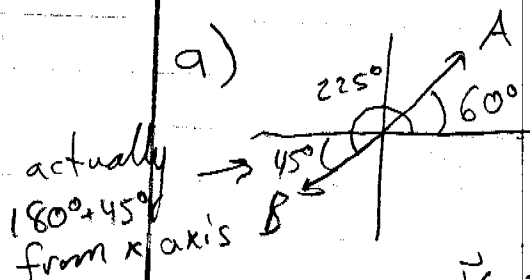


Test Solutions 2+4

2) Break this into components for simplicity



$$\vec{v}_A = |v_A| \cos(60^\circ) \hat{x} + |v_A| \sin(60^\circ) \hat{y}$$

$$= 15 \text{ mph } \hat{x} + 26 \text{ mph } \hat{y}$$

$$\vec{v}_B = |v_B| \cos(225^\circ) \hat{x} + |v_B| \sin(225^\circ) \hat{y}$$

$$= -14 \text{ mph } \hat{x} - 14 \text{ mph } \hat{y}$$

$$x = vt \quad \vec{x}_A = \vec{v}_A t = (15 \text{ mph})(3 \text{ hrs}) \hat{x} + (26 \text{ mph})(3 \text{ hrs}) \hat{y}$$

$$= 45 \text{ mi } \hat{x} + 78 \text{ mi } \hat{y}$$

$$\vec{x}_B = \vec{v}_B t = -(14 \text{ mph})(3 \text{ hrs}) \hat{x} - (14 \text{ mph})(3 \text{ hrs}) \hat{y}$$

$$= -42 \text{ mi } \hat{x} - 42 \text{ mi } \hat{y}$$

want distance b/w ships $= \sqrt{(\vec{x}_A - \vec{x}_B)^2}$

$$= \sqrt{(45 \text{ mi} + 42 \text{ mi})^2 + (78 + 42)^2} = \boxed{148 \text{ mi}}$$

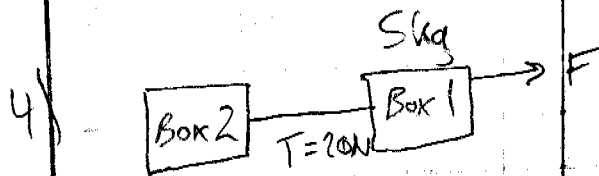
Note: this is very close to guessing that the two ships almost go directly apart from one another so $|\vec{v}| = |v_A - v_B| \approx 50 \text{ mph}$
so $\vec{x} = vt = 150 \text{ mi}$. Not strictly correct but a good guess.

b) velocity (a vector w/ direction)

$$\vec{v}_{\text{relative}} = \vec{v}_A - \vec{v}_B = 15 \text{ mph } \hat{x} + 26 \text{ mph } \hat{y} + 14 \text{ mph } \hat{x}$$

$$= \boxed{29 \text{ mph } \hat{x} + 40 \text{ mph } \hat{y}}$$

use $\sqrt{v_x^2 + v_y^2}$ for magnitude of v & $\tan(\theta) = \frac{40}{29}$ if you want



a) we want F where $F = ma$

since the boxes are pulled from rest we assume constant acceleration.

$x = 20\text{m}$ after $t = 5\text{s}$

$$x = \frac{1}{2}at^2 \rightarrow 20\text{m} = \frac{1}{2}a(5\text{s})^2$$

$$a = \frac{40}{25} \text{ m/s}^2$$

$$F = m_{\text{box 1}} a + 20\text{N} = (5\text{kg})\left(\frac{40}{25} \text{ m/s}^2\right) + 20\text{N} = \boxed{28\text{N}}$$

b) F on second box is 20N

$$F = ma \quad 20\text{N} = m_{\text{box 2}} \frac{40}{25} \text{ m/s}^2 \quad m_{\text{box 2}} = \boxed{12.5 \text{ kg}}$$