

CASE STUDY & PASSAGE BASED Questions

Useful for CBSE Exams 2025-26

Unit I - Relations & Functions

Relations & Functions, Inverse Trig. Functions

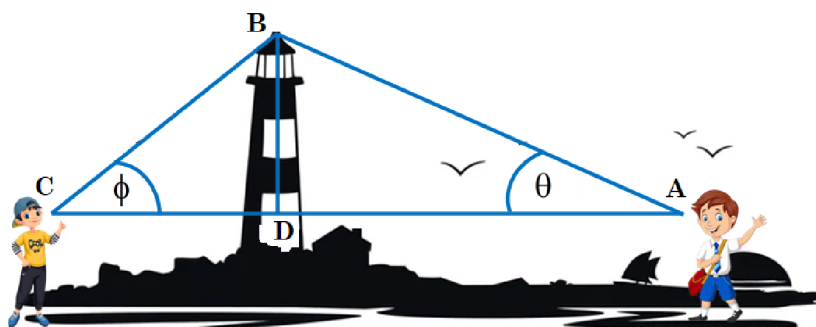
Q01. In two different societies, there are some school going students - including girls as well as boys. Satish forms two sets with these students, as his college project.



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 $R : A \rightarrow A$, where $R = \{(x, y) : x \text{ and } y \text{ are students of same sex}\}$. Is the relation 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?
- Q06. Rahul and Priyam are students of class XII. They are standing on either side of a light-house of 20 meters high. Rahul is standing at A and Priyam is at C. They observe its top at the angles of elevation θ and ϕ respectively (as shown in the figure below).



The distance between the two students is 30 meters and the distance between Rahul and the light-house is 20 meters.

Based on the above information, answer the following.

- (i) Find $\theta = \angle CAB$.
- (ii) Find the distance AB (as shown in the figure).
- (iii) Find $\phi = \angle BCA$.
- (iv) Find $\angle ABC$.

Q07. A general election of Lok Sabha is a gigantic exercise. About 911 million people were eligible to vote and voter turnout was about 67%, the highest ever.

**ONE - NATION
ONE - ELECTION**

FESTIVAL OF DEMOCRACY

GENERAL ELECTION - 2019



Let I be the set of all citizens of India who were eligible to exercise their voting right in general election held in 2019. A relation ‘R’ is defined on I as follows.

$$R = \{(V_1, V_2) : V_1, V_2 \in I \text{ and both use their voting right in general election - 2019}\}.$$

Based on the above information, answer the following.

- (i) Two friends X and Y $\in I$.
X and Y both exercised their voting right in the general election - 2019.
Then, state if $(X, Y) \in R$ is true or not. Give reason.
- (ii) Mr. ‘H’ and his wife ‘W’ both exercised their voting right in general election - 2019.
Then, state if the following statement is true or not. Give reason.
“If $(H, W) \in R$ then, we may or may not have $(W, H) \in R$.”
- (iii) Check if R is reflexive or, symmetric. Give reasons to support your answer.
- (iv) Mr. Ghanshyam exercised his voting right in general election - 2019.
While his brother (having voting right), Mr. Radheshyam went to have fun at a nearby mall. Can we have $(\text{Ghanshyam}, \text{Radheshyam}) \in R$? Give reason.
If Miss. Radhika (having voting right) goes with Mr. Radheshyam to the mall skipping the voting exercise, then is it correct to say $(\text{Radhika}, \text{Radheshyam}) \notin R$? Give reason.

Q15. Pratibha Vikas is an innovative program by the Government of Delhi, where cultural and literacy competitions are held between schools at cluster, block, district and state levels.

One of those competitions - Yogasana, is conducted under two categories : Middle school and High school.

From South Delhi district, three students from middle school and two students from high school were selected for the state level.



Let $M = \{m_1, m_2, m_3\}$ and $H = \{h_1, h_2\}$, represent the set of students from middle school and high school respectively who got selected for the state level from that district.

A relation $R : M \rightarrow M$ is defined by $R = \{(x, y) : x \text{ and } y \text{ are students from the same category}\}$.

On the basis of the above information, answer the following questions.

