
(iv) The intensity of light emitted by filament depends on the temperature. Hence, when current is passed through the bulb, the filament gets heated to high temperature(up to  $3400^{\circ}\text{C}$ ) and starts glowing.  
Hence, tungsten metal is used to make a solenoid type coil in an electric bulb.
- ii. Rancidity is the oxidation of fats and oils in food, which results in an unpleasant smell and taste. Storing food in airtight containers helps prevent rancidity by limiting the exposure of the food to oxygen in the air, which slows down the oxidation process.
- iii. Metallic character is the tendency of an element to lose electrons. As we move down a group in the periodic table, the number of electron shells increases. This increases the distance between the valence electrons and the nucleus, and the inner electrons shield the valence electrons from the nucleus's pull. This makes it easier for the atom to lose its valence electrons, so the metallic character increases.

**Q.2 B Answer the following : (Any three) (2 marks each)**

**6M**

- i. (i) Generally, liquids expand on heating and contract on cooling  
(ii) Water, however, behaves strangely between  $0^{\circ}\text{C}$  and  $4^{\circ}\text{C}$ .  
(iii) When water is heated from  $0^{\circ}\text{C}$  upto  $4^{\circ}\text{C}$ , instead of expanding it contracts. Its volume decreases and it becomes minimum at  $4^{\circ}\text{C}$ .  
(iv) Upon heating further, however, water starts to expand and its volume increases.  
(v) This behaviour of water between  $0^{\circ}\text{C}$  and  $4^{\circ}\text{C}$  is called anomalous behaviour of water.



- iii. Distinguish between Gravitational constant (G) and acceleration due to gravity (g).

|     | Gravitational constant(G)  | Acceleration due to gravity(g)   |
|-----|--|--|
| (i) | The gravitational force acting between unit masses kept at a unit distance away from each other equals gravitational constant(G) | The acceleration produced in a body under the influence of the force of gravity alone is called acceleration due to gravity(g) |

|       |  |  |
|-------|--|--|
| (ii)  | Gravitational constant is a scalar quantity.                       | Acceleration due to gravity is a vector quantity.  |
| (iii) | The value of gravitational constant is a constant.                 | The value of acceleration due to gravity depends only on the mass M and radius R of the earth or the planet. |
| (iv)  | The value of $G = 6.67 \times 10^{-11} \text{ Nm}^2 / \text{kg}^2$ | The value of $g = 9.8 \text{ m/s}^2$ on earth's surface.   |
| (v)   | The S.I. unit of gravitational is $\text{Nm}^2 / \text{kg}^2$      | The S.I. unit of acceleration due to gravity is $\text{m/s}^2$   |

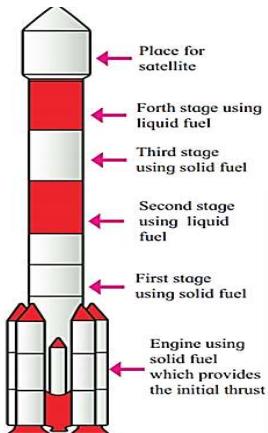
iv. (a) Satellite launcher: PSLV  
 (b) Satellite launcher: GSLV  
 (c) Function: To fix the location of any place on earth's surface  
 (d) Indian satellites: INSAT and GSAT

v. Isotopes are atoms of the same element that have same number of protons but a different number of neutrons.

In Mendeleev's periodic table, which is based on atomic mass, isotopes of the same element would have to be placed in different positions because they have different atomic masses. However, this would contradict the chemical properties of the elements. For example, chlorine has two isotopes, Cl-35 and Cl-37. Placing them in different positions would mean that chlorine would have two positions in the table, which is not feasible.

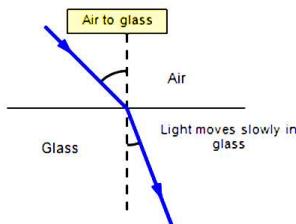
In the **modern periodic table**, which is based on atomic number, all isotopes of a given element have the same atomic number (number of protons). Therefore, they are placed in the same position in the periodic table. This is a significant advantage of the modern periodic table over Mendeleev's.

### Q.3 A

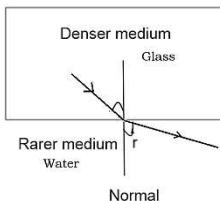


ii. (a) X belongs to Group 17 and 3rd periods, while Y belongs to Group 2 and 4th.  
 (b) X is a Nonmetal, while Y is a metal.  
 (c) Y will form a basic oxide, and it will have an ionic bonding.

