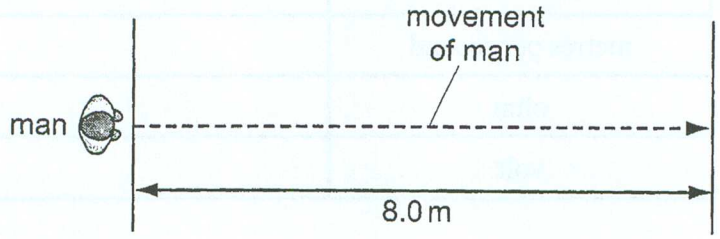
Topic 2 Kinematics

PAPER 1

MULTIPLE-CHOICE QUESTIONS

For each question, there are four possible answers. Choose the one you consider correct and record your choice (A, B, C or D) in the brackets provided.

1. A man crosses a road 8.0 m wide at a speed of 2.0 m/s.



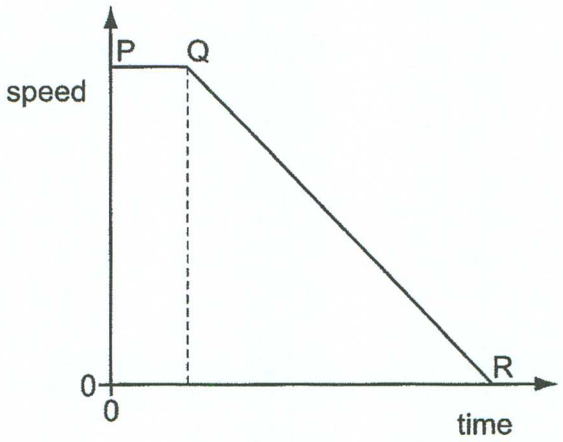
How long does the man take to cross the road? (2011/P1/Q2)

A 4.0 s **B** 6.0 s
C 10.0 s **D** 16.0 s ( )

2. A cyclist is riding along a road when an animal runs in front of him.

The graph shows the cyclist's motion.

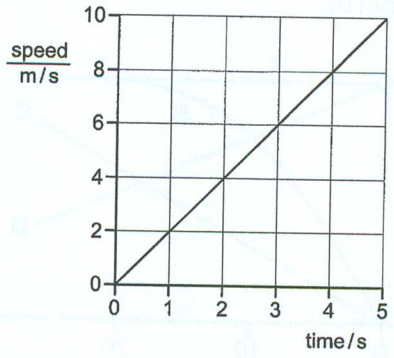
He sees the animal at P, starts to brake at Q and stops at R.



What is used to find the distance travelled after he applies the brakes? (2012/P1/Q2)

A the area under line PQ **B** the area under line QR
C the gradient of line PQ **D** the gradient of line QR ( )

3. The graph represents the motion of a car.



How far has the car moved between 0 and 5 s? (2013/P1/Q2 / 2018/P1/Q1)

A 2 m **B** 10 m
C 25 m **D** 50 m

( )

4. An object is falling freely in a vacuum near to the Earth's surface.

Which word describes the acceleration of the object? (2014/P1/Q2)

A constant
B decreasing
C increasing
D zero

( )

5. A car accelerates uniformly from 20 m/s to 30 m/s.

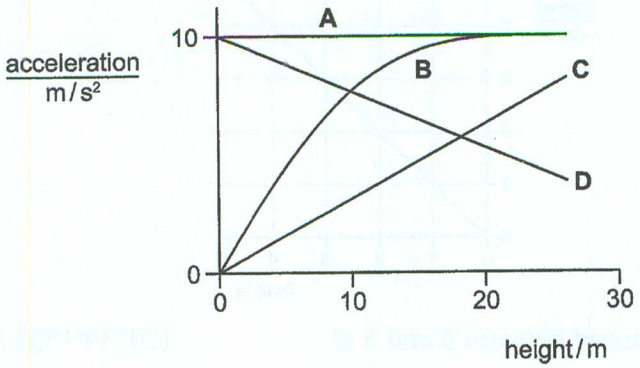
During this acceleration, the car travels 100 m. The average speed is 25 m/s.