- (i) Check if the relation R is reflexive. Justify your answer.
- (ii) Check if the relation R is symmetric. Justify your answer.
- (iii) Check if the relation R is transitive. Is R an equivalence relation? Justify your answer.
- (iv) Let a function $f : M \rightarrow H$ is defined as $f = \{(m_1, h_1), (m_2, h_2), (m_3, h_2)\}$.
Check whether the function f is one-one and onto. Justify your answer.

Unit II - Algebra

Matrices, Determinants

Q01. Two farmers Ramkrishna and Hari Prasad cultivated three varieties of rice namely Basmati, Permal and Naura.



Basmati



Permal



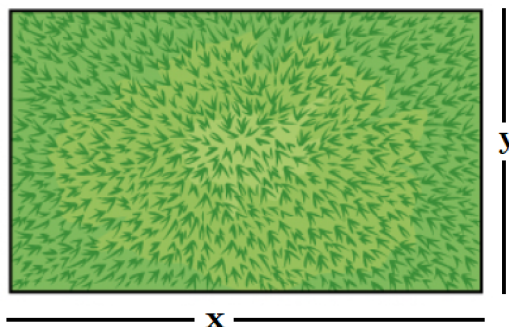
Naura

The sale (in Rupees) of these varieties of rice by both the farmers in the month of September and October are given by the following matrices 'A' and 'B' :

September Sales (in Rupees)			October Sales (in Rupees)			
Basmati	Permal	Naura	Basmati	Permal	Naura	
$A = \begin{pmatrix} 10000 & 20000 & 30000 \\ 50000 & 30000 & 10000 \end{pmatrix}$			and,	$B = \begin{pmatrix} 5000 & 10000 & 6000 \\ 20000 & 10000 & 10000 \end{pmatrix}$		
Ramkrishna			Ramkrishna			
Hari Prasad			Hari Prasad			

Based on the above information, answer the following.

- (i) Write the matrix, which represents the combined sale in September and October for each farmer in each variety.
 - (ii) Write the matrix, which represents the decrease in sales from September to October.
 - (iii) If the farmer Hari Prasad receives 2% profit on gross sales, then find the total profit obtained in October.
 - (iv) If Ramkrishna receives 2% profit on gross sales, then find the total profit obtained in the month of October.
 - (v) What is the difference in the total profit earned by both the farmers in the month of September, if both the farmers receive 2% profit on gross sales?
- Q08. 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 m².

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).
- (iv) Suppose that, Manjit gave the information about his plot in the following manner :
If its length is decreased by 50 m and breadth is increased by 50 m, then its area will remain the same, but if length is decreased by 20 m and breadth is decreased by 10 m, then its area will be decreased by 4800 m². In this situation, what will be dimensions of the plot? Assume that the length and breadth of the land be x and y (in metres) respectively. Use matrices.

Q09. Gautam buys 5 pens, 3 bags and 1 instrument box and pays a sum of ₹160. From the same shop, Vikram buys 2 pens, 1 bag and 3 instrument boxes and pays a sum of ₹190. Also Ankur buys 1 pen, 2 bags and 4 instrument boxes and pays a sum of ₹250.

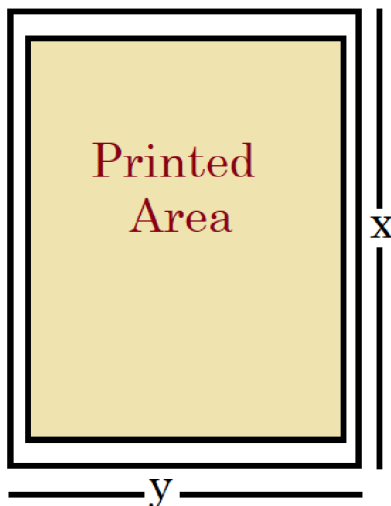
Based on the above information, answer the following questions.

- (i) Convert the given above situation into a matrix equation of the form $AX = B$.
- (ii) Find $|A|$.
- (iii) Find A^{-1} .
- (iv) Determine $P = A^2 - 5A$.

