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**PHYSICS-1P**

**TOPIC-Investigation Motion**

**D-T & V-T graph**

# Investigation Motion, D-T & V-T graph

1 An aeroplane takes two minutes to travel the short distance between airports on two islands.

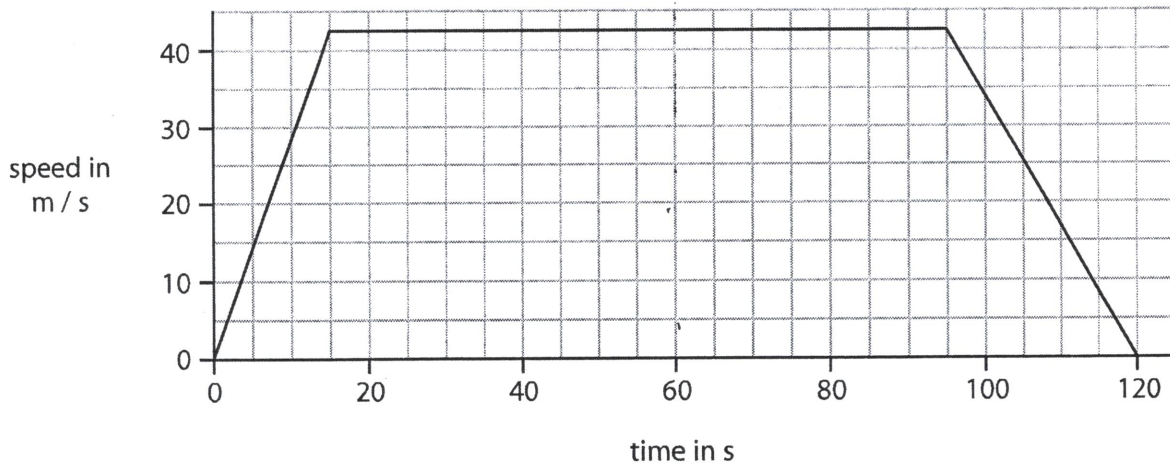


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The graph shows how the speed of the aeroplane changes as it

- takes off
- flies across the sea
- lands on the other island

When it is flying across the sea, the aeroplane travels at a constant speed.



(a) Use the graph to answer the following questions.

- (i) State the value of the constant speed.

(1)

speed ..... m/s

# Investigation Motion, D-T & V-T graph

(ii) Calculate the acceleration of the aeroplane at the start of the journey and give the unit.

(3)

acceleration = ..... unit .....

(iii) Calculate the total distance that the aeroplane travels.

(3)

57-112-13-10

distance = ..... m

(b) Each airport has a runway that is about 500 m long.

When it lands, the speed of the aeroplane is 40 m/s.

Explain why the airline should not use an aeroplane that has more mass and needs a higher speed for landing.

(3)

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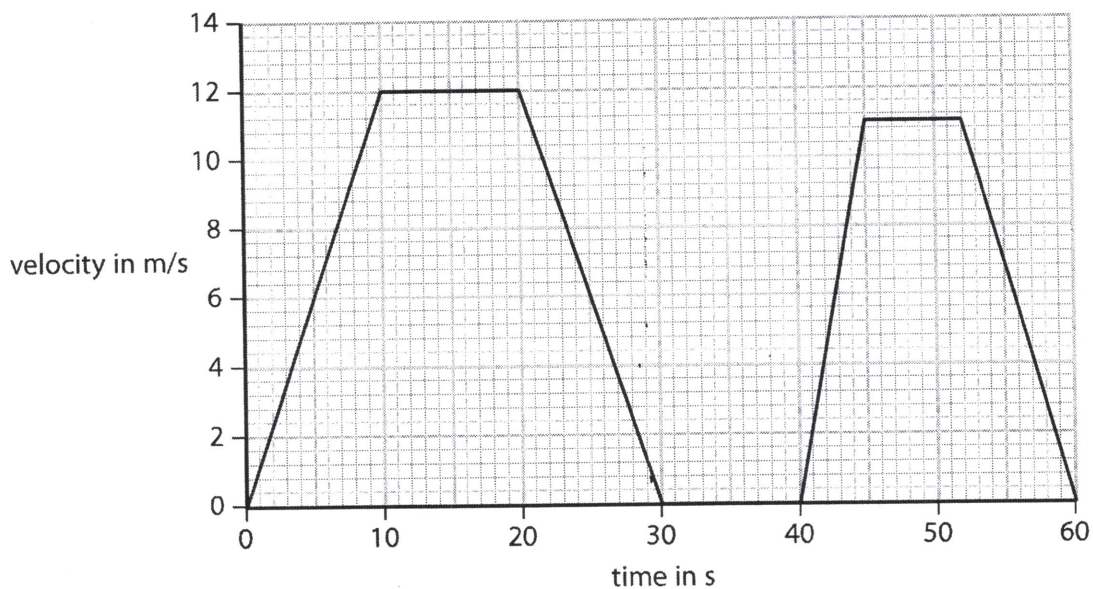
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**(Total for Question 10 = 10 marks)**

# Investigation Motion, D-T & V-T graph

2 A bus travels along a straight road.

The graph shows how the velocity of the bus changes during a short journey.



(a) (i) State the velocity of the bus after 25 s.

(1)

velocity = ..... m/s

(ii) How long is the bus stationary during its journey?

(1)

time = ..... s



JM-18-15-2

# Investigation Motion, D-t & v-t graph

(b) (i) State the equation linking acceleration, change in velocity and time taken. (1)

(ii) Calculate the acceleration of the bus during the first 10 seconds.  
Give the unit. (3)

acceleration = ..... unit .....

(c) (i) State the equation linking average speed, distance moved and time taken. (1)

(ii) The bus moves a total distance of 390 m during the journey.  
Calculate the average speed of the bus. (2)

average speed = ..... m/s

(d) The bus travels further in the first 30 seconds of its journey than it does during the last 30 seconds.  
Explain how the graph shows this. (2)

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**(Total for Question 2 = 11 marks)**

✓ 4 - 1 P - 15 - 2

# Investigation Motion, D-T & V-T graph

3 Two students, Jenny and Cho, are investigating motion.

Jenny walks in a straight line.

Cho measures the distance Jenny has walked at 10 s intervals.

(a) State **two** measuring instruments the students should use.

(2)

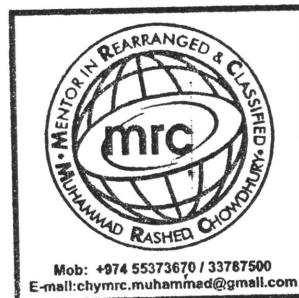
1 .....

2 .....

(b) The table shows their measurements.

