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**Mathematics**

Prepared by



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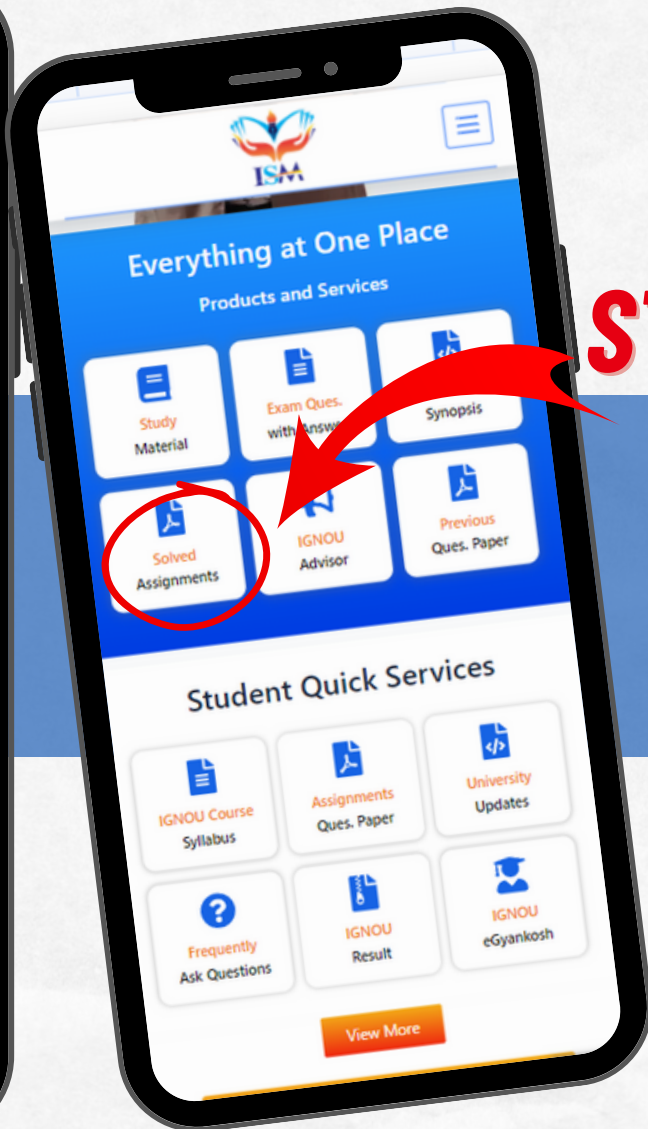
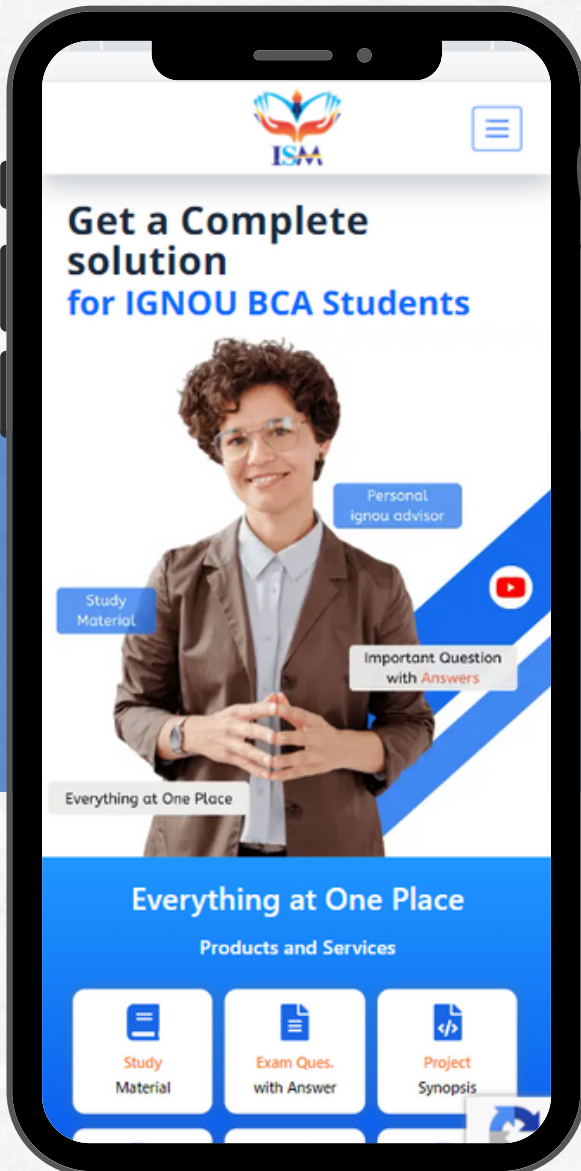