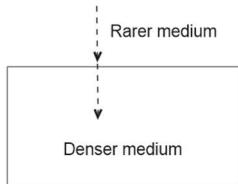
iii. (i) Effect - Speed decreases and bends towards the normal



(ii) Effect - speed increases and bends away from the normal



(iii) EFFECT- it passes through without bending or deviation

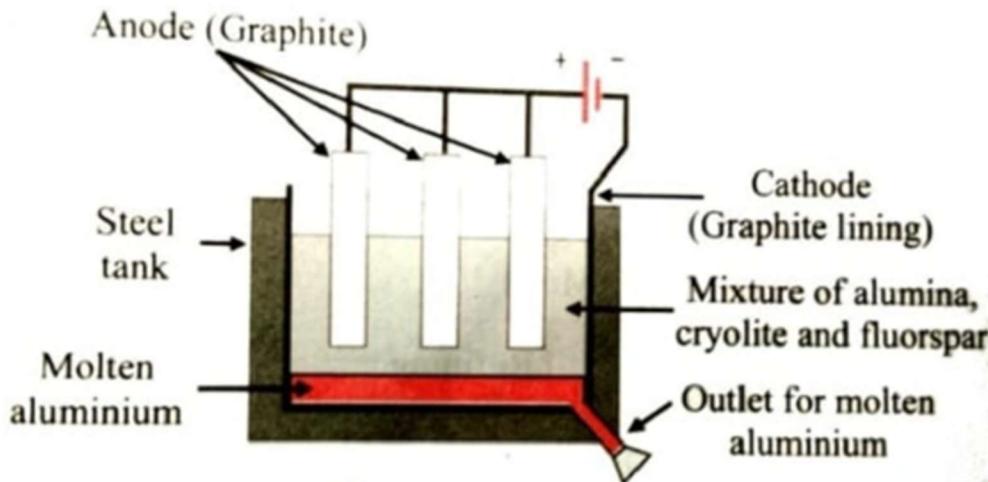


iv. (i) The pure alumina obtained from bauxite ore by Bayer's process or Hall's process is electrolyzed to obtain metallic aluminium;

(ii) Alumina has a very high melting point ( $> 2000^{\circ}\text{C}$ ).

(iii) Electrolysis of alumina is carried out in an electrolytic cell at a much lower temperature by dissolving it in molten cryolite ( $\text{Na}_3\text{AlF}_6$ ) and fluorspar ( $\text{CaF}_2$ ).

Addition of cryolite and fluorspar reduces the melting point to about  $1000^{\circ}\text{C}$



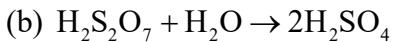
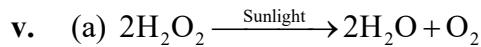
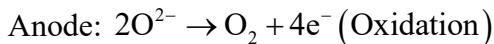
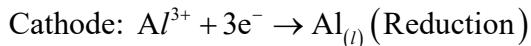
### Electrolytic reduction of alumina

(iv) The electrolytic cell is a large steel tank having a lining of carbon(graphite) on the inner side. The carbon lining acts as cathode. A set of carbon(graphite) rods dipped in the molten electrolyte acts as anode.

(v) On passing electric current, electrolysis of alumina takes place.

(vi) Aluminium is formed at the cathode and oxygen gas is liberated at the anode.

(vii) The electrode reactions are as follows:



vi. (i) Regelation

(ii) The phenomenon in which the ice converts to liquid due to applied pressure and then re-converts to ice once the pressure is removed is called regelation.

(iii) Preparation of ice balls uses phenomenon of regelation. The shredded ice is pressurised around the tip of the stick and then due to regelation gets re-freezed in the form of a single solid ice ball.

vii.

| A   | B   | C                       |
|---|---|-------------------------|
| (i) $\text{CH}_3 - \text{CH}_3 + \text{Cl}_2 \rightarrow$                           | $\text{CH}_3\text{CH}_2\text{Cl} + \text{HCl}$  | Substitution reaction   |
| (ii) $\text{CH}_3\text{CH}_2\text{CH}_3 + 5\text{O}_2$                              | $3\text{CO}_2 + 4\text{H}_2\text{O}$  | Combustion Reaction     |
| (iii) $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_3 + \text{Br}_2 \rightarrow$ | $\text{CH}_3 - \underset{\substack{\text{Br} \\  }}{\text{CH}} - \underset{\substack{\text{Br} \\  }}{\text{CH}} - \text{CH}_3$ | Addition Reaction       |
| (iv) $\text{CH}_3\text{CH}_2\text{COOH} + \text{NaOH} \rightarrow$                  | $\text{CH}_3\text{CH}_2\text{COONa} + \text{H}_2\text{O}$   | Neutralisation reaction |

viii. (i) Direct current (DC)

(ii) Alternating current(AC)

(iii) Current  $I_1$  is non-oscillatory , whereas current  $I_2$  is oscillatory in nature

Q.4 (a) (i) **Ciliary muscles:** They help the eye lens to adjust the focal length depending on the distance of the object by contracting or relaxing.

(ii) **Retina:** It is the screen inside the human eye which contains light sensitive cells. Image of an object is formed on this screen.

