IIT Madras

ONLINE DEGREE

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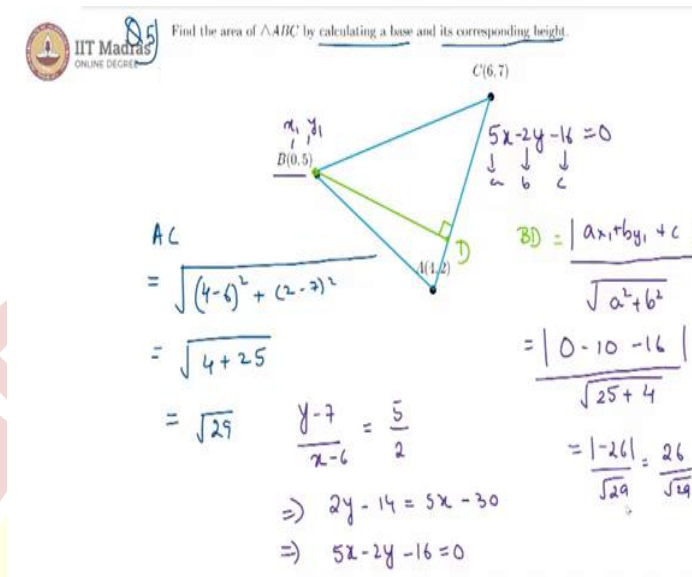
In this problem, should be our fifth question. Suppose to find the area of ABC, there are three points here. So, we need to make that triangle, our triangle would look something like this. But to find the area, we are supposed to calculate a base and its corresponding height. So, we are not supposed to use the formula which involves the three coordinates, instead, we will take any of these sides to be the base. So, let me take AC to be the base. So, we need to find the base length, which is AC, that would be by Euclidean distance formula, $\sqrt{(4-6)^2 + (2-7)^2}$.

So, this comes out to be $\sqrt{4+25}$. So, that gives us $\sqrt{29}$ is the base. Now the altitude, the height from B would be something like this, let us call this point D and this is 90 degrees, so B to D that length would be the height. So, BD is going to be the distance of the point B from the line AC, the shortest distance of point B, the line AC. So, for this we can use the distance formula of a point from a straight line. However, we first need to find out the equation of AC.

For that, let us use the 2 point form because we have 2 points, we will get $\frac{y-7}{x-6} = \frac{7-2}{6-4} = \frac{5}{2} =$ 2.5 . Anyway, if we cross multiply, we get 2y-14=5x-30, which gives us the equation to be 5x-2y-16=0 and the distance of (0,5) which is our B from this particular line. So, this line is our 5x-2y-16=0 .

So, that distance can be calculated from the formula, which is the $\frac{|ax_1+by_1+c|}{\sqrt{a^2+b^2}}$. So here a is our 5, b is -2 and c is -16. So, substituting and (x_1,y_1)is our coordinates of B, this is x_1 and this is y_1, so the coordinates of B. So here we get $\frac{|0-10-16|}{25+4}$, which then gives us $\frac{|-26|}{\sqrt{29}}$, $|-26|$ is then 26. So, this would be the height.

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Combining these two quantities, we get our area as half into base into height, which will then be $\frac{1}{2} \times AC \times BD$, which then gives us $\frac{1}{2} \times \sqrt{29} \times \frac{26}{\sqrt{29}}$, $\sqrt{29}$ and $\sqrt{29}$ cancels off, 2 cancels with 26 giving us 13. So, we get 13 square units as the area of our triangle ABC.