2. [*In this question the unit vectors* **i** *and* **j** *are due east and due north respectively.*]

A coastguard station O monitors the movements of a small boat.

At 10:00 the boat is at the point $(4\mathbf{i} - 2\mathbf{j})$ km relative to O.

At 12:45 the boat is at the point $(-3\mathbf{i} - 5\mathbf{j})$ km relative to O.

The motion of the boat is modelled as that of a particle moving in a straight line at constant speed.

(a) Calculate the bearing on which the boat is moving, giving your answer in degrees to one decimal place.

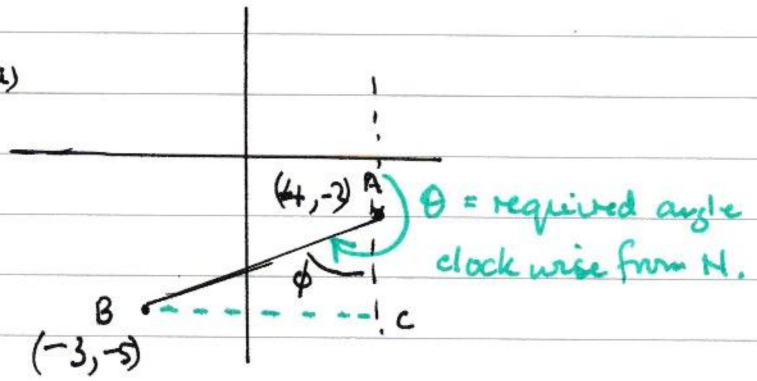
(3)

(b) Calculate the speed of the boat, giving your answer in km h^{-1}

2020

(3)

(a)



Direction $\overrightarrow{AB} = \begin{pmatrix} -3 \\ -5 \end{pmatrix} - \begin{pmatrix} 4 \\ -2 \end{pmatrix}$

$= \begin{pmatrix} -7 \\ -3 \end{pmatrix}$

So in $\triangle ABC$ $AC = 3$ $BC = 7$, $\tan\phi = 7/3 \Rightarrow \phi = 66.8^\circ$

So required bearing $= \theta = 180^\circ + \phi$

$= 180^\circ + 66.8^\circ = \underline{\underline{246.8^\circ}}$

(b) The distance $AB^2 = AC^2 + BC^2 = 9 + 49 = 58$

$AB = \sqrt{58}$

Speed $= \dfrac{\text{Distance}}{\text{Time}} = \dfrac{\sqrt{58}}{2.75}$ 10.00 → 12.45 = 2.75 hours

$\underline{\underline{= 2.77 \text{ km h}^{-1}}}$