What is the acceleration of this car? (2015/P1/Q3)

A 2.5 m/s^2 **B** 5.0 m/s^2
C 7.5 m/s^2 **D** 40 m/s^2

( )

6. Which graph shows the acceleration of free-fall for an object at different heights above the surface of the Earth? (2016/P1/Q2)



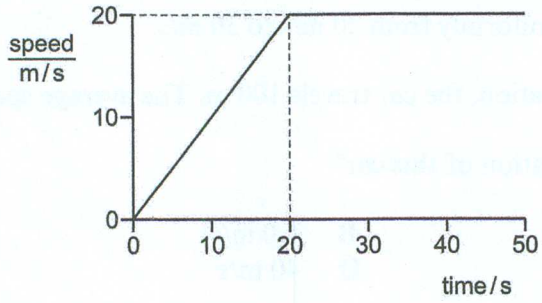
( )

7. A body near to the surface of the Earth is acted upon by a constant gravitational force.

What is the approximate initial rate of change of velocity of this body in free-fall? (2018/P1/Q3)

A 1 m/s
B 1 m/s²
C 10 m/s
D 10 m/s² ( )

8. A speed-time graph of an object moving in a straight line is shown.



How far does the object travel in 50 s? (2019/P1/Q2)

A 500 m
B 600 m
C 800 m
D 1000 m ( )

PAPER 2

STRUCTURED QUESTIONS

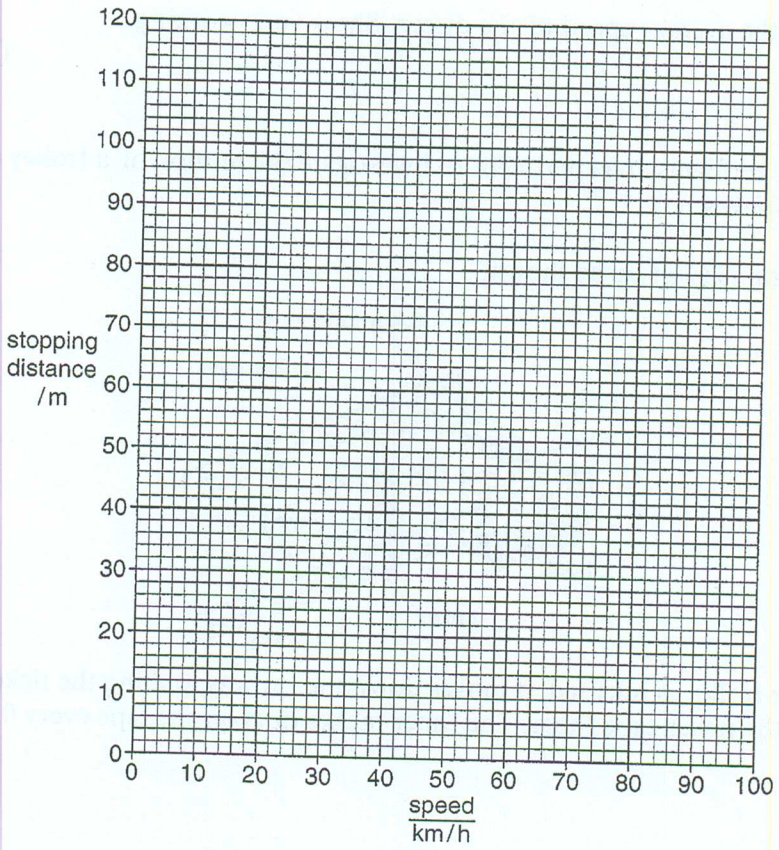
Section A

Answer the following questions.

1. (a) The table below shows stopping distances for a car in **dry** conditions.

