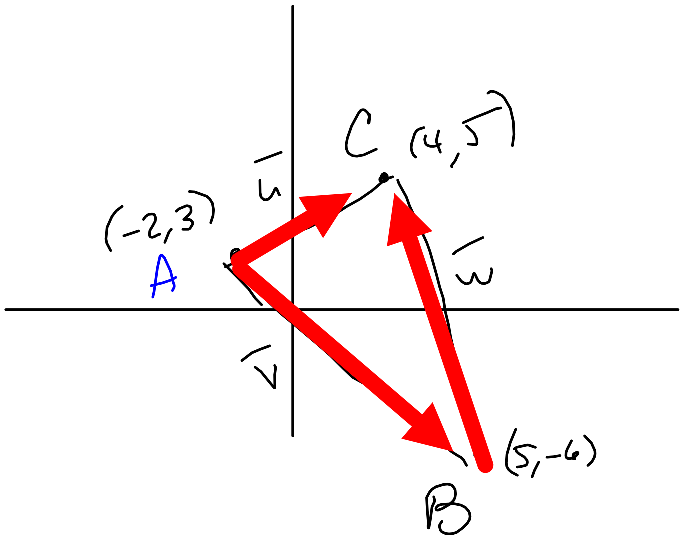
① **Use vectors to find the interior angles of the triangle with the given vertices.** (to 4 places)

(-2,3), (5, - 6), and (10, 13) = A, B, & C, respectively



$\overrightarrow{AC} = \langle 4-(-2), 5-3\rangle = \langle 6,2\rangle = \bar{u}$

$\overrightarrow{AB} = \langle 5-(-2), -6-3\rangle = \langle 7,-9\rangle = \bar{v}$

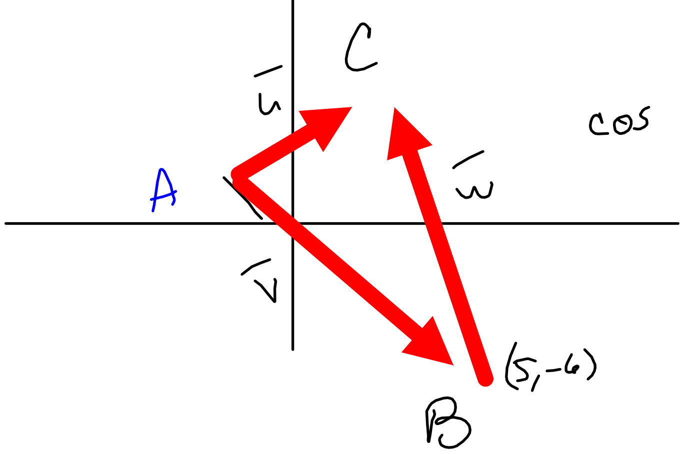
$\overrightarrow{BC} = \langle 4-5, -6-5\rangle = \langle -1,-11\rangle = \bar{w}$

$\|\bar{u}\| = \sqrt{6^2+2^2} = \sqrt{40} = 2\sqrt{10}$

$\|\bar{v}\| = \sqrt{7^2+9^2} = \sqrt{49+81} = \sqrt{130}$

$\|\bar{w}\| = \sqrt{1^2+11^2} = \sqrt{122}$

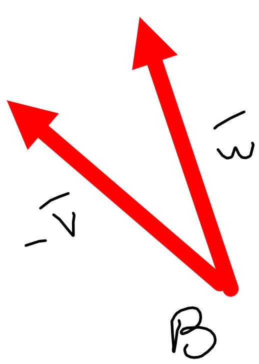
Don't overthink it, Steve. Just put the vectors butt-to-butt to find the angle.



