

M1 Vector Motion Edexcel

Questions taken from *January* Edexcel papers up to (and including) 2010.

1. A particle P moves with constant acceleration $(2\mathbf{i} - 5\mathbf{j}) \text{ ms}^{-2}$. At time $t = 0$, P has speed $u \text{ ms}^{-1}$. At time $t = 3 \text{ s}$, P has velocity $(-6\mathbf{i} + \mathbf{j}) \text{ ms}^{-1}$.

Find the value of u .

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2. Two boats A and B are moving with constant velocities. Boat A moves with velocity $9\mathbf{j} \text{ kmh}^{-1}$. Boat B moves with velocity $(3\mathbf{i} + 5\mathbf{j}) \text{ kmh}^{-1}$. At noon, A is at point O , and B is 10 km due west of O . At time t hours after noon, the position vectors of A and B relative to O are \mathbf{a} km and \mathbf{b} km respectively.

- (a) Find the bearing on which B is moving.
- (b) Find expressions for \mathbf{a} and \mathbf{b} in terms of t , giving your answer in the form $p\mathbf{i} + q\mathbf{j}$.
- (c) Find the time when B is due south of A .
- (d) At time t hours after noon, the distance between A and B is d km. By finding an expression for \overrightarrow{AB} , show that $d^2 = 25t^2 - 60t + 100$.
- (e) At noon, the boats are 10 km apart. Find the time after noon at which the boats are again 10 km apart.
3. Two ships P and Q are travelling at night with constant velocities. At midnight, P is at the point with position vector $(20\mathbf{i} + 10\mathbf{j}) \text{ km}$ relative to a fixed origin O . At the same time, Q is at the point with position vector $(14\mathbf{i} - 6\mathbf{j}) \text{ km}$. Three hours later, P is at the point with position vector $(29\mathbf{i} + 34\mathbf{j}) \text{ km}$. The ship Q travels with velocity $12\mathbf{j} \text{ kmh}^{-1}$. At time t hours after midnight, the position vectors of P and Q are \mathbf{p} km and \mathbf{q} km respectively.

- (a) Find the velocity of P , in terms of \mathbf{i} and \mathbf{j} .
- (b) Find expressions for \mathbf{p} and \mathbf{q} , in terms of t , \mathbf{i} and \mathbf{j} .
- (c) At time t hours after midnight, the distance between P and Q is d km. By finding an expression for \overrightarrow{PQ} , show that

$$d^2 = 25t^2 - 92t + 292.$$

- (d) Weather conditions are such that an observer on P can only see the lights on Q when the distance between P and Q is 15 km or less. Given that when $t = 1$, the lights on Q move into the sight of the observer, find the time, to the nearest minute, at which the lights on Q move out of sight of the observer.