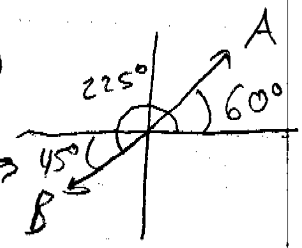
Test Solutions 2+4

2) Break this into components for simplicity

a)



actually $180° + 45°$ from x axis

$\vec{V}_A = |V_A|\cos(60°)\hat{x} + |V_A|\sin(60°)\hat{y}$

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

$\vec{V}_B = |V_B|\cos(225°)\hat{x} + |V_B|\sin(225°)$

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

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

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

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

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

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 $\vec{x} = |V|t = 150\text{ mi}$. Not strictly correct but a good guess.

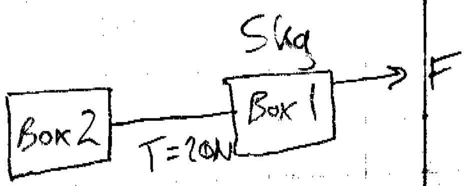
b) velocity (a vector w/ direction)

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

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

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

4)



a) we want F where $F = ma$

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

$x = 20\,m$ after $t = 5s$

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

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

$F = m_{box1}\,a + 20N = (5kg)(\frac{40}{25}\,m/s^2) + 20N = \boxed{28N}$

b) F on second box is 20N

$F = ma \qquad 20N = m_{box2}\frac{40}{25}\,m/s^2 \qquad m_{box2} = \boxed{12.5\,kg}$