(iii) **Optic nerve:** The sensitive cells on retina get excited when light falls them and generate electric Signals to the brain

(b) Cornea

(c) Real and inverted

ii. Complete the following table:

| S No | IUPAC Name  | Structural Formulae  |
|------|---|--|
| 1.   | Pent-2-ene  | $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_2 - \text{CH}_3$      |
| 2.   | <u>Butanoic acid</u>  | $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$                         |
| 3.   | Ethanamine  | $\text{CH}_3 - \text{CH}_2 - \text{NH}_2$                              |
| 4.   | <u>Methanal</u>   | $\text{H} - \underset{\substack{\text{O} \\   }}{\text{C}} - \text{H}$ |
| 5.   | $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \underset{\substack{  \\ \text{OH}}}{\text{CH}} - \text{CH}_3$ | Pentan-2-ol  |

SUBJECT: MATHS-I (ALGEBRA)

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SOLUTIONS

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Duration: 2 HRS.

**Q.1 A** Choose the correct alternative from the options given and write exact alphabetical letter to indicate the answer:

4M

**i)**

The determinant of a  $2 \times 2$  matrix  $\begin{vmatrix} a & b \\ c & d \end{vmatrix}$  is calculated as  $ad - bc$ .

Given the determinant:  $\begin{vmatrix} 5 & 3 \\ -7 & -4 \end{vmatrix}$

Here,  $a = 5$ ,  $b = 3$ ,  $c = -7$  and  $d = -4$ .

The value of the determinant is:

$$= (5)(-4) - (3)(-7)$$

$$= -20 - (-21)$$

$$= 1$$

**ii)**

$$(A) \frac{5}{x} - 3 = x^2$$

Multiplying by  $x$  to eliminate the fraction gives  $5 - 3x = x^3$ . This is a cubic equation because the highest power of  $x$  is 3.

$$(B) x(x + 5) = 2$$

Expanding the left side gives  $x^2 + 5x = 2$ . Rearranging it into the standard form gives

$$x^2 + 5x - 2 = 0. \text{ This is a quadratic equation.}$$

$$(C) n - 1 = 2n$$

Rearranging gives  $n = -1$ . This is a linear equation because the highest power of  $n$  is 1.

$$(D) \frac{1}{x^2}(x + 2) = x$$

Multiplying by  $x^2$  to eliminate the fraction gives  $x + 2 = x^3$ . This is a cubic equation.

**iii)**

An arithmetic progression (A.P.) is a sequence of numbers in which the difference between consecutive terms is constant. This constant difference is called the common difference, denoted by  $d$ .

To determine if the given sequence  $-10, -6, -2, 2, \dots$  is an A.P., we calculate the difference between consecutive terms:

$$\text{Second term minus first term: } (-6) - (-10) = -6 + 10 = 4$$

$$\text{Third term minus second term: } (-2) - (-6) = -2 + 6 = 4$$

$$\text{Fourth term minus third term: } 2 - (-2) = 2 + 2 = 4$$

Since the difference between consecutive terms is consistently 4, the sequence is an A.P. with a common difference  $d = 4$ .

**iv) The sum of the digits on the upper faces is 33.**

**Step 1 – Identify the favorable outcomes.**

The maximum possible sum of the digits on the upper faces of two dice is  $6 + 6 = 12$ . Since the required sum is 33, which is greater than the maximum possible sum, there are no favorable outcomes.

**Step 2 - Calculate the probability.**

The number of favorable outcomes is 0.

$$P(\text{sum}=33) = \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}} = \frac{0}{36} = 0$$

**Answer:** The probability is 0.

**Q.1 B Solve the following questions :**

**4M**

**i) Step 1 – Recall Cramer’s rule for a system of two linear equations**

The solution for a system of two linear equations in variables x and y using Cramer’s rule is given by:

$$x = \frac{D_x}{D}, \quad y = \frac{D_y}{D}$$

**Step 2 - Substitute the given values into the formula for x.**

Given the values  $D_x = 49$  and  $D = 7$ , substitute them into the formula for x:

$$x = \frac{49}{7}$$

**Step 3- Calculate the value of x.**

$$x = 7$$

**ii) Step 1- Identify the formula**

The sum of the first n natural numbers, often represented as  $S_n$ , is given by the formula;

$$S_n = 1 + 2 + 3 + \dots + n$$

This is an arithmetic progression with the first term  $a_1 = 1$ , the last term  $a_n = n$ , and the number of terms equal to n.

**Step 2 – Apply the arithmetic series formula**

The sum of an arithmetic series is given by the formula:

$$S_n = \frac{n}{2}(a_1 + a_n)$$

Substitute the value  $a_1 = n$  and  $a_n = n$  into the formula:

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

This can also be written as:

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

The sum of the first n natural numbers is  $S_n = \frac{n(n+1)}{2}$ .

**iii) Step 1: Understand CGST and SGST**

CGST (Central Goods and Services Tax) and SGST (State Goods and Services Tax) are two components of GST applied to intra-state transactions. The rates of CGST and SGST are always equal.

**Step 2: Calculate the rate of SGST**

Given that the rate of CGST is 9%, the rate of SGST will also be 9%.