Unit III - Calculus

☑ Continuity & Differentiability, Applications Of Derivatives, Integrals, Application Of Integrals, Differential Equations

Q01. Following is the pictorial description for a particular page, selected by a school administration.



The total area of the page is 150 cm².

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?

Q02. Mr Shashi, who is an architect, designs a building for a small company.

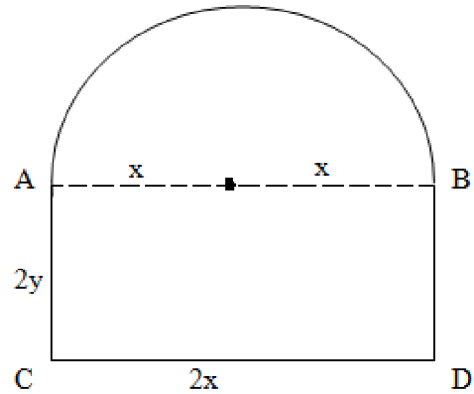
The design of window on the ground floor is proposed to be different than other floors.

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.



Q13. A fighter-jet of enemy is flying along the parabolic path $y = x^2 + 7$.

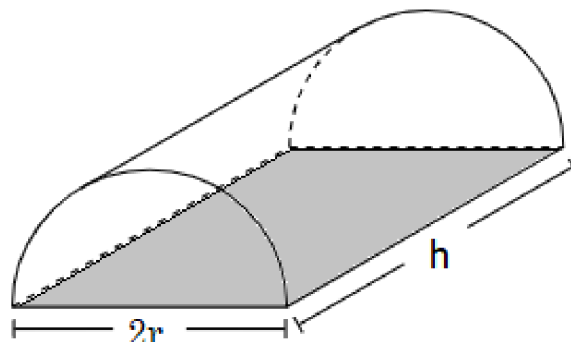


A soldier is assigned duty to shoot down the fighter-jet.

Based on above information, answer the following.

- (i) Assume that the soldier has located himself safely at a point $(3, 7)$. If he decides to shoot down the fighter-jet when it is nearest to him, then find the function $f(x)$ which determines the distance between the soldier and fighter-jet.
- (ii) If $u = [f(x)]^2$ then, find $\frac{du}{dx}$.
- (iii) Write $\frac{d^2u}{dx^2}$.
- (iv) When the soldier shoots the fighter-jet, then find the distance between him and the fighter-jet at that instant.
- (v) What will be the position of fighter-jet on the parabolic path, when the soldier shoots it down?

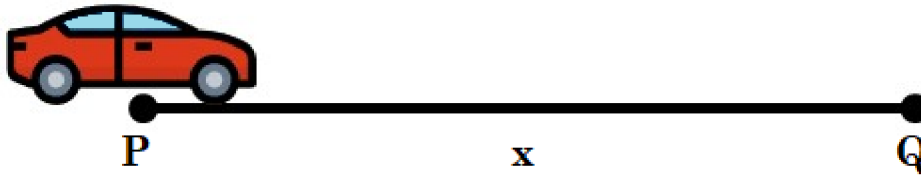
Q21. A company deals in casting and molding of metal on order received from its clients. A given quantity of metal (1000 cubic units) is to be cast into a half cylinder with a rectangular base and semicircular ends.



Using the information given above, answer the following.

- (i) Write an express for 'h', in terms of 'r'.
- (ii) Express the total surface area (A) of the half-cylinder, in terms of 'r'.
- (iii) Find $\frac{dA}{dr}$.
- (iv) For what value of r, the total surface area (A) will be minimum?
- (v) What is the value of h : (2r) ?

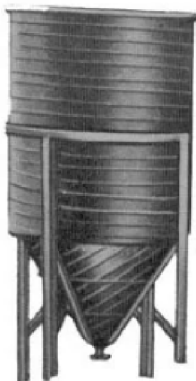
Q29. A car starts from a point P at time $t = 0$ seconds and stops at point Q.



The distance x, in the metres, covered by it, in t seconds is given by $x = t^2 \left(2 - \frac{t}{3} \right)$.

Based on the given information, answer the following.

- (i) Find the time taken by the car to reach Q. Use derivatives.
 - (ii) Find the distance between the points P and Q.
- Q36. A tank, as shown in the figure below, formed using a combination of a cylinder and a cone, offers better drainage as compared to a flat bottomed tank.

