Displacement/ Velocity/ Acceleration
Question Paper 1

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 1

Time Allowed: 60 minutes

Score: /50

Percentage: /100

Grade Boundaries:

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

1 Particles P and Q move on a straight line AOB. The particles leave O simultaneously, with P moving towards A and with Q moving towards B. The initial speed of P is $1.3\,\mathrm{m\,s^{-1}}$ and its acceleration in the direction OA is $0.1\,\mathrm{m\,s^{-2}}$. Q moves with acceleration in the direction OB of $0.016t\,\mathrm{m\,s^{-2}}$, where t seconds is the time elapsed since the instant that P and Q started to move from O. When $t = 20$, particle P passes through A and particle Q passes through B.

   (i) Given that the speed of Q at B is the same as the speed of P at A, f nd the speed of Q at time $t = 0$.   [4]

   (ii) Find the distance AB.   [3]

2 A particle P starts from rest and moves in a straight line for 18 seconds. For the first 8 seconds of the motion P has constant acceleration $0.25\,\mathrm{m\,s^{-2}}$. Subsequently P's velocity, $v\,\mathrm{m\,s^{-1}}$ at time t seconds after the motion started, is given by

$$v = -0.1t^2 + 2.4t - k,$$

where $8 \leqslant t \leqslant 18$ and k is a constant.

   (i) Find the value of v when $t = 8$ and hence find the value of k.   [2]

   (ii) Find the maximum velocity of P.   [2]

   (iii) Find the displacement of P from its initial position when $t = 18$.   [3]

3 A particle P starts from rest at a point O and moves in a straight line. P has acceleration $0.6t\,\mathrm{m\,s^{-2}}$ at time t seconds after leaving O, until $t = 10$.

   (i) Find the velocity and displacement from O of P when $t = 10$.   [5]

After $t = 10$, P has acceleration $-0.4t\,\mathrm{m\,s^{-2}}$ until it comes to rest at a point A.

   (ii) Find the distance OA.   [7]

4   A particle P moves in a straight line. P starts from rest at O and travels to A where it comes to rest, taking 50 seconds. The speed of P at time t seconds after leaving O is $v\,\mathrm{m\,s}^{-1}$, where v is defined as follows.

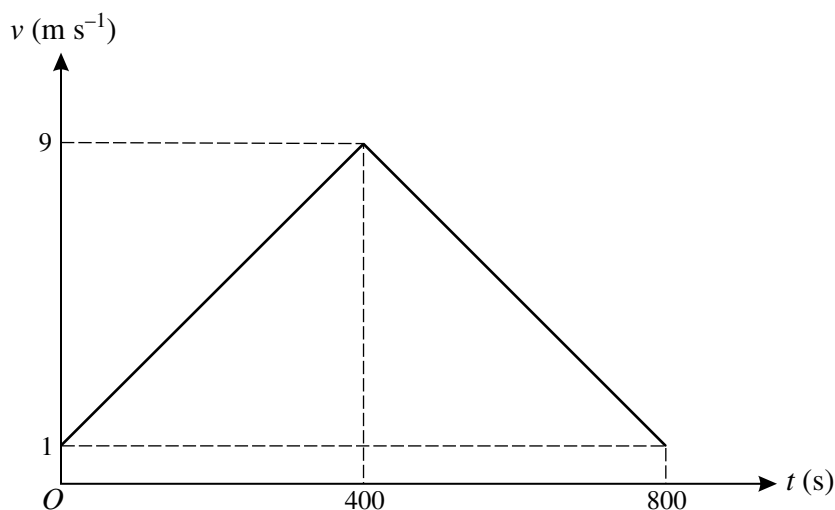$$\text{For } 0 \leqslant t \leqslant 5, \quad v = t - 0.1t^2,$$
$$\text{for } 5 \leqslant t \leqslant 45, \quad v \text{ is constant,}$$
$$\text{for } 45 \leqslant t \leqslant 50, \quad v = 9t - 0.1t^2 - 200.$$

   (i) Find the distance travelled by P in the first 5 seconds. [3]

   (ii) Find the total distance from O to A, and deduce the average speed of P for the whole journey from O to A. [6]

5 A tractor travels in a straight line from a point A to a point B. The velocity of the tractor is $v\,\text{m}\,\text{s}^{-1}$ at time t s after leaving A.

(i)

The diagram shows an approximate velocity-time graph for the motion of the tractor. The graph consists of two straight line segments. Use the graph to find an approximation for

(a) the distance AB, [2]

(b) the acceleration of the tractor for $0 < t < 400$ and for $400 < t < 800$. [2]

(ii) The actual velocity of the tractor is given by $v = 0.04t - 0.000\,05t^2$ for $0 \leqslant t \leqslant 800$.

(a) Find the values of t for which the actual acceleration of the tractor is given correctly by the approximate velocity-time graph in part **(i)**. [3]

For the interval $0 \leqslant t \leqslant 400$, the approximate velocity of the tractor in part **(i)** is denoted by $v_1\,\text{m}\,\text{s}^{-1}$.

(b) Express v_1 in terms of t and hence show that $v_1 - v = 0.000\,05(t - 200)^2 - 1$. [2]

(c) Deduce that $-1 \leqslant v_1 - v \leqslant 1$. [2]

6 A particle P is released from rest at a point on a smooth plane inclined at $30°$ to the horizontal. Find the speed of P

(i) when it has travelled $0.9\,\text{m}$,

(ii) $0.8\,\text{s}$ after it is released.

[4]