Rate of SGST = Rate of CGST

Rate of SGST = 9%

**Step 3: Calculate the rate of GST**

GST (Goods and Services Tax) is the sum of CGST and SGST.

Rate of GST = Rate of CGST + Rate of SGST

Rate of GST = 9% + 9%

Rate of GST = **18%**

**iv) Step 1: Find the total number of pens**

The total number of pens is the sum of the red, blue, and green pens.

Total pens = 5 (red) + 8 (blue) + 3 (green)

Total pens =  $5 + 8 + 3 = 16$

**Step 2: Find the number of blue pens**

The number of blue pens is given in the problem.

Number of blue pens = 8

**Step 3: Calculate the probability of picking a blue pen**

The probability of an event is the ratio of the number of favorable outcomes to the total number of possible outcomes.

$$P(\text{blue}) = \frac{\text{Number of blue pens}}{\text{Total number of pens}}$$

$$P(\text{blue}) = \frac{8}{16} = \frac{1}{2}$$

**Answer:** The probability of picking a blue pen is  $\frac{1}{2}$ .

**Q.2 A Complete the following activities. (Any two)**

**4M**

**i) The given equations are:**

$$5x + 3y = 9 \quad \dots(\text{I})$$

$$2x - 3y = 12 \quad \dots(\text{II})$$

Adding equation (I) and (II):

$$(5x + 3y) + (2x - 3y) = 9 + 12$$

$$7x = 21$$

$$x = \frac{21}{7}$$

$$x = 3$$

**Step 2: Substitute the value of x into equation (I) to find y.**

Substitute  $x = 3$  into equation (1):

$$5(3) + 3y = 9$$

$$15 + 3y = 9$$

$$3y = 9 - 15$$

$$3y = -6$$

$$y = \frac{-6}{3}$$

$$y = -2$$

The solution is  $(x, y) = (3, -2)$ .

**ii) Step 1:** Substitute the given root into the equation

Since  $x = 5$  is a root of the equation  $kx^2 - 14x - 5 = 0$  substitute  $x = 5$  into the equation.

**Solution:** One of the roots of equation  $kx^2 - 14x - 5 = 0$  is 5.

$\therefore$  Now Let  $x = 5$  in the equation.

$$k(5)^2 - 14(5) - 5 = 0$$

**Step 2:** Simplify the equation

Simplify the equation by performing the calculations.

$$k(25) - 70 - 5 = 0$$

$$25k - 75 = 0$$

**Step 3:** Solve for k

Isolate k to find its value.

$$25k - 75 = 0$$

$$25k = 75$$

$$\therefore k = \frac{75}{25} = 3$$

The value of k is 3.

**iii) Step 1:** Calculate the Market Value (MV)

The Market Value of a share is the Face Value (FV) plus the premium.

$$MV = FV + \text{Premium}$$

$$MV = 10 + 2$$

$$MV = 12$$

**Step 2:** Calculate the number of shares

The number of shares purchased is the total investment divided by the Market Value per share

$$\text{Number of shares} = \frac{\text{Total investment}}{MV}$$

$$\text{Number of shares} = \frac{12000}{12}$$

$$\text{Number of shares} = 1000$$

**Answer:**

Smita has purchased **1000** shares.

**Q.2 B Solve the following questions. (Any four)****8M**

i.  $3a + 5b = 26 \quad \dots\dots(1)$

$a + 5b = 22 \quad \dots\dots(2)$

$3a + 5b = 26 \quad \dots\dots(1)$

$a + 5b = 22 \quad \dots\dots(2)$

$$\begin{array}{r} - - - \\ 2a = 4 \end{array}$$

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

$$\therefore a = 2$$

Put in equation ....(1)

$$3a + 5b = 26$$

$$3(2) + 5b = 26$$

$$6 + 5b = 26$$

$$5b = 26 - 6$$

$$5b = 20$$

$$\therefore b = \frac{20}{5} \therefore b = 4$$

**ii. Step 1:** Identify the first term and the common difference.

The given arithmetic progression (A.P.) is 7, 13, 19, 25, ...

The first term,  $a$ , is 7.

The common difference,  $d$ , is the difference between any two consecutive terms.

$$d = 13 - 7 = 6$$

$$d = 19 - 13 = 6$$

So, the common difference is  $d = 6$ .

**Step 2:** Use the formula for the  $n^{\text{th}}$  term of an A.P.

The formula for the  $n^{\text{th}}$  term of an A.P. is given by:

$$a_n = a + (n - 1)d$$

We need to find the  $19^{\text{th}}$  term, so we will substitute  $n = 19$   $a = 7$  and  $d = 6$  into the formula.

$$a_{19} = 7 + (19 - 1)6$$

$$a_{19} = 7 + 18 \cdot 6$$

$$a_{19} = 7 + 108$$

$$a_{19} = 115$$

**Answer:** The  $19^{\text{th}}$  term of the A.P. is 115.

**iii** Step 1 :Substitute the root into the equation

Since  $x = 3$  is a root of the equation  $kx^2 - 10x + 3 = 0$ , we can substitute  $x = 3$  into the equation.

$$k(3)^2 - 10(3) + 3 = 0$$

Step 2 : Simplify and solve for k

$$9k - 30 + 3 = 0$$

$$9k - 27 = 0$$

$$9k = 27$$

$$k = \frac{27}{9}$$

$$k = 3$$

The value of k is 3.