Time in s	Distance walked in m
0	0
10	14
20	19
30	24
40	28
50	30
60	31

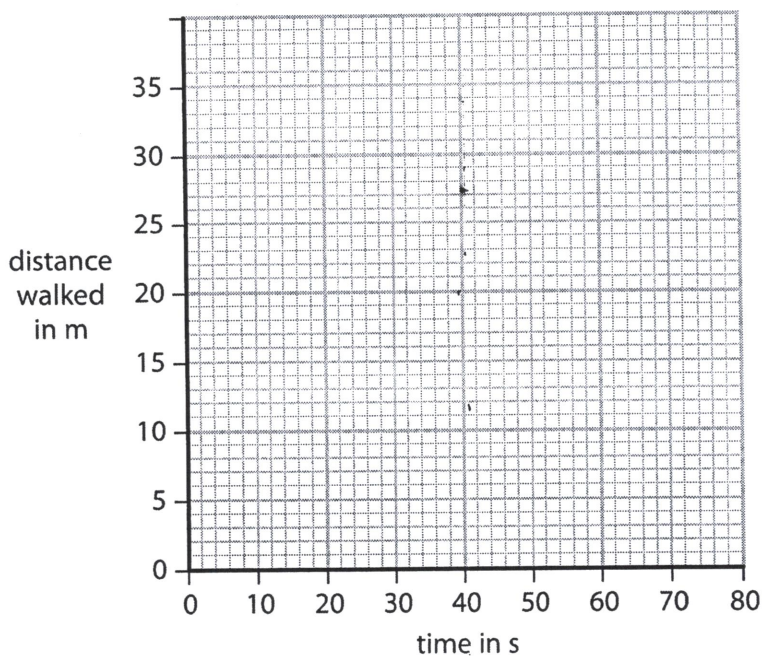
571-22-12-2



# Investigation Motion, D-T & V-T graph

Draw a graph of distance against time for this data.

(3)



5/11-2P-17-2

(c) How far had Jenny walked after 35 s?

(1)

Distance walked = ..... m

(d) (i) Describe how Jenny's speed changed during the investigation.

(1)

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(ii) What feature of the graph shows this change?

(1)

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**(Total for Question 2 = 8 marks)**

# Investigation Motion, D-T & V-T graph

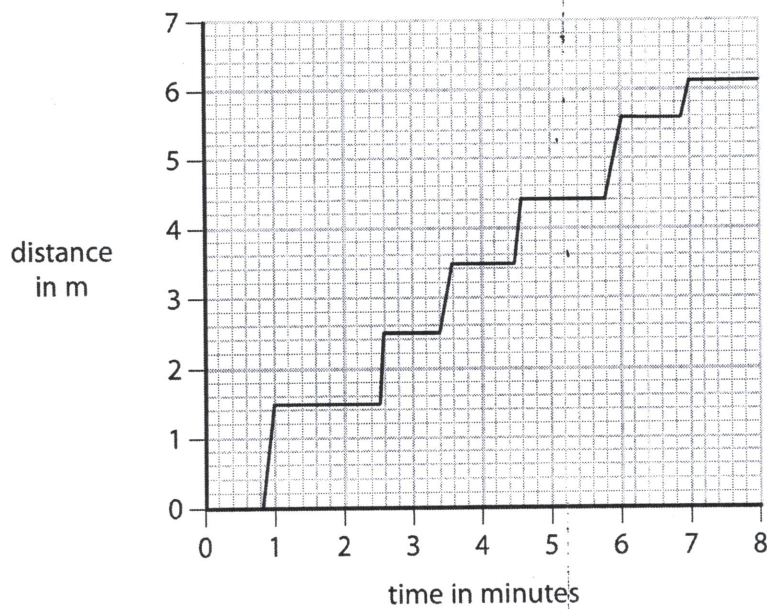
4 The diagram shows some people waiting in a queue at a supermarket.



The queue moves forward each time a person leaves the checkout.

Person X spends seven minutes in the queue before reaching the checkout.

The graph shows how distance changes with time for person X.





# Investigation Motion, D-T & V-T graph

(a) (i) What is the initial length of the queue?

(1)

initial length = ..... m

(ii) Explain how you could use the graph to work out the number of times person X is stationary.

(2)

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(b) (i) State the equation linking average speed, distance moved and time taken.

(1)

Ja-15-1P-4

(ii) Calculate the average speed of person X in the queue.

Give the unit.

(3)

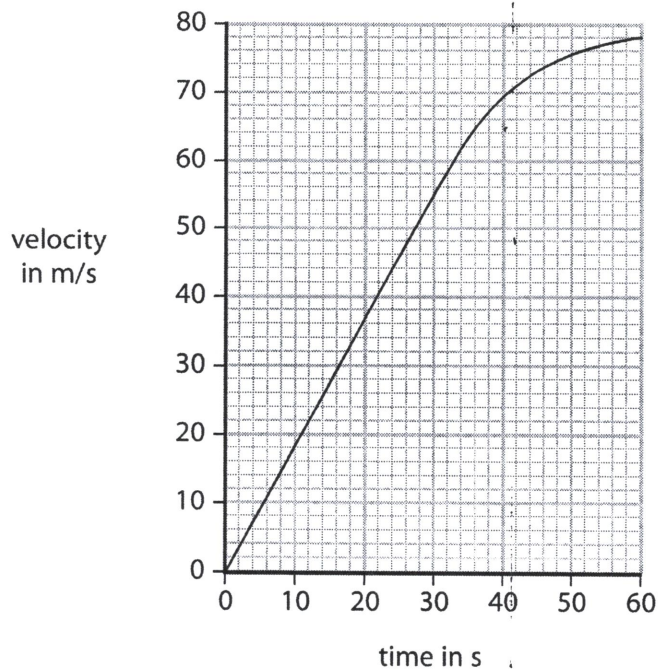
average speed = ..... unit .....

(Total for Question 4 = 7 marks)



# Investigation Motion, D-T & V-T graph

5 The graph shows how the velocity of an aircraft changes as it accelerates along a runway.



57-1P-12-11

(a) Use the graph to find the average acceleration of the aircraft.

(3)

Acceleration = ..... m/s<sup>2</sup>

(b) Explain why the acceleration is not constant, even though the engines produce a constant force.

(3)

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(Total for Question 11 = 6 marks)

6 A train travels 9 km from station A to station B.

It takes 15 minutes.

(a) (i) State the equation linking average speed, distance moved and time taken.

(1)

(ii) Calculate the average speed of the train and give its unit.

(3)

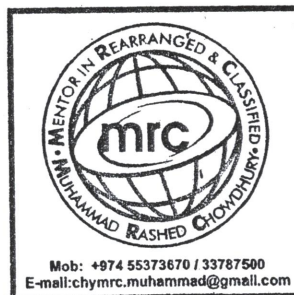
Average speed = ..... unit .....

(iii) The maximum speed of the train must be higher than the value you have calculated.

Explain why.

(2)

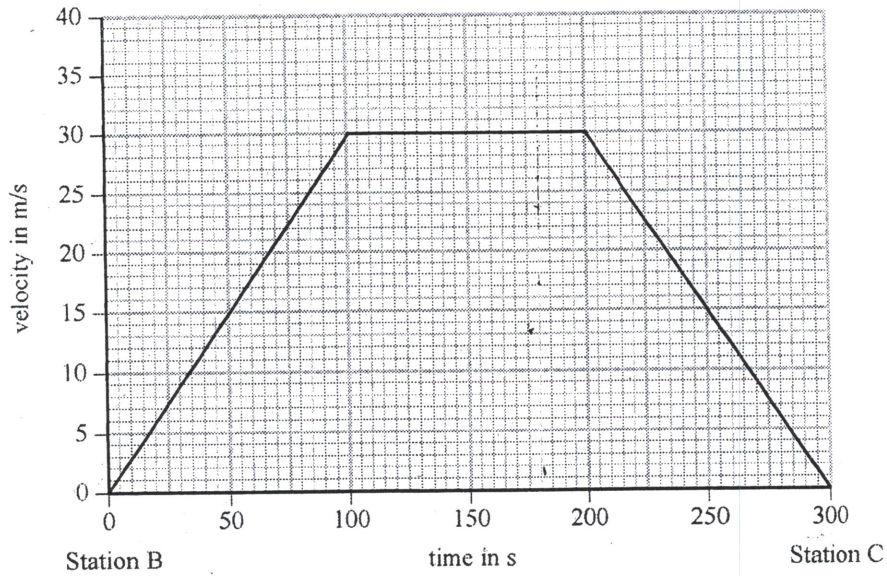
8  
11-11-8  
50



# Investigation Motion, D-T & V-T graph

(b) The train continues along a straight track from station B to station C.