$\frac{\text{speed}}{\text{km/h}}$	stopping distance / m
20	9
40	22
50	32
80	76
100	112

(i) Plot a graph of stopping distance against speed. Mark each point with a cross (×).
Draw a curved line of best fit. [2]

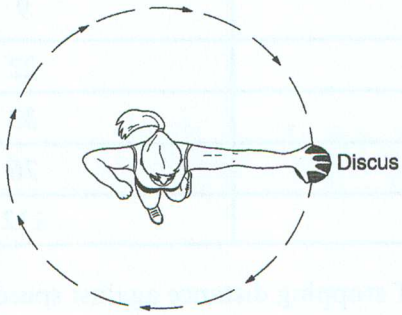


(ii) Use the graph to find the stopping distance for a car travelling at 30 km/h. [1]

(b) In **wet** conditions, would the stopping distances for the car increase or decrease?

Explain your answer. [1]
(2011/P2/A4)

2. An athlete throws a discus. The discus is held at arm's length. She turns in a circle before releasing the discus.

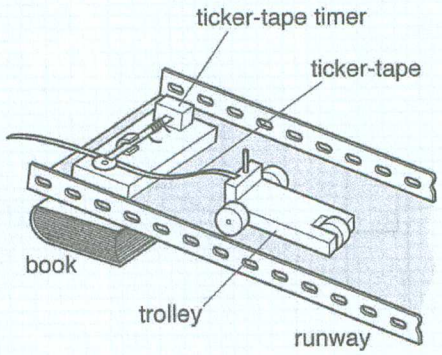


In completing one circle the discus travels 6 m in a time of 1.5 s.

Calculate the average speed of the discus. Show your working. [2]
(2013/P2/A3a)

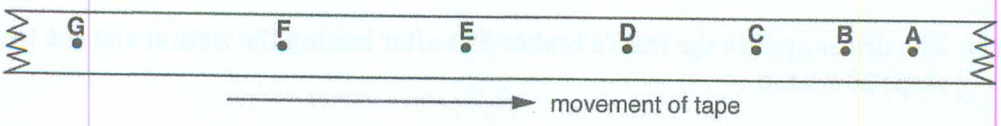
3. A student performs an experiment to investigate the motion of a trolley down an inclined runway.

The apparatus is set up as shown.



When the trolley is released, it moves down the runway, pulling the ticker-tape through the ticker-tape timer. The timer makes dots on the tape every 0.02 s.

A diagram of a section of the ticker-tape produced in the experiment is shown.



(a) The ticker-tape gives information about the motion of this trolley.

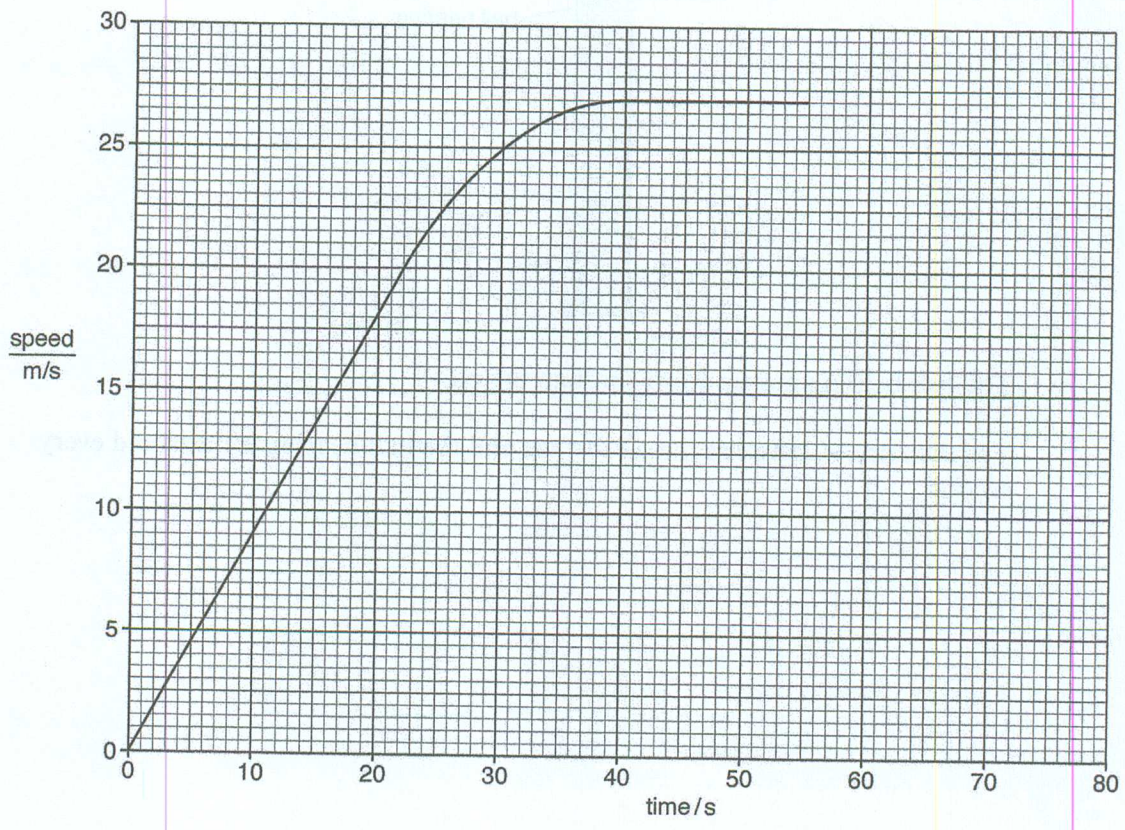
What conclusion can be made about the motion of this trolley? Explain your answer. [2]