**iv.** **Step 1:** Calculate the total taxable value

The taxable value of each tin is ₹ 2800. Since 2 tins were sold, the total taxable value is:

$$\text{Total taxable value} = 2 \times 2800 = 5600$$

**Step 2:** Calculate the total GST amount

The rate of GST is 28%. The total GST amount is calculated on the total taxable value

$$\text{Total GST amount} = 5600 \times \frac{28}{100} = 1568$$

**Step 3:** Calculate the CGST and SGST amounts

CGST (Central Goods and Services Tax) and SGST (State Goods and Services Tax) are each half of the total GST amount.

$$\text{CGST} = \text{SGST} = \frac{\text{Total GST amount}}{2} = \frac{1568}{2} = 784$$

**Answer:** The amount of CGST and SGST charged in the tax invoice is ₹ 784 each.

**v.** **Step 1 – Understand the assumed mean method**

The mean using the assumed mean method is calculated using the formula:

$$\bar{x} = A + \frac{\sum f_i d_i}{\sum f_i}$$

Where:

- $\bar{x}$  is the mean
- $A$  is the assumed mean
- $\sum f_i d_i$  is the sum of the products of the frequencies and the deviations
- $\sum f_i$  is the sum of the frequencies

**Step 2:** Identify the given values from the table

From the provided table, we can identify the following values:

- Assumed mean,  $A = 300$
- Sum of frequencies,  $\sum f_i = 50$

- Sum of the products of frequencies and deviations,  $\sum f_i i = 320$

**Step 3:** Calculate the mean

Substitute the values from Step 2 into the formula from Step 1:

$$\bar{x} = 300 + \frac{320}{50}$$

$$\bar{x} = 300 + 6.4$$

$$\bar{x} = 306.4$$

The mean is 306.4

**Q.3 A Complete the following activities (Any one)**

**3M**

**i. Step 1:** Calculate the taxable amount for Masala Dosa

The taxable amount is the product of the quantity and the rate.

Taxable amount for Masala Dosa = Quantity X Rate Taxable amount for Masala Dosa =  $2 \times 60 = 120.00$

**Step 2:** Calculate the CGST and SGST for Masala Tea

The CGST and SGST are both 2.5% of the taxable amount.

$$\text{CGST for Masala Tea} = 10.00 \times 2.5\% = 10.00 \times \frac{2.5}{100} = 0.25$$

$$\text{SGST for Masala Tea} = 10.00 \times 2.5\% = 10.00 \times \frac{2.5}{100} = 0.25$$

**Step 3:** Calculate the SGST for Coffee

$$\text{SGST for Coffee} = 20.00 \times 2.5\% = 20.00 \times \frac{2.5}{100} = 0.50$$

**Step 4:** Calculate the CGST for Masala Dosa

$$\text{CGST for Masala Dosa} = 120.00 \times 2.5\% = 120.00 \times \frac{2.5}{100} = 3.00$$

**Step 5:** Calculate the Total CGST

Total CGST = CGST for Coffee + CGST for Masala Tea + CGST for Masala Dosa

$$\text{Total CGST} = 0.50 + 0.25 + 3.00 = 3.75$$

**Step 6:** Calculate the Grand Total

Grand Total = Total Taxable Amount + Total CGST + Total SGST

$$\text{Grand Total} = 150.00 + 3.75 + 3.75 = 157.50$$

**Answer:**

The completed tax invoice is:

- Masala Tea CGST: 0.25
- Masala Tea SGST: 0.25
- Masala Dosa Taxable amount: 120.00
- Masala Dosa CGST: 3.00
- Coffee SGST: 0.50
- Total CGST : 3.75
- Grand Total : 157.50

The problem asks to form a committee of two from two boys (B<sub>1</sub>, B<sub>2</sub>) and two girls (G<sub>1</sub>, G<sub>2</sub>).

(a) Committee of 2 boys:

There is only one way to choose 2 boys from 2 boys.

(B<sub>1</sub>, B<sub>2</sub>)

(b) Committee of 2 girls:

There is only one way to choose 2 girls from 2 girls.