The graph shows how the velocity of the train changes with time during this part of the journey.



- (i) Use the graph to calculate the acceleration of the train, in  $\text{m/s}^2$ , during the first 100 seconds after it leaves station B. (3)

Acceleration = .....  $\text{m/s}^2$

- (ii) Use the graph to calculate the distance, in m, between station B and station C. (3)

Distance = ..... m

(Total for Question 8 = 12 marks)

# Investigation Motion, D-T & V-T graph

7 A skydiver jumps from an aircraft.

(a) The mass of the skydiver is 70 kg.

(i) State the equation linking weight, mass and  $g$ .

(1)

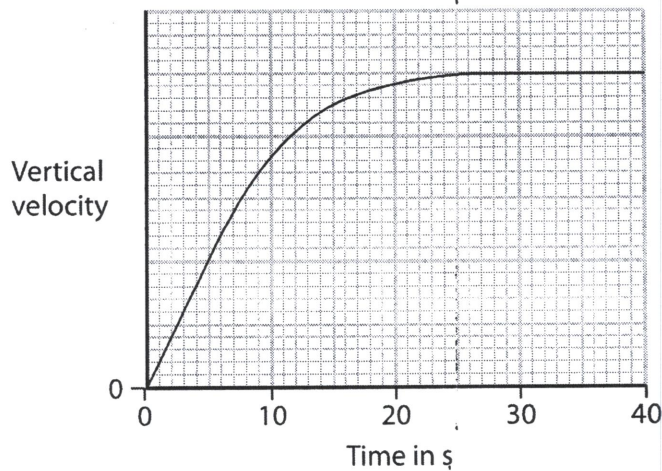
(ii) Calculate the weight of the skydiver and state the unit.

(2)

weight = ..... unit .....

(b) The graph shows the vertical velocity of the skydiver during the first 40 s of the fall.

His parachute is not open during this time.



Explain the shape of the graph.

(4)

# Investigation Motion, D-T & V-T graph

(c) The diagram shows the skydiver falling at a constant velocity.

Add **two** labelled arrows to the diagram to represent the forces acting on the skydiver.

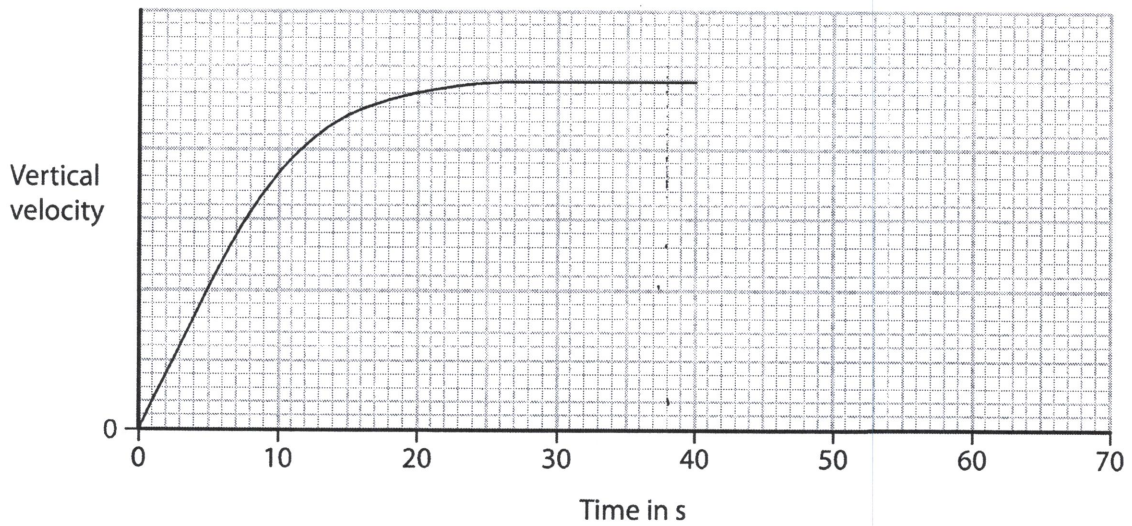
(3)



(d) The skydiver opens his parachute after 40 s.

Continue the line on the graph to show how the skydiver's vertical velocity changes and reaches terminal velocity.

(2)

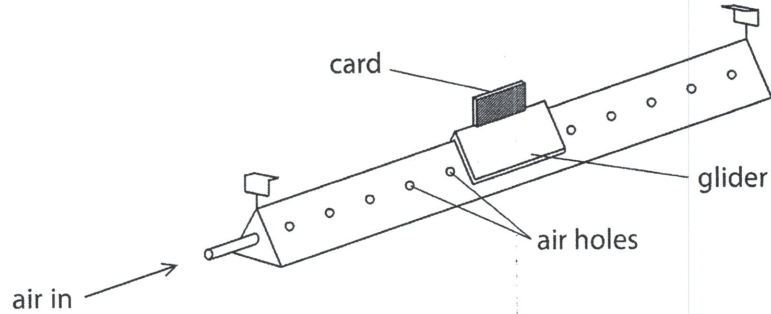


(Total for Question 7 = 12 marks)

# Forces, Momentum, Collisions, Moments



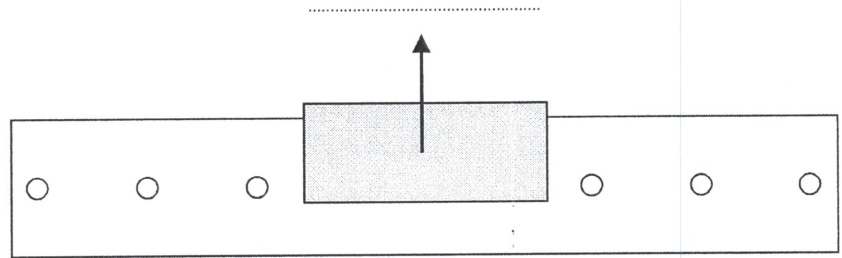
08 The diagram shows an air track that can be used to investigate motion.  
 Air comes out through a series of small holes in the air track.  
 A small glider floats on a cushion of air.



(a) (i) The diagram below shows the glider at rest on the air track.  
 Complete the diagram to show the forces acting on the glider.  
 Label the forces.  
 One force arrow has been drawn for you.

(3)

2-1P-16-4



(ii) Explain what effect the cushion of air has on the movement of the glider.

(2)

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# Forces, Momentum, Collisions, Moments

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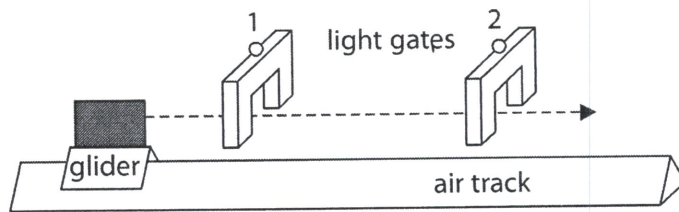
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571-1P-16-4

- (b) Two light gates connected to a data logger are placed above the air track so that the card will pass through them.

The glider moves at a constant speed to the right.



The length of the card is 8.3 cm.

The card takes 314 ms to pass through the first light gate.

