

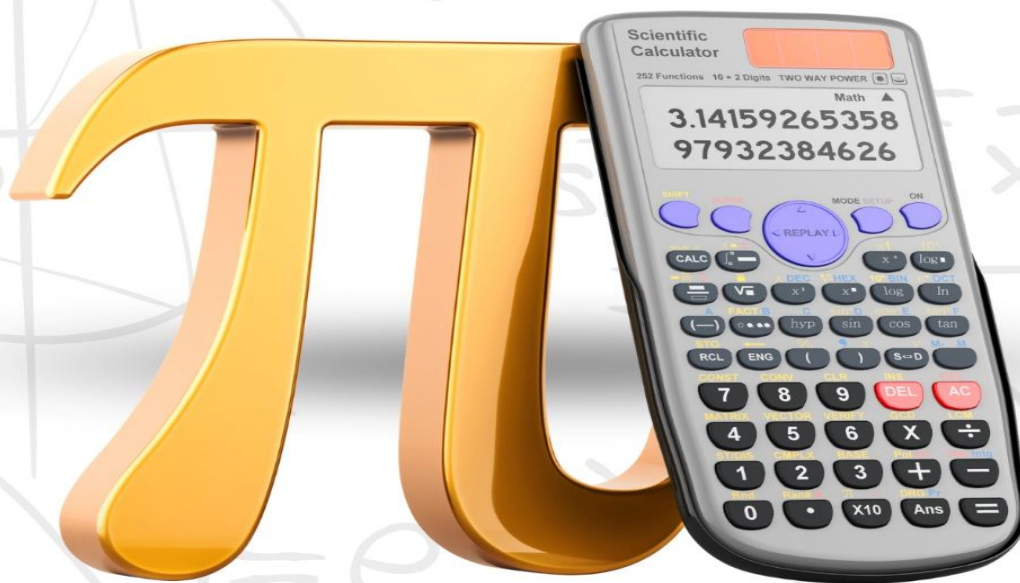
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# Mathematics Resource Material for Grade 10

CHAPTER-WISE COMPETENCY BASED AND  
CASE STUDY BASED QUESTIONS

Session 2026-27



*Prepared By:*

*Collaborative efforts of Trained Graduate Teachers  
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## CHAPTER 1-REAL NUMBERS

### Competency Based Question

**Q.1:** Three friends Virat, Rohit, and Sachin used to ride their bicycles around their Society's park every day in the evening. The shape of the society's park is a Rectangle. One day, they decide to play a game. All three have a ringing bell on their bicycle. They ring the bell at an interval of 9, 12, 15 minutes respectively means after every 9 mins. Virat rings the bell, after every 12 mins. Rohit rings the bell and after every 15 mins, Sachin rings the bell.



**Answer these following questions:**

**Q.1(a):** If only Sachin and Virat play this game, then after what time will they next ring together? **(1M)**

**Solution:** Sachin and Virat, the bell at an interval of 15 and 9 minutes respectively.  
factors of  $9 = 3 \times 3 = 3^2$ , factors of  $15 = 3 \times 5$ ,  
Time will they next ring together = LCM of 15 and 9 =  $3^2 \times 5 = 9 \times 5 = 45$  minutes.

**Q.1(b):** If only Rohit and Sachin play this game, then after what time will they next ring together? **(1M)**

**Solution:** Rohit and Sachin, the bell at an interval of 12 and 15 minutes respectively.  
factors of  $12 = 2 \times 2 \times 3 = 2^2 \times 3$ , factors of  $15 = 3 \times 5$ .  
Time will they next ring together = LCM of 12 and 15 =  $2^2 \times 3 \times 5 = 4 \times 15 = 60$  minutes.

**Q.1(c):** If they start ringing together a time, after what time will they next ring together? **(2 M)**

**Solution:** Virat, Rohit, and Sachin the bell at an interval of 9, 12 and 15 minutes respectively.  
factors of  $9 = 3 \times 3 = 3^2$ , factors of  $12 = 2 \times 2 \times 3 = 2^2 \times 3$ ,  
factors of  $15 = 3 \times 5$ ,  
Time will they next ring together = LCM of 9, 12 and 15 =  $2^2 \times 3^2 \times 5$   
 $= 4 \times 9 \times 5 = 180$  minutes.

**OR**

If one more friend, Rishab also join them from the beginning. Now Virat, Rohit, Sachin and Rishab ring at an interval of 9, 12, 15 and 20 minutes then after what time will they next ring together.

**Solution:** Virat, Rohit, Sachin and Rishab the bell at an interval of 9, 12, 15 and 20 minutes respectively.  
factors of  $9 = 3 \times 3$ , factors of  $12 = 2 \times 2 \times 3$   
factors of  $15 = 3 \times 5$ , factors of  $20 = 2 \times 2 \times 5$   
Time will they next ring together = LCM of 9, 12, 15 and 20 =  $2^2 \times 3^2 \times 5$   
 $= 4 \times 9 \times 5 = 180$  minutes.

**Q.2:** Diwali is the biggest festival in India. People give gifts to their loved ones and wish them 'Happy Diwali'. People give different types of gifts to their loved ones but most of them prefer to give sweets in gifts. Therefore, all sweet shops remain very busy on the Diwali festival in India.

One shopkeeper **A** prepares 396 Gulab-Jamuns and 342 Ras-Gullas. He packs them in combination.

Each container consists of either Gulab-Jamuns or Ras-Gullas but has an equal number of pieces. There is another sweets shopkeeper **B** beside shopkeeper **A**. Shopkeeper **B** prepares 350 Gulab-Jamuns and 400 Ras-Gullas. His packing follows the same rules as of shopkeeper **A**. There is another shopkeeper **C** who makes 500 Gulab-Jamuns and 400 Ras-Gullas. His packing follows the same rules as of shopkeeper **A** & 100 pieces, Shopkeeper **C** should put in each box.



**Answer these following questions:**

**Q.2(a):** Find the number of pieces, Shopkeeper **A** should put in each box so that number of boxes is the least. (1M)

**Solution:** Factors of 396 =  $2^2 \times 3^3 \times 11$ , Factors of 342 =  $2 \times 3^2 \times 19$

Number of boxes is the least = HCF of 396 and 342 =  $2 \times 3^2 = 2 \times 9 = 18$  pieces

**Q.2(b):** Find the number of pieces, Shopkeeper **B** should put in each box so that number of boxes is the least. (1M)

**Solution:** Factors of 350 =  $2 \times 5^2 \times 7$ , Factors of 400 =  $2^4 \times 5^2$

Number of boxes is the least = HCF of 350 and 400 =  $2 \times 5^2 = 2 \times 25 = 50$  pieces

**Q.2(c):** Find the ratio of the number of boxes required by shopkeeper **A** to shopkeeper **B**? (2M)

**Solution:** Total boxes for shopkeeper **A** =  $(396 + 342) / \text{HCF of } 396 \text{ \& } 342 = 738/18 = 41$  boxes

Total boxes for shopkeeper **B** =  $(350 + 400) / \text{HCF of } 350 \text{ \& } 400 = 750/50 = 15$  boxes

The ratio of the number of boxes required by shopkeeper **A** to shopkeeper **B** = 41:15

**OR**

**Q.2(d):** Find the ratio of the Number of boxes required by Shopkeeper **A** to shopkeeper **C**?

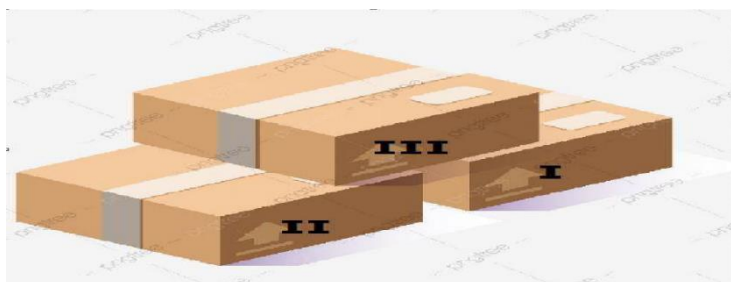
**Solution:** Total boxes for shopkeeper **A** =  $(396 + 342) / \text{HCF of } 396 \text{ \& } 342 = 738/18 = 41$  boxes

Total boxes for shopkeeper **C** =  $(500 + 400) / \text{HCF of } 500 \text{ \& } 400 = 900/100 = 9$  boxes

The ratio of the number of boxes required by shopkeeper **A** to shopkeeper **C** = 41:9

### 3-UNSOLVED CASE STUDY BASED QUESTIONS

**Q.3:** A merchant has 120 soap cubes of 1<sup>ST</sup> kind in box I, 180 soap cubes of 2<sup>ND</sup> kind in box II and 240 soap cubes of 3<sup>rd</sup> kind in box III. He wants to sell the soap cubes by filling three kinds of soap cubes in small packets of equal capacity



On the basis of above information, answer the following:

**Q.(i):** What would be the largest capacity of such packets? (1M)

**Q.(ii):** If he decided to put 3rd kind of soap cubes separately in small packets, how many packets are needed? (1M)

**Q.(iii):** How many total small packets are needed to pack all 3 kinds of soap cubes? (2M)

OR

**Q.(iv):** If merchant decided to sell only second and third kinds of soap cubes then how many small packets are required? (2M)

**Q.4:** Amit, Ashutosh and Avinash started a race on a circular ground. Amit takes 24 minutes Ashutosh takes 12 minutes and Avinash takes 18 minutes to complete a round. They started the race at 7:35 AM.

On the basis of above information, answer the following:



**Q.(i):** After how many minutes they will meet again? (1M)

**Q.(ii):** Number of rounds taken by Amit when they met again after start? (1M)

**Q.(iii):** What is the time when they met again after start? (2M)

OR

**Q.(iv):** How many total taken by all of them when they met again after start? (2M)

**Q.5:** A mathematical Exhibition is being conducted in your school and one of your friends is making a model of a factor tree. He has some difficulty and ask for your help in completing a quiz for the audience.

Observe the following factor tree and answer the following.

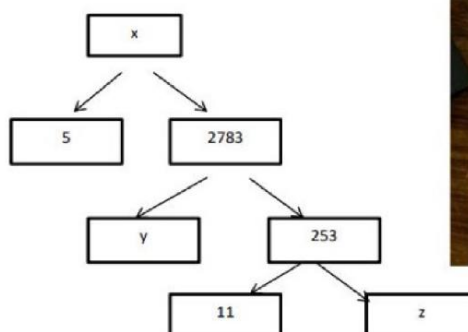
**Q.(i):** What will be the value of x? (1M)

**Q.(ii):** What will be the value of y? (1M)

**Q.(iii):** What will be the value of z? (2M)

OR

**Q.(iv):** Find the prime factor of 13915? (2M)

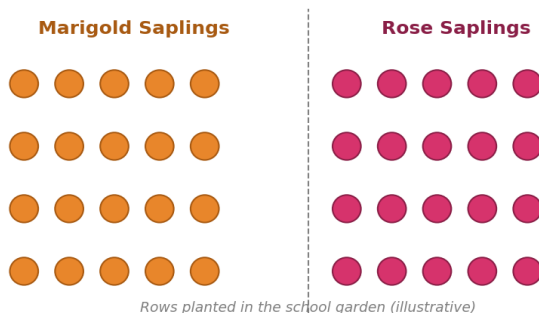


## Case Based Question

### Case Study 1: The School Garden

A school gardener has 945 marigold saplings and 675 rose saplings. She wants to plant them in the school garden in such a way that each row contains the same number of saplings, and only one type of flower is planted in a row.

She wants to use the minimum possible number of rows for planting all the saplings.



**Q.1** Using Euclid's Division Algorithm, find the maximum number of saplings that can be planted in one row, i.e., find the HCF of 945 and 675. **(1M)**

**Solution:** By Euclid's Division Algorithm, applying repeated division (larger  $\div$  smaller):

$$945 = 1 \times 675 + 270$$

$$675 = 2 \times 270 + 135$$

$$270 = 2 \times 135 + 0$$

Since the remainder becomes 0, the divisor at this stage is the HCF.

**$\therefore$  HCF (945, 675) = 135**

So, the maximum number of saplings that can be planted in one row is 135.

**Q2.** Express 945 as a product of its prime factors. **(1M)**

**Solution:**  $945 = 3 \times 315 = 3 \times 3 \times 105 = 3 \times 3 \times 3 \times 35 = 3 \times 3 \times 3 \times 5 \times 7$

**$\therefore 945 = 3^3 \times 5 \times 7$**

**Q3.** Using the prime factorization method, find the HCF and LCM of 945 and 675. Hence verify that  $\text{HCF} \times \text{LCM} = \text{Product of the two numbers}$ . **(2M)**

**Solution:** Prime factorization:

$$945 = 3^3 \times 5 \times 7$$

$$675 = 3^3 \times 5^2$$

HCF = product of smallest powers of common factors =  $3^3 \times 5 = 27 \times 5 = 135$

LCM = product of greatest powers of all factors involved =  $3^3 \times 5^2 \times 7 = 27 \times 25 \times 7 = 4725$

**Verification:**

$$\text{HCF} \times \text{LCM} = 135 \times 4725 = 6,37,875$$

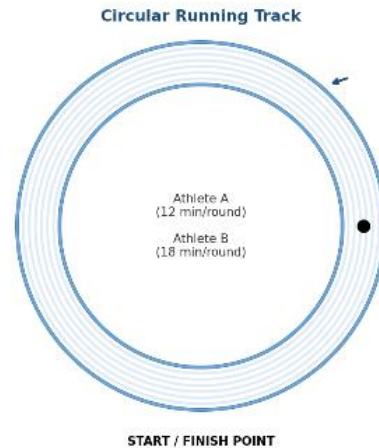
$$\text{Product of the numbers} = 945 \times 675 = 6,37,875$$

**Since both values are equal,  $\text{HCF} \times \text{LCM} = \text{Product of the two numbers}$  is verified.**

### Case Study 2: The Circular Running Track

Two athletes, A and B, start running together from the same starting point on a circular track and in the same direction. Athlete A completes one round of the track in 12 minutes, while Athlete B completes one round in 18 minutes.

The sports teacher wants to know after how much time both athletes will meet again at the starting point, so that the next event can be scheduled.



**Q.1.** Write the prime factorization of 12 and 18. (1M)

**Solution:**  $12 = 2 \times 2 \times 3 = 2^2 \times 3$   
 $18 = 2 \times 3 \times 3 = 2 \times 3^2$

**Q.2.** Find the LCM of 12 and 18. After how many minutes will Athletes A and B meet again at the starting point? (2M)

**Solution:** LCM = product of greatest powers of all factors involved =  $2^2 \times 3^2 = 4 \times 9 = 36$

**∴ Athletes A and B will meet again at the starting point after 36 minutes.**

**Q.3.** A third athlete, C, joins them at the same starting point and completes one round in 24 minutes. Find after how many minutes all three athletes will meet together at the starting point. Also, find the HCF of 12 and 18, and verify that  $\text{HCF} \times \text{LCM} = \text{Product of 12 and 18}$ .

**Solution:** Prime factorization:  $12 = 2^2 \times 3$ ,  $18 = 2 \times 3^2$ ,  $24 = 2^3 \times 3$

$\text{LCM}(12, 18, 24) = \text{product of greatest powers of all factors} = 2^3 \times 3^2 = 8 \times 9 = 72$

**∴ All three athletes will meet together at the starting point after 72 minutes.**

Now,  $\text{HCF}(12, 18) = \text{product of smallest powers of common factors} = 2 \times 3 = 6$

**Verification:**

$\text{HCF} \times \text{LCM} (\text{of } 12 \text{ and } 18) = 6 \times 36 = 216$

$\text{Product of the numbers} = 12 \times 18 = 216$

**Since both values are equal,  $\text{HCF} \times \text{LCM} = \text{Product of the two numbers}$  is verified.**



## CHAPTER 2- POLYNOMIALS

### Competency Based Question

**Q.1.** A taxi service charges a fixed booking fee of ₹50 and ₹12 per kilometre travelled. If  $x$  represents the distance (in km), write a linear polynomial for the total fare and find the fare for 8 km.

**Solution:** Total Fare =  $12x + 50$

For  $x = 8$ , Fare =  $12(8) + 50 = 146$ .

Hence, the linear polynomial is  $12x + 50$  and the fare for 8 km is ₹146.

**Q2.** The perimeter of a square is represented by  $P = 4s$ , where  $s$  is the side length. Find the perimeter when  $s = 7$  cm and state the degree of the polynomial.

**Solution:**  $P = 4s = 4 \times 7 = 28$  cm.

The highest power of  $s$  is 1, therefore the degree is 1.

### Unsolved Competency-Based Questions

**Q3.** A mobile recharge plan charges ₹99 as a fixed fee and ₹15 per GB of extra data. If  $x$  represents the extra GB used, write a linear polynomial for the total cost and find the cost for  $x = 6$

**Q4.** The temperature of a city is represented by  $T = 2x + 24$ , where  $x$  is the number of hours after noon. Find the temperature after 5 hours and identify the coefficient and constant term.

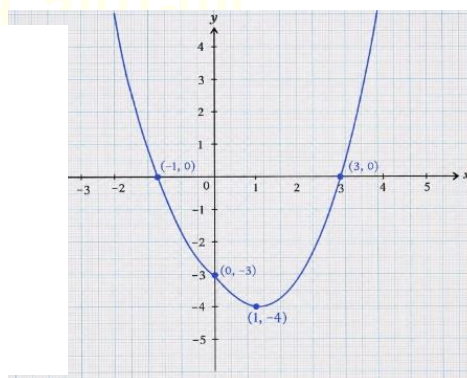
**Q5.** A plant grows 3 cm every week. Its height after  $x$  weeks is  $H = 3x + 12$ . Find the height after 10 weeks and explain why  $H$  is a linear polynomial.

### CASE STUDY BASED QUESTIONS

**CASE STUDY 1.** The Science Club of a KVS plotted the graph of a polynomial representing the growth pattern of a plant over time.

The graph represents the polynomial:  $p(x) = x^2 - 2x - 3$

The graph cuts the  $x$ -axis at  $x = -1$  and  $x = 3$



**Q1.** The number of zeroes of the polynomial is:

- (a) 0      (b) 1      (c) 2      (d) 3

**Answer:** (c) 2      (1 Mark)

**Q. ii)** One zero of the polynomial is:

- (a) 1      (b) 2      (c) -1      (d) 4

**Answer:** c) -1      (1 Mark)

**Q iii)** Find the sum of the zeroes of the polynomial  $x^2-2x-3$ .

(2 marks )

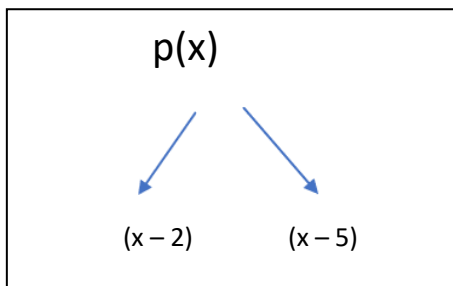
**Sol:** For a quadratic polynomial  $ax^2+bx+c$ ,

Sum of zeroes= $-b/a$

Here,  $a=1, b=-2$  sum of zeroes =  $-(b/a)= 2$ .

