2010 Q2.

(a)(i) $\vec{V_A} = 4\vec{i} - 3\vec{j}$

$\vec{V_B} = 5\vec{i} - 7\vec{j}$

$$\vec{V_{BA}} = \vec{V_B} - \vec{V_A}$$
$$= (5\vec{i} - 7\vec{j}) - (4\vec{i} - 3\vec{j})$$
$$= (5-4)\vec{i} + (-7+3)\vec{j}$$
$$= \vec{i} - 4\vec{j}$$

Magnitude: $= \sqrt{(1)^2 + (-4)^2} = \sqrt{17}\ m s^{-1}$

Direction: $= E\ Tan^{-1}(4)\ S$ i.e. $Tan\,\alpha = \frac{-4}{1}$

$= E\ 75.96°\ S$ $\boxed{\text{slope} = -4}$

(ii) $\vec{r_A} = 6\vec{i} - 14\vec{j}$

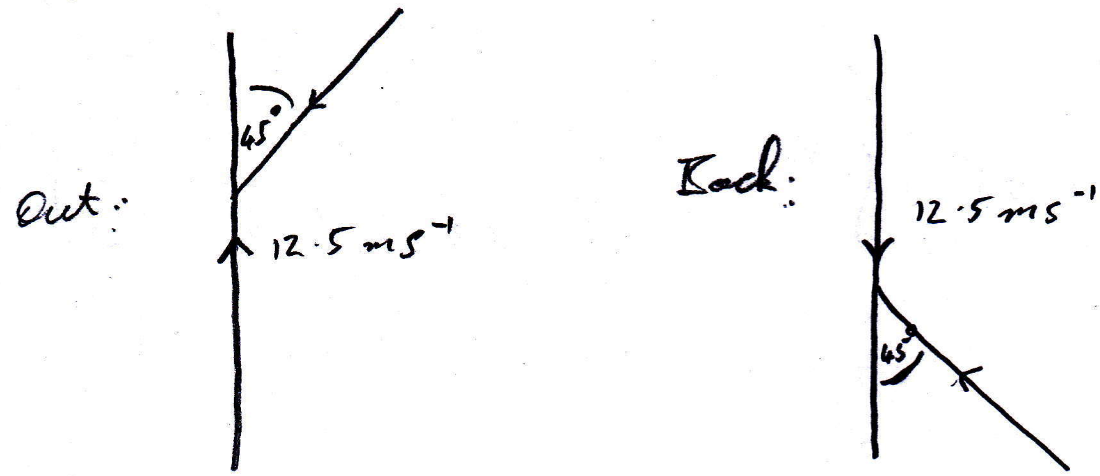
$\vec{r_B} = 3\vec{i} - 2\vec{j}$

$$\vec{r_{BA}} = (3\vec{i} - 2\vec{j}) - (6\vec{i} - 14\vec{j})$$
$$= -3\vec{i} + 12\vec{j}$$
$$= -3(\vec{i} - 4\vec{j})$$

Since $\vec{V_{BA}} = -k(\vec{r_{BA}})$ where $(k = \frac{1}{3})$

they are on a collision course.

(b)



Out:

$$\vec{V_M} = 12.5\vec{j}$$

$$\vec{V_{WM}} = -x\vec{i} - x\vec{j} \quad \text{(since angle is 45°)}.$$

$$\Rightarrow \vec{V_W} = \vec{V_{WM}} + \vec{V_M}$$

$$= -x\vec{i} + (12.5 - x)\vec{j} \quad (1)$$

Back:

$$\vec{V_M} = -12.5\vec{j}$$

$$\vec{V_{WM}} = -y\vec{i} + y\vec{j}$$

$$\vec{V_W} = \vec{V_{WM}} + V_M$$

$$= -y\vec{i} + (y - 125)\vec{j} \quad (2)$$

Since (1) = (2)

$$\Rightarrow -x\vec{i} + (12.5 - x)\vec{j} = -y\vec{i} + (y - 12.5)\vec{j}$$

$$\Rightarrow x = y \quad \text{and} \quad 12.5 - x = y - 12.5$$

$$\Rightarrow 12.5 - y = y - 12.5$$

$$\Rightarrow 25 = 2y$$

$$\Rightarrow 12.5 = y$$

$\Rightarrow \vec{V_W} = -12.5\vec{i} + 0\vec{j}$ with Magnitude 12.5 m/s and dir. = West.