- (i) State the relationship between average speed, distance moved and time taken.

(1)

- (ii) Calculate the average speed of the card as it passes through the first light gate.

(2)

average speed = ..... cm/s

- (iii) State the time taken for the card to pass through the second light gate.

(1)

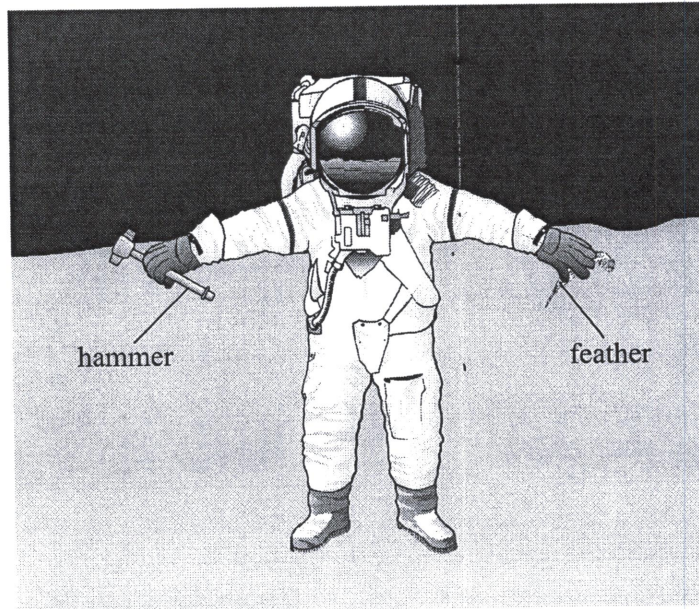
time taken = .....ms

**(Total for Question 4 = 9 marks)**



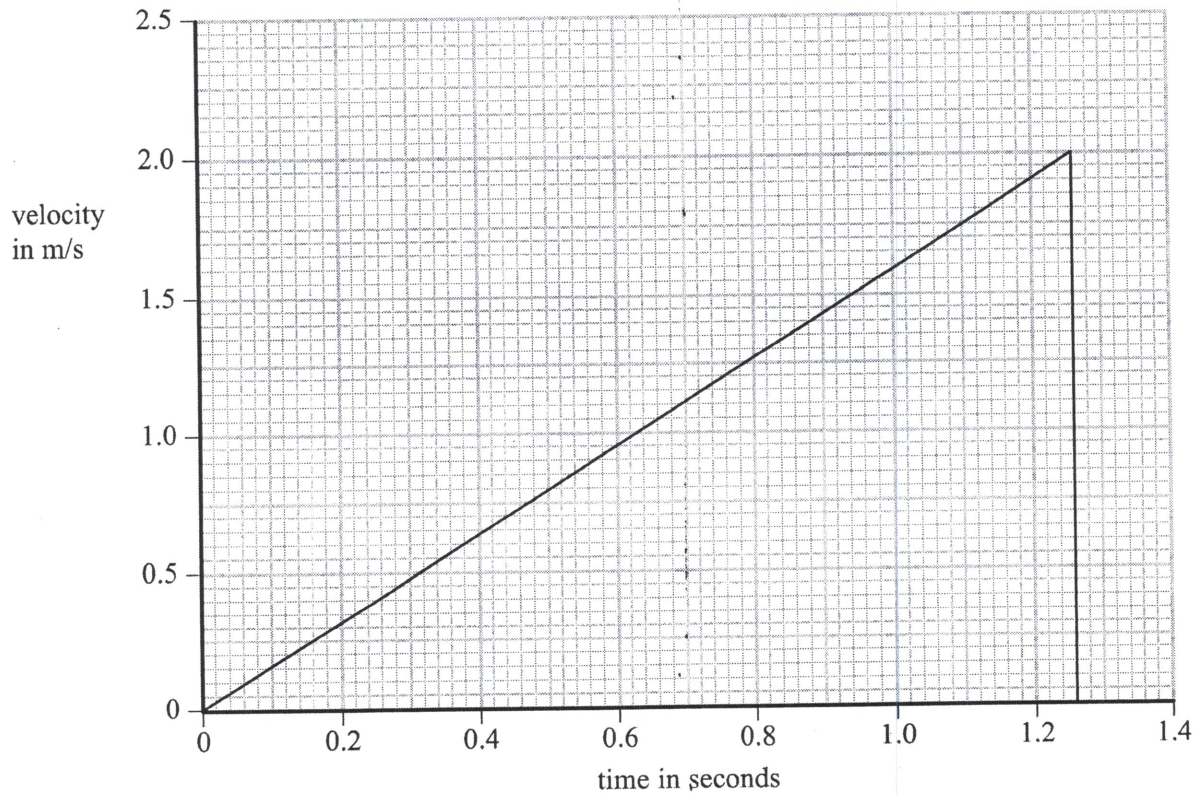
# Investigation Motion, D-T & V-T graph

9 The Apollo 15 mission landed on the Moon in 1971.  
The astronaut David Scott dropped a hammer and a feather.  
They were released from rest at the same time and from the same height.  
The hammer and the feather landed at the same time.



97-12-13-8

(a) The graph shows how the velocity of the hammer changed with time.



- (i) Use the graph to calculate the acceleration due to gravity on the Moon.  
Give the unit.

(3)

Acceleration = ..... Unit .....

- (ii) Use the graph to calculate the height the hammer was dropped from.

(2)

Height = ..... m

- (b) The gravitational field strength is smaller on the Moon than on the Earth.

Suggest why.

(1)

57-1P-13-8



# Investigation Motion, D-T & V-T graph

571-112-13-8

(c) If the same experiment is carried out on Earth, air resistance affects both objects.

The feather reaches the ground after the hammer, even though the force of air resistance is smaller on the feather than on the hammer.

Explain why the feather reaches the ground after the hammer.

(4)

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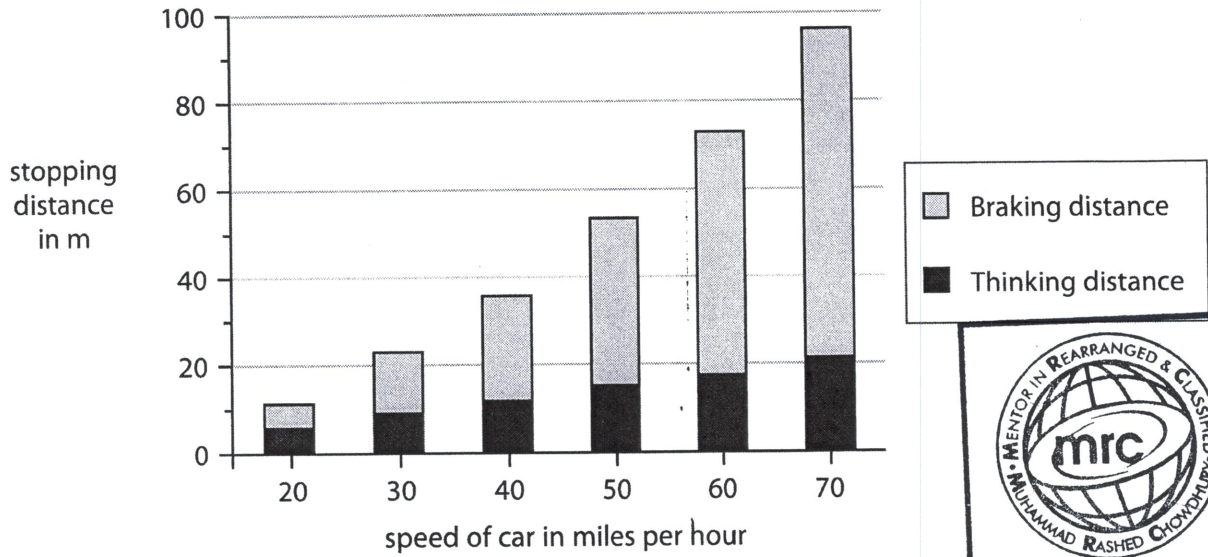
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(Total for Question 8 = 10 marks)



# Investigation Motion, D-T & V-T graph

- 1 The graph shows the minimum stopping distances, in metres, for a car travelling at different speeds on a dry road.



