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8. [In this question, \mathbf{i} and \mathbf{j} are horizontal unit vectors directed due east and due north respectively and position vectors are given relative to a fixed origin O .]

Two boats, P and Q , are moving with constant velocities.

The velocity of P is $15\mathbf{i}\text{ m s}^{-1}$ and the velocity of Q is $(20\mathbf{i} - 20\mathbf{j})\text{ m s}^{-1}$

- (a) Find the direction in which Q is travelling, giving your answer as a bearing. (2)

The boats are modelled as particles.

At time $t = 0$, P is at the origin O and Q is at the point with position vector $200\mathbf{j}$ m.

At time t seconds, the position vector of P is \mathbf{p} m and the position vector of Q is \mathbf{q} m.

- (b) Show that

$$\vec{PQ} = [5t\mathbf{i} + (200 - 20t)\mathbf{j}] \text{ m} \quad (5)$$

- (c) Find the bearing of P from Q when $t = 10$ (2)

- (d) Find the distance between P and Q when Q is north east of P (5)

- (e) Find the times when P and Q are 200 m apart. (3)



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Q8

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