

# CASE STUDY Questions

*Referred by CBSE for the Session 2023-24*

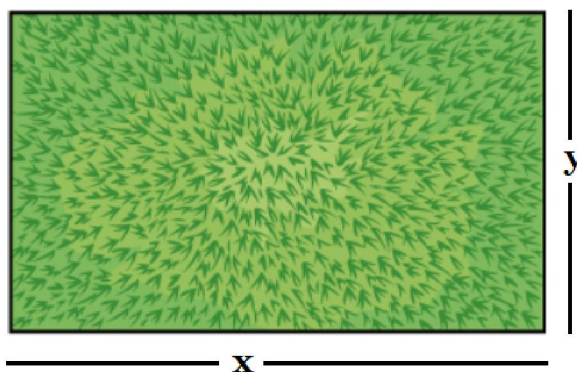
- Q01. In two different societies, there are some school going students - including girls as well as boys. Satish forms two sets with these students, as his college project.



Let  $A = \{a_1, a_2, a_3, a_4, a_5\}$  and  $B = \{b_1, b_2, b_3, b_4\}$  where  $a_i$ 's and  $b_i$ 's are the school going students of first and second society respectively. Satish decides to explore these sets for various types of relations and functions.

Using the information given above, answer the following :

- (i) Satish wishes to know the number of reflexive relations defined on set A. How many such relations are possible?
  - (ii) Let  $R : A \rightarrow A$ ,  $R = \{(x, y) : x \text{ and } y \text{ are students of same sex}\}$ . Is R an equivalence relation? Justify.
  - (iii) Satish and his friend Rajat are interested to know the number of symmetric relations defined on both the sets A and B, separately. Satish decides to find the symmetric relation on set A, while Rajat decides to find the symmetric relation on set B. What is difference between their results?
  - (iv) Let  $R : A \rightarrow B$ ,  $R = \{(a_1, b_1), (a_1, b_2), (a_2, b_1), (a_3, b_3), (a_4, b_2), (a_5, b_2)\}$ . Then, is R onto or one-one or both or none? Justify.
  - (v) To help Satish in his project, Rajat decides to form onto function from set A to B. How many such functions are possible?
- Q02. Manjit wants to donate a rectangular plot of land for a school in his village.



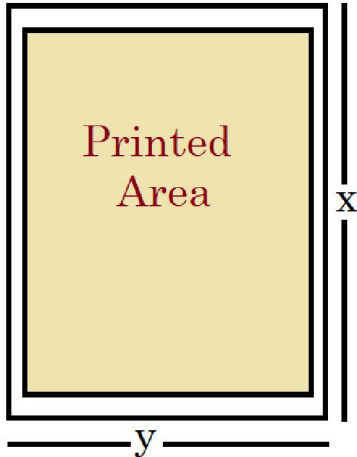
When he was asked to give dimensions of the plot, he told that :

- If its length is decreased by 50 m and breadth is increased by 50 m, then its area will remain same,
- If length is decreased by 10 m and breadth is decreased by 20 m, then its area will decrease by  $5300 \text{ m}^2$ .

For the information given above, answer the following :

- (i) Assume that the length and breadth of the land be  $x$  and  $y$  (in metres) respectively. Find the equations in terms of  $x$  and  $y$ .
- (ii) Using matrices, represent the linear equations obtained above in (i).
- (iii) Using matrices, determine the dimensions of the land (in metres). Also write the area of the rectangular plot of land (in square metres).

Q03. Following is the pictorial description for a particular page, selected by a school administration.



The total area of the page is  $150 \text{ cm}^2$ .

The combined width of the margin at the top and bottom is 3 cm and the side 2 cm.

Using the information given above, answer the following :

- (i) Find the relation between  $x$  and  $y$ .
- (ii) Find the area of page where printing can be done.
- (iii) Find the area of the printable region of the page, in terms of  $x$ .
- (iv) For what value of 'x', the printable area of the page is maximum? Use derivatives.
- (v) What should be dimension of the page so that it has maximum area to be printed?

Q04. Mr Shashi, who is an architect, designs a building for a small company.

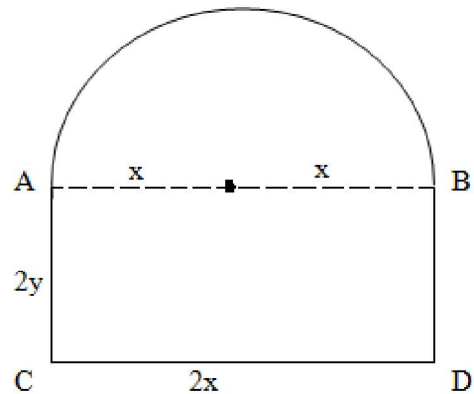
The design of window on the ground floor is proposed to be different than other floors.

The window is in the shape of a rectangle which is surmounted by a semi-circular opening.

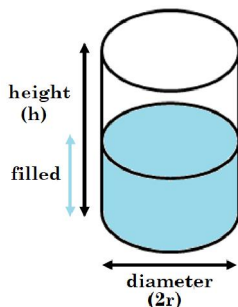
This window is having a perimeter of 10 m as shown below :

Based on the above information answer the following :

- (i) If  $2x$  and  $2y$  represents the length and breadth of the rectangular portion of the windows, then find the relation between the variables  $x$  and  $y$ .
- (ii) Find the combined area (A) of the rectangular region and semi-circular region of the window expressed as a function of  $x$ .
- (iii) Find the maximum value of area A, of the whole window.
- (iv) The owner of this small company is interested in maximizing the area of the whole window so that maximum light input is possible. For this to happen, find the length of rectangular portion of the window.
- (v) In order to get the maximum light input through the whole window, find the area (in terms of square meter) of only semi-circular opening of the window.