**Q2.** During a Mathematics Exhibition in KVS, students prepared a chart showing a polynomial and its factors.

Polynomial Tree



$$p(x) = (x-2)(x-5)$$

The polynomial represented by the chart is  $P(x)=x^2-7x+10$ , whose zeroes are 2 and 5.

**(i)** The degree of the polynomial  $x^2-7x+10$  is:

- (a) 1                      (b) 2                      (c) 3                      (d) 0

**Answer:** (b) 2

(1 Mark)

**(ii)** The product of the zeroes is:

- (a) 7                      (b) 5                      (c) 10                      (d) 2

**Answer:** (c) 10

(1 Mark)

**(iii)** Verify the relationship between the zeroes and coefficients of the polynomial  $x^2-7x+10$ .

**Solution:** Given:  $a=1, b=-7, c=10$

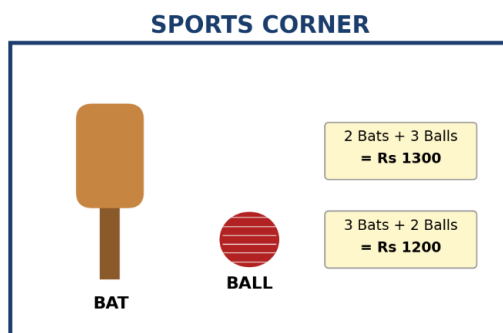
Zeroes:  $\alpha=2, \beta=5$  Sum of zeroes:  $\alpha + \beta = 2+5=7$

Product of zeroes:  $\alpha \beta = 2 \times 5 = 10$

(2 Marks)

## CHAPTER 3-LINEAR EQUATION IN TWO VARIABLE

### Case Study 1: The Sports Corner



Aarav went to a sports shop, “Sports Corner”, to buy a bat and some balls for his school team. The shopkeeper told him that the cost of 2 bats and 3 balls together is Rs 1300, while the cost of 3 bats and 2 balls together is Rs 1200. Aarav wants to find out the individual cost of one bat and one ball before making his purchase.

- (1) If the cost of one bat is Rs  $x$  and the cost of one ball is Rs  $y$ , represent the given information algebraically as a pair of linear equations. **[1 Mark]**
- (2) Using the equations formed above, find the cost of one bat. **[1 Mark]**
- (3) Find the cost of one ball, and verify your solution by substituting both values back into the original equations. **[2 Marks]**

#### Solution:

**Q1:** Cost of 1 bat = Rs  $x$ , cost of 1 ball = Rs  $y$ .

From the given information:

$$2x + 3y = 1300 \text{ ... (i)}$$

$$3x + 2y = 1200 \text{ ... (ii)}$$

These form the required pair of linear equations.

**Q2:** Multiply equation (i) by 3 and equation (ii) by 2:

$$6x + 9y = 3900 \text{ ... (iii)}$$

$$6x + 4y = 2400 \text{ ... (iv)}$$

Subtracting (iv) from (iii):  $5y = 1500$ , so  $y = 300$ .

Substituting  $y = 300$  in (i):  $2x + 3(300) = 1300 \Rightarrow 2x + 900 = 1300 \Rightarrow 2x = 400 \Rightarrow x = 200$ .

Cost of one bat = Rs 200.

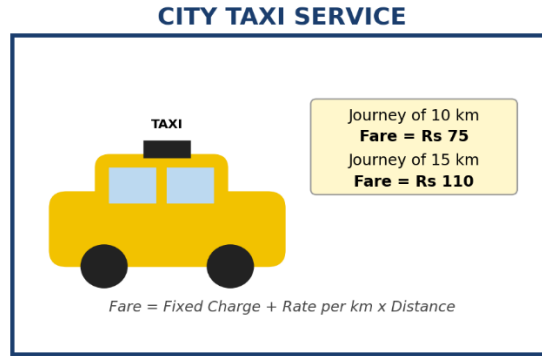
**Q3:** Cost of one ball = Rs 300 (found above).

Verification in (i):  $2(200) + 3(300) = 400 + 900 = 1300 \checkmark$

Verification in (ii):  $3(200) + 2(300) = 600 + 600 = 1200 \checkmark$

Hence, cost of 1 bat = Rs 200 and cost of 1 ball = Rs 300.

## Case Study 2: City Taxi Service



Meera hires a taxi from “City Taxi Service” for travelling within her city. The taxi fare includes a fixed charge along with a charge for every kilometre travelled. For a journey of 10 km, the fare is Rs 75, while for a journey of 15 km, the fare is Rs 110. Meera wants to understand how the fare is calculated so that she can estimate the cost for other distances.

- (1) If the fixed charge is Rs  $x$  and the rate per km is Rs  $y$ , write the pair of linear equations that represent the given information. **[1 Mark]**
- (2) Find the fixed charge of the taxi. **[1 Mark]**
- (3) Find the rate charged per km, and hence calculate the total fare for a journey of 20 km. **[2 Marks]**

### Solution:

**Q1:** Let fixed charge = Rs  $x$  and rate per km = Rs  $y$ .

For 10 km:  $x + 10y = 75$  ... (i)

For 15 km:  $x + 15y = 110$  ... (ii)

These form the required pair of linear equations.

**Q2:** Subtracting (i) from (ii):  $5y = 35$ , so  $y = 7$ .

Substituting  $y = 7$  in (i):  $x + 10(7) = 75 \Rightarrow x + 70 = 75 \Rightarrow x = 5$ .

Fixed charge = Rs 5.

**Q3:** Rate per km = Rs 7 (found above).

Total fare for 20 km =  $x + 20y = 5 + 20(7) = 5 + 140 = \text{Rs } 145$ .

Hence, the rate per km is Rs 7, and the fare for a 20 km journey is Rs 145.



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## CHAPTER 4- QUADRATIC EQUATION

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### Competency Based Question

#### 1, Garden Design

A gardener wants to design a rectangular flower bed such that its length is 4 m more than its breadth. The area of the bed is  $96 \text{ m}^2$ .

- (a) Form a quadratic equation representing this situation, taking breadth as  $x$  m.
- (b) Find the dimensions of the flower bed.
- (c) If the gardener wants to leave a 1 m wide path all around the bed, find the new area enclosed (including the path).

#### 2. Speed and Time (Application-Based)

A train travels a distance of 360 km at a uniform speed. If the speed had been 5 km/h more, it would have taken 1 hour less to cover the same distance.

- (a) Frame the quadratic equation for the original speed of the train.
- (b) Find the original speed and the time taken.
- (c) Explain why one of the roots obtained is rejected in this context.

#### 3. Nature of Roots (Reasoning-Based)

Two students, Aman and Priya, are discussing the equation  $kx^2 + 6x + 1 = 0$ .

Aman says, "For some value of  $k$ , this equation will have equal roots."

- (a) Find the value of  $k$  for which the equation has equal roots.
- (b) Justify, using the discriminant, why your answer is correct.
- (c) For what range of values of  $k$  will the equation have no real roots?

#### 4. Profit and Number Patterns (Real-Life Application)

A shopkeeper buys a number of books for ₹1,200. If he had bought 10 more books for the same amount, each book would have cost him ₹20 less.

- (a) Form a quadratic equation to find the number of books he bought.
- (b) Solve the equation and find the original number of books and their cost per book.
- (c) Verify your answer by checking both conditions given in the problem.

#### 5. Assertion-Reason Type

**Assertion (A):** The quadratic equation  $2x^2 - 4x + 3 = 0$  has no real roots.

**Reason (R):** A quadratic equation  $ax^2 + bx + c = 0$  has no real roots if its discriminant ( $b^2 - 4ac$ ) is less than zero.

Choose the correct option:

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

## ANSWERS

### 1. Garden Design

#### (a) Forming the equation

Let breadth =  $x$  m, so length =  $(x + 4)$  m

Area = length  $\times$  breadth = 96

$$x(x + 4) = 96$$

$$x^2 + 4x - 96 = 0$$

#### (b) Solving

$$x^2 + 4x - 96 = 0$$

$$x^2 + 12x - 8x - 96 = 0$$

$$x(x + 12) - 8(x + 12) = 0$$

$$(x + 12)(x - 8) = 0$$

$$\text{So } x = -12 \text{ or } x = 8$$

Since breadth cannot be negative,  $x = 8$

**Breadth = 8 m, Length =  $8 + 4 = 12$  m**

#### (c) Area including the path

With a 1 m path all around, new dimensions:

New length =  $12 + 1 + 1 = 14$  m

New breadth =  $8 + 1 + 1 = 10$  m

New total area =  $14 \times 10 = 140 \text{ m}^2$

### 2. Speed and Time

#### (a) Forming the equation

Let original speed =  $x$  km/h

Time taken originally =  $360/x$  hours

New speed =  $(x + 5)$  km/h, new time =  $360/(x+5)$  hours

Given: original time - new time = 1

$$360/x - 360/(x+5) = 1$$

Multiply throughout by  $x(x+5)$ :

$$360(x + 5) - 360x = x(x + 5)$$

$$360x + 1800 - 360x = x^2 + 5x$$

$$1800 = x^2 + 5x$$

$$x^2 + 5x - 1800 = 0$$

#### (b) Solving

$$x^2 + 5x - 1800 = 0$$

$$x^2 + 45x - 40x - 1800 = 0$$

$$x(x + 45) - 40(x + 45) = 0$$

$$(x + 45)(x - 40) = 0$$

$$x = -45 \text{ or } x = 40$$

**Original speed = 40 km/h**

Time taken =  $360/40 = 9$  hours

### (c) Why the negative root is rejected

Speed represents a physical quantity and **cannot be negative**. Hence  $x = -45$  has no real-world meaning in this context and is rejected, leaving  $x = 40$  as the only valid solution.

---

## 3. Nature of Roots

Equation:  $kx^2 + 6x + 1 = 0$

Here  $a = k$ ,  $b = 6$ ,  $c = 1$

### (a) Finding $k$ for equal roots

For equal roots, discriminant  $D = 0$

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

$$(6)^2 - 4(k)(1) = 0$$

$$36 - 4k = 0$$

$$k = 9$$

### (b) Justification

The discriminant  $D = b^2 - 4ac$  determines the nature of roots:

$D > 0 \rightarrow$  real and distinct roots

$D = 0 \rightarrow$  real and equal roots

$D < 0 \rightarrow$  no real roots

Since we set  $D = 36 - 4k = 0$  and solved to get  $k = 9$ , substituting back:

$$D = 36 - 4(9) = 36 - 36 = 0 \checkmark$$

This confirms that at  $k = 9$ , the equation has two equal real roots, validating Aman's statement.

### (c) Range of $k$ for no real roots

For no real roots:  $D < 0$

$$36 - 4k < 0$$

$$-4k < -36$$

$$k > 9$$

**For  $k > 9$ , the equation has no real roots.**

(Note:  $k \neq 0$ , since  $k$  is the coefficient of  $x^2$ , otherwise the equation won't remain quadratic.)

#### 4. Profit and Number Patterns

##### (a) Forming the equation

Let number of books originally bought =  $x$

Cost per book =  $1200/x$

If 10 more books bought: number =  $(x + 10)$ , cost per book =  $1200/(x+10)$

Given: original cost per book – new cost per book = 20

$$1200/x - 1200/(x+10) = 20$$

Multiply throughout by  $x(x+10)$ :

$$1200(x + 10) - 1200x = 20x(x + 10)$$

$$1200x + 12000 - 1200x = 20x^2 + 200x$$

$$12000 = 20x^2 + 200x$$

Divide by 20:

$$600 = x^2 + 10x$$

$$x^2 + 10x - 600 = 0$$

##### (b) Solving

$$x^2 + 10x - 600 = 0$$

$$x^2 + 30x - 20x - 600 = 0$$

$$x(x + 30) - 20(x + 30) = 0$$

$$(x + 30)(x - 20) = 0$$

$$x = -30 \text{ or } x = 20$$

Since number of books can't be negative,  $x = 20$

**Original number of books = 20**

**Cost per book =  $1200/20 = ₹60$**

##### (c) Verification

Original: 20 books at ₹60 each = ₹1,200 ✓

New situation:  $20 + 10 = 30$  books at  $(1200/30) = ₹40$  each = ₹1,200 ✓

Difference in cost per book =  $60 - 40 = ₹20$  ✓ (matches given condition)

Both conditions are satisfied.

## 5. Assertion-Reason

Equation:  $2x^2 - 4x + 3 = 0$

Here  $a = 2$ ,  $b = -4$ ,  $c = 3$

**Calculating the discriminant:**

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

$$D = (-4)^2 - 4(2)(3) = 16 - 24 = -8$$

Since  $D = -8 < 0$ , the equation has **no real roots**, so **Assertion (A) is true**.

The Reason (R) correctly states the general rule for discriminant and no real roots, so **Reason (R) is also true**, and it correctly explains why A is true.

**Correct option: (a) Both A and R are true, and R is the correct explanation of A.**

### Case Based Question

#### CASE STUDY 1

Rohan travels from his home to a nearby town, which is **60 km away**. Due to less traffic on the return journey, his speed increases by **10 km/h**. As a result, he takes **1 hour less** to cover the same distance on the return trip.



Let the speed of Rohan while going to the town be  $x$  km/h.

$$\frac{60}{x} - \frac{60}{x + 10} = 1$$

The situation is represented by:

Based on the information given above, answer the following questions :

Q1. Simplify and make quadratic equation.

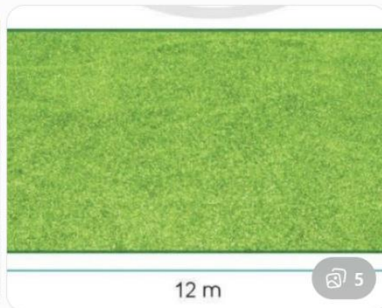
Q2. Find the discriminant of the quadratic equation and define the nature of the root.a

Q3. Solve the quadratic equation and find Rohan's speed while going to the town and while returning.



## CASE STUDY 2

The students of a school are planning to develop a rectangular playground. The length of the playground is 4 m more than its breadth. The area of the playground is  $96 \text{ m}^2$ .



Let the breadth of the playground be  $x$  m. Then the length is  $(x + 4)$  m.

Based on the information given above, answer the following questions :

- Q1. Write the quadratic equation to find the area of the field. (1)
- Q2. Is it possible to find the solution? Explain how (1)
- Q3. Solve the quadratic equation and find the dimensions of the playground. (2)

OR

If we increase in length and breadth by 4m then how much area will increase?

## ANSWERS CASE STUDY 1

**Q1. Simplify and make the quadratic equation.**

$$60(x+10)-60xx(x+10)=1600x(x+10)=1x(x+10)=600x^2+10x-600=0$$

**Quadratic Equation:**

$$x^2+10x-600=0$$

**Q2. Find the discriminant and nature of roots.**

For

$$x^2+10x-600=0 \quad a=1, \quad b=10, \quad c=-$$

$$D=b^2-4ac \quad D=(10)^2-4(1)(-600) \quad D=100+2400=2500$$

**Discriminant = 2500**

Since  $D > 0$  and 2500 is a perfect square, the roots are: Real, distinct and rational

**Q3. Find Rohan's speeds.**

$$x^2 + 10x - 600 = 0 \Rightarrow x = \frac{-10 \pm \sqrt{10^2 + 2400}}{2} = \frac{-10 \pm 50}{2} \Rightarrow x = 20 \text{ or } x = -30$$

Speed cannot be negative.

$$x = 20 \text{ km/h}$$

Speed while returning:

$$20 + 10 = 30 \text{ km/h}$$

**Answer:**

Going speed = **20 km/h**

Returning speed = **30 km/h**

**Q2. Is it possible to find the solution? Explain.**

**Yes**, The dimensions can be found by solving the quadratic equation using:

Factorisation method, or

Quadratic formula.

---

**Q3. Find the dimensions of the playground.**

$$x^2 - 4x - 96 = 0 \Rightarrow (x - 12)(x + 8) = 0 \Rightarrow x = 12 \text{ or } x = -8$$

Reject negative value.

$$\text{Length} = 12 \text{ m}, \quad \text{Breadth} = 12 - 4 = 8 \text{ m}$$

**Answer:**

$$\text{Length} = 12 \text{ m}, \text{ Breadth} = 8 \text{ m}$$

**OR**

If both length and breadth are increased by **4 m**:

New dimensions:

$$(12 + 4) = 16 \text{ m} \quad (8 + 4) = 12 \text{ m}$$

New Area:

$$16 \times 12 = 192 \text{ m}^2$$

Original Area:

$$96 \text{ m}^2$$

Increase in area:

$$192 - 96 = 96 \text{ m}^2$$

**Answer:**

$$96 \text{ m}^2$$

The area increases by **96 square metres**.

## CHAPTER 5 - ARTHMATIC PROGRESSION

### Competency Based Question

A cricket stadium has seats arranged in rows. The first row has 30 seats, the second row has 32 seats, the third row has 34 seats, and so on, with each row having 2 more seats than the previous one. There are 25 rows in total.

(i) What type of sequence do the number of seats in each row form? State the common difference.

(ii) Find the number of seats in the 15th row

(iii) Find the total number of seats in the stadium.

SOLUTION- (i) The number of seats in the rows can be written as a sequence: **30, 32, 34, .....**

**Common Difference (d):** The difference between any two consecutive terms is:

$$d = 32 - 30 = 2$$

(ii)  $n^{\text{th}}$  term of an AP is:  **$a_n = a + (n - 1)d$**

Where  $a$  is the first term = 30 and  $d$  is the common difference = 2

$$a_n = 30 + (n - 1)2$$

$$a_n = 30 + 2n - 2$$

$$a_n = 2n + 28$$

To find the number of seats specifically in the 15<sup>th</sup> row, substitute  $n = 15$

$$a_{15} = 2(15) + 28$$

$$a_{15} = 30 + 28$$

$$a_{15} = 58$$

**Answer:** There are **58 seats** in the 15<sup>th</sup> row.

(iii) Total Number of Seats in the Stadium

$$S_n = n/2 [2a + (n - 1)d]$$

$$n = 25 (\text{total number of rows}), a = 30, d = 2$$

$$S_{25} = 25/2 [2(30) + (25 - 1)2]$$

$$S_{25} = 25/2 [60 + (24 \times 2)]$$

$$S_{25} = 25/2 [60 + 48]$$

$$S_{25} = 25/2 [108]$$

$$S_{25} = 25 \times 54$$

$$S_{25} = 1350$$

**Answer:** The total number of seats in the stadium is **1,350**.

Q2. As part of an environmental awareness programme, a school decides that on Day 1 a class plants 3 saplings, on Day 2 it plants 5 saplings, on Day 3 it plants 7 saplings, and the pattern continues for 12 days, with 2 more saplings planted each day than the previous day.

(i) Is this sequence an AP? Justify your answer.

(ii) Find the total number of saplings planted during the 12-day drive.

(iii) If the school wants to plant exactly 168 saplings using the same daily pattern, after how many days will the target be achieved?