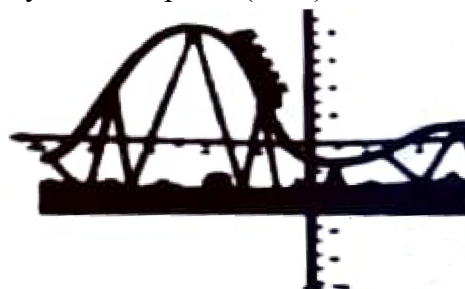


A tap is connected to such a tank whose conical part is full of water. Water is dripping out from a tap at the bottom at the uniform rate of $2 \text{ cm}^3/\text{s}$.

The semi-vertical angle of the conical tank is 45° .

On the basis of given information, answer the following questions.

- (i) Find the volume of water in the tank in terms of its radius r.
 - (ii) Find rate of change of radius at an instant when $r = 2\sqrt{2}$ cm.
 - (iii) Find the rate at which the wet surface of the conical tank is decreasing at an instant when radius $r = 2\sqrt{2}$ cm.
 - (iv) Find the rate of change of height 'h' at an instant when slant height is 4 cm.
- Q41. The equation of the path traced by a roller-coaster is given by the polynomial $f(x) = a(x+9)(x+1)(x-3)$.
If the roller-coaster crosses y-axis at a point $(0, -1)$, answer the following questions.



- (i) Find the value of 'a'.
- (ii) Find $f''(x)$ at $x = 1$.

Q42. The relation between the height of the plant ('y' in cm) with respect to its exposure to the sunlight is governed by the following equation

$$y = 4x - \frac{1}{2}x^2, \text{ where 'x' is the number of days exposed to the sunlight, for } x \leq 3.$$

Based on the above information, answer the following.

- (i) Find the rate of growth of the plant with respect to the number of days exposed to the sunlight.
- (ii) Does the rate of growth of the plant increase or decrease in the first three days? What will be the height of the plant after 2 days?



Q54. Ramesh, the owner of a sweet selling shop, purchased some rectangular card board sheets of dimension 25 cm by 40 cm to make container packets without top. Let x cm be the length of the side of the square to be cut out from each corner to give that sheet the shape of the container by folding up the flaps.

Based on the above information, answer the following equations.

- (i) Express the volume (V) of each container as function of x only.
- (ii) Find $\frac{dV}{dx}$.
- (iii) For what value of x, the volume of each container is maximum?
- (iv) Check whether V has a point of inflection at $x = \frac{65}{6}$ or not?

Unit IV - Vectors & 3 D Geometry

Vector Algebra, Three Dimensional Geometry

Q01. A butterfly is moving in a straight path in the space.



Let this path be denoted by a line l whose equation is $\frac{x-1}{2} = \frac{2-y}{3} = \frac{z-3}{4}$ say.

Using the information given above, answer the following with reference to the line l .

- (i) Write the position vector of the given point on the line.
- (ii) What are the direction ratios of the line?
- (iii) If the z-coordinate of a point on this line is 11, then write the x-coordinate of the same point on this line.
- (iv) Write the vector equation of the given line.
- (v) Write a unit vector in the direction of the vector parallel to the given line.

Q07. Two motorcycles A and B are running at the speed more than the allowed speed on the roads represented by the lines $\vec{r} = \lambda(\hat{i} + 2\hat{j} - \hat{k})$ and $\vec{r} = (3\hat{i} + 3\hat{j}) + \mu(2\hat{i} + \hat{j} + \hat{k})$ respectively.



Based on the above information, answer the following questions.

- (i) Write the direction ratios of the lines $\vec{r} = \lambda(\hat{i} + 2\hat{j} - \hat{k})$ and $\vec{r} = (3\hat{i} + 3\hat{j}) + \mu(2\hat{i} + \hat{j} + \hat{k})$.
 - (ii) Write a point, through which the line $\vec{r} = (3\hat{i} + 3\hat{j}) + \mu(2\hat{i} + \hat{j} + \hat{k})$ passes.
 - (iii) Find the shortest distance between the given lines. Check if the lines intersect each other.
 - (iv) Will the lines intersect each other? Find the point at which the motorcycles may collide.
- Q08. Teams A, B and C went for playing a tug of war game. Teams A, B and C have attached a rope to a metal ring and are trying to pull the ring into their own area.