- (a) Complete the equation to show the link between stopping distance, thinking distance and braking distance.

(1)

Stopping distance = .....

- (b) Describe the patterns shown in the graph.

(2)

- (c) Use the graph to estimate the stopping distance for a car travelling at 35 miles per hour.

(1)

Stopping distance = ..... m

# Investigation Motion, D-T & V-T graph

(d) To find the minimum stopping distance, several different cars were tested.

Suggest how the data from the different cars should be used to give the values in the graph.

(1)

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57-17-12-3

(e) The tests were carried out on a dry road.

If the road is icy, describe and explain what change there would be, if any, to

(i) the thinking distance

(2)

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(ii) the braking distance

(2)

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(Total for Question 3 = 9 marks)



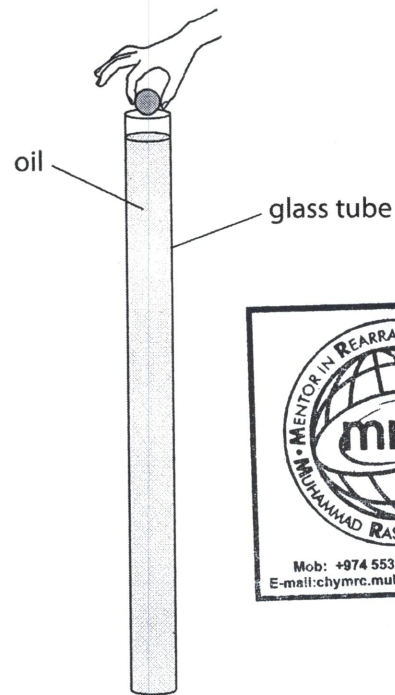
# Investigation Motion, D-T & V-T graph

11 A student investigates terminal velocity.

She uses a tall glass tube filled with oil.

She drops a metal ball into the tube.

The ball falls through the oil.



5-1P-14-5

(a) Use ideas about forces to explain how a falling object can reach a terminal velocity.

(5)

A series of horizontal dotted lines for writing the answer to question (a).

# Investigation Motion, D-T & V-T graph

(b) Describe how the student could find out if the ball reaches terminal velocity as it falls through the oil.

In your answer, you should include

- the measuring instruments that the student will need
- the measurements that she should take
- how she could use her measurements to find out if the ball reached terminal velocity.

You may include a labelled diagram in your answer.

(5)

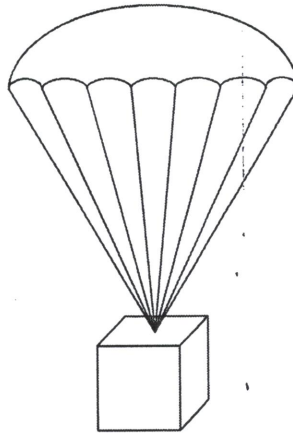
5-1P-14-5

Area with horizontal dotted lines for writing the answer.

**(Total for Question 5 = 10 marks)**

# Investigation Motion, D-T & V-T graph

12 The diagram shows a box attached to a parachute, falling at constant velocity.



4-1P-15-12

(a) State the name for this constant velocity.

(1)

(b) Explain, in terms of forces, why the box and parachute fall at constant velocity.

(4)

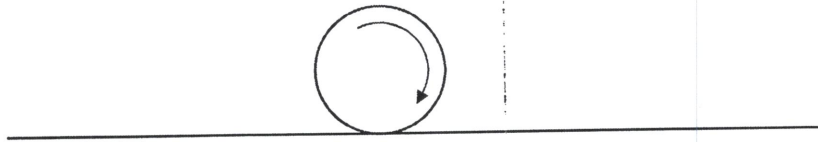
(Total for Question 12 = 5 marks)



# Investigation Motion, D-T & V-T graph

13 A golfer practises hitting balls on a golf course.

(a) Ball X rolls along level ground, as shown in the diagram.



(i) Add labelled arrows to the diagram to show the directions of two of the forces acting on ball X. (2)

(ii) Explain why ball X slows down and stops. (3)

2-15-10-13

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(b) The golfer hits ball Y at an angle into the air.

He gives it the same initial kinetic energy as ball X.

Suggest why ball Y travels much further than ball X before it stops.

(1)

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# Investigation Motion, D-T & V-T graph

(c) The mass of ball Y is 45 g.

The golfer gives the ball 36 J of kinetic energy when he hits it.

(i) State the equation linking kinetic energy, mass and speed.

(1)

(ii) Calculate the initial speed of ball Y.

(4)

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initial speed = ..... m/s

(iii) Ball Y reaches a maximum height of 30 m.

Suggest how the golfer should hit ball Y so it can reach a greater height.

(1)

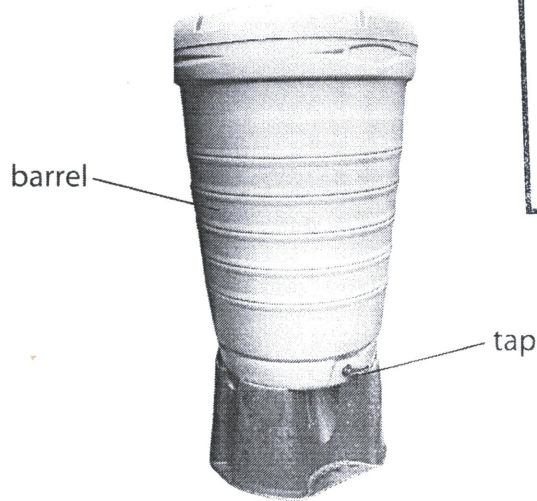
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(Total for Question 13 = 12 marks)



# Investigation Motion, D-T & V-T graph

- 14 The photograph shows a water barrel with a tap.  
The barrel is used to store rainwater.



24-JUN-15

A student investigates the water depth in the barrel.  
She measures the depth and then opens the tap.  
As water flows out of the barrel, she measures the depth every minute.  
The table shows her results.

Time in minutes	Depth in cm
0	86
1	52
2	31
3	18
4	11
5	7
6	4

(a) Which two measuring instruments should the student use in her investigation?