$\cos A = \dfrac{\bar{u}\cdot\bar{v}}{\|\bar{u}\|\|\bar{v}\|} = \dfrac{42-18}{\sqrt{40}\sqrt{130}} = \dfrac{24}{\sqrt{40\cdot 130}}$

$\rightarrow A = \arccos\left(\dfrac{24}{\sqrt{5200}}\right) \approx 70.55996515 \approx °$

$\boxed{A \approx 7.5600°}$



$\cos B = \dfrac{-\bar{v}\cdot\bar{w}}{\|\bar{v}\|\|\bar{w}\|} = \dfrac{-\langle 7,-9\rangle\cdot\langle -1,11\rangle}{\sqrt{130}\sqrt{122}} = \dfrac{-(-7-99)}{\sqrt{130\cdot 122}}$

$= \dfrac{106}{\sqrt{130\cdot 122}} \approx 32.68055471°$

$\boxed{B \approx 32.6806°}$

$C = 180° - A - B \approx 70.55996515° - 32.68055471° \approx 76.75948009°$

$\rightarrow \boxed{C \approx 76.7595°}$

$\bar{u} = \langle 6,2\rangle$ $\quad 2\sqrt{10} = \|\bar{u}\|$

$\bar{v} = \langle 7,-9\rangle$ $\quad \sqrt{130} = \|\bar{v}\|$

$\bar{w} = \langle -1,11\rangle$ $\quad \sqrt{122} = \|\bar{w}\|$

$\bar{u} = \langle 2, 8 \rangle$

$\bar{v} = \langle 7, -1 \rangle$

$$\text{proj}_{\bar{v}} \bar{u} = \frac{\bar{u} \cdot \bar{v}}{\|\bar{v}\|^2} \bar{v} = \frac{14 - 8}{49 + 1} \bar{v} = \frac{6}{50} \langle 7, -1 \rangle$$

$$= \; = \frac{3}{25} \langle 7, -1 \rangle = \left\langle \frac{21}{25}, -\frac{1}{25} \right\rangle$$

write $\bar{u}$ as the sum of 2 orthogonal vectors $\bar{w}_1$ & $\bar{w}_2$ such that $\bar{w}_1 \parallel \bar{v}$ & $\bar{w}_2 \perp \bar{v}$.

$$\bar{w}_1 = \text{proj}_{\bar{v}} \bar{u} = \frac{\bar{u} \cdot \bar{v}}{\|\bar{v}\|^2} \bar{v} = \frac{14 - 8}{7^2 + 1^2} \bar{v} = \frac{6}{50} = \frac{3}{25} \langle 7, -1 \rangle$$

$$\boxed{\text{proj}_{\bar{v}}(\bar{u}) = \left\langle \frac{21}{25}, \frac{-3}{25} \right\rangle} = \bar{w}_1$$

$$\bar{w}_2 = \bar{u} - \bar{w}_1 = \langle 2, 8 \rangle - \left\langle \frac{21}{25}, -\frac{3}{25} \right\rangle = \left\langle \frac{50 - 21}{25}, \frac{200 + 3}{25} \right\rangle$$

$$\boxed{= \left\langle \frac{29}{25}, \frac{203}{25} \right\rangle = w_2}$$

3

10pts

(5 pts) A father is pulling his son in a wagon on the beach. If the angle the handle makes with the ground is 45^0, and he's pulling with a force of 30 pounds, what is the work done if he pulls the wagon 100 yards? Give your answer in foot-pounds, rounded to the nearest whole number

$$\vec{F} = \|\vec{F}\| \langle \cos 45^0, \sin 45^0 \rangle$$

$$= 30 \left\langle \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}} \right\rangle$$

$$\vec{v} = \langle 100, 0 \rangle$$

WORK $= \vec{F} \cdot \vec{v} = \left\langle \frac{30}{\sqrt{2}}, \frac{30}{\sqrt{2}} \right\rangle \cdot \langle 100, 0 \rangle$

$$= \frac{3000}{\sqrt{2}} = \frac{3000\sqrt{2}}{2} = 1500\sqrt{2} \approx 2121.320343$$

$\approx \boxed{2121 \text{ ft-lbs}} \approx$ WORK