



Various Vector Problems

(16 pts)

Directions - Solve the following problems using the method learned in class. Show ALL work neatly using proper units, significant figures and the GUESS method where appropriate.

1. Two ropes pull on a log. The first rope pulls with a force of 14.0 newtons at 16.0°. The second rope pulls with a force of 16.5 newtons at 309°. What is the resultant force?

(2 pts)

(2 pts)

1. Break vector into components.

$$F_{1x} = 14.0 \text{ N} (\cos 16.0^\circ) = 13.5 \text{ N right}$$

$$F_{1y} = 14.0 \text{ N} (\sin 16.0^\circ) = 3.86 \text{ N up}$$

$$F_{2x} = 16.5 \text{ N} (\cos 309^\circ) = 10.4 \text{ N right}$$

$$F_{2y} = 16.5 \text{ N} (\sin 309^\circ) = 12.8 \text{ N down}$$

2. Sum of x and y components

$$F_{\text{net}x} = F_{1x} + F_{2x} = 13.5 \text{ N} + (10.4 \text{ N}) = 23.9 \text{ N right}$$

$$F_{\text{net}y} = F_{1y} + F_{2y} = 3.86 \text{ N} + (-12.8 \text{ N}) = 8.9 \text{ N down}$$

(2 pts)

3. Magnitude of net force

$$F_{\text{net}} = (F_x^2 + F_y^2)^{1/2} = (23.9 \text{ N}^2 + (-8.9 \text{ N})^2)^{1/2} = 26 \text{ N}$$

(2 pts)

4. Find the angle (gives you direction)

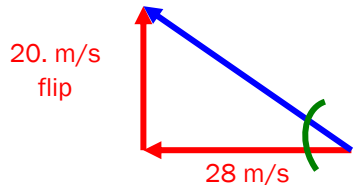
$$\theta = \tan^{-1}(O/A) = \tan^{-1}(-8.9 \text{ N} / 23.9 \text{ N}) = -20.0^\circ$$

26 N at 20.° below horizon
 OR
 26 N at 340.°

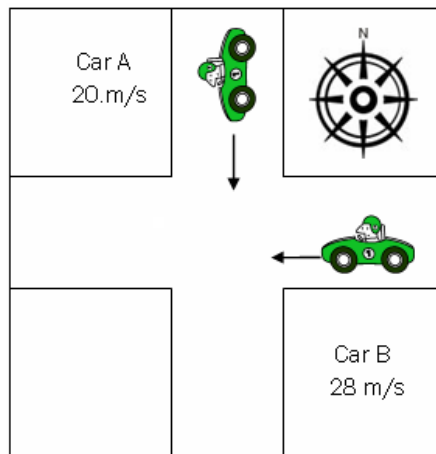
2. Use the diagram to the right to answer the questions.
 $V_{AG} = 20. \text{ m/s}$ $V_{BG} = 28 \text{ m/s}$

(3 pts)

- a. What is the relative velocity of car B with respect to car A? Remember to include angle and direction.

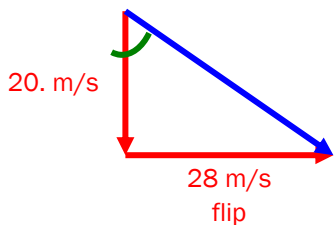


$$\begin{aligned} \bar{v} &= \sqrt{v_y^2 + v_x^2} \\ &= \sqrt{(20. \text{ m/s})^2 + (28 \text{ m/s})^2} \\ &= 34 \text{ m/s} \\ \theta &= \tan^{-1} \left(\frac{v_x}{v_y} \right) \\ &= \tan^{-1} \left(\frac{20. \text{ m/s}}{28 \text{ m/s}} \right) \\ &= 36^\circ \text{ N of W} \end{aligned}$$



(3 pts)

- b. What is the relative velocity of car A with respect to car B? Remember to include angle and direction.



$$\begin{aligned} \bar{v} &= \sqrt{v_y^2 + v_x^2} \\ &= \sqrt{(20. \text{ m/s})^2 + (28 \text{ m/s})^2} \\ &= 34 \text{ m/s} \\ \theta &= \tan^{-1} \left(\frac{v_y}{v_x} \right) \\ &= \tan^{-1} \left(\frac{28 \text{ m/s}}{20. \text{ m/s}} \right) \\ &= 54^\circ \text{ E of S} \end{aligned}$$

Answers in size order: 26, 36, 54, 340.