SOLUTION- Number of saplings planted on Day 1 ,  $a = 3$

Number of saplings planted on Day 2 = 5

Number of saplings planted on Day 3 = 7

Increment in saplings per day ,  $d = 2$

(i) Is this sequence an AP? Justify your answer. [1]

The sequence representing the number of saplings planted day by day is: **3, 5, 7, .....**

To determine if the sequence is an Arithmetic Progression (AP), we find the difference between consecutive terms:

$$\bullet \quad a_2 - a_1 = 5 - 3 = 2, \quad a_3 - a_2 = 7 - 5 = 2$$

**Justification:** Since the common difference ( $d = a_{\{n\}} - a_{\{n-1\}}$ ) remains constant at **2** throughout, the sequence is **an Arithmetic Progression (AP)**.

**(ii) Find the total number of saplings planted during the 12-day drive. [1]**

The total number of saplings planted is the sum of the first 12 terms of the AP. The formula for the sum of the first  $n$  terms  $S_n$  is:

$$S_n = n^2 [2a + (n - 1)d]$$

For  $n = 12$

$$S_{12} = [2(3) + (12 - 1)2]$$

$$S_{12} = 6 \times [6 + 11 \times 2]$$

$$S_{12} = 6 \times [6 + 22]$$

$$S_{12} = 6 \times 28$$

$$S_{12} = 168$$

**Final Answer:** The total number of saplings planted over the 12 days is **168**

**(iii) If the school wants to plant exactly 168 saplings using the same daily pattern, after how many days will the target be achieved? [2]**

Setting  $S_n = 168$ :

$$S_n = n^2 [2a + (n - 1)d]$$

$$168 = n^2 [2 \times 3 + (n - 1) \times 2]$$

$$168 = n[3 + (n - 1)]$$

$$168 = 3n + n^2 - n$$

$$n^2 + 2n - 168 = 0$$

Factorising:

$$n^2 + 14n - 12n - 168 = 0$$

$$(n + 14)(n - 12) = 0$$

When  $(n + 14) = 0$

$$n = -14 \text{ (rejected)}$$

When  $(n - 12) = 0$

$$n = 12$$

Answer- after 12 days will the target be achieved

**Unsolved questions-**

Q3. A manufacturing unit produced 600 smartphones in its third year and 700 smartphones in its seventh year. Assuming that the production increases uniformly by a fixed number every year:

- (I). Find the initial production in the first year.
- (II). What will be the production in the 10<sup>TH</sup> year?
- (III). Find the total production of smartphones in the first 10 years.

Q4. Rahul joins a software company with an initial annual salary of ₹4,50,000. According to his contract, he receives a fixed annual increment of ₹25,000 every year.

- (I). What will be Rahul's annual salary in his 8<sup>TH</sup> year of service?
- (II). After how many years will his annual salary reach ₹6,50,000?
- (III). Calculate the total earnings Rahul accumulates from the company over a career span of 12 years.

Q5. Ananya wants to buy a bicycle costing ₹3,500. She puts ₹100 into her piggy bank in the first week of the year and increases her weekly savings by ₹20 every week.

- (I). How much money does she save specifically in the 25<sup>TH</sup> week?
- (II). In which week will her weekly saving increment reach ₹500 for that single week?
- (III). Will she be able to buy the bicycle after 50 weeks? Justify with calculations of her total savings.

**Case Based Question**

Raman is a fitness freak and great athlete. He always wants to make his nation proud by winning medals and prizes in the athletic activities. An upcoming activity for athletes was going to be organised by Railways. Raman wants to participate in 200 m race. He can currently run that distance in 51 seconds. But he wants to increase his speed, so to do it in 31 seconds. With each day of practice, it takes him 2 seconds less.

- 1. He wants to make his best time as 31 sec. In how many days will he be able to achieve his target? (2)
  - 2. What will be the difference between the time taken on 5<sup>th</sup> day and 7<sup>th</sup> day. (2)
- OR
- 3. Which term of the arithmetic progression 3, 15, 27, 39 .... Will be 120 more than its 21<sup>st</sup> term?

**Ans:**

- (i) Let, the number of days taken to achieve the target be n.

In the given A.P.,  $a = 51$ ,  $d = -2$

$$\text{Since } a_n = a + (n - 1)d \Rightarrow 31 = 51 + (n - 1)(-2)$$

$$\Rightarrow 31 - 51 = (n - 1)(-2) \Rightarrow -20 = (n - 1)(-2)$$

$$\Rightarrow (n - 1) = 10 \Rightarrow n = 11$$

Hence, 11 days are needed to achieve the target.

- (ii)  $A_5 = a + 4d = 51 + 4(-2) = 51 - 8 = 43 \text{ sec}$

$$A_7 = a + 6d = 51 + 6(-2) = 51 - 12 = 39 \text{ sec}$$

Now, time difference =  $43 - 39 = 4 \text{ sec}$ .

OR

(iii) We have,  $a = 3$  and  $d = 12$

$$\therefore a_{21} = a + 20d = 3 + 20 \times 12 = 243$$

Let  $n$ th term of the given AP be 120 more than its 21<sup>st</sup> term. Then,  $a_n = 120 + a_{21}$

$$\Rightarrow 3 + (n - 1)d = 120 + 243$$

$$\Rightarrow 3 + 12(n - 1) = 363 \Rightarrow 12(n - 1) = 360$$

$$\Rightarrow n - 1 = 30 \Rightarrow n = 31$$

Hence, 31<sup>st</sup> term of the given AP is 120 more than its 21<sup>st</sup> term.

2. A school auditorium has to be constructed with a capacity of 2000 people. The chairs in the auditorium are arranged in a concave shape facing towards the stage in such a way that each succeeding row has 5 seats more than the previous one.

(a) If the first row has 15 seats, then how many seats will be there in 12<sup>th</sup> row?

(b) If there are 15 rows in the auditorium, then how many seats will be there in the middle row?

(c) If total 1875 guests were there in the auditorium for a particular event, then how many rows will be needed to make all of them sit?

OR

(c) If total 1250 guests were there in the auditorium for a particular event, then how many rows will be left blank out of total 30 rows?

**Ans:**

(a)  $a = 15$ ,  $d = 5$

$$A_{12} = 15 + 11 \times 5 = 70$$

(b)  $N = 15$

Middle row = 8<sup>th</sup> row

$$A_8 = 15 + 7 \times 5 = 50$$

$$(c) 1875 = n/2 [2 \times 15 + (n - 1) \times 5]$$

$$\Rightarrow n$$

$$2 + 5n - 750 = 0$$

$$(n + 30)(n - 25) = 0 \Rightarrow n = 25$$

$$\therefore \text{Total number of rows required} = 25$$

OR

$$(c) 1250 = n/2 [2 \times 15 + (n - 1) \times 5]$$

$$\Rightarrow n$$

$$2 + 5n - 500 = 0$$

$$(n + 25)(n - 20) = 0 \Rightarrow n = 20$$

$$\therefore \text{Number of rows left} = 30 - 20 = 10$$



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## CHAPTER 6- TRIANGLE

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### Competency Based Question

Q1. The Burj Khalifa, located in Dubai, United Arab Emirates, is the tallest tower in the world, standing at approximately 828 m. It features the highest observation deck open to the public. While walking on the deck, a person observed the shadows of the Burj Khalifa and nearby buildings. At one point, he noted that the shadow of the Burj Khalifa measured 207 m, while the shadow of a building named 'P' was 46 m long.

Based on the above information answer the following:

- (i) Name the property which can be used to find out the length of the building 'P'.
- (ii) Calculate the height of building 'P'.
- (iii) (a) What is the length of shadow of Burj Khalifa when the length of shadow of building 'Q' is 81 meters.

OR

- (b) At the Same instance when the length of the shadow of Burj Khalifa was 207 m, what will be the length of the shadow of building 'Q' of height 108 m?

Solution: Since the sun's rays make the same angle with all buildings at the same time, the triangles formed by the buildings and their shadows are **similar triangles**.

#### **(i) Property used**

**Basic Proportionality of Similar Triangles (Similarity of Triangles)** can be used.

#### **(ii) Height of Building P**

Height of Burj Khalifa / Shadow of Burj Khalifa = Height of Building P / Shadow of Building P  
Height of Building P = 184 m

#### **(iii) (a) Length of shadow of Burj Khalifa when the shadow of building Q is 81 m**

First find the height of building Q:

From part (iii)(b), height of building Q = **108 m**

Using similarity:

$$108/81 = 43/X$$

For Burj Khalifa

$$828/X = 43$$

$$X = 621$$

Length of shadow of Burj Khalifa = 621 m

#### **(iii) (b) Length of shadow of building Q of height 108 m when Burj Khalifa's shadow is 207 m**

$$828/207 = 108/x$$

$$x = 27$$

Length of shadow of building Q = 27 m

**Q2.** A farmer had a triangular piece of land. He put a fence, parallel to one of the sides of the field as shown in the figure.

Based on the above information answer the following questions:

- If the point D is 20 m away from point A, whereas AB and AC are 80 m and 100 m respectively, find the length of AE.
- If  $AD = x + 1$ ,  $DB = 3x - 1$ ,  $AE = x + 3$ ,  $EC = 3x + 4$ , then find the value of x.
- State whether  $BDAD = AE EC$  or not. Give reason.

OR

If P and Q are the mid points of sides YZ and XZ respectively in  $\triangle ZYX$ , then state whether  $PQ \parallel YX$  or not. Give reason.

Ans. Assume in  $\triangle ABC$ , D lies on AB, E lies on AC and  $DE \parallel BC$ .

By the **Basic Proportionality Theorem (BPT)**:

$$AD/AB = AE/AC$$

**1. Find the length of AE**

Given:  $AD=20$  m,  $AB=80$  m,  $AC=100$  m

Using BPT:  $20/80 = AE/100$

$$AE = 25 \text{ m}$$

**Find the value of x**

Given:  $AD=x+1$ ,  $DB=3x-1$ ,  $AE=x+3$ ,  $EC=3x+4$

Since  $DE \parallel BC$

$$AD/DB = AE/EC$$

$$x+1/3x-1 = x+3/3x+4$$

$$x=7$$

**Q3.** Meenal wanted to determine the height of a tower near her house using the properties of similar triangles. Her house is 20 m tall. When Meenal's house casts a 10 m long shadow on the ground, the tower simultaneously casts a 50 m long shadow, and Arun's house casts a 20 m long shadow, as shown below.

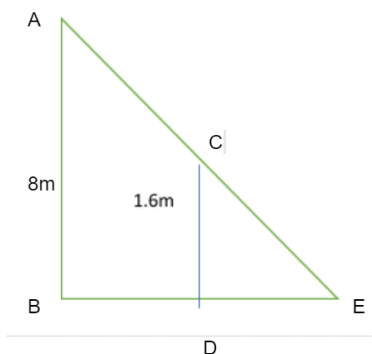
Based on the above information, answer the following questions.

- What is the height of the tower?
- What will be the length of the shadow of the tower when Meenal's house casts a shadow of 15 m?
- (a) If the tower casts a 40 m shadow, what is the length of the shadow cast by Arun's house?

OR

- If the tower casts a 40 m shadow, what will be the length of the shadow cast by Meenal's house?

**Q4.** Peter, who is 1.6 m tall standing near A lamp post. He observed his shadow and the shadow of the lamp post on the ground. He finds the length of a shadow CE to be to metre while the length of the shadow of the lamp post AE was 6 m.



Based on the above information. answer the following questions:

- i.  $\triangle ADE \sim \triangle CDE$
- ii. Find the length of the lamp post AB
- iii. (a) Find the ratio of the sides DE and BD

OR

Find the ratio of perimeters of the triangles ABE and CDE.

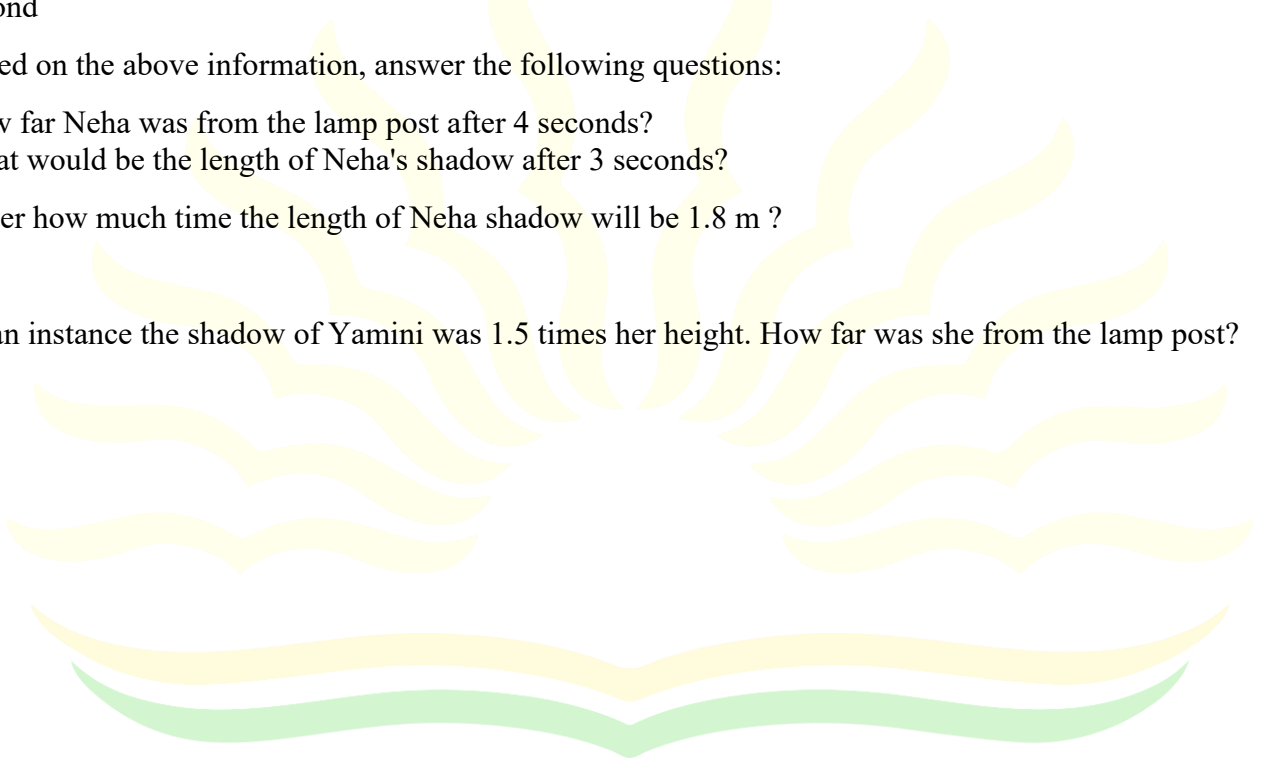
**Q5.** Walking regularly is a good habit to keep us healthy and stress free. After dinner, some people were walking in the society park. A person noticed the dynamic shadows of walking people formed due to light from the lamp posts and started observing them. He observed that as people were moving away from the lamp post, the length of the shadow gradually increases. In the same group there, was Neha of height 180 cm, who was talking to Yamini and moving away from a 5.4 m high lamp post at a speed of 0.6 m per second

Based on the above information, answer the following questions:

- i. How far Neha was from the lamp post after 4 seconds?
- ii. What would be the length of Neha's shadow after 3 seconds?
- iii. After how much time the length of Neha shadow will be 1.8 m ?

OR

At an instance the shadow of Yamini was 1.5 times her height. How far was she from the lamp post?



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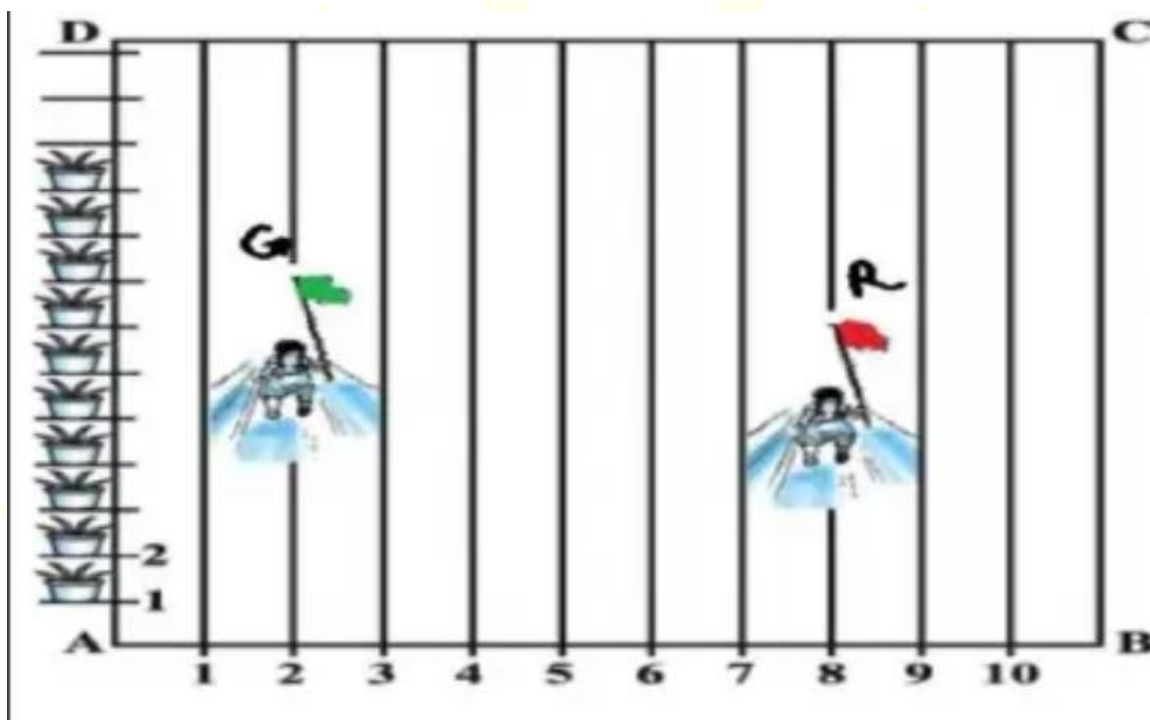
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## CHAPTER 7- COORDINATE GEOMETRY

### Competency Based Question

#### Case Study 1

In order to conduct Sports Day activities in your School, lines have been drawn with chalk powder at a distance of 1 m each, in a rectangular shaped ground ABCD, 100 flower pots have been placed at a distance of 1 m from each other along AD, as shown in given figure below. Niharika runs  $\frac{1}{4}$  the distance AD on the 2nd line and posts a green flag. Preet runs  $\frac{1}{5}$  distance AD on the eighth line and posts a red flag.