(b) (i) Measure and record the distance travelled by the trolley between dots **E** and **F**. Give your answer to one decimal place. [1]

(ii) Calculate the average speed of the trolley between dots **E** and **F**. [1]

(2018/P2/A2)

4. The graph shows how the speed of a train changes with time as it leaves a station.



(a) Describe the acceleration of the train during the first 20 s of its journey. [1]

(b) From the graph, determine at what time the train first reaches its greatest speed. [1]

(c) The driver applies the train's brakes 55 s after leaving the station and the train stops 20 s later.

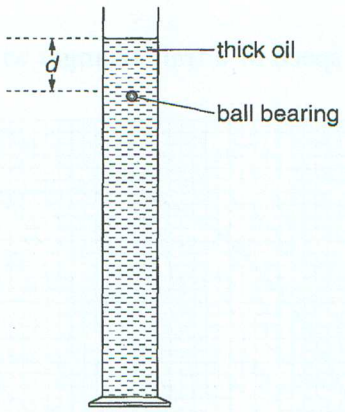
Complete the graph to show how the speed of the train decreases until the train stops. [1]

(2019/P2/A4)

Section B

Answer the following questions.

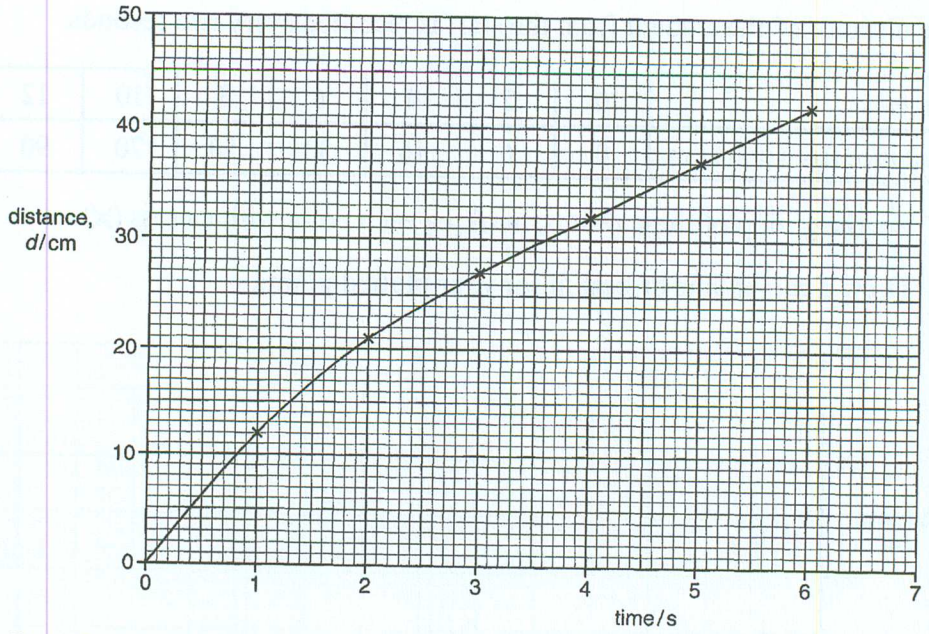
1. (a) A ball bearing is dropped into a long tube containing **thick** oil.