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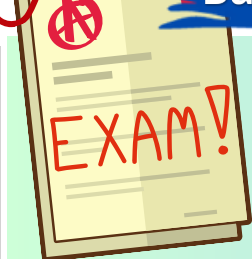
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Ques.13 Using integration, find length of curve  $y=3-x$  from  $(-1,4)$  to  $(3,0)$

$$\begin{aligned}y &= 3 - x && \text{from } (-1, 4) \text{ to } (3, 0) \\ \frac{dy}{dx} &= -1 \\ &= \int_{-1}^3 \sqrt{1 + 1} \, dx \\ &= \sqrt{2} x^3_{-1} \\ &= \sqrt{2} (3 + 1) \\ &= 4\sqrt{2} \text{ units}\end{aligned}$$

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Ques.14 Show that the lines, given below, Intersect each other.

$$\frac{x-5}{4} = \frac{y-7}{-4} = \frac{z-3}{-5} \text{ and } \frac{x-8}{4} = \frac{y-4}{-4} = \frac{z-5}{4}$$

Handwritten solution for Question 14:

$$\frac{x-5}{4} = \frac{y-7}{-4} = \frac{z-3}{-5} \text{ and } \frac{x-8}{4} = \frac{y-4}{-4} = \frac{z-5}{4}$$

$$\vec{r} = (5\hat{i} + 7\hat{j} + 3\hat{k}) + t(4\hat{i} - 4\hat{j} - 5\hat{k})$$

$$\vec{r} = (8\hat{i} + 4\hat{j} + 5\hat{k}) + t_1(4\hat{i} - 4\hat{j} + 4\hat{k})$$

$$\vec{a} = 5\hat{i} + 7\hat{j} + 3\hat{k}$$

$$\vec{b} = 4\hat{i} - 4\hat{j} - 5\hat{k}$$

$$\vec{c} = 8\hat{i} + 4\hat{j} + 5\hat{k}$$

$$\vec{d} = 4\hat{i} - 4\hat{j} + 4\hat{k}$$

$$\vec{c} - \vec{a} = 3\hat{i} - 3\hat{j} + 2\hat{k}$$

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$$\vec{b} \times \vec{d} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 4 & -4 & -5 \\ 4 & -4 & 4 \end{vmatrix}$$

$$= \hat{i}(-16 - 20) - \hat{j}(16 + 20) + \hat{k}(-16 + 16)$$

$$= \hat{i}(-36) - \hat{j}(36) + \hat{k}(0)$$

$$= -36\hat{i} - 36\hat{j}$$

$$(\vec{c} - \vec{a}) \cdot (\vec{b} \times \vec{d}) = (3\hat{i} - 3\hat{j} + 2\hat{k}) \cdot (-36\hat{i} - 36\hat{j})$$

$$= -108 + 108$$

$$= 0$$

The shortest distance between the line is 0.

Hence, the two lines intersect.

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Ques.15 A tailor needs at least 40 large buttons and 60 small buttons. In the market, buttons are available in two boxes or cards. A box contains 6 large and 2 small buttons and a card contains 2 large and 4 small buttons. If the cost of a box is \$3 and cost of a card is \$2, find how many boxes and cards should be purchased so as to minimize the expenditure.

Let  $x$  boxes  
 $y$  cards

$$\text{Cost incurred (in \$)} = 3x + 2y$$

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Large buttons :  $6x + 2y \geq 40$

Small buttons  $2x + 4y \geq 60$

Minimize  $C = 3x + 2y$

$C(A) = C(0, 20) = 3(0) + 2(20) = 40$

$C\left(\frac{5}{2}, \frac{55}{2}\right) = 3\left(\frac{5}{2}\right) + 2\left(\frac{55}{2}\right) = 62.5$

$C(30, 0) = 3(30) + 2(0) = 90$

The least cost occurs when tailor purchases just 20 cards and the least cost is 40.



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Ques. 16 Find the scalar component of projection of the vector.

$$\vec{a} = 2\hat{i} + 3\hat{j} + 5\hat{k} \text{ on the vector } \vec{b} = 2\hat{i} - 2\hat{j} - \hat{k}$$

$$\vec{a} = 2\hat{i} + 3\hat{j} + 5\hat{k}$$

$$\vec{b} = 2\hat{i} - 2\hat{j} - \hat{k}$$

Scalar projection of  $\vec{a}$  on  $\vec{b} = \frac{\vec{a} \cdot \vec{b}}{|\vec{b}|}$

$$\vec{a} \cdot \vec{b} = 2(2) + 3(-2) + 5(-1) = -7$$

$$|\vec{b}| = \sqrt{2^2 + (-2)^2 + (-1)^2}$$

$$= \sqrt{9} = 3$$

Scalar projection of  $\vec{a}$  on  $\vec{b} = \frac{-7}{3}$

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