1 A driving instructor gives a student a sudden order to stop the car in the shortest possible time.

Fig. 1.1 shows the speed-time graph of the motion of the car from the moment the order is given.

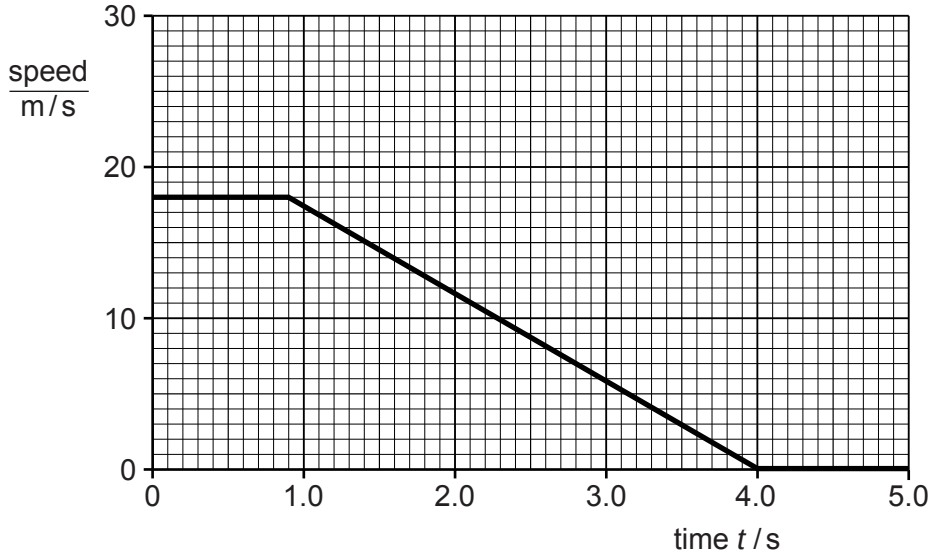

Fig. 1.1

(a) The order to stop is given at time $t = 0$ s.

(i) State the speed of the car at $t = 0$ s.

speed = ...[1]

(ii) Suggest why the car continues to travel at this speed for 0.9 s.

.....

.....[1]

(b) Calculate

(i) the deceleration of the car between $t = 0.9$ s and $t = 4.0$ s,

deceleration = ...[2]

(ii) the total distance travelled by the car from $t = 0$ s.

distance = ...[3]

(c) Describe and explain a danger to a driver of not wearing a safety belt during a sudden stop.

.....

.....

.....

.....[2]

[Total: 9]

2 An experiment is carried out to find the acceleration of free fall.

A strip of paper is attached to a heavy object. The object is dropped and falls to the ground, pulling the paper strip through a timer. The timer marks dots on the paper strip at intervals of 0.020 s.

Fig. 1.1 shows a section of the paper strip with the first three dots marked. The first dot on the paper strip, labelled A, is marked at the instant the object is dropped.

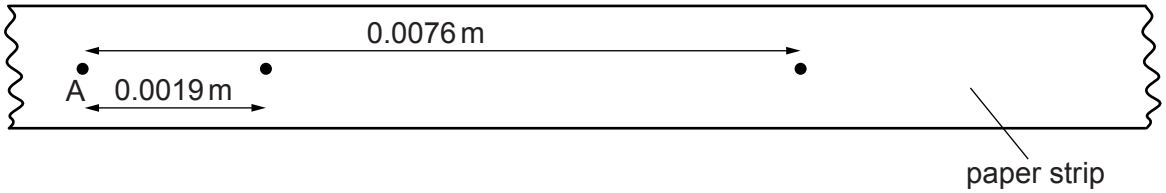

Fig. 1.1 (not to scale)

(a) State how the dots on the paper strip show that the object is accelerating.

.....

.....[1]

(b) Calculate the average speed of the object

(i) in the first 0.020 s after the object is dropped,

average speed = ...