The ball bearing moves down through the oil.

The distance, *d*, between the oil surface and the ball bearing is measured every second.

The results obtained are shown on the graph.



(i) Calculate the average speed of the ball bearing travelling down the tube for the first 6 seconds. Show your working. [2]

(ii) On the graph, mark with a **T** a time when the ball bearing is travelling at a constant speed. [1]

(iii) How far down the tube does the ball bearing travel in 7 seconds? [1]

(b) The experiment in (a) is repeated using **thin** oil.

(i) What happens to the time taken for the ball bearing to reach the bottom of the measuring cylinder? [1]

(ii) Explain your answer to (b)(i). [1]

(2012/P2/B7a, b)

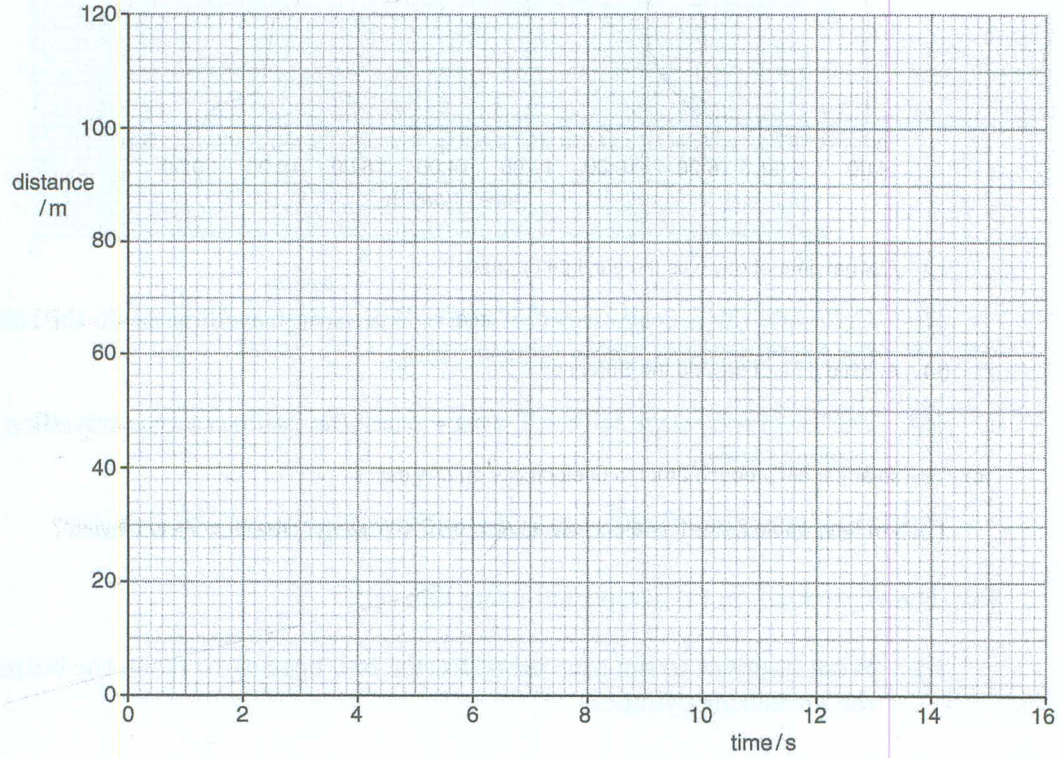
2. A student runs a 100 metre race.