- Find the position of green flag and red flag. (1)
- What is the distance between both the flags? (1)
- If Rashmi has to post a blue flag exactly halfway between the line segment joining the two flags, where should she post her flag? (2)

OR

- If Joy has to post a flag at one-fourth distance from green flag, in the line segment joining the green and red flags, then where should he post his flag? (2)

i) Answer:  $G(2,25)$  and  $R(8,20)$

ii) Answer: square root of 61

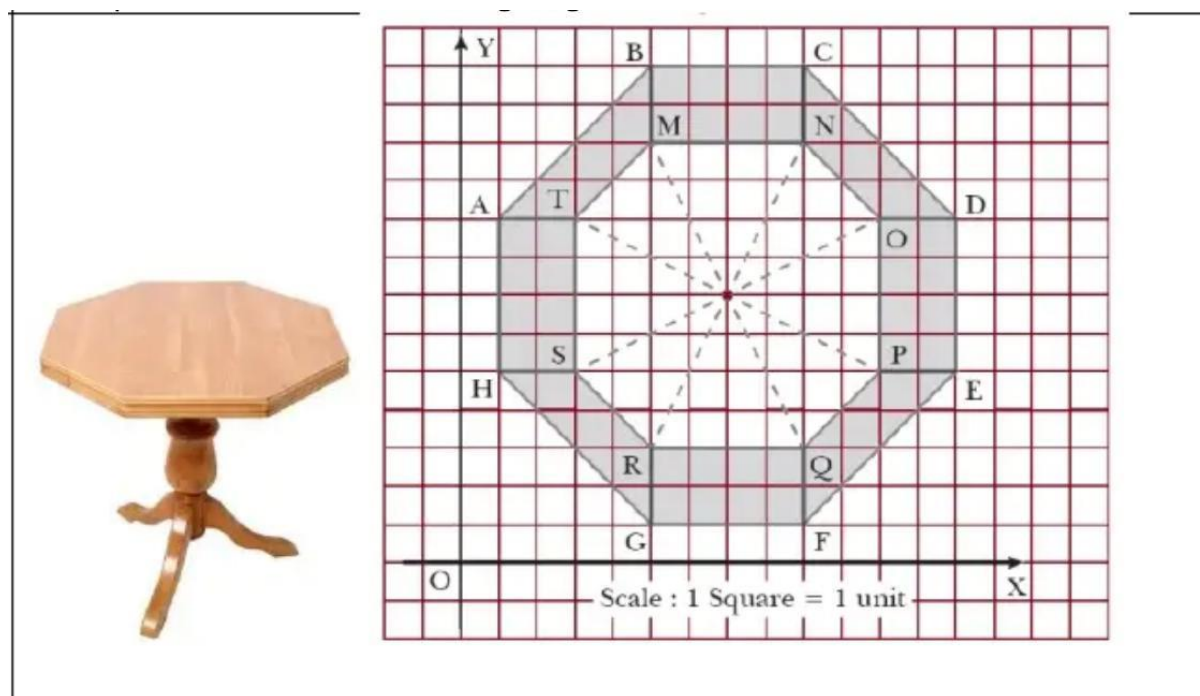
iii) Answer:  $(5, 22.5)$

iv) Answer:  $(3.5, 24)$

### Case Study 2

The top of a table is shown in the figure given below:

Scale: 1 Square = 1 unit



On the basis of above information answer the following questions.

- Find the distance between points A and B. (1)
- If G is taken as the origin, and x, y axis put along GF and GB, then find the point denoted by coordinate (4, 2). (1)
- Write the co-ordinates of the mid point of line segment joining points M and Q. (2)

OR

- Find the coordinates of H, G and also find the distance between them. (2)

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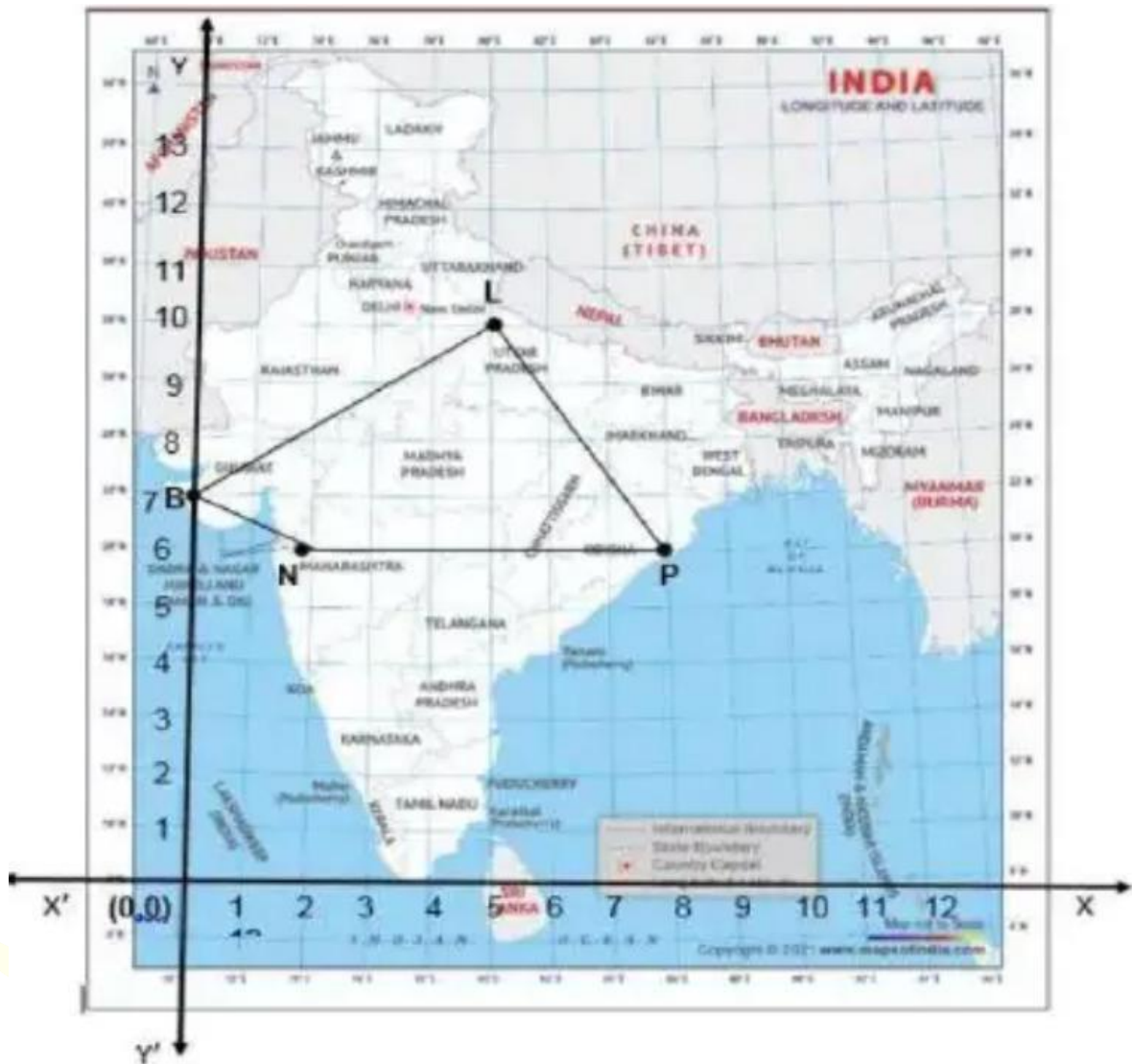
### Case Study 3

In a GPS, The lines that run east-west are known as lines of latitude, and the lines running north-south are known as lines of longitude. The latitude and the longitude of a place are its coordinates and the distance formula is used to find the distance between two places.

The distance between two parallel lines is approximately 150 km.

A family from Uttar Pradesh planned a round trip from Lucknow (L) to Puri (P) via Bhuj (B) and Nashik (N) as shown in the given figure below-

Based on the above information answer the following questions using the coordinate geometry.



i) Find the distance between Lucknow (L) to Bhuj(B).

ii) If Kota (K), internally divide the line segment joining Lucknow (L) to Bhuj (B) into 3 : 2 then find the coordinate of Kota (K). (1)

iii) Name the type of triangle formed by the places Lucknow (L), Nashik (N) and Puri (P) (1)

OR

iv) Find a place (point) on the longitude (y-axis) which is equidistant from the points Lucknow (L) and Puri (P). (2)

Ans:-(i)  $LB = \text{square root of } ((x_2 - x_1)^2 + (y_2 - y_1)^2)$  implies  $LB = \text{square root of } ((0 - 5)^2 + (7 - 10)^2)$

$LB = \text{square root of } ((5)^2 + (3)^2)$  implies  $LB = \text{square root of } (25 + 9)$  implies  $LB = \text{square root of } 34$

Hence the distance is 150 times square root of 34 km

(ii) Coordinate of Kota (K) is  $((3 * 5 + 2 * 0)/(3 + 2), (3 * 7 + 2 * 10)/(3 + 2))$

---



### Case Study 4

A hockey field is the playing surface for the game of hockey. Historically, the game was played on natural turf (grass) but nowadays it is predominantly played on an artificial turf.

It is rectangular in shape - 100 yards by 60 yards. Goals consist of two upright posts placed equidistant from the centre of the backline, joined at the top by a horizontal crossbar. The inner edges of the posts must be 3.66 metres (4 yards) apart, and the lower edge of the crossbar must be 2.14 metres (7 feet) above the ground.

Each team plays with 11 players on the field during the game including the goalie.

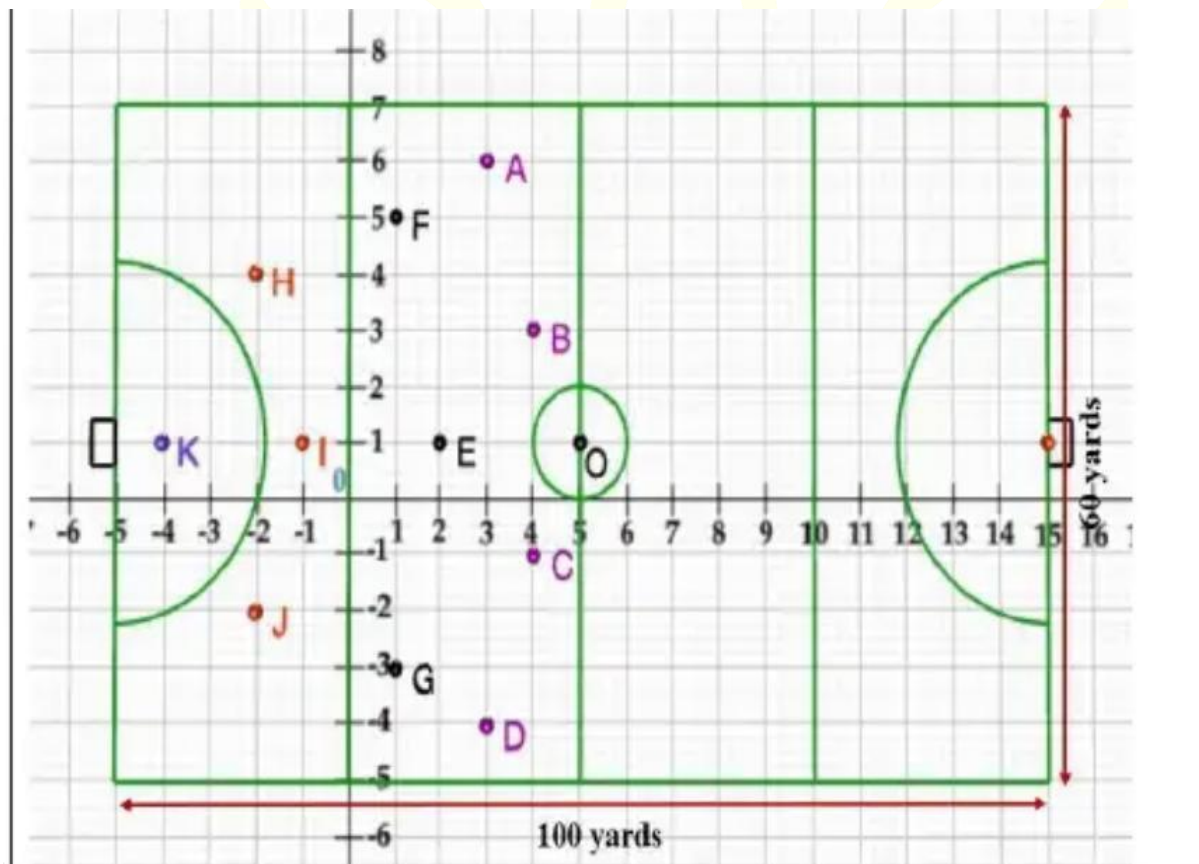
Positions you might play include-

Forward: As shown by players A, B, C and D.

Midfielders: As shown by players E, F and G.

Fullbacks: As shown by players H, I and J.

Goalie: As shown by player K

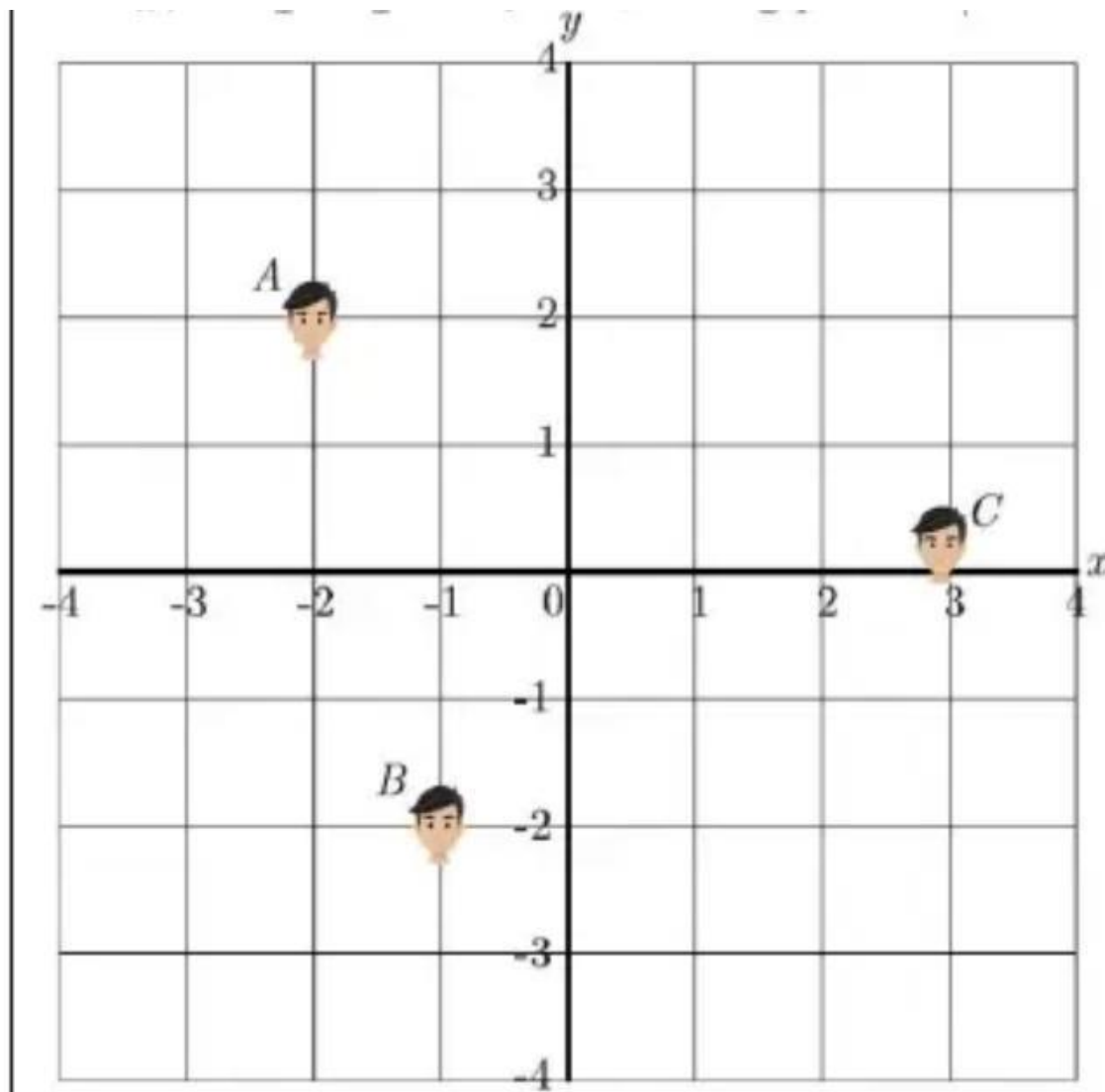


Using the picture of a hockey field below, answer the questions that follow:

- Find the coordinates of the centroid of triangle EHJ. (1)
  - If a player P needs to be at equal distances from A and G, such that A, P and G are in straight line, find the coordinates of position P. (1)
  - Find the point on x axis equidistant from I and E. (2)
- OR
- Find the point on y axis equidistant from B and C. (2)

### Case Study 5 (Book 2)

Aditya, Ritesh and Damodar are fast friend since childhood. They always want to sit in a row in the classroom. But teacher doesn't allow them and rotate the seats row-wise everyday. Ritesh is very good in maths and he does distance calculation everyday. He consider the centre of class as origin and marks their position on a paper in a co-ordinate system. One day Ritesh make the following diagram of their seating position marked Aditya as A, Ritesh as B and Damodar as C.



- What is the distance between A and B (1)
- What is the distance between B and C (1)
- A point D lies on the line segment between points A and B such that  $AD : DB = 4 : 3$ . What are the coordinates of point D (2)

OR

- If the point  $P(k, 0)$  divides the line segment joining the points  $A(2, -2)$  and  $B(-7, 4)$  in the ratio  $1 : 2$ , then find the value of  $k$  (2)

---

### Answer Case Study 1

- i) Answer: G(2,25) and R(8,20)
- ii) Answer: square root of 61
- iii) Answer: (5, 22.5)
- iv) Answer: (3.5,24)

### Answer Case Study 2

- Ans: (i) Distance between A(1, 9) and B(5, 13) is = square root of  $((5-1)^2 + (13-9)^2)$  = square root of  $(16+16)$  = square root of 32 = 4 units times square root of 2
- (ii) Midpoint of the line segment joining M(5, 11) and Q(9, 3) is given by  $((5+9)/2, (11+3)/2) = (14/2, 14/2) = (7,7)$
- (iii) If G is (0, 0) then Q is (4, 2).

OR

As per graph the coordinate of H is (1, 5) and of G is (5, 1).

Distance HG = square root of  $((5-1)^2 + (1-5)^2)$  = square root of  $(16+16)$  = square root of 32 = 4 units times square root of 2

### Answer Case Study 3

- (i)  $LB = \text{square root of } ((x_2 - x_1)^2 + (y_2 - y_1)^2)$  implies  $LB = \text{square root of } ((0 - 5)^2 + (7 - 10)^2)$   
 $LB = \text{square root of } ((5)^2 + (3)^2)$  implies  $LB = \text{square root of } (25 + 9)$  implies  $LB = \text{square root of } 34$   
Hence the distance is 150 times square root of 34 km
- (ii) Coordinate of Kota (K) is  $((3 * 5 + 2 * 0)/(3 + 2), (3 * 7 + 2 * 10)/(3 + 2))$

---

## Case Based Question

### Case Study 1: School Garden Planning

#### Situation:

A school decided to design a rectangular garden on the school grounds. A coordinate grid was placed over the school map with 1 unit = 1 metre. The four corners of the garden are marked as follows:

- A(1, 2)
- B(5, 2)
- C(5, 6)
- D(1, 6)

The school also plans to place a water fountain at the centre of the garden and a flagpost at the midpoint of side BC. Answer the questions below based on this situation.