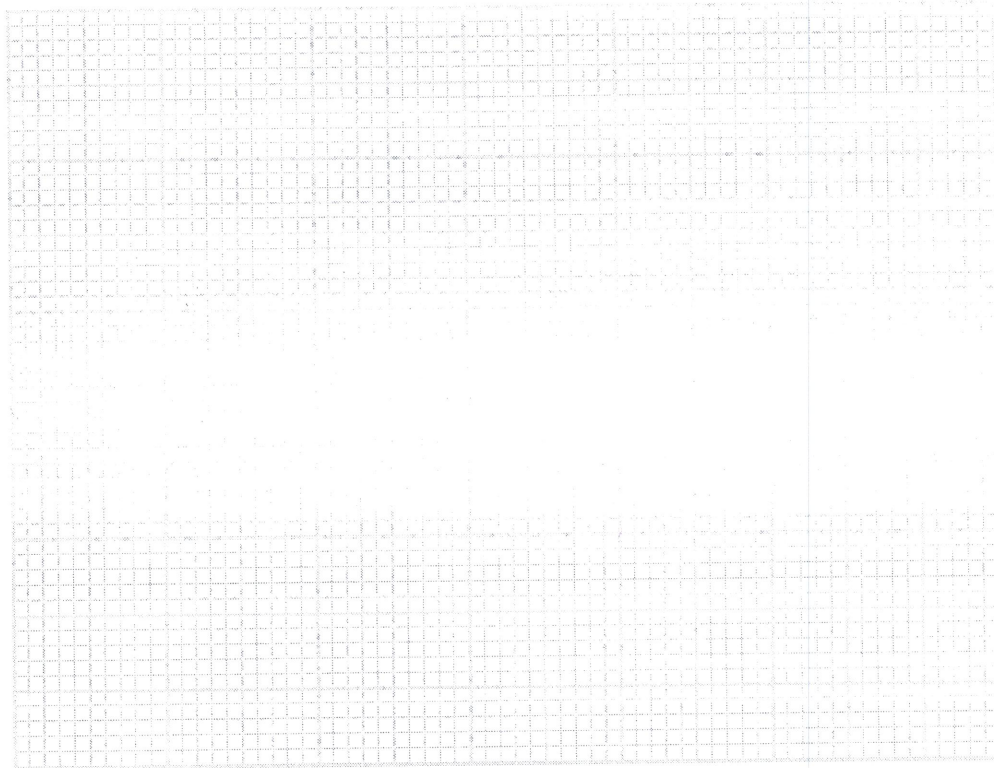
(2)

1 .....

2 .....

## Investigation Motion, D-T & V-T graph

- (b) (i) Plot a graph to show how the depth changes with time, and draw the curve of best fit.



2 P - JN - 15

- (ii) Describe the relationship between depth and time.

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- (c) The student notices that the water flows out less quickly as time passes.

Suggest a reason for the decrease in flow.

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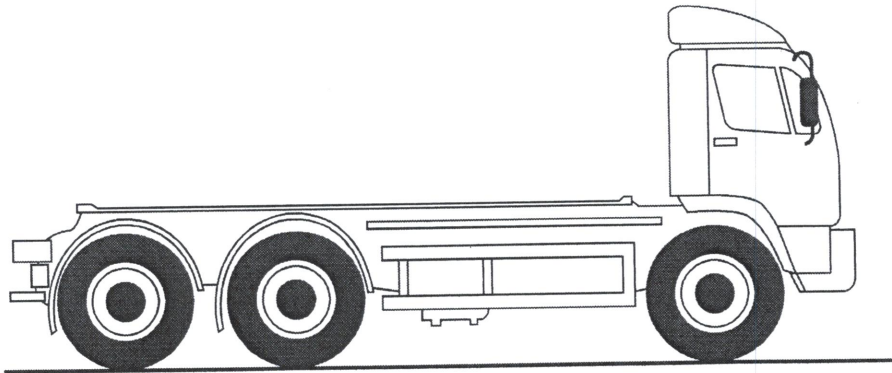
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(Total for Question 4 = 10 marks)

# Investigation Motion, D-T & V-T graph

15 The diagram shows a lorry with a curved roof.



(a) Give a reason why the roof is shaped in this way.

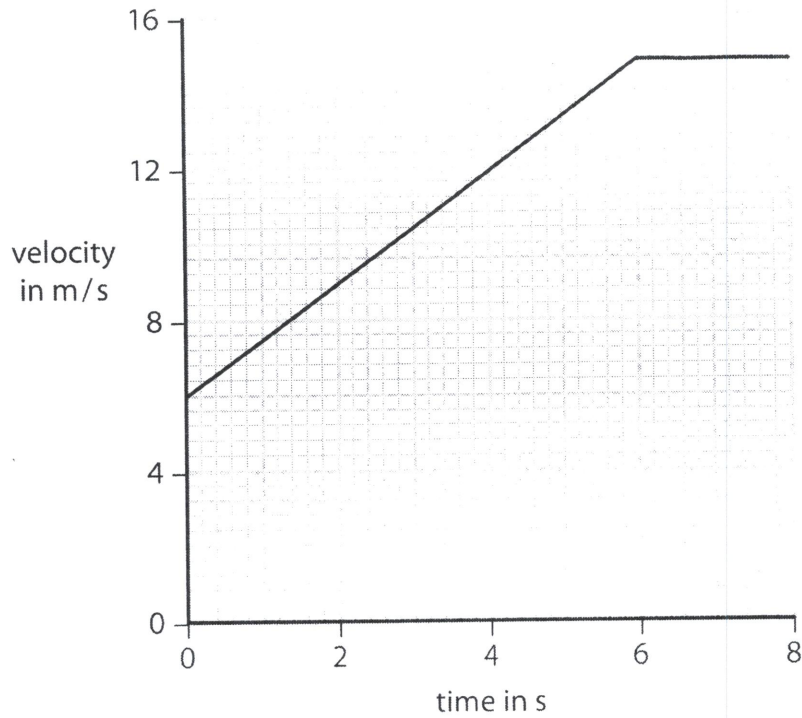
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# Investigation Motion, D-T & V-T graph

(c) The graph shows part of another journey.



The lorry accelerates and then travels at a constant velocity.

(i) State the relationship between acceleration, change in velocity and time. (1)

(ii) Calculate the acceleration of the lorry during the first 6 s. (2)

acceleration = ..... m/s<sup>2</sup>

(iii) Calculate the distance travelled during the 8 s shown on the graph. (3)

distance = ..... m

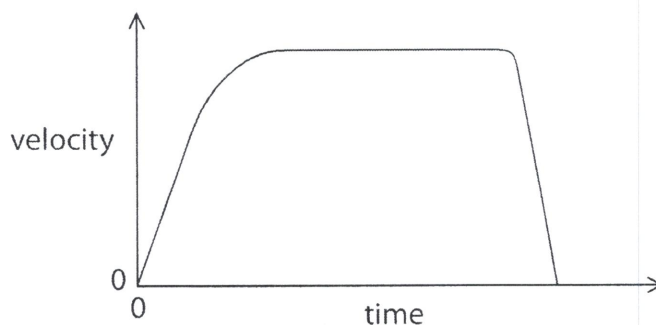
PA 24-17-81

# Investigation Motion, D-T & V-T graph

Answer ALL questions.

16 A toy car rolls down a ramp and hits a cushion.

The graph shows how its velocity changes with time.