(G<sub>1</sub>, G<sub>2</sub>)

(c) Committee of one boy and one girl:

The possible combinations are:

(B, G<sub>1</sub>), (B<sub>1</sub>, G<sub>2</sub>), (B<sub>2</sub>, G<sub>1</sub>), (B<sub>2</sub>, G<sub>2</sub>)

### Step 2: Find the sample space (S)

The sample space (S) is the set of all possible outcomes for a committee of two. It includes all the combinations from the previous step.

$$S = \{(B_1, B_2), (G_1, G_2), (B_1, G_1), (B_1, G_2), (B_2, G_1), (B_2, G_2)\}$$

Answer:

(a) Committee of 2 boys = {(B<sub>1</sub>, B<sub>2</sub>)}  
(b) Committee of 2 girls = {(G<sub>1</sub>, G<sub>2</sub>)}  
(c) Committee of one boy and one girl = {(B<sub>1</sub>, G<sub>1</sub>), (B<sub>1</sub>, G<sub>2</sub>), (B<sub>2</sub>, G<sub>1</sub>), (B<sub>2</sub>, G<sub>2</sub>)}  
(d) Sample space (S) = {(B<sub>1</sub>, B<sub>2</sub>), (B<sub>1</sub>, G<sub>1</sub>), (B<sub>1</sub>, G<sub>2</sub>), (B<sub>2</sub>, G<sub>1</sub>), (B<sub>2</sub>, G<sub>2</sub>), (G<sub>1</sub>, G<sub>2</sub>)}  
**Q3.B** Solve the following questions (Any two) 6M

i. **Step 1:** Write the equations in matrix form

The given simultaneous equations are:

$$4m + 6n = 54$$

$$3m + 2n = 28$$

The matrix form of the equations is:

$$A = \begin{pmatrix} 4 & 6 \\ 3 & 2 \end{pmatrix}, X = \begin{pmatrix} m \\ n \end{pmatrix}, B = \begin{pmatrix} 54 \\ 28 \end{pmatrix}$$

**Step 2:** Calculate the determinant of the coefficient matrix, D

$$D = \det(A) = \begin{vmatrix} 4 & 6 \\ 3 & 2 \end{vmatrix} = (4)(2) - (6)(3) = 8 - 18 = -10$$

**Step 3:** Calculate the determinant of the matrix for m, D<sub>m</sub>

To find D<sub>m</sub>, replace the first column of matrix A with the constant terms from matrix B.

$$D_m = \begin{vmatrix} 54 & 6 \\ 28 & 2 \end{vmatrix} = (54)(2) - (6)(28) = 108 - 168 = -60$$

**Step 4 :** Calculate the determinant of the matrix for n, D<sub>n</sub>

To find D<sub>n</sub>, replace the second column of matrix A with the constant terms from matrix B.

$$D_n = \begin{vmatrix} 4 & 54 \\ 3 & 28 \end{vmatrix} = (4)(28) - (54)(3) = 112 - 162 = -50$$

**Step 5:** Solve for m and n using Cramer's rule

The formulas for m and n are:

$$m = \frac{D_m}{D}$$

$$n = \frac{D_n}{D}$$

Substitute the calculated values:

$$m = \frac{-60}{-10} = 6$$

$$n = \frac{-50}{-10} = 5$$

**Answer :**

The solution to the simultaneous equations is  $m = 6$  and  $n = 5$ .

**ii.**  $x^2 + 10x + 2 = 0$  comparing with  $ax^2 + bx + c = 0$ .

We get,  $a = 1$ ,  $b = 10$ ,  $c = 2$

$$\therefore b^2 - 4ac = (10)^2 - 4 \times 1 \times 2$$

$$= 100 - 8$$

$$= 92$$

$$\therefore x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\therefore x = \frac{-10 \pm \sqrt{92}}{2 \times 1}$$

$$\therefore x = \frac{-10 \pm \sqrt{23 \times 4}}{2}$$

$$\therefore x = \frac{-10 \pm 2\sqrt{23}}{2}$$

$$\therefore x = \frac{2(-5 \pm \sqrt{23})}{2}$$

$$\therefore x = -5 + \sqrt{23} \text{ or } x = -5 - \sqrt{23}$$

$\therefore$  Roots of the quadratic equation are  $-5 + \sqrt{23}$  or  $-5 - \sqrt{23}$ .

**iii.** **1. The sum of the digits on the upper faces is at least 10**

**Step 1:** Determine the total number of outcomes

When two dice are rolled, each die has 6 possible outcomes. The total number of outcomes is the product of the outcomes for each die.

$$\text{Total outcomes} = 6 \times 6 = 36$$

**Step 2:** Identify the favorable outcomes

The favorable outcomes are the pairs of numbers whose sum is at least 10. These pairs are:

- (4,6)
- (5, 5), (5, 6)
- (6, 4), (6, 5), (6, 6)

The number of favorable outcomes is 6.

**Step 3:** Calculate the probability

The probability is the ratio of the number of favorable outcomes to the total number of outcomes.

$$P(\text{sum} \geq 10) = \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}} = \frac{6}{36} = \frac{1}{6}$$

## 2. The sum of the digits on the upper faces is 33

**Step 1:** Determine the range of possible sums

The minimum sum from rolling two dice is  $1 + 1 = 2$ .

The maximum sum is  $6 + 6 = 12$ .

The sum of 33 is outside of this range.

**Step 2:** Calculate the probability

Since it is impossible for the sum to be 33, the number of favorable outcomes is 0.

$$P(\text{sum} = 33) = \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}} = \frac{0}{36} = 0$$

Answer: The probability is 0.