#### Questions:

**Q1.** Find the distance between corners A(1, 2) and B(5, 2). **[1 mark]**

**Q2.** Find the coordinates of the midpoint of side BC, where B is (5, 2) and C is (5, 6). **[1 mark]**

**Q3.** Find the coordinates of the centre of the garden (the point equidistant from all four corners). Using the distance formula, verify that this centre point is equidistant from A(1, 2) and C(5, 6). **[2 marks]**

### Answers:

#### Answer 1 (1 mark):

Using the distance formula:  $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$d(A, B) = \sqrt{[(5 - 1)^2 + (2 - 2)^2]} = \sqrt{[16 + 0]} = \sqrt{16} = 4 \text{ metres}$$

#### Answer 2 (1 mark):

Midpoint formula:  $M = ((x_1 + x_2)/2, (y_1 + y_2)/2)$

Midpoint of BC =  $((5+5)/2, (2+6)/2) = (5, 4)$

The flagpost is placed at (5, 4).

#### Answer 3 (2 marks):

Centre of garden = midpoint of diagonal AC (or BD)

$$\text{Centre} = ((1+5)/2, (2+6)/2) = (6/2, 8/2) = (3, 4)$$

Verification using distance formula:

$$\text{Distance from centre (3,4) to A(1,2)} = \sqrt{[(3-1)^2 + (4-2)^2]} = \sqrt{[4+4]} = \sqrt{8} = 2\sqrt{2}$$

$$\text{Distance from centre (3,4) to C(5,6)} = \sqrt{[(3-5)^2 + (4-6)^2]} = \sqrt{[4+4]} = \sqrt{8} = 2\sqrt{2}$$

Since both distances are equal ( $2\sqrt{2}$ ), the centre is equidistant from A and C. ✓

---

## Case Study 2: Town Planning and Road Layout

### Situation:

A town planner is designing a new sector. On a coordinate map (scale: 1 unit = 100 m), three main landmarks are placed as follows:

- Community Hall at P(2, 3)
- Hospital at Q(8, 3)
- School at R(5, 9)

A new bus stop is to be built on road PQ such that it divides PQ in the ratio 2:1 from P. The planner also needs to know the distance between the Hospital and the School to plan a road. Answer the questions below.

### Questions:

**Q1.** Find the distance between the Community Hall P(2, 3) and the Hospital Q(8, 3). [1 mark]

**Q2.** Find the coordinates of the bus stop that divides PQ in the ratio 2:1 from P. [1 mark]

**Q3.** Find the distance between the Hospital Q(8, 3) and the School R(5, 9). Also check whether the triangle formed by P, Q, and R is isosceles by comparing two sides. [2 marks]

### Answers:

#### Answer 1 (1 mark):

$$d(P, Q) = \sqrt{[(8-2)^2 + (3-3)^2]} = \sqrt{[36 + 0]} = \sqrt{36} = 6 \text{ units} = 600 \text{ m}$$

#### Answer 2 (1 mark):

Using Section Formula: Bus stop =  $((m \cdot x_2 + n \cdot x_1)/(m+n), (m \cdot y_2 + n \cdot y_1)/(m+n))$

Here  $m:n = 2:1$ ,  $P(2,3)$ ,  $Q(8,3)$

$$x = (2 \times 8 + 1 \times 2)/(2+1) = (16+2)/3 = 18/3 = 6$$

$$y = (2 \times 3 + 1 \times 3)/(2+1) = (6+3)/3 = 9/3 = 3$$

Bus stop is at  $(6, 3)$ .

**Answer 3 (2 marks):**

$$\text{Distance QR} = \sqrt{(8-5)^2 + (3-9)^2} = \sqrt{9 + 36} = \sqrt{45} = 3\sqrt{5} \text{ units}$$

Checking if triangle PQR is isosceles:

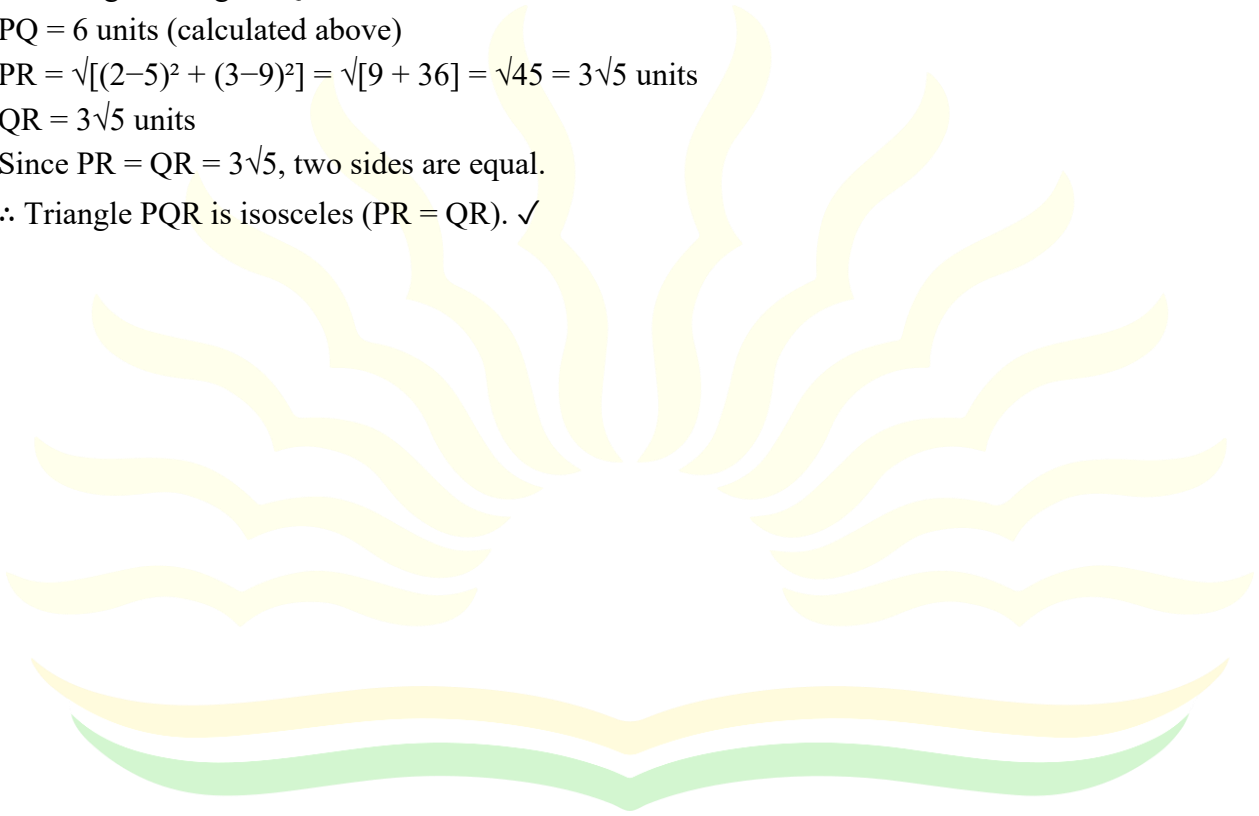
$PQ = 6$  units (calculated above)

$$PR = \sqrt{(2-5)^2 + (3-9)^2} = \sqrt{9 + 36} = \sqrt{45} = 3\sqrt{5} \text{ units}$$

$$QR = 3\sqrt{5} \text{ units}$$

Since  $PR = QR = 3\sqrt{5}$ , two sides are equal.

$\therefore$  Triangle PQR is isosceles ( $PR = QR$ ). ✓



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वेद्रीय विद्यालय अंगणवाडी

## CHAPTER8- INTRODUCTION TO TRIGONOMETRY

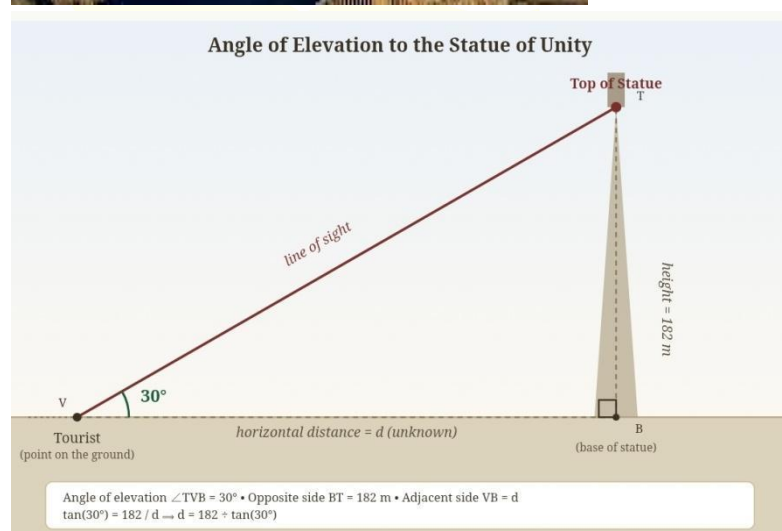
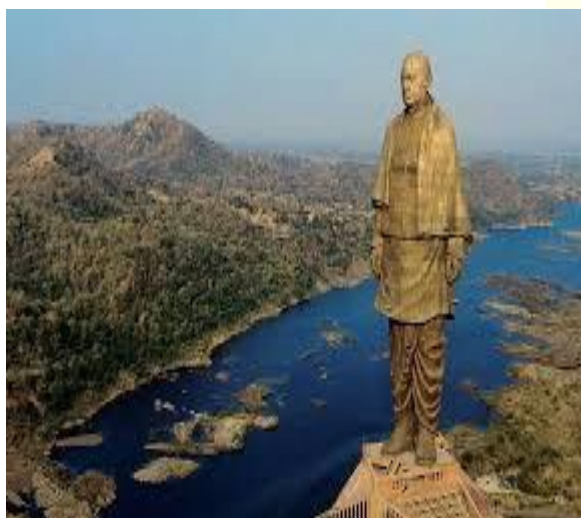
### Competency Based Question

*Competency-Based Questions Rooted in Indian Heritage*

### SOLVED QUESTIONS

#### Question 1

#### Statue of Unity, Kevadia (Gujarat):



The Statue of Unity, dedicated to Sardar Vallabhbhai Patel, is the world's tallest statue at 182 m. A tourist standing at a point on the ground, away from the base of the statue, observes the angle of elevation of the top of the statue to be  $30^\circ$ .

- Find the distance of the tourist from the base of the statue (use  $\sqrt{3} \approx 1.73$ ).
- If the tourist walks closer so that the angle of elevation becomes  $60^\circ$ , find the new distance from the base.
- By how much did the tourist's distance from the base decrease? What does this tell you about the relationship between angle of elevation and distance?



**Solution:**

Let the foot of the statue be B and the top be A, so  $AB = 182$  m. Let the tourist be at point C on the ground, so that triangle ABC is right-angled at B.

**(a) Distance when angle of elevation =  $30^\circ$ :**

$$\tan 30^\circ = AB / BC$$

$$1/\sqrt{3} = 182 / BC$$

$$BC = 182\sqrt{3} \approx 182 \times 1.73 \approx 314.9 \text{ m}$$

**(b) Distance when angle of elevation =  $60^\circ$ :**

$$\tan 60^\circ = AB / BC'$$

$$\sqrt{3} = 182 / BC'$$

$$BC' = 182/\sqrt{3} = 182/1.73 \approx 105.2 \text{ m}$$

**(c) Reasoning:**

Decrease in distance  $\approx 314.9 - 105.2 = 209.7$  m.

As the tourist moves closer to the statue, the angle of elevation increases. This confirms that for a fixed height, angle of elevation and horizontal distance from the base are inversely related — a smaller distance gives a larger angle of elevation.

**(d) What is the angle of elevation of the top of the statue from this point?**

(A)  $30^\circ$

(B)  $45^\circ$

(C)  $60^\circ$

(D)  $90^\circ$

**Correct Answer: (B)**

$\tan \theta = \text{height} / \text{distance} = 34/34 = 1$ , and  $\tan 45^\circ = 1$ , so  $\theta = 45^\circ$ .

(E) The Statue of Unity (182 m tall) casts a shadow on the ground when sunlight falls at a certain angle of elevation.

**If the angle of elevation of the sun is  $45^\circ$ , what is the length of the shadow cast by the statue?**

(A) 91 m

(B) 182 m

(C)  $182\sqrt{3}$  m

(D)  $182/\sqrt{3}$  m

**Correct Answer: (B)**

At  $45^\circ$  elevation,  $\tan 45^\circ = \text{height} / \text{shadow} = 1$ , so shadow length = height = 182 m.

**Question 2 [5 Marks]**

**Adiyogi Shiva Statue, Coimbatore (Tamil Nadu):**

The Adiyogi Shiva statue at the Isha Yoga Centre stands 34 m tall, built to mark the 112 ways of attaining moksha mentioned in yogic culture. A devotee standing on level ground looks up at the top of the statue's head with an angle of elevation of  $45^\circ$ .



- (a) Find the distance of the devotee from the base of the statue.
- (b) Find the distance between the devotee's eye and the top of the statue (i.e., the line of sight, assuming the devotee's height is negligible).
- (c) Another devotee stands twice as far from the base. Will the angle of elevation from this point be more, less, or exactly half of  $45^\circ$ ? Justify.

**Solution:**

Let the base of the statue be B and the top be A, so  $AB = 34$  m. Let the devotee stand at point C, with triangle ABC right-angled at B and angle  $ACB = 45^\circ$ .

(d) A visitor stands exactly at a distance equal to the height of the 34 m Adiyogi statue (i.e., 34 m from its base).

**What is the angle of elevation of the top of the statue from this point?**

- (A)  $30^\circ$
- (B)  $45^\circ$
- (C)  $60^\circ$
- (D)  $90^\circ$

**Correct Answer: (B)**

$\tan \theta = \text{height} / \text{distance} = 34/34 = 1$ , and  $\tan 45^\circ = 1$ , so  $\theta = 45^\circ$ .

**(a) Distance from the base (BC):**

$$\tan 45^\circ = AB / BC$$

$$1 = 34 / BC$$

$$BC = 34 \text{ m}$$

**(b) Line of sight (AC):**

$$\sin 45^\circ = AB / AC$$

$$1/\sqrt{2} = 34 / AC$$

$$AC = 34\sqrt{2} \approx 48.1 \text{ m}$$

**(c) Reasoning:**

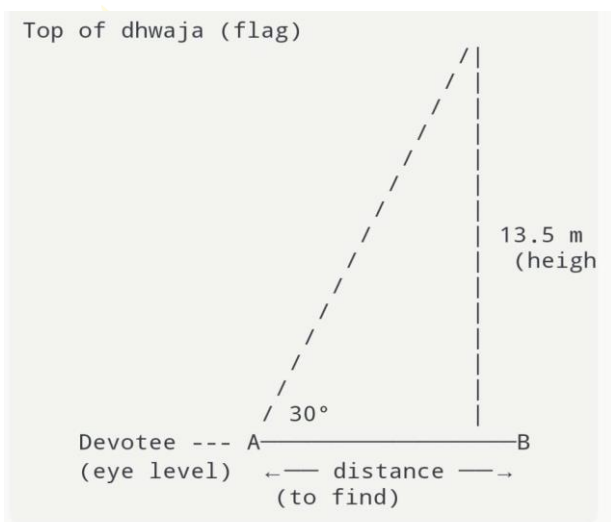
If the distance doubles to 68 m, then  $\tan \theta = 34/68 = 0.5$ , giving  $\theta = \tan^{-1}(0.5) \approx 26.6^\circ$ .

This is less than  $45^\circ$ , but NOT exactly half of  $45^\circ$  (which would be  $22.5^\circ$ ). So the angle of elevation decreases, but the tangent ratio — not the angle itself — is what changes proportionally with distance. This shows that angle of elevation is not linearly related to distance.

## UNSOLVED QUESTIONS

### Question 3

#### Jagannath Puri Rath Yatra (Odisha):



**Labeling for the triangle:**

- **B** = foot of the chariot (on the ground)
- Top point = top of the flag/dhwaja
- **A** = position of the devotee
- **AB** = horizontal distance from devotee to chariot (base, unknown — call it  $x$ )
- Vertical side = height of chariot = 13.5 m (perpendicular)



During the famous Rath Yatra at Puri, the main chariot of Lord Jagannath, called Nandighosa, is about 13.5 m tall. A devotee standing on the road, at some distance from the chariot, observes the angle of elevation of the top of the chariot's flag (dhwaja) to be  $30^\circ$ .

- (a) Find the distance of the devotee from the base of the chariot.
- (b) If the devotee moves to a point where the angle of elevation becomes  $60^\circ$ , find the new distance.
- (c) The crowd pulls the chariot forward along the road using long ropes. Explain, using the idea of angle of elevation, why people standing very close to the moving chariot must constantly look up at a much steeper angle than those standing farther back.

(d) The Nandighosa chariot is approximately 13.5 m tall. A devotee  $13.5\sqrt{3}$  m away from its base looks up at the top of the chariot.

**What is the angle of elevation observed by the devotee?**

- (A)  $30^\circ$
- (B)  $45^\circ$
- (C)  $60^\circ$
- (D)  $90^\circ$

**Correct Answer: (A)**

$\tan \theta = 13.5 / (13.5\sqrt{3}) = 1/\sqrt{3}$ , and  $\tan 30^\circ = 1/\sqrt{3}$ , so  $\theta = 30^\circ$ .

---

**Question 4** [5 Marks]

**Shri Vitthal-Rukmini Mandir, Pandharpur (Maharashtra)**

Lakhs of Varkari pilgrims walk to Pandharpur every year for the Ashadhi Ekadashi yatra to have darshan of Lord Vitthal. Standing on the bank of the Chandrabhaga river, a pilgrim looks up at the top of the temple's tall stone shikhara (spire) at an angle of elevation of  $60^\circ$ . The pilgrim is standing 25 m away from the base of the shikhara.



- (a) Draw a rough labelled figure showing the pilgrim, the shikhara, and the angle of elevation.
- (b) Find the height of the shikhara (use  $\sqrt{3} \approx 1.73$ ).
- (c) If the pilgrim walks 15 m closer to the temple, find the new angle of elevation. (Hint: find the new distance first, then identify the standard angle whose tangent matches.)
- (d) A pilgrim views the top of the temple shikhara at an angle of elevation of  $60^\circ$  from a certain point, then walks directly towards the temple.