(a) Constant velocity on the graph is shown by

- A the area under the line
- B the horizontal part of the line
- C the sloping line at the end
- D the sloping line at the start

(b) The distance travelled is shown by

- A the area under the line
- B the horizontal part of the line
- C the sloping line at the end
- D the sloping line at the start

(c) The average velocity of the toy car is given by

- A the change in velocity divided by the time taken
- B the distance moved divided by the time taken
- C the time taken divided by the change in velocity
- D the time taken divided by the distance moved

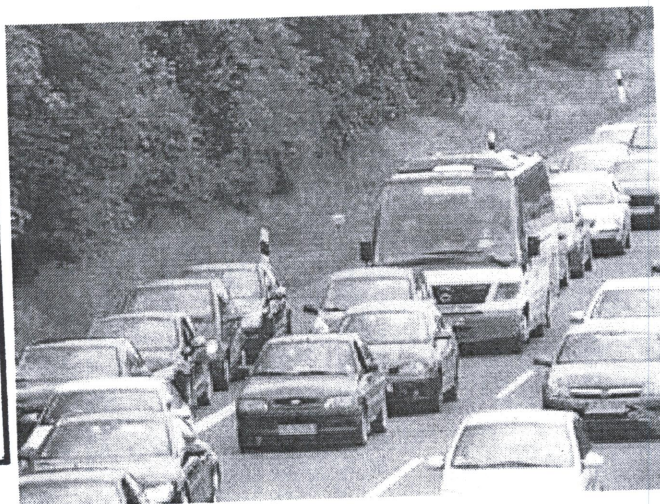


(Total for Question 1 = 3 marks)

# Investigation Motion, D-T & V-T graph

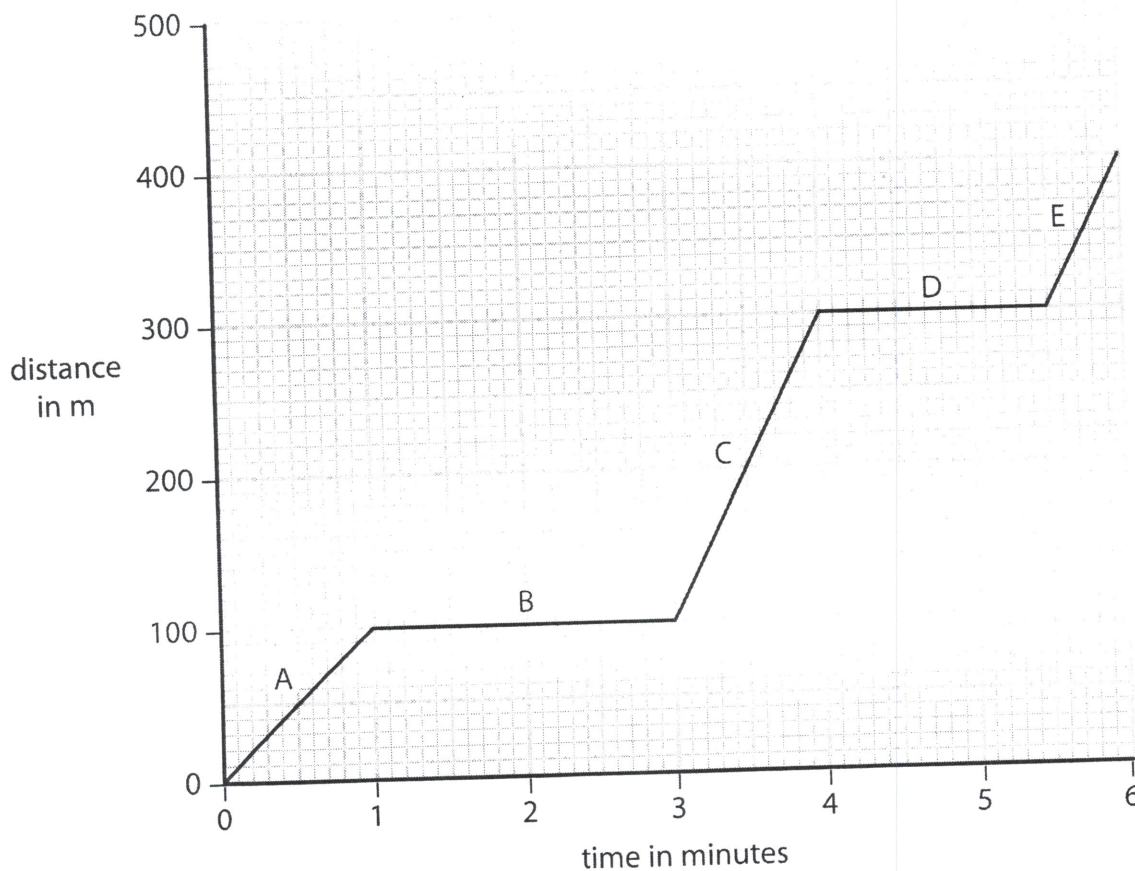
A car travels along a very busy road.

17



© AnRo0002 (Wikipedia)

The graph shows how the distance travelled by the car changes during a six-minute period.



(a) Calculate the total amount of time the car is stationary during this period.

(2)

IPR-17-17



# Investigation Motion, D-T & V-T graph

(b) Explain which stage of the graph, A, B, C, D or E, shows the car moving at the slowest speed. (2)

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(c) (i) State the equation linking average speed, distance moved and time taken. (1)

(1)

(ii) Calculate the speed of the car at stage C.

Give a suitable unit for your answer. (3)

(3)

speed = ..... unit .....

(d) State two factors that could affect the braking distance of the car. (2)

(2)

1 .....

2 .....

**(Total for Question 2 = 10 marks)**

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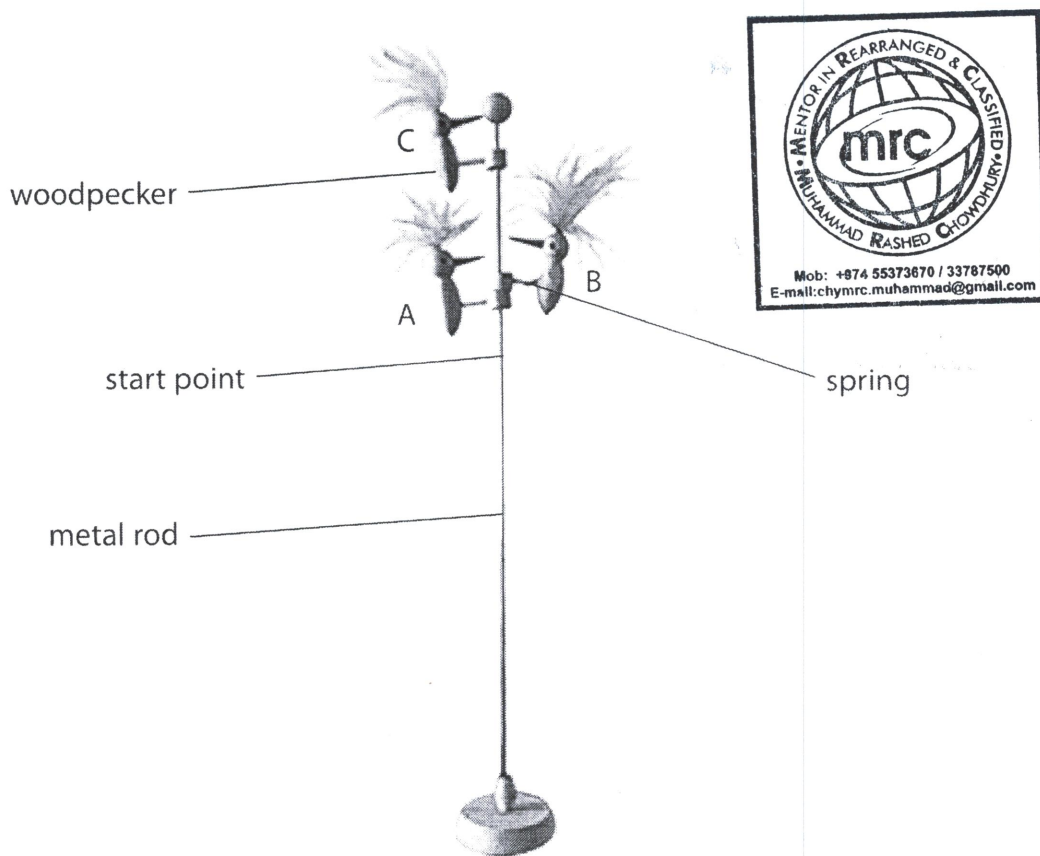
## Investigation Motion, D-T & V-T graph

18

A student investigates a toy.