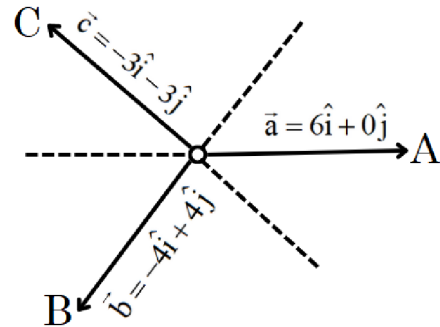
Team A pulls with force $F_1 = 6\hat{i} + 0\hat{j}$ kN.

Team B pulls with force $F_2 = -4\hat{i} + 4\hat{j}$ kN.

Team C pulls with force $F_3 = -3\hat{i} - 3\hat{j}$ kN.

Based on the above information, answer the following.

- (i) What is the magnitude of the force of Team A?
- (ii) Which team will win the game?
- (iii) Find the magnitude of the resultant force exerted by the teams.
- (iv) In what direction is the ring getting pulled?



Unit VI - Probability

Probability

Q01. The members of a consulting firm rent cars from three rental agencies :



Agency X



Agency Y



Agency Z

50% from agency X, 30% from agency Y and 20% from agency Z.

From past experience, it is known that 9% of the cars from agency X need a service and tuning before renting, 12% of cars from agency Y need a service and tuning before renting and 10% of the cars from agency Z need a service and tuning before renting.

Assume that the rental car delivered to the firm needs service and tuning.

For the information given above, answer the following.

- (i) Find the probability that the cars need service and tuning, if it came from agency Y.
- (ii) Find the probability that the cars need service and tuning, if it came from agency Z.
- (iii) What is the probability that the car needs service and tuning?
- (iv) If the rental car delivered to the firm need service and tuning, then find the probability that agency X is to be blamed.
- (v) If the rental car delivered to the firm need service and tuning, then find the probability that agency Z is not to be blamed.

Q07. There are three categories of students in a class of 60 students :

- A : Very hard working students
- B : Regular but not so hard working
- C : Careless and irregular.



It's known that 10 students are in category A, 30 in category B and rest in category C. It is also found that probability of students of category A, unable to get good marks in the final year examination is, 0.002, of category B it is 0.02 and of category C, this probability is 0.20.

Based on the above information answer the following.

- (i) If a student selected at random was found to be the one who could not get good marks in the examination, then find the probability that this student is of category C.
- (ii) Assume that a student selected at random was found to be the one who could not get good marks in the examination. Then find the probability that this student is either of category A or of category B.
- (iii) Find the probability that the student is unable to get good marks in the examination.
- (iv) A student selected at random was found to be the one who could not get good marks in the examination. Then find the probability that this student is of category A.
- (v) A student selected at random was found to be the one who could not get good marks in the examination. Then find the probability that this student is **NOT** of category A.

Q18. Three persons A, B and C apply for the job of Manager in a Private Company.



Chances of their selection (A, B and C) are in the ratio 1 : 2 : 4.

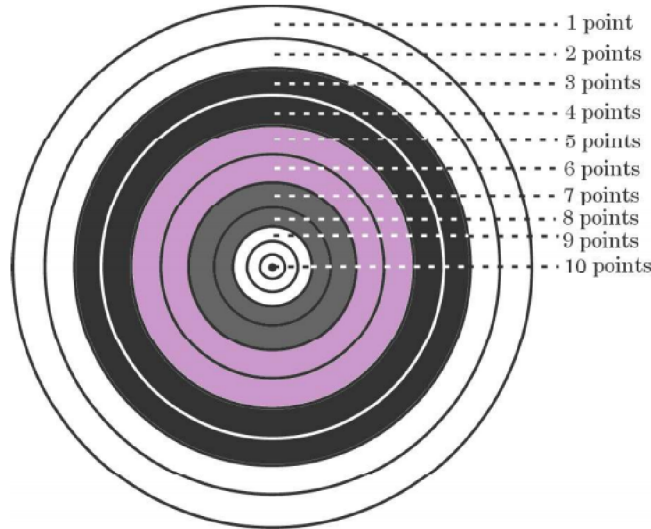
The probabilities that A, B and C can introduce changes to improve profits of the company are 0.8, 0.5 and 0.3 respectively.

