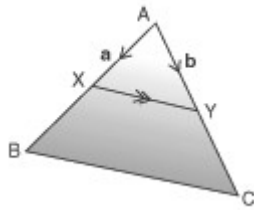


Maths Questions

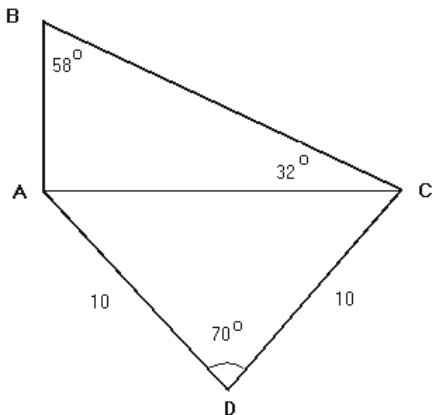


Q: In the triangle ABC the points x and y are the mid points of AB and AC. Show the line XY is parallel to BC and half its length.

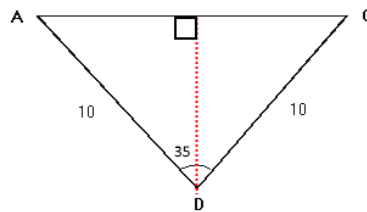
$$XY = \frac{1}{2} AC - \frac{1}{2} AB$$

$$XY = \frac{1}{2} (AC - AB) \quad \leftarrow \text{Sub } BC = AC - AB$$

$$XY = \frac{1}{2} BC$$

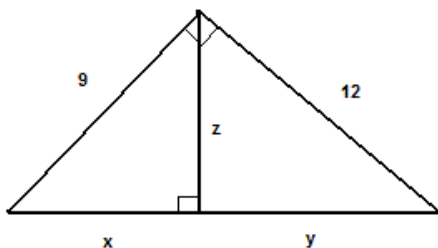


Q: Find the length of side AB in the figure to the left



$$\begin{aligned} \sin(\theta) &= O/C \\ \sin(35^\circ) &= \frac{1}{2} AC / AD \\ AC &= 2\sin(35^\circ)(10) \\ AC &= 11.42 \end{aligned}$$

$$\begin{aligned} \tan(\theta) &= O/A \\ \tan(32^\circ) &= AB / AC \\ AB &= \tan(32^\circ)(11.42) \\ AB &= 7.169 \end{aligned}$$



Q: Find the lengths x, y and z

3 equations using pythagoras:

$$(x + y)^2 = 9^2 + 12^2$$

$$12^2 = z^2 + y^2$$

$$9^2 = z^2 + x^2$$

Rearrange 1:

$$(x + y)^2 = 9^2 + 12^2$$

$$x = 15 - y$$

Substitute 3 from 2:

$$12^2 - 9^2 = z^2 + y^2 - (z^2 + x^2)$$

$$63 = y^2 - x^2$$

$$63 = y^2 - (15 - y)^2$$

$$63 = y^2 - (225 - 15y - 15y - y^2)$$

$$y = 9.6$$

$$x = 15 - 9.6 = 5.4$$

Solve for z:

$$z^2 = 12^2 - y^2$$

$$z = \sqrt{12^2 - 9.6^2}$$

$$z = 7.2$$

Q: Find a, b and c so that the graph of the quadratic function $f(x) = ax^2 + bx + c$ has a vertex at $(-2, 1)$ and passes through the point $(0, -3)$

Vertex Form:

$$f(x) = a(x - h)^2 + k$$

$$f(x) = a(x + 2)^2 + 1 \quad \leftarrow \text{sub in } (0, -3)$$

$$-3 = a(0 + 2)^2 + 1$$

$$a = -1$$

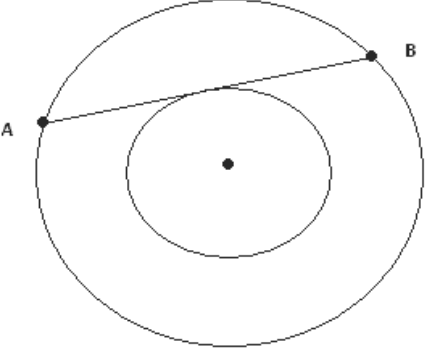
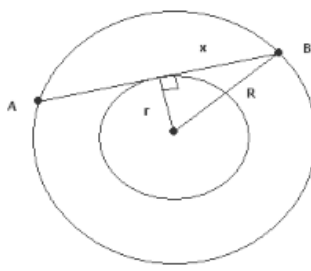
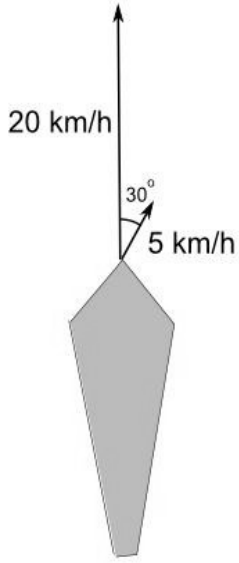
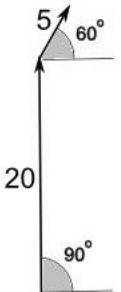
$$f(x) = a(x + 2)^2 + 1$$