## 3. The digit on the first die is greater than the digit on second die

**Step 1:** Determine the total number of outcomes

The total number of outcomes is 36, as determined in the first problem.

**Step 2:** Identify the favorable outcomes

We need to find the pairs (first die, second die) where the first number is greater than the second.

- If the first die is 2, the second can be 1. (1 outcome)
- If the first die is 3, the second can be 1, 2. (2 outcomes)
- If the first die is 4, the second can be 1, 2, 3. (3 outcomes)
- If the first die is 5, the second can be 1, 2, 3, 4. (4 outcomes)
- If the first die is 6, the second can be 1, 2, 3, 4, 5. (5 outcomes)

The total number of favorable outcomes is  $1 + 2 + 3 + 4 + 5 = 15$ .

**Step 3:** Calculate the probability

$$P(\text{first die} > \text{second die}) = \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}} = \frac{15}{36} = \frac{5}{12}$$

**Answer:** The probability is  $\frac{5}{12}$ .

iv.

| Class (Number of working hours) | Frequency (Number of workers) | Cumulative frequency less than the upper limit |
|---------------------------------|-------------------------------|--|
| 50-100                          | 33                            | 33   |
| 100-150                         | 30                            | 63   |
| 150-200 (Median Class)          | 90                            | 153  |
| 200-250                         | 80                            | 233  |
| 250-300                         | 17                            | 250  |
|                                 | $N = 250$                     |  |

From the above table, we get

$L$  (Lower class limit of the median class) = 150

$N$  (Sum of frequencies) = 250

$h$  (Class interval of the median class) = 50

$f$  (Frequency of the median class) = 90

$cf$  (Cumulative frequency of the class preceding the median class) = 63

$$\text{Now, Median} = L + \left( \frac{\frac{N}{2} - cf}{f} \right) \times h$$

$$= 150 + \left( \frac{\frac{250}{2} - 63}{90} \right) \times 50$$

$$= 150 + \left( \frac{125 - 63}{90} \right) \times 50$$

$$= 150 + \left( \frac{62}{9} \right) \times 5$$

$$= 150 + \frac{310}{9}$$

$$= 150 + 34.44$$

$$= 184.44 \text{ mangoes}$$

$$= 184 \text{ mangoes}$$

Hence, the median of data is 184 mangoes.

**Q.4**

**Solve the following questions (Any two)**

**8M**

**i. Step 1: Set up the given equation**

Let the first term of the A.P. be  $a$  and the common difference be  $d$ . The  $k^{\text{th}}$  term of an A.P. is given by the formula  $a_k = a + (k - 1)d$ .

The problem states that  $m$  times the  $m^{\text{th}}$  term is equal to  $n$  times the  $n^{\text{th}}$  term. We can write this as:

$$m \cdot a_m = n \cdot a_n$$

Substitute the formula for the  $m^{\text{th}}$  and  $n^{\text{th}}$  terms:

$$m[a + (m - 1)d] = n[a + (n - 1)d]$$

**Step 2: Simplify the equation to find a relationship between  $a$  and  $d$**

Expand both sides of the equation:

$$ma + m(m - 1)d = na + n(n - 1)d$$

Group terms with  $a$  and  $d$ :

$$ma - na = n(n - 1)d - m(m - 1)d$$

$$a(m - n) = d[n(n - 1) - m(m - 1)]$$

$$a(m - n) = d[n^2 - n - m^2 + m]$$

$$a(m - n) = d[(n^2 - m^2) - (n - m)]$$

$$a(m - n) = d[(n - m)(n + m) - (n - m)]$$

$$a(m - n) = d[-(m - n)(n + m) + (m - n)]$$

$$a(m - n) = d(m - n)[1 - (n + m)]$$

$$a(m - n) = d(m - n)[1 - m - n]$$

Since  $m \neq n$ , we can divide both sides by  $(m - n)$ :

$$a = d(1 - m - n)$$

$$a = -d(m + n - 1)$$

This can be rewritten as:

$$a + (m + n - 1)d = 0$$

### Step 3: Show that the $(m + n)^{\text{th}}$ term is zero

The  $(m + n)^{\text{th}}$  term of the A.P. is given by the formula:

$$a_{m+n} = a + (m + n - 1)d$$

From the result of Step 2, we know that  $a + (m + n - 1)d = 0$ .

Therefore,  $a_{m+n} = 0$

## ii. Show the following data by a frequency polygon

### Step 1: Find the midpoints of the class intervals

To construct a frequency polygon, you first need to find the midpoint of each class interval. The midpoint is calculated by adding the upper and lower limits of the class and dividing by 2.

$$\text{Midpoint for 200-400: } \frac{200 + 400}{2} = 300$$

$$\text{Midpoint for 400-600: } \frac{400 + 600}{2} = 500$$

$$\text{Midpoint for 600-800: } \frac{600 + 800}{2} = 700$$

$$\text{Midpoint for 800-1000: } \frac{800 + 1000}{2} = 900$$

$$\text{Midpoint for 1000-1200: } \frac{1000 + 1200}{2} = 1100$$

### Step 2: Plot the points

Next, plot the midpoints on the x-axis and the corresponding frequencies (number of families) on the y-axis. The points to be plotted are: (300, 240), (500, 300), (700, 450), (900, 350), and (1100, 160).