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

- (i) If the change takes place in the company, then find the probability that it is due to the appointment of C.
- (ii) If the change takes place in the company, then find the probability that it is due to the appointment of A.
- (iii) If the change takes place in the company, then find the probability that it is due to the appointment of B.

- (iv) Find the probability that the change takes place in the company.
- (v) If the change does not take place, then determine the probability that it is due to the appointment of C.

Q27. In a game of Archery, each ring of the Archery target is valued. The centre-most ring is worth 10 points and rest of the rings are allotted points 9 to 1 in sequential order moving outwards.



Archer A is likely to earn 10 points with a probability of 0.8 and Archer B is likely to earn 10 points with a probability of 0.9.

Based on the above information, answer the following.

- (i) Write the probability that archer A does not earn 10 points.
 - (ii) Write the probability that archer B does not earn 10 points.
 - (iii) If both of them hit the Archery target, then find the probability that exactly one of them earns 10 points.
 - (iv) If both of them hit the Archery target, then find the probability that both of them earn 10 points. Also, write the probability if none of them earns 10 point.
- Q31. Read the following passage and the answer the questions given below.



A shopkeeper sells three types of flowers seeds A_1 , A_2 and A_3 .

These are sold as mixture, where their proportions are 4:4:2 respectively.

Also their germination rates are 45%, 60% and 35% respectively.

Let A_1 : seed A_1 is chosen, A_2 : seed A_2 is chosen and A_3 : seed A_3 is chosen.

Also let E: seed germinates.

- (i) Find $P(A_1)$, $P(A_2)$ and $P(A_3)$.
- (ii) Write $P(E | A_1) + P(E | A_2) + P(E | A_3)$.
- (iii) Find the probability of a randomly chosen seed to germinate. Express your answer in %.

- (iv) Calculate the probability that it is of the type A_2 given that a randomly chosen seed does not germinate.

Q38. Read the following passage and then answer the questions given below.



There are two anti craft guns, named as A and B. The probabilities that the shell fired from them hits an airplane are 0.3 and 0.2 respectively. Both of them fired one shell at an airplane at the same time.

- (i) What is the probability that the shell fired from exactly one of them hit the plane?
 (ii) If it is known that the shell fired from exactly one of them hit the plane, then what is the probability that it was fired from B?



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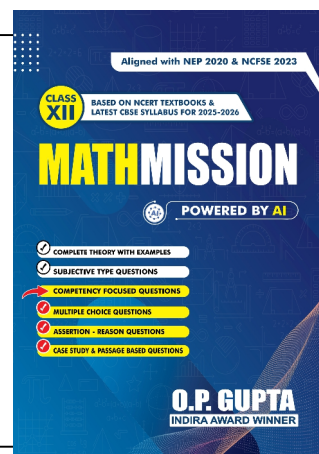
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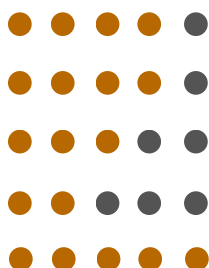
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TABLE OF CONTENTS

