Q. 7. (i) **Case 1:** $\overrightarrow{v_C} = 3\vec{j}$

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

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

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

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

$\Rightarrow x = y - 3$

$\Rightarrow x - y = -3$

Case 2: $\overrightarrow{v_C} = 9\vec{j}$

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

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

$= x\vec{i} + (y - 9)\vec{j}$

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

$\Rightarrow x = -(y - 9)$

$\Rightarrow x + y = 9$

But, $\underline{x - y = -3}$ … add

$\Rightarrow 2x = 6$

$\Rightarrow x = 3$

$\Rightarrow y = 6$

$\Rightarrow \overrightarrow{v_W} = 3\vec{i} + 6\vec{j}$ m/s

(ii) $\overrightarrow{v_C} = p\vec{j}$

$\overrightarrow{v_W} = 3\vec{i} + 6\vec{j}$

$\overrightarrow{v_{WC}} = \overrightarrow{v_W} - \overrightarrow{v_C} = 3\vec{i} + (6 - p)\vec{j}$

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

$\Rightarrow 6 - p = 0 \quad \Rightarrow \quad p = 6$

$\Rightarrow$ She must cycle at 6 m/s North.

Q. 8. (i) $\overrightarrow{v_M} = -2\vec{j}$

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

$\overrightarrow{v_{WM}} = \overrightarrow{v_W} - \overrightarrow{v_M} = x\vec{i} + (y + 2)\vec{j}$

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

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

Also, $\sqrt{x^2 + y^2} = 10$

$\Rightarrow x^2 + y^2 = 100$ … let $x = -(y + 2)$

$\Rightarrow (y + 2)^2 + y^2 = 100$

$\Rightarrow y^2 + 4y + 4 + y^2 = 100$

$\Rightarrow 2y^2 + 4y - 96 = 0$

$\Rightarrow y^2 + 2y - 48 = 0$

$\Rightarrow (y + 8)(y - 6) = 0$

$\Rightarrow y = -8, \cancel{y = 6}$

$\Rightarrow x = 6$

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

Note: The $y = 6$ solution is excluded because this would mean the man is cycling into the wind while travelling south. The wind could not therefore appear to be coming from the North-West.

(ii) $\overrightarrow{v_M} = 2\vec{j}$

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

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

$= 6\vec{i} - 10\vec{j}$

$\tan\theta = \frac{10}{6} = \frac{5}{3}$

$\Rightarrow \theta = 59°$ N of W

Q. 9. (i) **Case 1:** $\overrightarrow{v_G} = 4\vec{i}$

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

$\overrightarrow{v_{WG}} = \overrightarrow{v_W} - \overrightarrow{v_G}$

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

$\overrightarrow{v_{WG}}$ from the North-West

$\Rightarrow x - 4 = -y \quad \Rightarrow \quad x = 4 - y$

Case 2: $\overrightarrow{v_G} = 6\vec{j}$

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

$\overrightarrow{v_{WG}} = \overrightarrow{v_W} - \overrightarrow{v_G}$

$= x\vec{i} + (y - 6)\vec{j}$

$|\overrightarrow{v_{WG}}| = 10$