

Constant Acceleration 2D

Question Paper 2

Level	A Level
Subject	Maths
Exam Board	AQA
Module	Mechanics 1
Topic	Motion
Sub Topic	Constant Acceleration 2D
Booklet	Question Paper - 2

Time Allowed: 50 minutes

Score: /42

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

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Q1. A particle moves with constant acceleration $(-0.4\mathbf{i} + 0.2\mathbf{j}) \text{ m s}^{-2}$. Initially, it has velocity $(4\mathbf{i} + 0.5\mathbf{j}) \text{ m s}^{-1}$. The unit vectors \mathbf{i} and \mathbf{j} are directed east and north respectively.

(a) Find an expression for the velocity of the particle at time t seconds. (2)

(b) (i) Find the velocity of the particle when $t = 22.5$. (2)

(ii) State the direction in which the particle is travelling at this time. (1)

(c) Find the time when the speed of the particle is 5 m s^{-1} . (6)

(Total 11 marks)

Q2. A helicopter is initially hovering above a lighthouse. It then sets off so that its acceleration is $(0.5\mathbf{i} + 0.375\mathbf{j}) \text{ m s}^{-2}$. The helicopter does not change its height above sea level as it moves. The unit vectors \mathbf{i} and \mathbf{j} are directed east and north respectively.

(a) Find the speed of the helicopter 20 seconds after it leaves its position above the lighthouse. (4)

(b) Find the bearing on which the helicopter is travelling, giving your answer to the nearest degree. (3)

(c) The helicopter stops accelerating when it is 500 metres from its initial position.

Find the time that it takes for the helicopter to travel from its initial position to the point where it stops accelerating.

(5)
(Total 12 marks)

- Q3.** A boat moves with constant acceleration, so that its velocity \mathbf{v} m s⁻¹ at time t seconds is given by

$$\mathbf{v} = (4.5 - 0.9t)\mathbf{i} + (2 + 0.5t)\mathbf{j}$$

where the unit vectors \mathbf{i} and \mathbf{j} are directed east and north respectively.

- (a) Find the velocity of the boat when $t = 0$. (1)
- (b) Find the velocity of the boat when $t = 5$. (1)
- (c) State the direction in which the boat is travelling when $t = 5$. (1)
- (d) Find the acceleration of the boat. (3)
- (e) The mass of the boat is 250 kg. Find the magnitude of the resultant force acting on the boat. (3)
- (f) Draw a diagram to show the direction of the resultant force on the boat and calculate the angle between this force and the unit vector \mathbf{i} . (4)

(Total 13 marks)

- Q4.** A ship moves with constant acceleration. At time t seconds, its velocity is \mathbf{v} m s⁻¹, where

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$$\mathbf{v} = (9 - 0.01t)\mathbf{i} + (7 - 0.03t)\mathbf{j}$$

The unit vectors \mathbf{i} and \mathbf{j} are directed east and north respectively.

(a) Write down the velocity of the ship when $t = 0$. (1)

(b) Find the acceleration of the ship. (2)

(c) Find t when the ship is travelling south-east. (3)

(Total 6 marks)