$$f(x) = -(x + 2)^2 + 1 \quad \leftarrow \text{sub in 'a'}$$

$$f(x) = -(x + 2)(x + 2) + 1$$

$$f(x) = -x^2 - 4x - 3 \quad \leftarrow \text{of the form } ax^2 + bx + c$$

$$b = -4, c = -3$$

	<p>Q: The two circles below are concentric (have same center). The radius of the large circle is 10 and that of the small circle is 6. What is the length of the chord AB?</p>  <p> $r = \text{radius of small circle} = 6$ $R = \text{radius of large circle} = 10$ $x = \frac{1}{2} AB$ $r^2 + x^2 = R^2$ $6^2 + x^2 = 10^2$ $x = 8$ $AB = 16$ </p>
$A = \begin{bmatrix} 2 & 1 \\ 5 & -3 \end{bmatrix} \quad B = \begin{bmatrix} -2 & 4 \\ 3 & -2 \end{bmatrix}$	<p>Q: What is $2A + B^T$?</p> $2A = \begin{vmatrix} 4 & 2 \\ 10 & -6 \end{vmatrix} \quad B^T = \begin{vmatrix} -2 & 3 \\ 4 & -2 \end{vmatrix} \quad 2A + B^T = \begin{vmatrix} 2 & 5 \\ 14 & -8 \end{vmatrix}$
$A = \begin{bmatrix} 3 & -1 & 2 \\ -2 & 4 & 0 \end{bmatrix} \quad B = \begin{bmatrix} 2 & 0 \\ -1 & 4 \\ -3 & 2 \end{bmatrix}$	<p>Q: What is AB?</p> $AB = \begin{vmatrix} (3*2) + (-1*-1) + (2*-3) & (3*0) + (-1*4) + (2*2) \\ (-2*2) + (-1*4) + (0*-3) & (-2*0) + (4*4) + (0*2) \end{vmatrix} = \begin{vmatrix} 1 & 0 \\ -8 & 16 \end{vmatrix}$
$A = \begin{bmatrix} 1 & x \\ 2 & 3 \end{bmatrix} \quad B = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix}$	<p>Q: If $AB = BA$ then what is the value of x?</p> $AB = \begin{vmatrix} 1+x & 1+2x \\ 5 & 8 \end{vmatrix} \quad BA = \begin{vmatrix} 3 & x+3 \\ 5 & x+6 \end{vmatrix} \quad 1+x = 3 \text{ as } AB = BA$ <p>$x = 2$</p>
<p>Q: If $a = (5, -12)$, what is the magnitude and direction of a?</p> <p> $\ a\ = \sqrt{5^2 + (-12)^2}$ $\ a\ = 13$ </p> <p> $\Theta = \tan^{-1}(y/x) \text{ from polar form}$ $\Theta = \tan^{-1}(-12, 5) = 292.6^\circ$ </p>	
	<p>Q: A ship is heading due north at 20 km/h but is blown off course by the wind which is blowing from 30° west of south at 5 km/h. What is the speed of the ship, and in which direction is it traveling?</p>  <p>Convert from polar to Cartesian: $(x, y) = (\ r\ \cos\Theta, \ r\ \sin\Theta)$ ship $(x, y) = (20\cos(90^\circ), 20\sin(90^\circ)) = (0, 20)$ wind $(x, y) = (5\cos(60^\circ), 5\sin(60^\circ)) = (2.5, 4.33)$</p> <p>Add the two vectors: Final $= (0, 20) + (2.5, 4.33) = (2.5, 24.330)$</p> <p>Convert back to polar coordinates: $r = \sqrt{x^2 + y^2}$ $r = 24.46 \text{ km/h}$</p> <p> $\Theta = \tan^{-1}(y/x)$ $\Theta = 84.1^\circ \text{ from } +x \text{ axis (east)}$ </p>