

Displacement/ Velocity/ Acceleration

Question Paper 4

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Kinematics of motion in a straight line
Sub Topic	Displacement, velocity, acceleration
Booklet	Question Paper 4

Time Allowed: 55 minutes

Score: /46

Percentage: /100

Grade Boundaries:

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

- 1 Two cyclists P and Q travel along a straight road ABC , starting simultaneously at A and arriving simultaneously at C . Both cyclists pass through B 400 s after leaving A . Cyclist P starts with speed 3 m s^{-1} and increases this speed with constant acceleration 0.005 m s^{-2} until he reaches B .

(i) Show that the distance AB is 1600 m and find P 's speed at B . [3]

Cyclist Q travels from A to B with speed $v \text{ m s}^{-1}$ at time t seconds after leaving A , where

$$v = 0.04t - 0.0001t^2 + k,$$

and k is a constant.

(ii) Find the value of k and the maximum speed of Q before he has reached B . [6]

Cyclist P travels from B to C , a distance of 1400 m, at the speed he had reached at B . Cyclist Q travels from B to C with constant acceleration $a \text{ m s}^{-2}$.

(iii) Find the time taken for the cyclists to travel from B to C and find the value of a . [4]

- 2 A and B are two points which are 10 m apart on the same horizontal plane. A particle P starts to move from rest at A , directly towards B , with constant acceleration 0.5 m s^{-2} . Another particle Q is moving directly towards A with constant speed 0.75 m s^{-1} , and passes through B at the instant that P starts to move. At time T s after this instant, particles P and Q collide. Find

(i) the value of T , [4]

(ii) the speed of P immediately before the collision. [1]

- 3 A particle P moves on a straight line, starting from rest at a point O of the line. The time after P starts to move is t s, and the particle moves along the line with constant acceleration $\frac{1}{4} \text{ m s}^{-2}$ until it passes through a point A at time $t = 8$. After passing through A the velocity of P is $\frac{1}{2}t^{\frac{2}{3}} \text{ m s}^{-1}$.

(i) Find the acceleration of P immediately after it passes through A . Hence show that the acceleration of P decreases by $\frac{1}{12} \text{ m s}^{-2}$ as it passes through A . [4]

(ii) Find the distance moved by P from $t = 0$ to $t = 27$. [3]

4 A small ball of mass 0.4 kg is released from rest at a point 5 m above horizontal ground. At the instant the ball hits the ground it loses 12.8 J of kinetic energy and starts to move upwards.

(i) Show that the greatest height above the ground that the ball reaches after hitting the ground is 1.8 m. [4]

(ii) Find the time taken for the ball's motion from its release until reaching this greatest height. [3]

5 The top of a cliff is 40 metres above the level of the sea. A man in a boat, close to the bottom of the cliff, is in difficulty and fires a distress signal vertically upwards from sea level. Find

(i) the speed of projection of the signal given that it reaches a height of 5 m above the top of the cliff, [2]

(ii) the length of time for which the signal is above the level of the top of the cliff. [2]

The man fires another distress signal vertically upwards from sea level. This signal is above the level of the top of the cliff for $\sqrt{17}$ s.

(iii) Find the speed of projection of the second signal. [3]

6 An aeroplane moves along a straight horizontal runway before taking off. It starts from rest at O and has speed 90 m s^{-1} at the instant it takes off. While the aeroplane is on the runway at time t seconds after leaving O , its acceleration is $(1.5 + 0.012t) \text{ m s}^{-2}$. Find

(i) the value of t at the instant the aeroplane takes off, [4]

(ii) the distance travelled by the aeroplane on the runway. [3]