**As the pilgrim walks closer to the temple (height of shikhara remaining fixed), what happens to the angle of elevation?**

- (A) It decreases
- (B) It increases
- (C) It stays exactly the same
- (D) It becomes  $0^\circ$

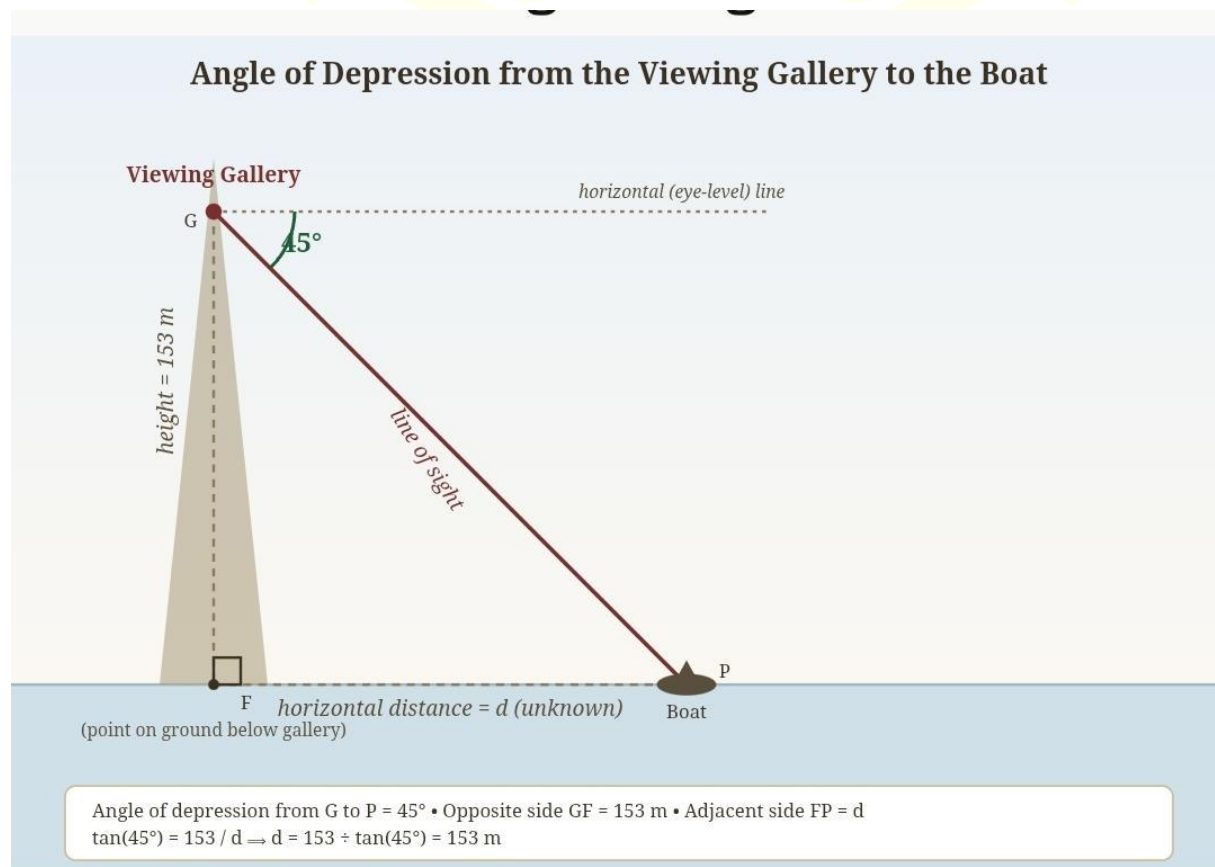
**Correct Answer: (B)**

For a fixed height, decreasing the horizontal distance increases  $\tan \theta$  ( $= \text{height/distance}$ ), so the angle of elevation increases.

### Question 5

#### Statue of Unity viewing gallery (Gujarat):

The Statue of Unity has a viewing gallery built into the statue at a height of 153 m above the ground, from where visitors get a panoramic view of the Sardar Sarovar Dam. A boat on the Narmada river is seen from the viewing gallery at an angle of depression of  $45^\circ$ .





- (a) Find the horizontal distance of the boat from the base of the statue.
- (b) If the boat moves further away so that the angle of depression reduces to  $30^\circ$ , find how far the boat is now from the base.
- (c) A visitor says, 'Since the angle of depression decreased, the boat must have moved closer.' Is this statement correct? Explain the error in reasoning.

### Statue of Unity viewing gallery:

From the 153 m high viewing gallery of the Statue of Unity, a visitor looks down at a car parked near the riverbank at an angle of depression  $\theta$ .

**Which of the following correctly relates the angle of depression  $\theta$  to the angle of elevation  $\phi$  of the visitor's position as seen from the car?**

- (A)  $\theta$  and  $\phi$  are unrelated
- (B)  $\theta = \phi$ , by alternate angles between parallel lines
- (C)  $\theta = 90^\circ - \phi$
- (D)  $\theta = 2\phi$

**Correct Answer: (B)**

The horizontal line at the gallery is parallel to the horizontal ground. The line of sight is a transversal, so the angle of depression and angle of elevation are alternate interior angles and hence equal.

### Case Based Question

#### Case Study 1 — The Qutub Minar Problem ✓ SOLVED

Passage: Students of a school visit Qutub Minar, Delhi. A student stands 72 m away from the base of the Minar and observes its top at an angle of elevation of  $60^\circ$ . A right triangle is formed between the student (S), the base of the Minar (B), and the top of the Minar (T), with the right angle at B. The student uses trigonometric ratios to find the height of the Minar without physically measuring it.

- (a) In the right triangle STB, identify the side opposite to the angle of elevation and the side adjacent to it at point S. [1 mark]
- (b) Write the trigonometric ratio that relates the height TB, the distance SB = 72 m, and the angle of elevation  $60^\circ$  at S. [1 mark]
- (c) Calculate: (i) the height of Qutub Minar TB, and (ii) the length of the line of sight ST (hypotenuse). [Use:  $\tan 60^\circ = \sqrt{3}$ ,  $\cos 60^\circ = \frac{1}{2}$ ] [2 marks]

#### ✓ SOLUTION

- (a) Side OPPOSITE to  $\angle TSB$  ( $60^\circ$ ) = TB = Height of Minar.  
Side ADJACENT to  $\angle TSB$  = SB = 72 m | Hypotenuse = ST (Line of sight).



(b)  $\tan 60^\circ = \text{Opposite} / \text{Adjacent} = TB / SB \Rightarrow \tan 60^\circ = TB / 72$

(c) Step 1 — Height of Minar:

$$\tan 60^\circ = TB / 72 \Rightarrow \sqrt{3} = TB / 72 \Rightarrow TB = 72\sqrt{3} \text{ m}$$

$$\therefore \text{Height of Qutub Minar} = 72\sqrt{3} \approx 124.71 \text{ m}$$

Step 2 — Line of sight (Hypotenuse ST):

$$\cos 60^\circ = SB / ST \Rightarrow \frac{1}{2} = 72 / ST \Rightarrow ST = 144 \text{ m}$$

$$\therefore \text{Length of line of sight} = 144 \text{ m}$$

### Case Study 2 — Ladder Leaning Against a Wall ✓ SOLVED

Passage: A 10 m long ladder is leaning against a vertical wall. The foot of the ladder (F) is placed on the horizontal ground at a distance of 5 m from the base of the wall (G). The ladder (hypotenuse), the wall (perpendicular) and the ground (base) form a right-angled triangle, with the right angle at G. A worker uses trigonometric ratios to find the angle the ladder makes with the ground and the height it reaches on the wall.

- In the right triangle, name the hypotenuse and write which side is adjacent to the angle  $\theta$  at F (foot of ladder). [1 mark]
- Using the given values, calculate  $\cos \theta$  and hence find the angle  $\theta$  that the ladder makes with the ground. [1 mark]
- Find the height  $h$  reached by the ladder on the wall. Verify your answer using Pythagoras theorem. [Use:  $\sin 60^\circ = \sqrt{3}/2$ ] [2 marks]

### ✓ SOLUTION

(a) Hypotenuse = Ladder FW = 10 m.

Side adjacent to  $\theta$  at F = FG (ground) = 5 m. | Side opposite = GW (wall height).

(b)  $\cos \theta = \text{Adjacent} / \text{Hypotenuse} = FG / FW = 5 / 10 = \frac{1}{2}$

Since  $\cos 60^\circ = \frac{1}{2}$ ,  $\therefore \theta = 60^\circ$

(c) Height  $h$  (wall):

$$\sin 60^\circ = GW / FW \Rightarrow (\sqrt{3}/2) = h / 10 \Rightarrow h = 5\sqrt{3} \text{ m}$$

$$\therefore \text{Height reached on wall} = 5\sqrt{3} \approx 8.66 \text{ m}$$

Verification by Pythagoras Theorem:

$$FG^2 + GW^2 = 5^2 + (5\sqrt{3})^2 = 25 + 75 = 100 = 10^2 = FW^2$$

✓ ✎ **UNSOLVED CASE-BASED QUESTIONS (Attempt yourself)**

**Case Study 3 — River Width — Angle of Depression ✎ UNSOLVED**

Passage: Priya is sitting on the balcony of her house which is 8 m above the ground, on the bank of a river. She observes a flower pot placed at the base of a temple on the opposite bank. The angle of depression from Priya's eye (P) to the flower pot (F) is  $30^\circ$ . The point G directly below Priya on the ground, F and P form a right-angled triangle. Use trigonometric ratios to find the width of the river and the distance PF.

- (a) State the angle of depression. Also write the angle of elevation of P as seen from F. Give reason. [1 mark]
- (b) Write the equation using an appropriate trigonometric ratio to find the width  $w$  of the river. [1 mark]
- © Find (i) the width  $w$  of the river, and (ii) the length of line of sight PF. [Use:  $\tan 30^\circ = 1/\sqrt{3}$ ,  $\sec 30^\circ = 2/\sqrt{3}$ ] [2 marks]

Space for Answer:

- (a) \_\_\_\_\_
- (b) \_\_\_\_\_
- (c) \_\_\_\_\_

**Case Study 4 — School Ramp for Specially-Abled Students ✎ UNSOLVED**

Passage: A school constructs a ramp (AB) for specially-abled students. The ramp rises from the ground at point B to a platform at point A, which is 3 m above the ground. The horizontal distance BC (from the foot of the ramp to the base of the platform) is  $3\sqrt{3}$  m. The ramp AB, vertical side AC = 3 m, and horizontal base BC =  $3\sqrt{3}$  m form a right-angled triangle with the right angle at C. The school wants to find the angle of inclination  $\theta$  and length of the ramp.

- (a) Name the right angle in the triangle formed. Which side is the hypotenuse (the ramp AB)? [1 mark]
- (b) Write  $\tan \theta$  using the given sides. Find the angle of inclination  $\theta$  of the ramp. [1 mark]
- (c) Calculate the length  $L$  of the ramp AB. Verify using Pythagoras theorem. [Use:  $\sin 30^\circ = 1/2$ ,  $\cos 30^\circ = \sqrt{3}/2$ ] [2 marks]

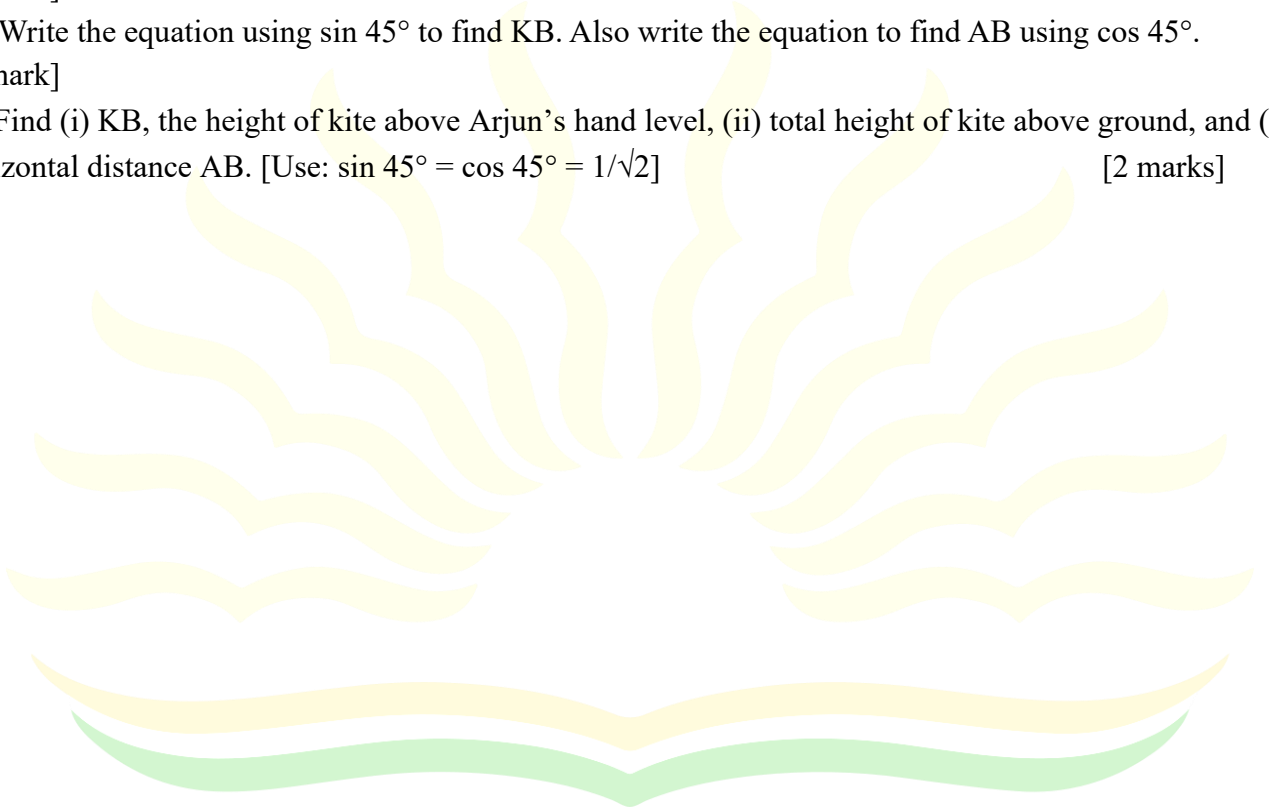
Space for Answer:

- (a) \_\_\_\_\_
- (b) \_\_\_\_\_
- (c) \_\_\_\_\_

### Case Study 5 — Kite Flying — Makar Sankranti ✎ UNSOLVED

Passage: Arjun is flying a kite (K) on Makar Sankranti. The string AK is 100 m long and taut, making an angle of  $45^\circ$  with the horizontal ground. Arjun holds the string at point A, which is 1.5 m above the ground. B is the point directly below K at the same horizontal level as A. The triangle KAB is right-angled at B. Arjun wants to find KB (height of kite above the level of A) and the total height above the ground.

- (a) In right triangle KAB (right-angled at B), name the hypotenuse and the side adjacent to  $45^\circ$  at A. [1 mark]
- (b) Write the equation using  $\sin 45^\circ$  to find KB. Also write the equation to find AB using  $\cos 45^\circ$ . [1 mark]
- (c) Find (i) KB, the height of kite above Arjun's hand level, (ii) total height of kite above ground, and (iii) horizontal distance AB. [Use:  $\sin 45^\circ = \cos 45^\circ = 1/\sqrt{2}$ ] [2 marks]



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## CHAPTER9- APPLICATION TO TRIGONOMETRY

### Competency Based Question

#### Solved Questions

1. During the morning assembly, a student observes the top of the school's water tank at an angle of elevation of  $45^\circ$ . If the student is standing 18 m away from the base of the tank, find the height of the water tank.

#### Solution:

Let AB be the height of the water tank and BC be the distance of the student from its base.

Given:  $BC = 18$  m,  $\angle ACB = 45^\circ$

Using,  $\tan 45^\circ = AB/BC$

$$1 = AB/18$$

$$AB = 18 \text{ m}$$

Therefore, the height of the water tank is 18 m.

2. A mobile network company installs a signal pole in a village. From a point on the ground 30 m away from its base, the angle of elevation of the top of the pole is  $60^\circ$ . Find the height of the pole.

Solution: Let AB be the height of the pole.

Given:  $BC = 30$  m,  $\angle ACB = 60^\circ$

Using,  $\tan 60^\circ = AB/BC$

$$\sqrt{3} = AB/30$$

$$AB = 30\sqrt{3} \text{ m}$$

Therefore, the height of the pole is  $30\sqrt{3}$  m.

3. From the roof of a school building 21 m high, the angle of depression of a bicycle parked on the ground is  $30^\circ$ . Find the distance of the bicycle from the foot of the building.

#### Solution:

Let BC be the required distance.

Given:  $AB = 21$  m

Angle of depression =  $30^\circ$

Therefore, angle of elevation =  $30^\circ$

Using,  $\tan 30^\circ = AB/BC$

$$1/\sqrt{3} = 21/BC$$

$$BC = 21\sqrt{3} \text{ m}$$

Therefore, the bicycle is  $21\sqrt{3}$  m away from the building.

#### (Unsolved)

3. The National Flag is hoisted on a vertical pole in the school playground. A student standing 15 m away from the pole observes the top of the pole at an angle of elevation of  $60^\circ$ . Find the height of the pole

4. A security camera is fixed at the top of a building. The building is 24 m high. The angle of depression of a vehicle standing on the ground is  $45^\circ$ . Find the distance of the vehicle from the foot of the building.
5. A solar street light is installed on a straight road near the school. From a point 12 m away from its base, the angle of elevation of its top is  $30^\circ$ . Find the height of the street light.

### Case Based Question

#### **Case 1 — Lokhandwala Minerva in Mahalaxmi, Mumbai,**

is India's tallest completed residential skyscraper, soaring to a height of 301 meters (988 feet) with 78 floors.

A surveyor stands 90 m from Lokhandwala Minerva and observes a bird at its 30th floor at the height of 90 metres .

- a) Find angle of elevation from surveyor to the bird. (1M)
- b) Find the height from 30th floor to top of the building. (1M)
- c) If the same bird flies at the height of  $90\sqrt{3}$ , find the angle of elevation from the observer to the bird seated at the top of the Minerva. (2M)



**Case 2 — Vindhyachal Super Thermal Power Station(NTPC Singrauli Chimney, MP.)** is located in **Waidhan, Singrauli district**. This is India's largest thermal power plant. It has a capacity of **4,760 MW** and uses multiple chimneys . It features a large 275-meter tall twin-flue RCC

A safety engineer observes a 120 m industrial chimney at a  $60^\circ$  angle of elevation, with a warning marker at 60 m. Warning marker is a danger point regarding safety.

