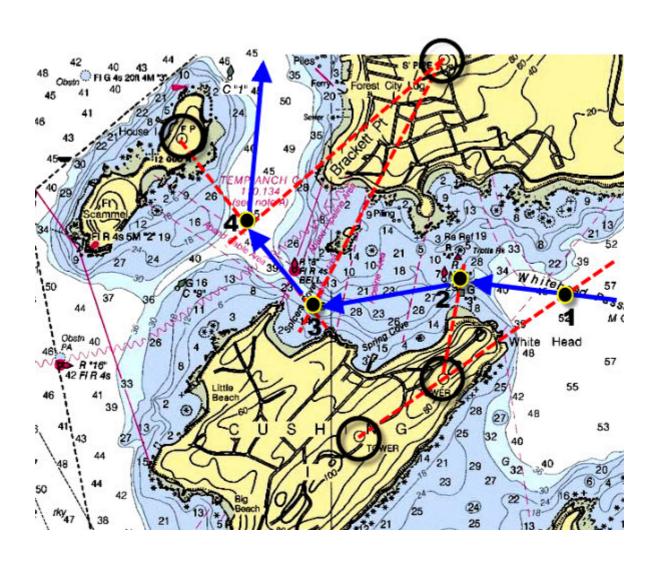
A-Level Pure Mathematics

Year 1 and Year 2

V E C T O R S I I



VECTORS II

Chapter 1

A-Level Pure Mathematics Vectors II: Year 1 and Year 2

1.1 Vectors and Kinematics

Example 1

A particle moves with initial velocity $(7 i + 6 j) \text{ ms}^{-1}$ It is accelerating at $(-3 i + 5 j) \text{ ms}^{-2}$

(i) What is its velocity when t = 4 seconds?

(ii) What is its speed when t = 4 seconds?

Example 2

A particle is moving with initial velocity (-2 i + j) ms⁻¹ A constant acceleration of (i - 2j) ms⁻² acts upon it.

(i) What is its displacement vector over the next 5 seconds?

(ii) If it was initially at position (3i + 4j), where is it when t is 5 seconds?

1.2 Exercise

Question 1

A particle is initially moving with velocity (3 i + j) ms⁻¹ It is constantly accelerating at (-i + 2 j) ms⁻²

(i) What is its velocity when t = 7 seconds?

(ii) What is its speed when t = 7 seconds?

Question 2

A particle is moving with initial velocity (3 i + 2 j) ms⁻¹ A constant acceleration of (4 i - j) ms⁻² acts upon it.

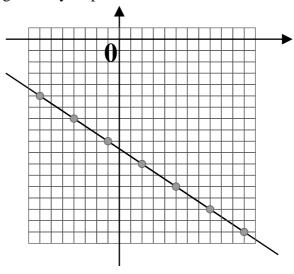
(i) What is its displacement vector over the next 3 seconds?

(ii) If initially at position (-20 i + 2 j), what is its position when t is 3 seconds?

Question 3

M1 examination question, May 2010, Q1 with Hint added A particle P is moving with constant velocity (-3 i + 2 j) ms⁻¹ At time t = 6 s P is at the point with position vector (-4 i - 7 j) m Find the distance of P from the origin at time t = 2 s

HINT: This diagram may help...



[**5** marks]

Question 4

M1 examination question, January 2009, Q1 A particle P moves with constant acceleration (2i - 5j) ms⁻² At time t = 0 P has speed u ms⁻¹ At time t = 3 s, P has velocity (-6i + j) ms⁻¹ Find the value of u

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M1 examination question, January 2008, Q6 [In this question, the unit vectors **i** and **j** are due east and due north respectively]

A particle *P* is moving with constant velocity (-5 i + 8 j) ms⁻¹

(a) Find the speed of P

- [2 marks]
- (**b**) Find the direction of motion of *P*, giving your answer as a bearing

[3 marks]

At time t = 0 P is at the point A with position vector (7i - 10j) m relative to a fixed origin O. When t = 3 s, the velocity of P changes and it moves with velocity (ui + vj) ms⁻¹, where u and v are constants. After a further u s, it passes through u and continues to move with velocity (ui + vj) ms⁻¹

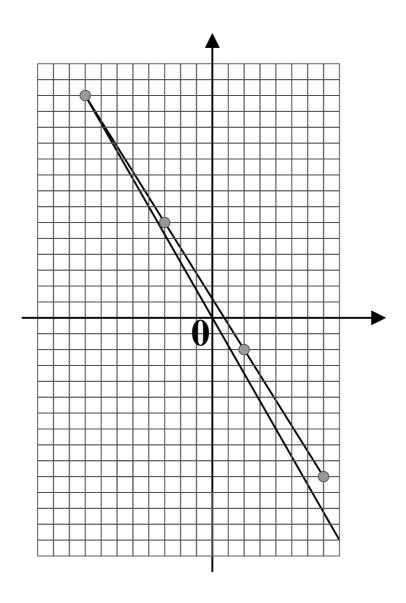
(c) Find the values of u and v

[5 marks]

(**d**) Find the total time taken for *P* to move from *A* to a position which is due south of *A*

[3 marks]

HINT: This diagram may help...



Question 6

M1 examination question, January 2010, Q7

[In this question, the unit vectors \mathbf{i} and \mathbf{j} are horizontal unit vectors due east and due north respectively and position vectors are given with respect to a fixed origin]

A ship *S* is moving along a straight line with constant velocity.

At time t hours the position vector of S is s km

When
$$t = 0$$
, $s = 9i - 6j$

When
$$t = 4$$
, $s = 21 i + 10 j$

(a) Find the speed of S

[4 marks]

(**b**) Find the direction in which S is moving, giving your answer as a bearing

(c) Show that s = (3t+9)i + (4t-6)j

[2 marks]

A lighthouse L is located at the point with position vector (18 i + 6 j) km When t = T, the ship S is 10 km from L.

(\mathbf{d}) Find the possible values of T.

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M1 examination question, June 2007, Q7

A boat *B* is moving with constant velocity. At noon, *B* is at the point with position vector (3i - 4j) km with respect to a fixed origin *O*. At 14:30 on the same day, *B* is at the point with position vector (8i + 11j) km

(a) Find the velocity of b, giving your answer in the form p i + q j

[3 marks]

At time t hours after noon, the position vector of B is b km

(**b**) Find, in terms of t, an expression for \boldsymbol{b}

nother boat C is also moving with constant velocity. The position vector of C , km, at time t hours after noon, is given by $\mathbf{c} = (-9\mathbf{i} + 20\mathbf{j}) + t(6\mathbf{i} + \lambda\mathbf{j})$
where λ is a constant.
Fiven that C intercepts B , \mathbf{c}) find the value of λ
[5 marks] show that, before C intercepts B, the boats are moving with the same speed
[3 marks]
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