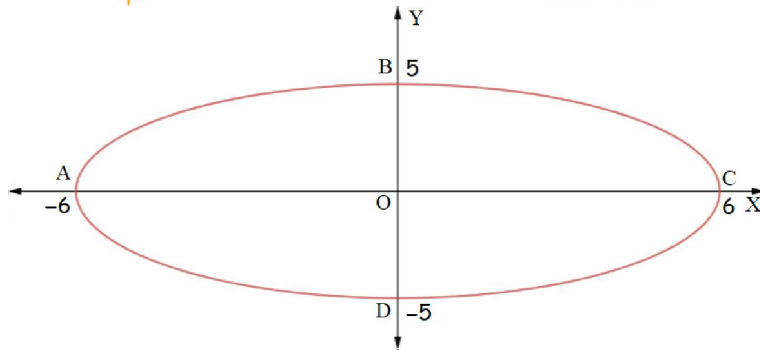
Q05. Read the following passage and answer the questions given below.



A cylindrical tank of radius 10 m is being filled with water at the rate of 314 cubic metre per hour.

- (i) Find the rate of increase of the depth (h) of the water in the tank. Use  $\pi = 3.14$ .
- (ii) Find the rate of increase of the curved surface area (A) of the water in the tank.

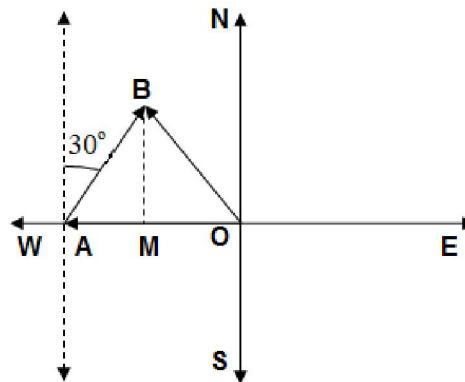
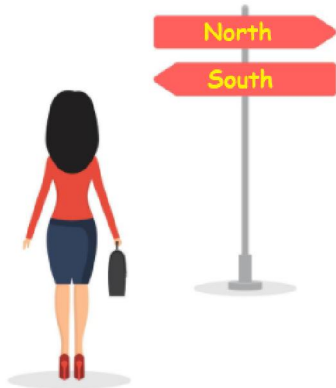
Q06. In the Commonwealth games event 2010, an Indian player won the gold-medal in his game. The shape of gold medal is as shown in the figure below i.e., it is elliptical in shape.



Assume that the gold medal is described by the ellipse  $\frac{x^2}{36} + \frac{y^2}{25} = 1$ , when it is kept on xy-plane.

Using the information given above, answer the following :

- (i) Write an integral to give area of the elliptical gold medal in first quadrant, with respect to xy-plane.
  - (ii) Write an expression (integral) for the area of the ellipse above x-axis.
  - (iii) Considering the given diagram, find the ar(ABCOA).
  - (iv) What is the area of elliptical gold medal?
  - (v) What is the area of closed region BCDOB?
- Q07. Anjani walks 4 km towards west, then 3 km in a direction 30° east of north and then she stops. The situation above has been depicted in the diagram as shown below, assuming that the girl starts her walk from O :



In the diagram, ON represents positive y-axis and North direction, OE represents positive x-axis and East direction. Similarly, OW is representing negative x-axis and West direction, whereas OS represents negative y-axis and South direction.

Let  $OA = 4$  km,  $AB = 3$  km.

Using the information given above, answer the following :

- (i) What is the vector  $\overrightarrow{OA}$  ?
- (ii) What is the position vector of point B?

- (iii) What is the vector  $\overline{AB}$ ?
- (iv) What is the value of  $\overline{AB} \times \overline{OA}$ ?
- (v) What is the ar (OAB)?

Q08. A coach is training 3 players. He observes that the player A can hit a target 4 times in 5 shots, player B can hit 3 times in 4 shots and the player C can hit 2 times in 3 shots.



Keeping the above discussion in mind, answer the following :

- (i) Let A : the target is hit by A, B : the target is hit by B and, C : the target is hit by C. Then, find the probability that A, B and, C all will hit.
- (ii) Referring to (i), what is the probability that B, C will hit and A will lose?

- (iii) With reference to the events mentioned in (i), what is the probability that ‘any two of A, B and C will hit’?
- (iv) What is the probability that ‘none of them will hit the target’?
- (v) What is the probability that A, B will hit and C will lose?

Q09. Two friends Arpan and Sachin play a game. As per rules, in this game a person wins a rupee for a six and loses a rupee for any other number when a fair die is thrown.



Arpan decided to throw the die thrice but to quit as and when he gets a six.

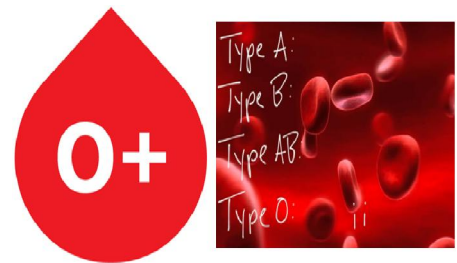
Based on the given information, answer the following questions.

- (i) Let X be the amount won (or lost) by Arpan. What are the possible values of X?
- (ii) Find the probability distribution of X.

Q10. Suppose that 6% of the people with blood group O are left handed and 10% of those with other blood groups are left handed. It is known that 30% of the people have blood group O.

Based on the above information, answer the following.

- (i) What is the probability that the person selected is a left handed person? Write your answer in percentage.
- (ii) If a left handed person is selected at random, what is the probability that he/she will have blood group O?



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