- a. Calculate horizontal distance, line-of-sight length. (1M)
- b. Calculate  $\tan \theta$  for the marker, and reason about the  $90^\circ$  edge case. (1M)
- c. Find the angle of depression from 250 meters below from the top of the chimney to the safety engineer. (2M)

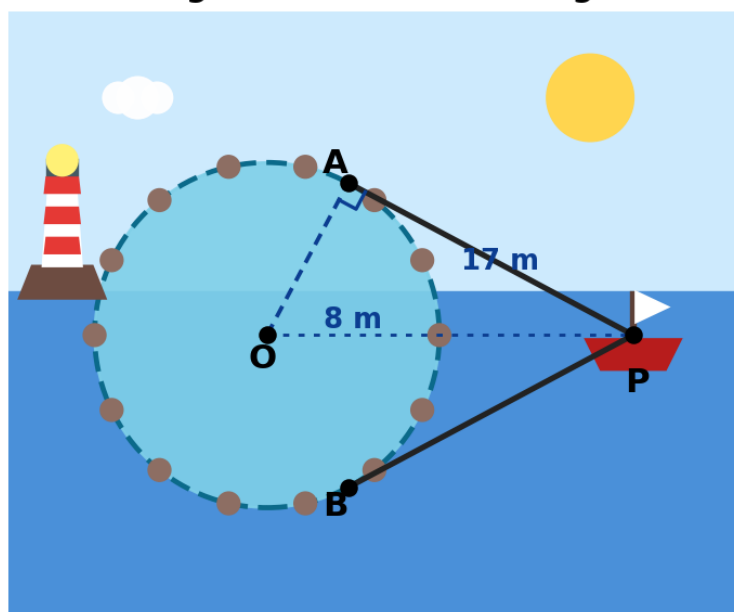


## CHAPTER 10- CIRCLES

### Question 1 — Lighthouse Reef Warning (Marine Navigation)

A lighthouse keeper monitors a circular shallow-water reef with centre O and radius 8 m. To keep vessels safe, two warning ropes PA and PB are stretched from a single buoy fixed at point P, outside the reef. Each rope just touches the boundary of the reef, so PA and PB are tangents to the circular reef at points A and B respectively. The straight-line distance from the buoy P to the centre O of the reef is measured to be 17 m.

#### Lighthouse Reef Warning



- (i) State the relationship between the radius OA and the rope PA at the point of contact A, and write the measure of  $\angle OAP$ . [1 Mark]
- (ii) Find the length of the warning rope PA. [1 Mark]
- (iii) Find the perimeter of the quadrilateral OAPB formed by the two radii and the two ropes. [2 Marks]

#### Solution 1 — Lighthouse Reef Warning

- (i) [1 Mark]  $OA \perp PA$ , i.e.  $\angle OAP = 90^\circ$ .

Reason: The radius drawn to the point of contact is perpendicular to the tangent.

- (ii) [1 Mark]  $PA = 15$  m.

$$\text{In right } \triangle OAP, OP^2 = OA^2 + PA^2 \Rightarrow 17^2 = 8^2 + PA^2$$

$$PA^2 = 289 - 64 = 225 \Rightarrow PA = \sqrt{225} = 15 \text{ m.}$$

- (iii) [2 Marks] Perimeter of OAPB = 46 m.

$PB = PA = 15$  m (tangents from an external point are equal) and  $OB = OA = 8$  m (radii).

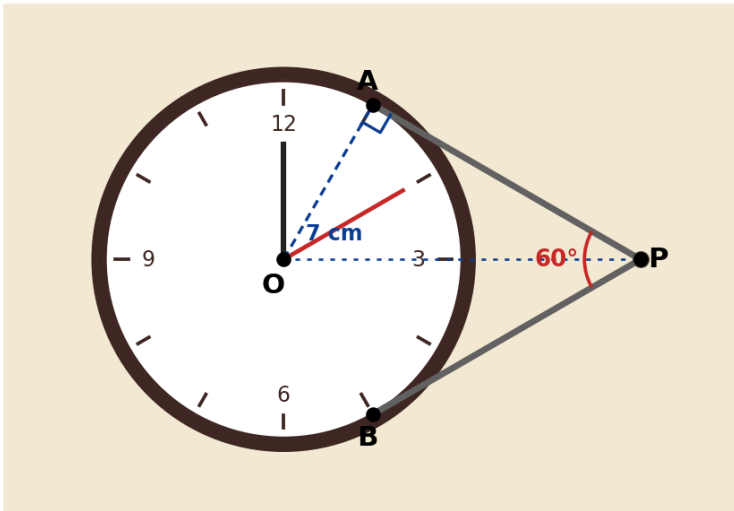
$$\text{Perimeter} = OA + AP + PB + BO = 8 + 15 + 15 + 8 = 46 \text{ m}$$



### Question 2 — Decorative Wall Clock (Interior Design)

A circular decorative wall clock has centre O and radius 7 cm. An interior designer fixes two straight metal rods PA and PB from a single nail P on the wall, so that each rod just touches the rim of the clock tangentially at points A and B. The two rods are inclined to each other at an angle of  $\angle APB = 60^\circ$ .

#### Decorative Wall Clock



- (i) Find the measure of the angle  $\angle AOB$  subtended by the two radii at the centre O. [1 Mark]
- (ii) The line OP bisects  $\angle APB$ . Write the measure of  $\angle OPA$ . [1 Mark]
- (iii) Using the right triangle OAP, find the distance OP (from the nail to the centre) and the length of the rod PA. [2 Marks]

#### Solution 2 — Decorative Wall Clock

- (i) [1 Mark]  $\angle AOB = 120^\circ$ .

In quadrilateral OAPB,  $\angle OAP = \angle OBP = 90^\circ$ , so  $\angle AOB = 360^\circ - 90^\circ - 90^\circ - 60^\circ = 120^\circ$ .  
(Equivalently,  $\angle AOB$  and  $\angle APB$  are supplementary:  $180^\circ - 60^\circ = 120^\circ$ .)

- (ii) [1 Mark]  $\angle OPA = 30^\circ$ .

OP bisects  $\angle APB$ , so  $\angle OPA = \frac{1}{2} \times 60^\circ = 30^\circ$ .

- (iii) [2 Marks] OP = 14 cm and PA =  $7\sqrt{3}$  cm ( $\approx 12.12$  cm).

In right  $\triangle OAP$ ,  $\sin(\angle OPA) = OA / OP \Rightarrow \sin 30^\circ = 7 / OP \Rightarrow \frac{1}{2} = 7 / OP \Rightarrow OP = 14$  cm.

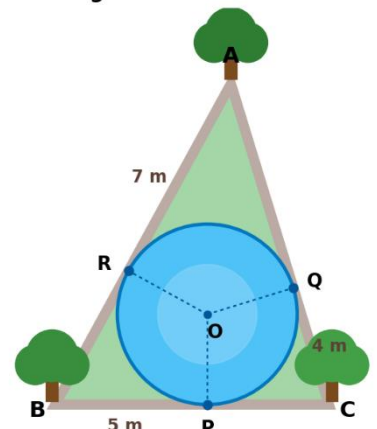
Then  $PA^2 = OP^2 - OA^2 = 14^2 - 7^2 = 196 - 49 = 147 \Rightarrow PA = \sqrt{147} = 7\sqrt{3}$  cm.

### Question 3 — Triangular Park with a Pond (Urban Landscaping)

A triangular park ABC has a circular pond inscribed inside it with centre O, so that the boundary of the pond touches all three straight walking edges BC, CA and AB at points P, Q and R respectively. During a survey, the lengths along the edges from the corners up to the points of contact were noted as: AR = 7 m, BP = 5 m and CQ = 4 m.

- (i) Write the length of AQ, giving the property used. [1 Mark]
- (ii) Write the length of BR. [1 Mark]
- (iii) Find the perimeter of the triangular park ABC. [2 Marks]

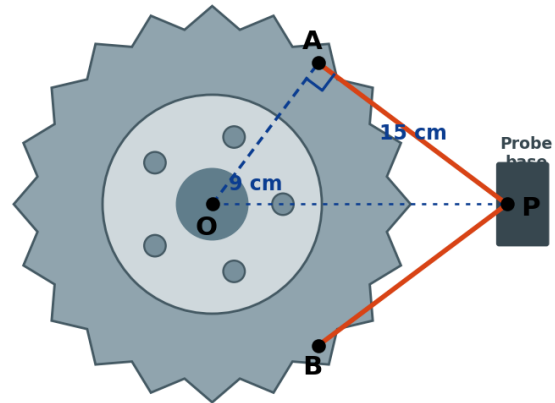
#### Triangular Park with a Pond



#### Question 4 — Machine Gear Inspection (Mechanical Engineering)

A circular gear in a machine has centre O and radius 9 cm. During inspection, two measuring probes PA and PB are placed from a single fixed reference point P outside the gear, such that both probes touch the gear tangentially at points A and B. The distance from the reference point P to the centre O of the gear is 15 cm.

Machine Gear Inspection

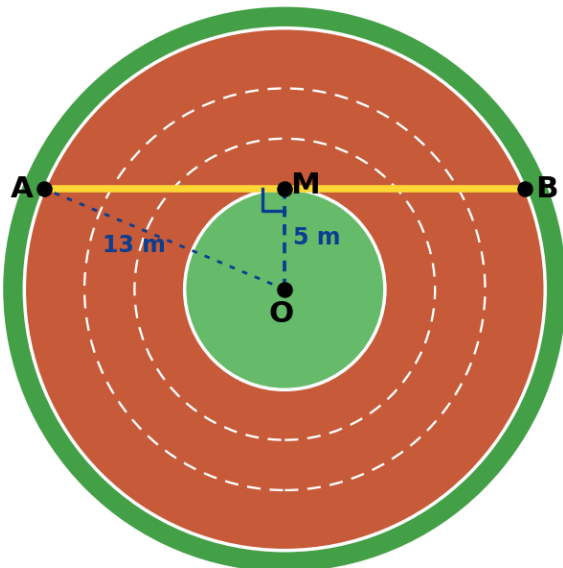


- (i) Find the length of the probe PA. [1 Mark]
- (ii) Write the length of the second probe PB, giving a reason. [1 Mark]
- (iii) Find the area of the quadrilateral OAPB formed by the two radii and the two probes. [2 Marks]

#### Question 5 — Concentric Running Tracks (Stadium Athletics)

A stadium has two concentric (same-centre) circular running tracks sharing the common centre O. The outer track has radius 13 m and the inner track has radius 5 m. A straight practice rope is laid as a chord AB of the outer track in such a way that it just touches the inner track tangentially at its mid-region point M.

Concentric Running Tracks



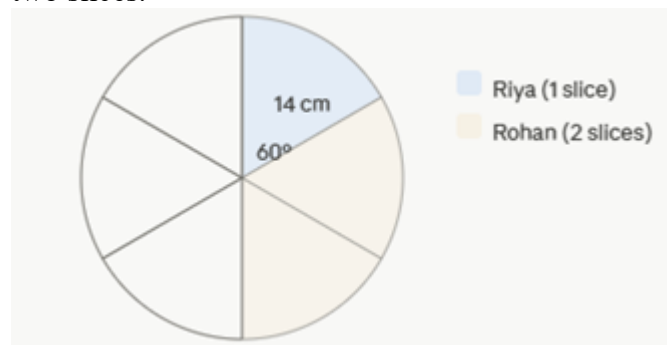
- (i) State the relationship between OM and the chord AB at the point of contact M. [1 Mark]
- (ii) Find the length AM. [1 Mark]
- (iii) Find the length of the full chord AB. Justify the step used. [2 Mark]

## CHAPTER11- AREA RELATED TO CIRCLE

### Competency Based Question

#### Question 1 — The Pizza Problem

A pizza of radius 14 cm is divided into 6 equal slices. Riya takes one slice and her brother Rohan takes two slices.



Sub-questions:

- (a) What is the angle subtended by each slice at the centre? [1 mark]
- (b) What is the arc length of Riya's slice? (Use  $\pi = 22/7$ ) [1 mark]
- (c) Find the total area of pizza taken by Rohan. (Use  $\pi = 22/7$ ) [2 marks]

#### Solution

(a) Total angle =  $360^\circ$ . Pizza divided into 6 equal slices.

Angle per slice =  $360^\circ \div 6 = 60^\circ$

(b) Arc length of sector =  $(\theta/360) \times 2\pi r$   
 $= (60/360) \times 2 \times (22/7) \times 14$   
 $= (1/6) \times 2 \times (22/7) \times 14$   
 $= (1/6) \times 88$   
 $= 88/6$   
 $\approx 14.67 \text{ cm}$

(c) Rohan takes 2 slices  $\rightarrow$  angle =  $2 \times 60^\circ$   
 $= 120^\circ$

Area of sector =  $(\theta/360) \times \pi r^2$   
 $= (120/360) \times (22/7) \times 14 \times 14$   
 $= (1/3) \times (22/7) \times 196$   
 $= (1/3) \times 616 = 205.33 \text{ cm}^2$

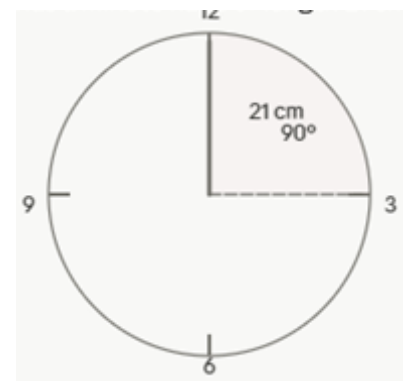
$\therefore$  Area of pizza taken by Rohan  $\approx 205.33 \text{ cm}^2$

#### Question 2 — The Clock Watcher

A clock has a minute hand of length 21 cm. Observe the clock face below.

Sub-questions:

- (a) How many degrees does the minute hand rotate in 15 minutes? [1 M]
- (b) What is the arc length swept by the minute hand in 15 minutes? [1 M]
- (c) [2 marks] Find the area swept by the minute hand in 45 minutes.  
(Use  $\pi = 22/7$ ) [2 marks]



#### Solution:

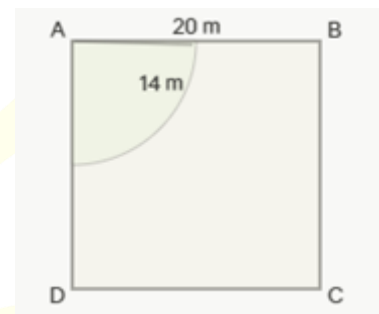
(a) In 60 minutes the minute hand rotates  $360^\circ$ . In 15 minutes  $\rightarrow (15/60) \times 360^\circ = 90^\circ$

$$\begin{aligned}
 \text{(b) Arc length} &= (\theta/360) \times 2\pi r \\
 &= (90/360) \times 2 \times (22/7) \times 21 \\
 &= (1/4) \times 132 = 33 \text{ cm} \\
 \text{(c) In 45 minutes} \rightarrow \text{angle} &= (45/60) \times 360^\circ \\
 &= 270^\circ
 \end{aligned}$$

$$\begin{aligned}
 \text{Area swept} &= (\theta/360) \times \pi r^2 \\
 &= (270/360) \times (22/7) \times 21 \times 21 \\
 &= (3/4) \times (22/7) \times 441 \\
 &= (3/4) \times 1386 \\
 &= 1039.5 \text{ cm}^2
 \end{aligned}$$

### Question 3 — The Grazing Horse

A horse is tied at the corner A of a square field of side 20 m with a rope of length 14 m. Study the figure and answer the questions.



Sub-questions:

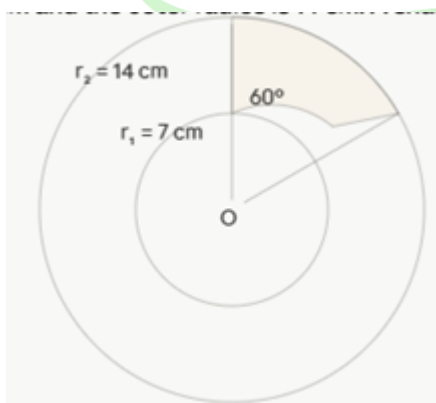
- What angle does the grazing region make at corner A? [1 mark]
- What fraction of the circle of radius 14 m is the grazing region? [1 mark]
- Find the area the horse can graze. (Use  $\pi = 22/7$ ) [2 marks]

**Solution:**

- The interior angle of a square =  $90^\circ$ . The horse is at corner A.  $\therefore$  The grazing region subtends  $90^\circ$  at A.
- Grazing region is a sector with  $\theta = 90^\circ$  out of  $360^\circ$ .  
Fraction =  $90/360 = 1/4$
- Area =  $(\theta/360) \times \pi r^2 = (90/360) \times (22/7) \times 14 \times 14 = (1/4) \times (22/7) \times 196 = (1/4) \times 616 = 154 \text{ m}^2$   
 $\therefore$  The horse can graze an area of  $154 \text{ m}^2$ .

### Question 4 — The Archery Target

An archery target has two concentric circles with centre O. The inner radius is 7 cm and the outer radius is 14 cm. A shaded sector of angle  $60^\circ$  is cut out.



Sub-questions:

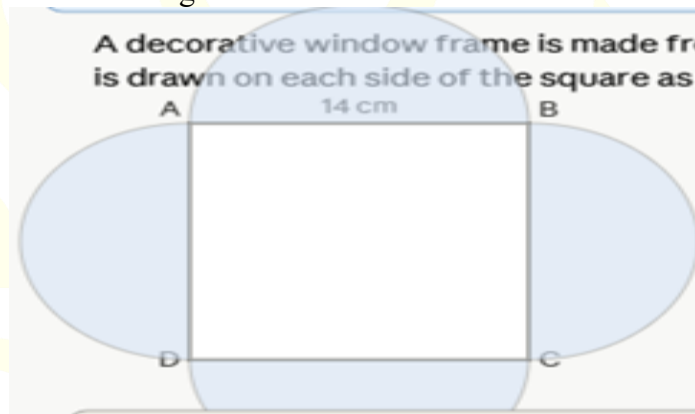
- Find the area of the sector of the larger circle (radius 14 cm) for  $60^\circ$ . [1 mark]
- Find the area of the sector of the smaller circle (radius 7 cm) for  $60^\circ$ . [1 mark]
- Hence, find the area of the shaded annular sector. (Use  $\pi = 22/7$ ) [2 marks]

**Solution**

- a. Area of larger sector =  $(60/360) \times (22/7) \times 14^2$   
 $= (1/6) \times (22/7) \times 196$   
 $= (1/6) \times 616$   
 $= 616/6 \approx 102.67 \text{ cm}^2$
- b. Area of smaller sector =  $(60/360) \times (22/7) \times 7^2$   
 $= (1/6) \times (22/7) \times 49$   
 $= (1/6) \times 154$   
 $= 154/6 \approx 25.67 \text{ cm}^2$
- c. Area of annular sector = Area of larger sector – Area of smaller sector  
 $= 616/6 - 154/6 = 462/6 = 77 \text{ cm}^2$   
 $\therefore$  Area of shaded annular sector =  $77 \text{ cm}^2$

**Question 5**

A decorative window frame is made from a square tile of side 14 cm. A semicircle is drawn on each side of the square as diameter, as shown in the figure.

**Sub-questions:**

- (a) What is the radius of each semicircle? [1 mark]  
 (b) What is the total area of the 4 semicircles? [1 mark]  
 (c) [2 marks] Find the area of the shaded (petal) design inside the square. ( $\pi = 22/7$ ) [2 marks]

**Solutions**

- (a) Each semicircle has diameter = side of square = 14 cm.  $\therefore$  Radius of each semicircle =  $14/2 = 7 \text{ cm}$   
 (b) Area of one semicircle =  $(1/2)\pi r^2 = (1/2) \times (22/7) \times 7^2$   
 $= (1/2) \times 154 = 77 \text{ cm}^2$

Total area of 4 semicircles =  $4 \times 77 = 308 \text{ cm}^2$

- (c) Area of square =  $14 \times 14 = 196 \text{ cm}^2$

Let unshaded regions (I, II, III, IV) be four corner pieces inside the square.

