Q. 3. (i) Let the velocity of the woman be $\overrightarrow{v_L}$, and the velocity of the wind, $\overrightarrow{v_W}$

Case 1: $\overrightarrow{v_L} = -2\vec{j}$

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

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

$= x\vec{i} + (y + 2)\vec{j}$

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

$\Rightarrow x = -(y + 2)$

$\Rightarrow x + y = -2$

Case 2: $\overrightarrow{v_L} = -14\vec{j}$

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

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

$= x\vec{i} + (y + 14)\vec{j}$

$\overrightarrow{v_{WL}}$ towards North-East

$\Rightarrow x = y + 14$

$\Rightarrow x - y = 14$

But, $\underline{x + y = -2}$ … add

$\Rightarrow 2x = 12$

$\Rightarrow x = 6$

$\Rightarrow y = -8$

$\Rightarrow \overrightarrow{v_W} = 6\vec{i} - 8\vec{j}$ m/s

(ii) Speed $= |\overrightarrow{v_W}| = \sqrt{6^2 + (-8)^2}$

$= 10$ m/s

Q. 4. **Case 1:** $\overrightarrow{v_C} = 7\vec{j}$

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

$\overrightarrow{v_{WC}} = \overrightarrow{v_W} - \overrightarrow{v_C}$

$= x\vec{i} + (y - 7)\vec{j}$

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

$\Rightarrow x = -(y - 7)$

$\Rightarrow x + y = 7$

Case 2: $\overrightarrow{v_P} = -\vec{i}$

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

$\overrightarrow{v_{WP}} = \overrightarrow{v_W} - \overrightarrow{v_P} = (x + 1)\vec{i} + y\vec{j}$

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

$\Rightarrow x + 1 = y$

$\Rightarrow x - y = -1$

But, $\underline{x + y = 7}$ … add

$\Rightarrow 2x = 6$

$\Rightarrow x = 3$

$\Rightarrow y = 4$

$\Rightarrow \overrightarrow{v_W} = 3\vec{i} + 4\vec{j}$

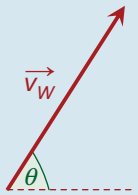
$|\overrightarrow{v_W}| = \sqrt{3^2 + 4^2}$

$= 5$ m/s

$\tan\theta = \frac{4}{3}$

$\Rightarrow \theta = 53.13°$

$\Rightarrow 53.13°$ N of E



Q. 5. **Case 1:** $\overrightarrow{v_B} = \vec{j}$

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

$\overrightarrow{v_{WB}} = \overrightarrow{v_W} - \overrightarrow{v_B}$

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

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

$\Rightarrow x = y - 1$

$\Rightarrow x - y = -1$

Case 2: $\overrightarrow{v_B} = 5\vec{j}$

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

$\overrightarrow{v_{WB}} = \overrightarrow{v_W} - \overrightarrow{v_B} = x\vec{i} + (y - 5)\vec{j}$

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

$\Rightarrow x = -(y - 5)$

$\Rightarrow x + y = 5$

But, $\underline{x - y = -1}$ … add

$\Rightarrow 2x = 4$

$\Rightarrow x = 2$

$\Rightarrow y = 3$

$\Rightarrow \overrightarrow{v_W} = 2\vec{i} + 3\vec{j}$ m/s

Q. 6. **Case 1:** $\overrightarrow{v_C} = 3\vec{i} + 2\vec{j}$

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

$\overrightarrow{v_{WC}} = \overrightarrow{v_W} - \overrightarrow{v_C}$

$= (x - 3)\vec{i} + (y - 2)\vec{j}$

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

$\Rightarrow x - 3 = -(y - 2)$

$\Rightarrow x + y = 5$

Case 2: $\overrightarrow{v_C} = 7\vec{i}$

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

$\overrightarrow{v_{WC}} = \overrightarrow{v_W} - \overrightarrow{v_C} = (x - 7)\vec{i} + y\vec{j}$

$\overrightarrow{v_{WC}}$ from North

$\Rightarrow x - 7 = 0 \Rightarrow x = 7$

$\Rightarrow y = -2$

$\Rightarrow \overrightarrow{v_W} = 7\vec{i} - 2\vec{j}$ m/s