

Using $F=ma$ without Kinematics

Question Paper 8

Level	A Level
Subject	Maths
Exam Board	AQA
Module	Mechanics 1
Topic	Newton's Law of motion
Sub Topic	Using $F=ma$ without kinematics
Booklet	Question Paper - 8

Time Allowed: 60 minutes

Score: /48

Percentage: /100

Grade Boundaries:

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

- Q1.** A train travels along a straight horizontal track. It starts from rest and accelerates at 0.5 m s^{-2} for 10 seconds.
- (a) Find the speed of the train after 10 seconds. (2)
- (b) Find the distance that the train travels in the first 10 seconds. (2)
- (c) The train has a mass of 200 tonnes and experiences a resistance force of 40 000 N. Find the magnitude of the forward driving force that acts on the train while it is accelerating at 0.5 m s^{-2} . (3)
- (Total 7 marks)**

- Q2.** A particle of mass 60 kg is on a rough surface inclined at an angle of 40° to the horizontal.
- (a) Find the magnitude of the normal reaction force acting on the particle. (2)
- (b) If the particle remains at rest, find the minimum value of the coefficient of friction between the particle and the slope. (4)
- (c) If the coefficient of friction between the particle and the slope is 0.2, the particle slides down the slope. Find the acceleration of the particle in this case. (5)
- (Total 11 marks)**

- Q3.** A block of wood has mass 4 kg. It is placed on a rough horizontal surface and is pulled by a horizontal string. The coefficient of friction between the block and the surface is 0.4.
- (a) Draw a diagram to show the forces acting on the block. (1)
- (b) Calculate the magnitude of the normal reaction force acting on the block.

(1)

(c) If the acceleration of the block is 2 m s^{-2} , find the tension in the string.

(3)

(d) If the tension in the string is 20 N, find the acceleration of the block.

(2)

(Total 7 marks)

Q4. A block, of mass 5 kg, is held at rest on a rough plane, which is inclined at 30° to the horizontal. The block is released and slides down the plane. The coefficient of friction between the block and the plane is 0.2.

(a) Draw a diagram to show the forces acting on the block as it slides.

(1)

(b) Show that the magnitude of the friction force acting on the block is approximately 8.5 N.

(3)

(c) Find the acceleration of the block.

(4)

(d) Find the speed of the block when it has travelled 1.2 metres down the slope.

(3)

(Total 11 marks)

Q5. 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)