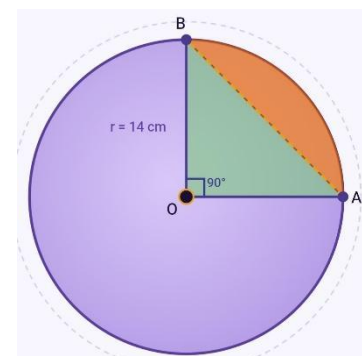
$$\begin{aligned} \text{Area of (I + III)} &= \text{Area of square} - 2 \text{ semicircles on top \& bottom} \\ &= 196 - 2 \times 77 \\ &= 196 - 154 = 42 \text{ cm}^2 \end{aligned}$$

Similarly, Area of (II + IV) =  $42 \text{ cm}^2$

$$\begin{aligned} \therefore \text{Shaded area} &= \text{Area of square} - \text{Area of (I+II+III+IV)} = 196 - (42 + 42) \\ &= 196 - 84 \\ &= 112 \text{ cm}^2 \end{aligned}$$

### Case Based Question Case Study 1: Glass Window Design

An architect designs a circular stained-glass window of radius 14 cm. A chord divides a sector of angle  $90^\circ$ . The area of the triangle formed by the two radii and the chord is  $98 \text{ cm}^2$ .



#### Questions

- i. Find the area of the sector. (1 Mark)
- ii. Find the area of the minor segment. (1 Mark)
- iii. What percentage of the sector is occupied by the minor segment? (2M)

#### Solution

- i.  $(90/360) \times (22/7) \times 14^2 = 154 \text{ cm}^2$   
Answer:  $154 \text{ cm}^2$
- ii.  $154 - 98 = 56 \text{ cm}^2$   
Answer:  $56 \text{ cm}^2$
- iii.  $(56/154) \times 100 = 4/11 \times 100 = 36.36\%$   
Answer:  $36.36\%$

### Case Study 2 — The School Garden

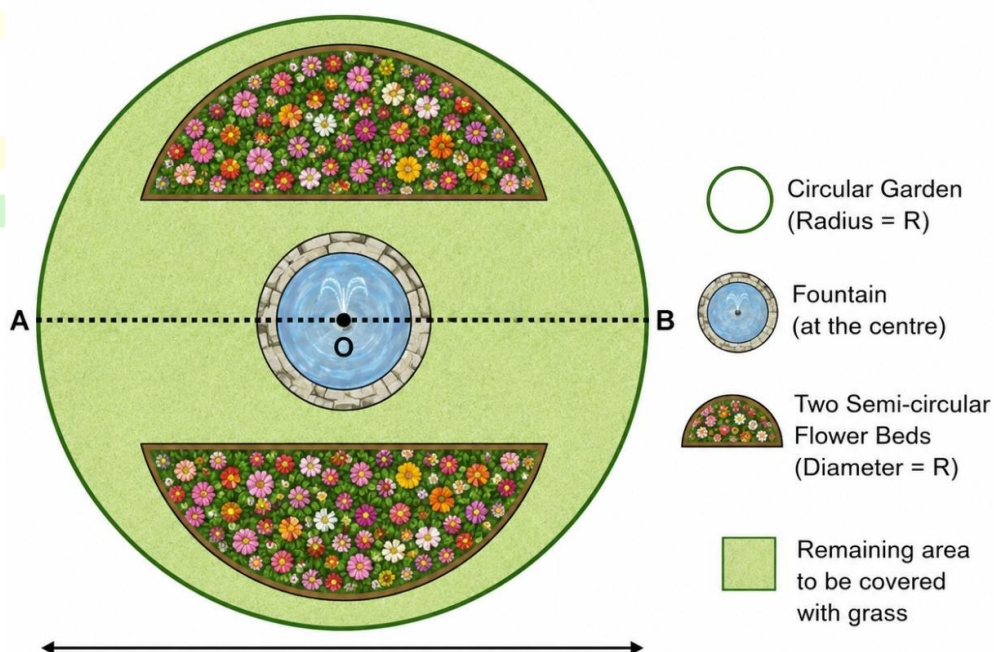
A school has decided to develop a circular garden in the centre of its campus. The garden has a radius of 21 m. Inside the garden, the school has planned the following:

A circular fountain of radius 7 m at the centre.

Two semi-circular flower beds on opposite sides of the fountain, each with a diameter equal to the radius of the garden.

The remaining area is to be covered with grass.

(Use  $\pi = 22/7$ )



Answer the following questions based on the above information:

Q1. What is the area of the circular fountain?

- a.  $616 \text{ m}^2$  (b)  $308 \text{ m}^2$  (c)  $154 \text{ m}^2$  (d)  $77 \text{ m}^2$



Q2. The diameter of each semi-circular flower bed is equal to the radius of the garden . What is the area of one semi-circular flower bed?

- a. 173.25 m<sup>2</sup> (b) 346.5 m<sup>2</sup> (c) 693 m<sup>2</sup> (d) 86.6 m<sup>2</sup>

Q3. What is the area to be covered with grass (remaining area after fountain and flower beds)?

- a. 885.5 m<sup>2</sup> (b) 732.5 m<sup>2</sup> (c) 885.75 m<sup>2</sup> (d) 900 m<sup>2</sup>

**✓ Answer Key with Solutions**

Q1. Answer: © 154 m<sup>2</sup>

Area of fountain =  $\pi r^2 = (22/7) \times 7 \times 7 = 154 \text{ m}^2$

Q2. Answer: (a) 173.25 m<sup>2</sup>

Radius of semi-circle =  $21/2 = 10.5 \text{ m}$

Area of one semi-circle =  $(1/2)\pi r^2 = (1/2) \times (22/7) \times 10.5 \times 10.5 = 173.25 \text{ m}^2$

Q3. Answer: © 885.75 m<sup>2</sup>

Grass area = Total area – Fountain area – Flower bed area

=  $1386 - 154 - 346.5 = 885.5 \text{ m}^2$

**Q3.** A Ferris wheel has a radius of 10.5 m. During a ride, a passenger moves through an angle of 180° from the bottom to the top of the wheel.

**Questions**

- (i) What fraction of the wheel's circumference is travelled? (1 Mark)
- (ii) Find the arc length travelled by the passenger. (1 Mark)
- (iii) If one full revolution takes 8 minutes, how much time is taken to travel this distance? (2 Marks)

**Q4.** A circular garden of radius 14 m has a decorative fountain occupying a sector of angle 120°.

**Questions**

- i. Find the area occupied by the fountain. (1 Mark)
- ii. What fraction of the garden is occupied by the fountain? (1 Mark)
- iii. Find the area available for planting flowers in the remaining part of the garden. (2 Marks)

**Q5.** A circular park has a radius of 28 m. Every morning, Neha jogs along an arc that subtends an angle of 90° at the centre of the park.

**Questions**

- (i) What fraction of the park's boundary does Neha cover? (1 Mark)
- (ii) Find the length of the arc covered by Neha. (1 Mark)
- (iii) If she completes this jog 5 times, what total distance does she cover? (2 Marks)

### Case Based Question

## PARTY HAT MATHEMATICS 🎉

★ **PARTY HAT MATHEMATICS** ★

A clever design. A perfect fit! 🎉

🎉 A factory manufactures party hats by fixing a cone on the top of a cylindrical box of the same radius.

The cylindrical box has **radius 5 cm** and **height 12 cm**.

The cone has the **same radius** and **height 12 cm**.

★ Take  $\pi = \frac{22}{7}$ .



GIVEN

- ★ Radius of cylinder (and cone) = 5 cm
- ★ Height of cylinder = 12 cm
- ★ Height of cone = 12 cm
- ★  $\pi = \frac{22}{7}$ .



 The cone and the cylinder have the same radius.

### Real-Life Context / Situation Based

A factory manufactures colorful party hats for celebrations. Each hat is made by fixing a cone on the top of a cylindrical box, both having the same radius.

The cylindrical box has a radius of 5 cm and a height of 12 cm. The cone placed on top also has the same radius and a height of 12 cm.

Take  $\pi = \frac{22}{7}$ .

Answer the following questions:

- (i) Find the volume of the cylindrical part. (1 mark)
- (ii) Find the volume of the conical part. (1 mark)
- (iii) Find the total volume of the party hat. (2 marks)

### Combination of Cylinder and Hemisphere

A school installs a decorative water fountain consisting of a cylinder surmounted by a hemisphere of the same radius. Radius = 3.5 m and height of cylinder = 8 m. Use  $\pi = 22/7$ .

#### Formulae

Volume of Cylinder =  $\pi r^2 h$

Volume of Hemisphere =  $(2/3)\pi r^3$

#### Questions

Q1. (1 Mark) The total height of the fountain is:

- (a) 8 m
- (b) 10.5 m
- (c) 11.5 m
- (d) 12 m

Answer: (c) 11.5 m

Q2. (1 Mark) The radius of the hemisphere is:

- (a) 2.5 m
- (b) 3.5 m
- (c) 7 m
- (d) 8 m

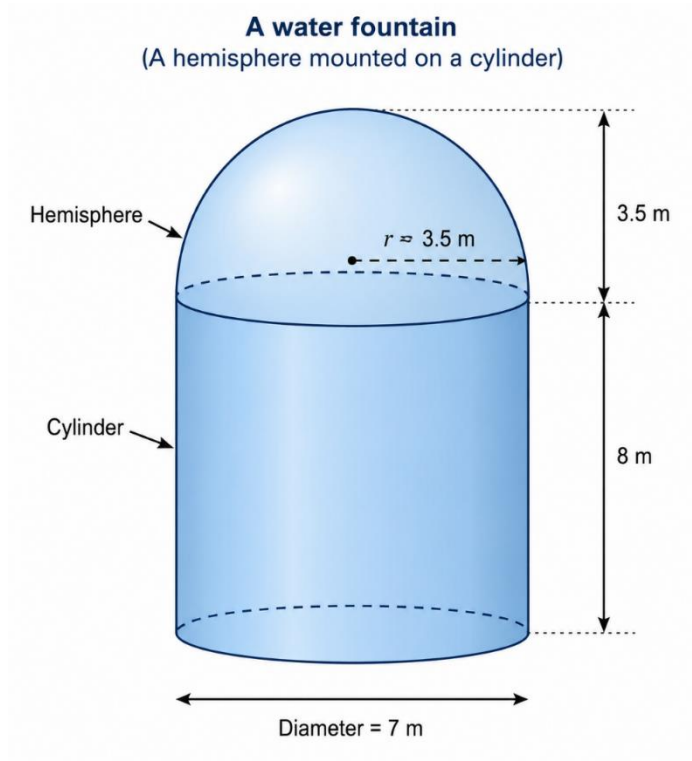
Answer: (b) 3.5 m

Q3. (2 Marks) Find the total volume of the fountain.

Volume of Cylinder =  $\pi r^2 h = (22/7) \times (3.5)^2 \times 8 = 308 \text{ m}^3$

Volume of Hemisphere =  $(2/3)\pi r^3 = (2/3) \times (22/7) \times (3.5)^3 = 89.83 \text{ m}^3$

Total Volume =  $397.83 \text{ m}^3$  (approximately).



तत् त्वं पूषन् अपावृणु

श्रीशंखेन्द्राचार्य संभाषण

## CHAPTER 13-STATISTICS

### COMPETENCY BASED QUESTIONS - CLASS 10 (STATISTICS)

#### Q.1 The Green Energy Initiative

To promote sustainability, a smart city council installed solar panels across 60 residential societies . The council tracked the daily electricity generation (in kWh) for these societies over a month to analyze efficiency and plan battery storage upgrades.

The collected data is presented in the grouped frequency table below:

| Daily Electricity Generated (in kWh) | Number of Residential Societies |
|--------------------------------------|---------------------------------|
| 100 – 120                            | 12                              |
| 120-140                              | 14                              |
| 140-160                              | X                               |
| 160-180                              | 8                               |
| 180-200                              | Y                               |
| Total                                | 60                              |

The council's data analyst calculated that the median daily electricity generated is 144 kWh .

- A. Formulate a linear equation representing the total number of societies. Answer  
Since the total frequency is given as 60 .

$$\begin{aligned}12 + 14 + x + 8 + y &= 60 \\x + y &= 26 \quad \text{Equation (1)}\end{aligned}$$

- B. Find the missing frequencies x and y using the median value.

**Ans** Identify Median Class: Since the Median is given as 144, it lies in the class interval 140 - 160  
Parameters: Lower limit (l) = 144 is not l; l = 140, h = 20, f = x, cf = 26,  $N/2 = 60/2 = 30$ . Using the

Median Formula:

$$\begin{aligned}\text{Substitute } x &= 20 \text{ into Equation 1:} \\x &= 20 \text{ and } y = 6.\end{aligned}$$

2. The Morena Municipal Corporation surveyed 80 households to find out how much garbage they generate daily in kilograms." garbage in kg / day

| Garbage in kg/ day | 0-2 | 2-4 | 4-6 | 6-8 | 8-10 |
|--------------------|-----|-----|-----|-----|------|
| Number of houses   | 12  | 20  | 24  | 16  | 8    |

A. The Mayor claims that "the average household generates less than 5 kg of waste." Verify this using the mean. Is the claim correct or incorrect?

**Ans** Mean =  $\Sigma fx / \Sigma f$   
 $\Sigma fx = (12 \times 1) + (20 \times 3) + (24 \times 5) + (16 \times 7) + (8 \times 9)$   
 $= 12 + 60 + 120 + 112 + 72$   
 $= 376$   
Mean =  $376/80$   
 $= 4.7 \text{ kg/day}$   
Mayor's claim :- Average waste is less than 5 kg  
 $4.7 < 5$  - claim is right .

B. In which range do "most households" fall? Determine this by calculating the mode

**Ans .** Most frequency = 24  
That's why modal class = 4 - 6 kg/ day Mode formula:  
Mode =  $l + [(f_1 - f_0) / (2f_1 - f_0 - f_2)] \times h$   
Where ,  $l = 4$   
 $f_1 = 24$   
 $f_0 = 20$   
 $f_2 = 16$   
 $h = 2$   
Mode =  $4 + [(24 - 20) / (48 - 20 - 16)] \times 2$   
 $= 4 + (4/12) \times 2$   
 $= 4 + 0.67$   
 $= 4.67 \text{ kg/day (approx)}$

C. If the government provides compost bins to 50% of households, to which category of households (based on kg/day generation) should they be distributed?

**Ans .** Total houses = 80 and it's 50 % is 40 Cumulative frequency:

0-2 → 12  
0-4 → 32  
0-6 → 56

- The 40th percentile falls in the 4-6 kg/day range.
- Therefore the government should give compost bin to households discharging waste to about 6 kg/day.
- 56 homes with 0-6 kg/day will be covered (over 50%).

3. Jio , Airtel and Vi asks 60 students of class 10, that how much mobile data they use daily.

| Data usage (gb/day) | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 |
|---------------------|-----|-----|-----|-----|-----|
| Number of students  | 10  | 16  | 12  | 14  | 8   |

A ) A student uses 3.5 GB/day. Is he above average user? Give reason.

B. If Vi wants 75% students to feel "I use less than average", should they advertise 'Mean' or 'Median'? Why?

**Q.4** . The following table shows the age distribution of cases of a certain disease admitted during a year in a particular hospital:

| Class     | 5-14 | 15-24 | 25-34 | 35-44 | 45-54 | 55-64 |
|-----------|------|-------|-------|-------|-------|-------|
| Frequency | 6    | 11    | 21    | 23    | 14    | 5     |

- A. Find the average age for which maximum cases occurred.  
B. Which mathematical concept is used in this problem?

**Q.5** A group of 71 people visited to a museum on a certain day. The following table shows their ages

| Age in years     | Less than 10 | Less than 20 | Less than 30 | Less than 40 | Less than 50 | Less than 60 |
|------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Number of person | 3            | 10           | 22           | 40           | 54           | 71           |

Based on the above information answer the following

- A. Find the median age of the persons visited the museum  
B. If the price of the ticket for the age group 30-40 is ₹30 .then the total amount spent by this age group is :



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## CHAPTER 14- PROBABILITY

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### Case Based Question

#### Real-Life Context / Situation Based

##### Case Study 1 (Solved)

In a school laboratory activity, students are given a bag containing colored balls. The bag has 5 red balls, 3 blue balls, and 2 green balls. A student is asked to pick one ball randomly without looking inside the bag. This activity helps students understand the concept of probability based on equally likely outcomes.

#### Questions:

- (a) Find the probability of drawing a red ball. (1 mark)
- (b) Find the probability of drawing a blue ball. (1 mark)
- © Find the probability of not drawing a green ball. (2 marks)

#### Solution:

Total balls = 10

$P(\text{Red}) = 1/2$

$P(\text{Blue}) = 3/10$

$P(\text{Not Green}) = 4/5$

#### Real-Life Context / Situation Based

##### Case Study 2 (Solved)

During a mathematics game session, a student rolls a fair die. Each face of the die is numbered from 1 to 6, and each outcome has an equal chance of occurring. The teacher uses this activity to explain probability through real-life experiments involving random outcomes.

#### Questions:

- (a) Find the probability of getting an even number. (1 mark)
- (b) Find the probability of getting a number greater than 4. (1 mark)
- © Find the probability of getting a number less than or equal to 3. (2 marks)

#### Solution:

Even =  $1/2$ ,  $>4 = 1/3$ ,  $\leq 3 = 1/2$

### **Real-Life Context / Situation Based**

#### **Case Study 3**

In a card game, a well-shuffled deck of 52 playing cards is used. Each card has an equal chance of being drawn. The deck consists of four suits and includes face cards such as kings, queens, and jacks. A player draws one card at random.

**Questions:**

- (a) Find the probability of getting a king. (1 mark)
- (b) Find the probability of getting a heart card. (1 mark)
- © Find the probability of getting a non-face card. (2 marks)

### **Real-Life Context / Situation Based**

#### **Case Study 4**

A spinner is divided into 8 equal sections, numbered from 1 to 8. When the spinner is spun, each number has an equal chance of appearing. This experiment is often used in classrooms to demonstrate probability concepts in a simple and engaging way.

**Questions:**

- (a) Find the probability of getting an odd number. (1 mark)
- (b) Find the probability of getting a number divisible by 4. (1 mark)
- © Find the probability of getting a number less than 6. (2 marks)

### **Real-Life Context / Situation Based**

#### **Case Study 5**

A box contains marbles of different colors used in a classroom activity. There are 4 white, 5 black, and 1 yellow marble in the box. A student randomly picks one marble without looking. This situation helps in understanding probability based on favorable outcomes.

**Questions:**

- (a) Find the probability of selecting a white marble. (1 mark)
- (b) Find the probability of selecting a black marble. (1 mark)
- (c) Find the probability of not selecting a yellow marble. (2 marks)