The distance of the student from the start is recorded every two seconds.

time / s	0	2	4	6	8	10	12	14
distance from start / m	0	6	16	30	50	70	90	102

(a) On the grid, plot these results, marking each point with a cross (×). [1]

(b) Draw a curved line of best fit for your plotted points. [1]



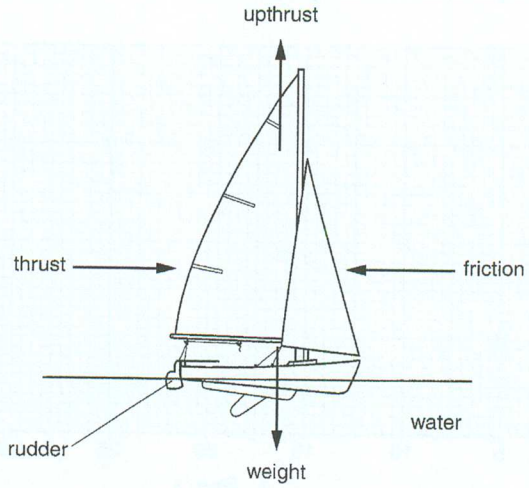
(c) How far is the student from the start after the first 5 seconds? [1]

(d) Calculate the average speed of the student between 50 metres and 90 metres from the start. [2]

(2015/P2/B8a)

3. A racing yacht is moving at a constant speed on smooth water.

The diagram shows the direction of the four forces acting on the yacht.



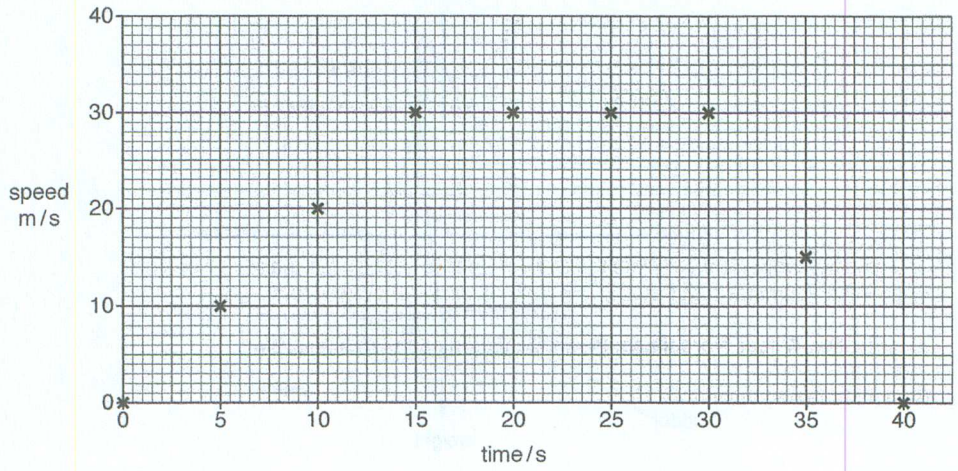
During the race the yacht travels 1050 km in 150 hours.

Calculate the average speed of the yacht in metres per second. [2]

(2016/P2/B5c)

4. A car travels along a straight road. The speedometer reading is taken after every 5 seconds.

   The observations are plotted on the graph below.



   (a) Complete the speed-time graph to show how speed varies with time. [1]

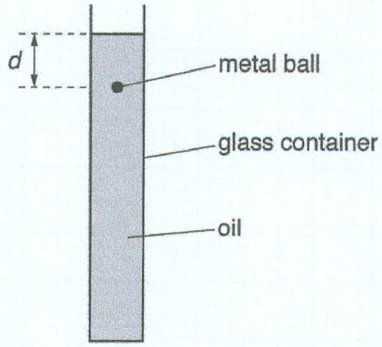
   (b) Calculate the acceleration of the car over the first 15 seconds of its journey. [1]

   (c) Calculate the total distance travelled by the car during its journey. [2]
   (2017/P2/B5b)

5. A racing car takes 1.25 hours to complete a 350 kilometre race.

   Calculate the average speed of the car in kilometres per hour, km/h. [1]
   (2017/P2/B7a)

