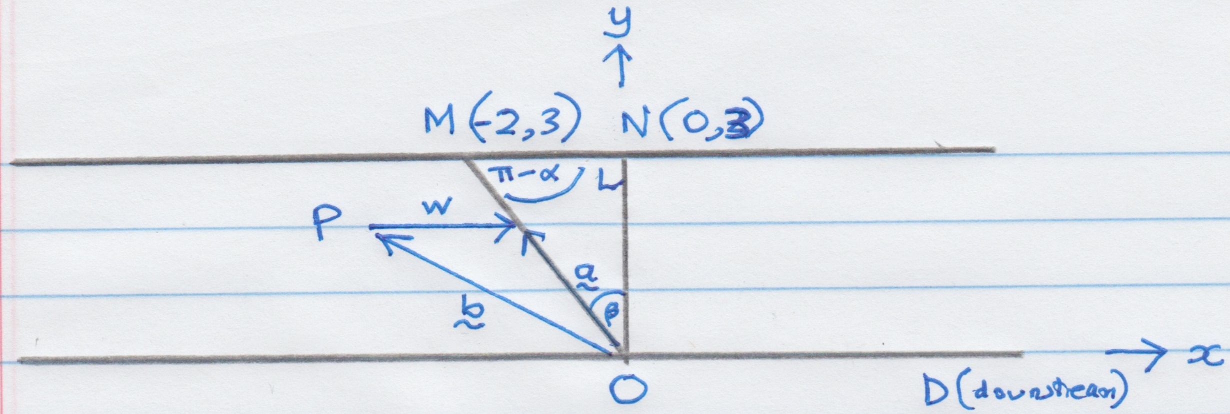

Let the flow be in the positive x direction. Then the velocity of the water is $\underset{\sim}{w} = \frac{7}{2}\underset{\sim}{i}$. Let $\underset{\sim}{b}$ be the velocity of the boat relative to the water, and $\underset{\sim}{a}$ the actual velocity relative to the land. Then

$$\underset{\sim}{b} + \underset{\sim}{w} = \underset{\sim}{a}$$

Let $\underset{\sim}{a}$ have direction cosines $\cos\alpha$, $\cos\beta$ and $\cos\gamma$ (cosines of angles with x, y and z axes, respectively). Then from the diagram, specifically triangle ONM, we have

$$\cos(\beta) = \frac{3}{\sqrt{2^2+3^2}}, \quad \cos(\pi-\alpha) = \frac{2}{\sqrt{2^2+3^2}}, \quad \cos(\gamma)=0$$

$$\Rightarrow \quad \hat{\underset{\sim}{a}} = \cos\alpha\,\underset{\sim}{i} + \cos\beta\,\underset{\sim}{j} = \frac{-2\underset{\sim}{i}+3\underset{\sim}{j}}{\sqrt{13}}$$

(because $\cos\alpha = -\cos(\pi-\alpha)$). Also, $b = |\underset{\sim}{b}| = 13$ (km/h)

$$\text{But} \quad \underset{\sim}{b} = \underset{\sim}{a} - \underset{\sim}{w} = a\hat{\underset{\sim}{a}} - \frac{7}{2}\underset{\sim}{i}$$

$$= \left(\frac{-2a}{\sqrt{13}} - \frac{7}{2}\right)\underset{\sim}{i} + \frac{3a}{\sqrt{13}}\underset{\sim}{j}$$

$$\text{So} \quad b = \sqrt{\left(\frac{-2a}{\sqrt{13}} - \frac{7}{2}\right)^2 + \left(\frac{3}{\sqrt{13}}\right)^2} = 13 \Rightarrow a^2 + \frac{14a}{\sqrt{13}} - \frac{627}{4} = 0$$

$\Rightarrow a = \frac{1}{2}\left(\sqrt{\frac{8347}{13}} - \frac{14}{\sqrt{13}}\right) \approx 10.728$. So time taken is

$$\frac{OM}{a} = \frac{\sqrt{13}}{a} = \frac{26}{\sqrt{8347}-14} \approx 0.33608 \text{ hr} \approx 20.165 \text{ mins}$$

Also, if θ is the angle DOP then $\cos\theta = \hat{\underset{\sim}{b}}\cdot\underset{\sim}{i} = \frac{\underset{\sim}{b}\cdot\underset{\sim}{i}}{b} = \frac{b\cdot i}{13}$

$$= \frac{\frac{-2a}{\sqrt{13}} - \frac{7}{2}}{13} = \frac{-63-2\sqrt{8347}}{338} \approx -0.72699 \Rightarrow \theta \approx 136.6^\circ$$