Possibility 1: $\sin\alpha = \frac{3}{5}, \cos\alpha = \frac{4}{5} \quad \Rightarrow \overrightarrow{v_B} = 9\vec{i} + 3\vec{j}$. Reject

Possibility 2: $\sin\alpha = \frac{3}{5}, \cos\alpha = -\frac{4}{5} \quad \Rightarrow \overrightarrow{v_B} = \vec{i} + \vec{j}$. Correct

Possibility 3: $\sin\alpha = \frac{4}{5}, \cos\alpha = \frac{3}{5} \quad \Rightarrow \overrightarrow{v_B} = 8\vec{i} + 2\vec{j}$. Reject

Possibility 4: $\sin\alpha = \frac{4}{5}, \cos\alpha = -\frac{3}{5} \quad \Rightarrow \overrightarrow{v_B} = 2\vec{i} + 2\vec{j}$. Correct

(i) $\overrightarrow{v_C} = -4\vec{i} + 3\vec{j}$ **OR** $-3\vec{i} + 4\vec{j}$ m/s

(ii) $\overrightarrow{v_B} = \vec{i} + \vec{j}$ **OR** $2\vec{i} + 2\vec{j}$ m/s

Exercise 4E

Q. 1. (i) **Case 1:** $\overrightarrow{v_M} = 4\vec{i}$

$\overrightarrow{v_W} = x\vec{i} + y\vec{j}$

$\Rightarrow \overrightarrow{v_{WM}} = \overrightarrow{v_W} - \overrightarrow{v_M}$

$= (x-4)\vec{i} + y\vec{j}$

$\overrightarrow{v_{WM}}$ from the north

$\Rightarrow x - 4 = 0$

$\Rightarrow x = 4$

Case 2: Let $\overrightarrow{v_L}$ = velocity of the woman

$\overrightarrow{v_L} = -\vec{j}$

$\overrightarrow{v_W} = x\vec{i} + y\vec{j}$

$\Rightarrow \overrightarrow{v_{WL}} = \overrightarrow{v_W} - \overrightarrow{v_L}$

$= x\vec{i} + (y+1)\vec{j}$

$\overrightarrow{v_{WL}}$ from the north-west

$\Rightarrow x = -(y+1)$ … but $x = 4$

$\Rightarrow 4 = -y - 1$

$\Rightarrow y = -5$

$\Rightarrow \overrightarrow{v_W} = 4\vec{i} - 5\vec{j}$ m/s

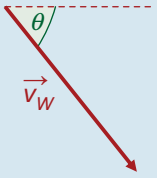
(ii) Speed $= |\overrightarrow{v_W}| = \sqrt{4^2 + (-5)^2}$

$= \sqrt{41}$ m/s

$\Rightarrow \tan\theta = \frac{5}{4}$

$\Rightarrow \theta = 51.34°$

51.34° S of E



(iii) $\overrightarrow{v_M} = 4\vec{j}$

$\overrightarrow{v_W} = 4\vec{i} - 5\vec{j}$

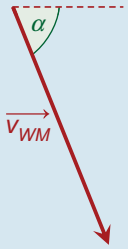
$\overrightarrow{v_{WM}} = \overrightarrow{v_W} - \overrightarrow{v_M}$

$= 4\vec{i} - 9\vec{j}$

$\tan\alpha = \frac{9}{4}$

$\Rightarrow \alpha = 66°$

$\Rightarrow 66°$ S of E



Q. 2. **Case 1:** Walking South

$\overrightarrow{v_M} = -\vec{j}$

$\overrightarrow{v_W} = x\vec{i} + y\vec{j}$

$\overrightarrow{v_{WM}} = \overrightarrow{v_W} - \overrightarrow{v_M}$

$= x\vec{i} + (y+1)\vec{j}$

$\overrightarrow{v_{WM}}$ from South-West

$\Rightarrow x = y + 1$

$\Rightarrow x - y = 1$

Case 2: Walking North

$\overrightarrow{v_M} = 3\vec{j}$

$\overrightarrow{v_W} = x\vec{i} + y\vec{j}$

$\overrightarrow{v_{WM}} = \overrightarrow{v_W} - \overrightarrow{v_M} = x\vec{i} + (y-3)\vec{j}$

$\overrightarrow{v_{WM}}$ from North-West

$\Rightarrow x = -(y-3)$

$\Rightarrow x + y = 3$

But, $\underline{x - y = 1}$ … add

$\Rightarrow 2x = 4$

$\Rightarrow x = 2$

$\Rightarrow y = 1$

$\Rightarrow \overrightarrow{v_W} = 2\vec{i} + \vec{j}$ m/s