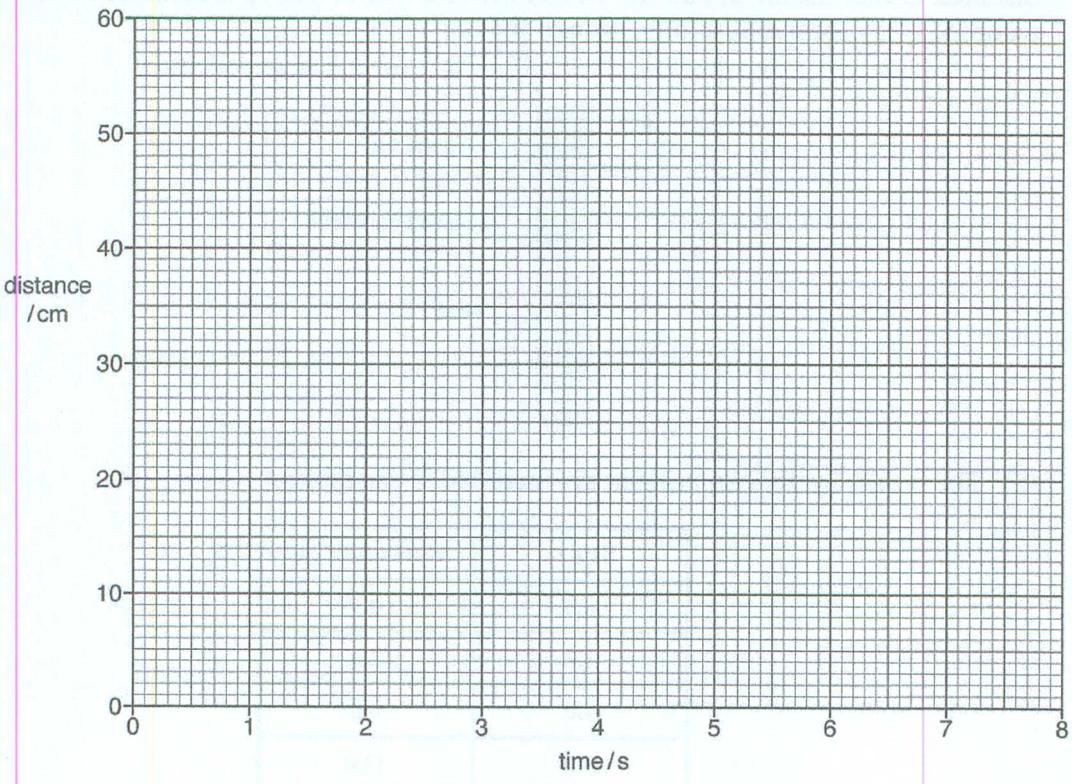
6. A scientist performs an experiment to investigate the motion of a metal ball falling through a column of oil as shown in the diagram. The metal ball is released. The distance, d, that the metal ball travels from the surface of the oil is measured and recorded every second as it falls through the oil.



(a) The results for this experiment are recorded in the table.

time / s	distance d / cm
0.0	0.0
1.0	2.0
2.0	6.0
3.0	12.0
4.0	20.0
5.0	30.0
6.0	45.0
7.0	60.0

(i) Plot a graph of these results, marking each point with a cross (×). [1]
(ii) Draw a best-fit line taking into account all the plotted points. [1]



(iii) From your graph determine the time when the speed of the metal ball **first** becomes uniform. Give your answer to one decimal place. [1]

(b) In a second experiment, the scientist uses the same metal ball but replaces the oil with a thicker oil.
(i) On the same grid that you used for **(a)(i)** sketch a second line to show the results you would expect when using thicker oil. Label this line with the letter **L**. [1]
(ii) Explain the effect on the motion of the metal ball when using thicker oil. [2]

(c) In a third experiment, the scientist repeated the first experiment using a metal ball of the same mass but with a larger diameter.
(i) Name an instrument that can be used to measure the diameter of the metal ball. [1]
(ii) The larger metal ball takes longer to fall a certain distance through the oil. Suggest why. [1]

(2018/P2/B5)