

===== *Show All Work!* =====

1. Let  $u = \langle -3, 4 \rangle$  and  $v = \langle 7, 1 \rangle$

a) Find  $|2u + v|$ .

$$= | \langle -6, 8 \rangle + \langle 7, 1 \rangle |$$

$$= | \langle 1, 9 \rangle | = \sqrt{1^2 + 9^2} = \boxed{\sqrt{82}}$$

b) Find the direction angle of  $u$ .

$$\tan^{-1}\left(\frac{4}{-3}\right) + 180^\circ = \boxed{126.87^\circ}$$

c) Find a vector that has the same direction as  $u$  but has a magnitude of 2.

Unit vector in same direction =  $\left\langle \frac{-3}{5}, \frac{4}{5} \right\rangle$

magn. of  $\frac{2}{5} \rightarrow$  mult by 2  $\rightarrow$   $\boxed{\left\langle \frac{-6}{5}, \frac{8}{5} \right\rangle}$

2. Let  $u = \langle 5, 2 \rangle$  and  $v = \langle -6, -2 \rangle$ . Find the dot product of  $u$  and  $v$ .

$$5(-6) + 2(-2) = -30 + -4 = \boxed{-34}$$

3. Find the measure of  $\angle B$  in  $\triangle ABC$ , given  $A(3, 2)$ ,  $B(6, -1)$ , and  $C(5, -8)$ .

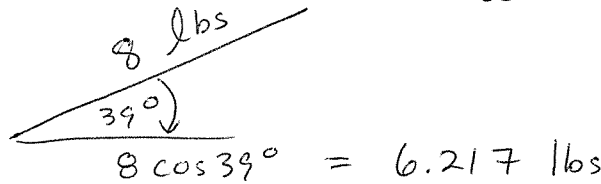
$$\vec{BA} = (3, 2) - (6, -1) = \langle -3, 3 \rangle$$

$$\vec{BC} = (5, -8) - (6, -1) = \langle -1, -7 \rangle$$

$$\theta = \cos^{-1}\left(\frac{\vec{BA} \cdot \vec{BC}}{|\vec{BA}| |\vec{BC}|}\right)$$

$$= \cos^{-1}\left(\frac{(-3)(-1) + 3(-7)}{\sqrt{18} \sqrt{50}}\right) = \cos^{-1}\left(\frac{-18}{30}\right) = \boxed{126.87^\circ}$$

4. A child is pulling his toy train along the ground on a string. The string makes an angle of  $39^\circ$  with the ground, and the child is applying 8 pounds of force in the direction of the string. How much work is done in pulling the toy forwards 25 feet?



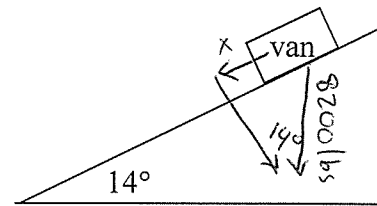
$$\begin{aligned} \text{WORK} &= \text{FORCE} \times \text{DIST} \\ &= (6.217 \text{ lbs})(25 \text{ ft}) \\ &= \boxed{155.43 \text{ ft-lbs}} \end{aligned}$$

5. A van weighing 8,200 lbs is parked on an incline of  $14^\circ$ . What amount of force is required to prevent the van from rolling down the hill?

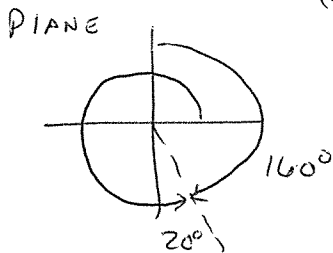
$$\sin 14^\circ = \frac{x}{8200}$$

$$x = 8200 \sin 14^\circ$$

$$\approx \boxed{1983.76 \text{ lbs}}$$



6. A pilot flies his plane with a bearing of  $160^\circ$  at an air speed of 500 mph. The wind is blowing at 40 mph with a bearing of  $145^\circ$ . Find the actual direction (bearing) and speed of the plane's motion relative to the ground.

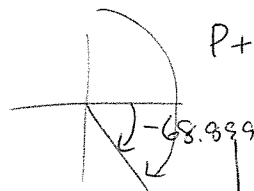


$$\theta_p = 290^\circ$$

$$\theta_w = 305^\circ$$

$$\begin{aligned} P &= \langle 500 \cos 290^\circ, 500 \sin 290^\circ \rangle \\ W &= \langle 40 \cos 305^\circ, 40 \sin 305^\circ \rangle \end{aligned}$$

$$P+W = \langle 193.953, -502.612 \rangle$$



$$|P+W| = \sqrt{(193.953)^2 + (-502.612)^2}$$

$$\approx \boxed{538.74 \text{ mph}}$$

$$\theta = \tan^{-1}\left(\frac{-502.612}{193.953}\right) \approx -68.899$$

$$\rightarrow \text{Bearing} = 90 - (-68.899) = \boxed{158.899^\circ}$$