S. No.	TOPICS	PAGES
01.	FORMULAE CLUSTER <ul style="list-style-type: none">a. Number System; Indices; Componendo and Dividendo; Algebraic identities; Solving a Quadratic equationb. Recap of important & relevant concepts of class XIc. Exponential; Logarithmic and some other seriesd. Concept of infinity; Mensuration formulae	(01 - 13)
02.	ALGEBRA OF MATRICES & DETERMINANTS <ul style="list-style-type: none">a. Definition of matrices and various typesb. Algebraic operations on matricesc. Transpose of matricesd. Existence of Inverse of Square matricese. Definition of determinants, minors, cofactorsf. Properties of determinantsg. Adjoint and inverse of Square matricesh. System of linear equations and solutioni. Application based problems	(14 - 73)
03.	RELATIONS & FUNCTIONS <ul style="list-style-type: none">a. Definition of relation and its various types viz. reflexive, symmetric, transitive and equivalence relationsb. Definition of a function; one-one function, onto function, bijection and Inverse of a function; Composition of functions (brief idea)	(74 - 105)
04.	INVERSE TRIGONOMETRIC FUNCTIONS <ul style="list-style-type: none">a. Domain and range of inverse trigo. functionsb. Principal value of inverse trigo. functionsc. Graphs of inverse trigo. functionsd. Various formulae (properties) of inverse trigo. functions	(106 - 131)
05.	CONTINUITY & DIFFERENTIABILITY <ul style="list-style-type: none">a. Continuity of a functionb. Differentiability of a functionc. Derivatives of various types of functions viz. inverse trigo. functions, logarithmic and exponential functions, differentiation using logarithmic formulae, implicit functions, parametric functions; second order derivative	(132 - 195)
06.	APPLICATIONS OF DERIVATIVES <ul style="list-style-type: none">a. Rate of changeb. Increasing and decreasing functionsc. Maxima and minima of functions; application based problems	(196 - 225)
07.	INDEFINITE INTEGRALS <ul style="list-style-type: none">a. Integration as reverse process of differentiationb. Integration using Substitution method and, completing the perfect square methodc. Integration using trigonometric formulae	(226 - 292)

	<ul style="list-style-type: none"> d. Integration using Partial fraction and By parts method e. Miscellaneous forms of integrals 	
08.	DEFINITE INTEGRALS	(293 - 340)
	<ul style="list-style-type: none"> a. Properties of definite integral and their proof b. Problems based on evaluation of definite integration c. Problems based on properties of definite integrals 	
09.	APPLICATION OF INTEGRALS	(341 - 353)
	<ul style="list-style-type: none"> a. Area bounded by lines b. Area related to triangle c. Area of curves viz. parabola, circle, ellipse etc. d. Area bounded by trigonometric functions 	
10.	DIFFERENTIAL EQUATIONS	(354 - 375)
	<ul style="list-style-type: none"> a. Definition of a D.E., its order and degree b. Solving a D.E. using Variable separable method c. Identifying and solving a homogeneous D.E. d. Solving Linear differential equations 	
11.	LINEAR PROGRAMMING	(376 - 385)
	<ul style="list-style-type: none"> a. Maximization or minimization of objective function b. Bounded and unbounded feasible region 	
12.	VECTOR ALGEBRA	(386 - 413)
	<ul style="list-style-type: none"> a. Definition of vector, and various types b. Direction cosines, direction ratios of a vector c. Triangular and parallelogram law of vectors d. Product of vectors (Dot and Cross products) e. Scalar triple product of vectors 	
13.	THREE DIMENSIONAL GEOMETRY	(414 - 436)
	<ul style="list-style-type: none"> a. Equation of lines in various forms and other related aspects viz. angle between two lines, distance between skew and parallel lines, image of a point in the line b. Miscellaneous problems 	
14.	PROBABILITY	(437 - 463)
	<ul style="list-style-type: none"> a. Conditional probability, and types of events b. Total probability, Bayes theorem c. Some miscellaneous type of problems 	
15.	Competency Focused Questions	(464)
	<ul style="list-style-type: none"> ☑ MULTIPLE CHOICE QUESTIONS ▪ Chapterwise MCQs (465 - 533) ▪ Unitwise Assertion-Reason (A-R) Questions (534 - 555) ☑ CASE STUDY QUESTIONS ▪ Unitwise Case-study & Passage-based Questions (556 - 611) 	
16.	ANSWERS FOR ALL EXERCISES	(612 - 658)
17.	Selected H.O.T.S. Questions from recent CBSE Exams (held on 08 March, 2025)	(659 - 687)

SYLLABUS

MATHEMATICS (041)
Class XII ▪ (2025-26)

One Paper (Theory)
Time: 180 Minutes

Max Marks: 80

No.	UNITS	MARKS
I	Relations & Functions	08
II	Algebra	10
III	Calculus	35
IV	Vectors & 3 D Geometry	14
V	Linear Programming	05
VI	Probability	08
	Total	80

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While you shall go through this book, the questions in Miscellaneous (H.O.T.S.) require a good level of conceptual strength.

