7. [*In this question* **i** *and* **j** *are horizontal unit vectors directed due east and due north respectively and position vectors are given relative to a fixed origin O.*]

A boat, which is modelled as a particle, is moving with constant velocity $(-2\mathbf{i} + \mathbf{j})\,\text{km h}^{-1}$

At time $t = 1.5$ hours after noon, the boat passes through the point with position vector $(11\mathbf{i} + 3.5\mathbf{j})$ km.

(a) Show that, at time t hours after noon, the position vector of the boat is

$$[(14 - 2t)\mathbf{i} + (2 + t)\mathbf{j}]\,\text{km}$$

(3)

The boat is visible from O when it is 9 km or less from O.

(b) Find the length of time for which the boat is visible from O, showing your method clearly.

(4)

(c) Find the value of t when the boat is northwest of O.

(2)

At the instant when the boat is at the point P, OP is perpendicular to the direction in which the boat is moving.

(d) Show that $OP = \dfrac{18\sqrt{5}}{5}$ km

(*Solutions relying on calculator technology are not acceptable.*)

(6)

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Question 7 continued

(Total for Question 7 is 15 marks)

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