(ii) in the second 0.020 s after the object is dropped.

average speed = ...
[3]

(c) Use the results from **(b)** to calculate the acceleration of the falling object.

acceleration = ...[3]

[Total: 7]

3 A surveyor measures the dimensions of a room of constant height. Fig. 2.1 is a top view of the room and shows the measurements taken.

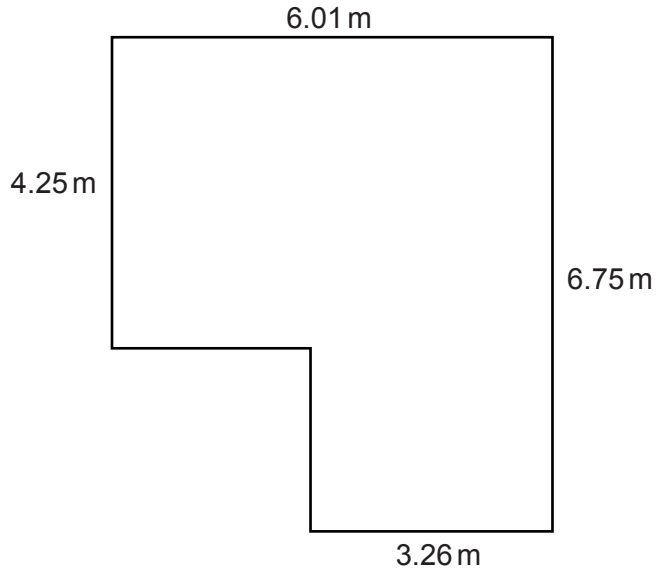

Fig. 2.1

(a) State an instrument that would be suitable to take these measurements.

..... [1]

(b) The volume of air in the room is 76.4 m^3. The density of the air is 1.2 kg/m^3.

Calculate the mass of air in the room.

mass = ... [2]

(c) A window in the room is open. The next day, the temperature of the room has increased, but the pressure of the air has stayed the same.

State and explain what has happened to the mass of air in the room.

.....

.....

.....

..... [3]

[Total: 6]

4 The period of the vertical oscillations of a mass hanging from a spring is known to be constant.

(a) A student times single oscillations with a stopwatch. In 10 separate measurements, the stopwatch readings were:

1.8 s, 1.9 s, 1.7 s, 1.9 s, 1.8 s, 1.8 s, 1.9 s, 1.7 s, 1.8 s, 1.8 s.

What is the best value obtainable from these readings for the time of one oscillation? Explain how you arrive at your answer.

best value = ...

explanation .....

.....

..... [1]

(b) Describe how, using the same stopwatch, the student can find the period of oscillation more accurately.

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 5]

5 **(a)** Complete the table below to identify the physical quantities as scalars or vectors.

physical quantity	scalar or vector
speed	
velocity	
distance	
force	
kinetic energy	

[3]

(b) Fig. 1.1 shows the path of a football as it is kicked along the ground between three players. The distances between the players are shown on Fig. 1.1.

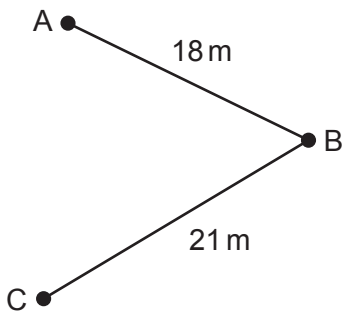

Fig. 1.1

The ball takes 1.2 s to travel from player A to player B.

(i) Calculate the average speed of the ball between A and B.

average speed = ...[2]

(ii) Player B kicks the ball to player C.
It travels with the same average speed.
Calculate the time taken for the ball to travel from B to C.

time = ...[2]

(iii) Suggest why the speed of the ball might change during its motion from A to B.

.....

.....[1]

(iv) Discuss whether the average velocities, from A to B and from B to C, are the same.

.....

.....

.....[1]

[Total: 9]