Besides that, there maybe certain questions or topics marked with * or ☼. These are deleted from CBSE Syllabus, still we have included them for learning continuity.

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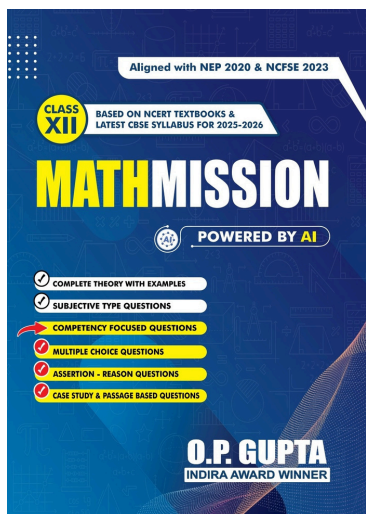



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Class 12 Books (Since 2021) for Maths (041)



 Shantha kaleeswaran



Awesome and a must have book

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This book is a blessing to class XI students and a great help to the teacher. As a teacher I had to refer many books including the internet for the different sections of questions. Separate books for mcqs case study questions etc. But Mr Gupta's book has solved all these in one go. All in one place. All categories of questions are dealt with ample examples. Thank you Gupta sir

 Amazon Customer



Excellent Book from an excellent Teacher

Reviewed in India on 13 September 2021

Thank you so much sir for this wonderful book. I appreciate your effort and I am sure that this will be an excellent reference book for both teachers and students those who are going to appear for coming board examination. Here we will get questions of all levels which helped me a lot in preparing question papers for my term 1 revision exams . I recommend this to all students and teachers

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 Manish Saxena



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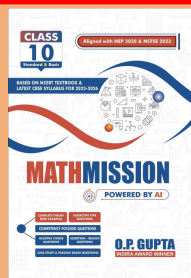
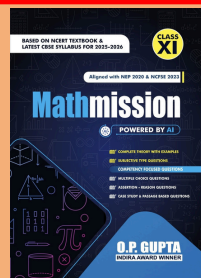
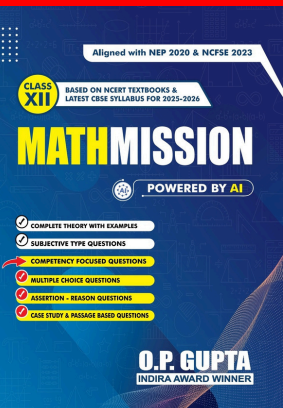
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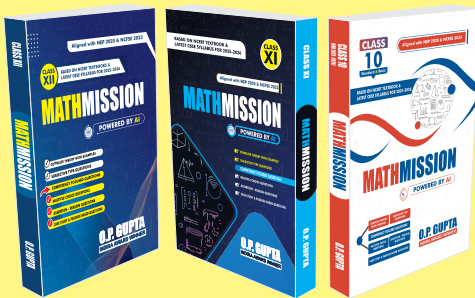
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ABOUT THE AUTHOR

O.P. GUPTA having taught math passionately over a decade, has devoted himself to this subject. Every book, study material or practice sheets, tests he has written, tries to teach serious math in a way that allows the students to learn math without being afraid. Undoubtedly his mathematics books are best sellers on Amazon and Flipkart. His resources have helped students and teachers for a long time across the country. He has contributed in CBSE Question Bank (issued in April 2021). Mr Gupta has been invited by many educational institutions for hosting sessions for the students of senior classes. Being qualified as an electronics & communications engineer, he has pursued his graduation later on with mathematics from University of Delhi due to his passion towards mathematics. He has been honored with the prestigious INDIRA AWARD by the Govt. of Delhi for excellence in education.

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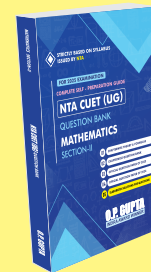
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