Constant Acceleration 1D

Question Paper 8

Level	A Level
Subject	Maths
Exam Board	AQA
Module	Mechanics 1
Topic	Motion
Sub Topic	Constant Acceleration 1D
Booklet	Question Paper - 8

Time Allowed: **51 minutes**

Score: **/42**

Percentage: **/100**

Grade Boundaries:

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

Q1. A hot air balloon is released from rest at ground level and rises vertically. It accelerates at a constant rate. It reaches a height of 120 metres after 50 seconds.

(a) Show that the acceleration of the balloon is 0.096 ms^{-2}

(3)

(b) Find the speed of the balloon when it is at a height of 200 metres.

(3)

(c) Find the time that it takes the balloon to reach a height of 200 metres.

(3)

(d) The mass of the balloon is 250 kg. Find the magnitude of the upward force acting on the balloon.

(3)

(Total 12 marks)

Q2. A van has mass 1200 kg. It travels with constant acceleration up a slope inclined at 4° to the horizontal. The length of the slope is 250 metres. At the bottom of the slope the van has a speed of 20 m s^{-1} and at the top its speed has dropped to 15 m s^{-1}.

(a) Show that the acceleration of the van while it is on the slope is –0.35 m s^{-1}

(3)

(b) A simple model assumes that no external resistance forces act on the van. A constant force of magnitude P newtons parallel to the slope acts on the van.

Find P.

(4)

(c) A more realistic model assumes that a resistance force does act on the van. This force has magnitude 300 newtons and acts parallel to the slope. Revise your answer to part (b) to take account of this extra force.

(2)

(d) In reality the resistance force will not be constant. Explain why.

(2)

(Total 11 marks)

Q3. A sprinter starts from rest, and accelerates at 2 m s^{-2} for the first 4 seconds of a race. Assume that the sprinter moves along a straight line.

(a) Find the distance travelled by the sprinter in the first 4 seconds.

(2)

(b) Find the speed of the sprinter at the end of the first 4 seconds.

(2)

(c) The sprinter then travels at this speed for the remainder of the race. He travels a total distance of 100 metres. Find the total time that he takes to complete the race.

(4)

(Total 8 marks)

Q4. After a collision, a car and a van, of combined mass 3000 kg, slide together along a straight horizontal road. The coefficient of friction between the road and the tyres of the vehicles as they slide is 0.7.

(a) Model the car and the van as a single particle.

(i) Show that the magnitude of the frictional force acting is 20 580 N.

(3)

(ii) Find the acceleration of the car and van after the collision.

(2)

(iii) The car and the van slide together for a distance of 5 metres before coming to rest.

Using the result from part (a)(ii), show that just after the collision the car and van were moving at 8.28 m s^{-1} to three significant figures.

(3)

(b) The mass of the car is 1200 kg and the mass of the van is 1800 kg. Before the collision, the van was stationary.

Find the speed of the car just before the collision.

(3)
(Total 11 marks)