Question 1

(*a*) What is the shortest stopping time for a car which is travelling at 16 m s^{-1} and has a maximum deceleration of 2.5 m s^{-2}?

Question 2

1. In an experiment to investigate the relationship between the acceleration of a body and the force applied to it, a student recorded the following data.

F/N	0.20	0.40	0.60	0.80	1.00	1.20	1.40
a/m s^{-2}	0.08	0.18	0.28	0.31	0.45	0.51	0.60

Describe the steps involved in measuring the acceleration of the body. (12)

Using the recorded data, plot a graph to show the relationship between the acceleration of the body and the force applied to it.
What does your graph tell you about this relationship? (16)

Using your graph, find the mass of the body. (6)

On a trial run of this experiment, a student found that the graph did not go through the origin. Suggest a reason for this and describe how the apparatus should be adjusted, so that the graph would go through the origin. (6)

Question 3

1. In an experiment to measure the acceleration due to gravity, the time t for an object to fall from rest through a distance s was measured. The procedure was repeated for a series of values of the distance s. The table shows the recorded data.

s/cm	30	50	70	90	110	130	150
t/ms	247	310	377	435	473	514	540

Draw a labelled diagram of the apparatus used in the experiment.
Indicate the distance s on your diagram.
Describe how the time interval t was measured. (15)

Calculate a value for the acceleration due to gravity by drawing a suitable graph based on the recorded data. (21)

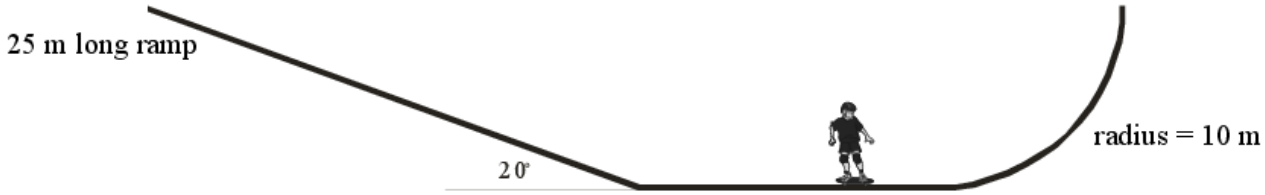
Give two ways of minimising the effect of air resistance in the experiment. (4)

Question 4

6. State Newton's laws of motion. (12)

Show that $F = ma$ is a special case of Newton's second law. (10)

A skateboarder with a total mass of 70 kg starts from rest at the top of a ramp and accelerates down it. The ramp is 25 m long and is at an angle of 20° to the horizontal. The skateboarder has a velocity of 12.2 m s^{-1} at the bottom of the ramp.



Calculate

(i) the average acceleration of the skateboarder on the ramp.
(ii) the component of the skateboarder's weight that is parallel to the ramp.
(iii) the force of friction acting on the skateboarder on the ramp. (18)

The skateboarder then maintains a speed of 10.5 m s^{-1} until he enters a circular ramp of radius 10 m.

What is the initial centripetal force acting on him?

What is the maximum height that the skateboarder can reach? (12)

Sketch a velocity-time graph to illustrate his motion. (4)

(acceleration due to gravity = 9.8 m s^{-2})

Question 5

(*a*) An Olympic hammer thrower swings a mass of 7.26 kg at the end of a light inextensible wire in a circular motion. In the final complete swing, the hammer moves at a constant speed and takes 0.8 s to complete a circle of radius 2.0 m.

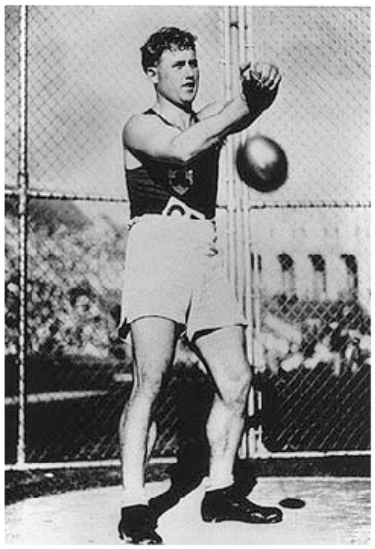
(i) What is the angular velocity of the hammer during its final swing? (6)

(ii) Even though the hammer moves at a constant speed, it accelerates. Explain. (4)

Calculate

(iii) the acceleration of the hammer during its final swing (9)

(iv) the kinetic energy of the hammer as it is released. (9)



Pat O'Callaghan of Kanturk, who won two Olympic gold medals for the hammer throw.