### Step 3: Connect the points

Connect the plotted points with straight line segments. To make the polygon "closed," you can extend the line segments to the midpoints of the adjacent, non-existent classes on either side, which would have a frequency of 0. This means you would connect the first point (300, 240) to a point (100, 0) and the last point (1100, 160) to a point (1300, 0).

### Answer:

The frequency polygon is a line graph connecting the points (300, 240), (500, 300), (700, 450), (900, 350), and (1100, 160).

## iii. Find m if the quadratic equation has real and equal roots

### Step 1: Identify the condition for real and equal roots

A quadratic equation in the form  $ax^2 + bx + c = 0$  has real and equal roots if its discriminant, Delta is equal to zero. The discriminant is given by the formula  $\Delta = b^2 - 4ac$

**Step 2: Identify the coefficients from the given equation**

The given equation is  $(m - 12)x^2 + 2(m - 12)x + 2 = 0$

Comparing this to the standard form  $ax^2 + bx + c = 0$  we have:

$$a = m - 12$$

$$b = 2(m - 12)$$

$$c = 2$$

**Step 3: Set the discriminant to zero and solve for m**

Substitute the values of a, b, and c into the discriminant formula and set it to zero:

$$b^2 - 4ac = 0$$

$$(2(m - 12))^2 - 4(m - 12)(2) = 0$$

$$4(m - 12)^2 - 8(m - 12) = 0$$

Factor out the common term  $4(m - 12)$ :

$$4(m - 12)(m - 14) = 0$$

This equation gives two possible solutions for m:

$$m - 12 = 0 \Rightarrow m = 12$$

$$m - 14 = 0 \Rightarrow m = 14$$

**Step 4: Check for a valid quadratic equation**

A quadratic equation requires the coefficient of the  $x^2$  term to be non-zero.

If  $m = 12$  then  $a = m - 12 = 12 - 12 = 0$  This would make the equation a linear equation, not a quadratic one. Therefore,  $m = 12$  is not a valid solution.

If  $m = 14$  then  $a = m - 12 = 14 - 12 = 2$  This is a valid quadratic equation.

**Answer:**

The value of m for which the equation has real and equal roots is 14.

**Q.5** Solve the following questions. (Any one) 3M

**i. Graphing a line and finding the area of a triangle**

**Step 1: Find the x and y intercepts of the equation**

To find the x-intercept, set  $y = 0$  in the equation  $3x + 4y = 12$

$$3x + 4(0) = 12$$

$$3x = 12$$

$$x = 4$$

The x-intercept is  $(4, 0)$ .

To find the y-intercept, set  $x = 0$  in the equation  $3x + 4y = 12$

$$3(0) + 4y = 12$$

$$4y = 12$$

$$y = 3$$

The y-intercept is  $(0, 3)$ .

**Step 2: Draw the graph**

Plot the x-intercept  $(4, 0)$  and the y-intercept  $(0, 3)$  on a coordinate plane. Draw a straight line connecting these two points. This line represents the graph of the equation  $3x + 4y = 12$ . The triangle is formed by this

line and the x-axis and y-axis in the first quadrant.

**Step 3: Find the area of the triangle**

The triangle formed has vertices at the origin (0, 0), the x-intercept (4,0), and the y-intercept (0, 3). The base of the triangle is the distance from the origin to the x-intercept, which is 4 units. The height of the triangle is the distance from the origin to the y-intercept, which is 3 units.

The formula for the area of a triangle is:

$$A = \frac{1}{2} \times \text{base} \times \text{height}$$

$$A = \frac{1}{2} \times 4 \times 3$$

$$A = \frac{1}{2} \times 12$$

$A = 6$  square units.

**ii.**

(1)

$$\text{Central angle for cars} = \frac{30\%}{100\%} \times 360^\circ = 108^\circ$$

$$\text{Central angle for tempos} = \frac{12\%}{100\%} \times 360^\circ = 43.2^\circ$$

$$\text{Central angle for buses} = \frac{8\%}{100\%} \times 360^\circ = 28.8^\circ$$

$$\text{Central angle for auto rikshaw} = \frac{10\%}{100\%} \times 360^\circ = 36^\circ$$

$$\text{Central angle for two wheelers} = \frac{40\%}{100\%} \times 360^\circ = 144^\circ$$

(2)

Number of two wheelers = 1200

$$\Rightarrow \frac{40\%}{100\%} \times \text{Total number of vehicles} = 1200$$

$$\Rightarrow \text{total number of vehicles} = \frac{100\%}{40\%} \times 1200$$

$$= 3000$$