- the toy has three woodpeckers
- each woodpecker is attached to a wooden ring by a spring
- a metal rod passes through the wooden rings
- the woodpeckers have different masses
- the springs are identical

When a woodpecker is pulled back and released, it vibrates and moves down the rod.



(a) A student uses this method to investigate the toy.

- measure the mass of woodpecker A
- move woodpecker A to the start point and release it
- record the time it takes for woodpecker A to travel 20 cm
- repeat the test two more times

The student uses the same method for woodpeckers B and C.

1P-1A-17

# Investigation Motion, D-T & V-T graph

The table shows the student's results.

Woodpecker	Mass in g	Time in s		
		test 1	test 2	test 3
<b>A</b>	11.2	11.8	11.1	10.8
<b>B</b>	8.3	3.1	5.4	5.5
<b>C</b>	5.9	8.5	9.0	8.7

(i) One of the time measurements in the table is anomalous.

Draw a circle around this anomalous measurement.

(1)

(ii) State the relationship between average speed, distance moved and time taken.

(1)

(iii) Calculate the average (mean) speed for woodpecker B.

(1)

average speed = ..... cm/s

(iv) Explain what type of graph the student should use to present his data.

(2)

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1P-2a-17

## Investigation Motion, D-T & V-T graph

(b) Before carrying out his investigation, the student made this prediction.

*'The smaller the mass of the woodpecker, the faster it moves down the rod.'*

Discuss whether the student's results support his prediction.

(3)

(Total for Question 3 = 11 marks)

# Investigation Motion, D-T & V-T graph

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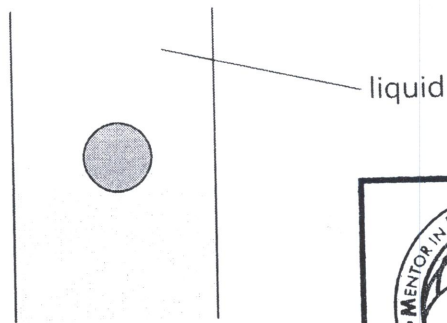
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AP-Ju-17

19 A student investigates the terminal velocity of steel balls falling through a thick liquid.

(a) (i) On the diagram, draw and label the forces acting on a steel ball as it falls at terminal velocity.

(3)



(ii) Explain, in terms of forces, what is meant by terminal velocity.

(3)

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(b) The student has five steel balls of different diameter and some thick oil.

(i) Name two additional pieces of apparatus the student would need in order to investigate the terminal velocity of the steel balls falling through the oil.

(2)

1 .....

2 .....

## Investigation Motion, D-T & V-T graph

- (ii) Describe a method the student could use to investigate how the diameter of a steel ball affects the terminal velocity.

In your answer, you should include

- a labelled diagram
- the measurements that the student should take
- how the student could use the measurements to find the terminal velocity.

(5)

1A-Ju-17

- (c) Explain which type of graph the student should use to display his results.

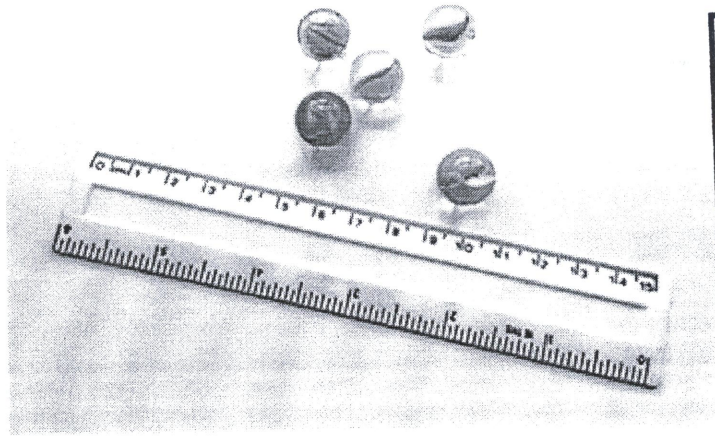
(2)

1P-Ju-17

(Total for Question 7 = 15 marks)

# Investigation Motion, D-T & V-T graph

20 Marbles is a game played with small balls of coloured glass.  
Each ball is known as a marble.



(a) Describe how a millimetre scale and two set squares can be used to measure the diameter of a marble.

You may draw a diagram to help your answer.

AP- Jan-17

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## Investigation Motion, D-T & V-T graph

(b) Describe an experiment to find the density of a marble.

You may draw a diagram to help your answer.

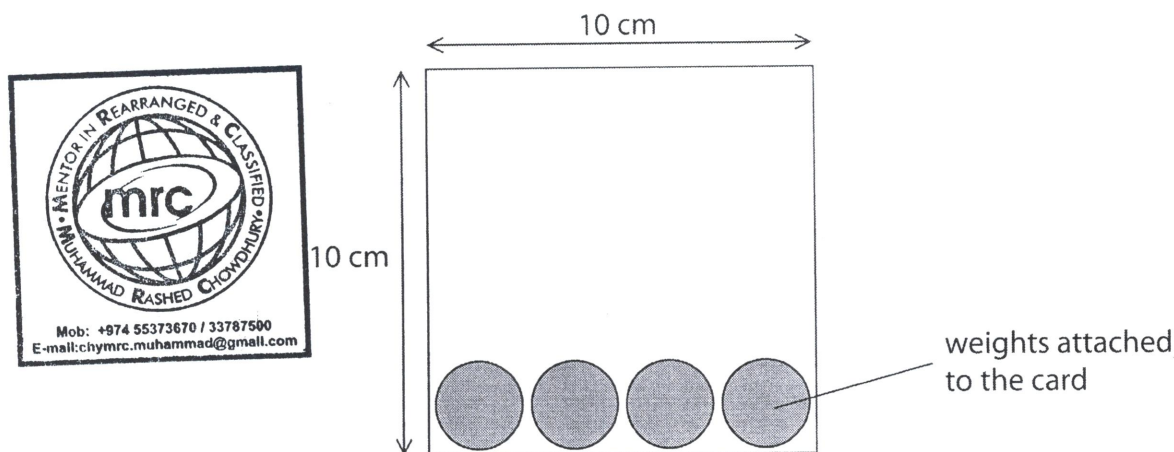
(5)

18-Ja-17



## Investigation Motion, D-T & V-T graph

- 21 A student investigates the motion of a 10 cm square piece of card as it falls. He attaches some weights to the bottom of the card to make sure it falls vertically.



- (a) Add an X to the diagram to show the position of the centre of gravity after the weights have been attached.
- (b) The student writes this plan for his investigation.

Measure the final speed of the card when it is dropped from different heights.

Drop the card from 6 different heights (10, 20, 30, 40, 50 and 60 cm) and measure the final speed using a light gate.

Repeat the final speed measurement 3 times for each height, and take an average.

Make sure that the initial speed of the card is always zero.

Which of these is the dependent variable in the student's investigation?

- A the final speed of the card
- B the initial height of the card
- C the initial speed of the card
- D the mass of the card

## Investigation Motion, D-T & V-T graph

(c) The table shows the student's results.

Height in cm	Final speed in m/s			
	trial 1	trial 2	trial 3	average (mean)
10.0	1.40	1.38	1.40	1.39
20.0	1.97	1.96	1.97	1.97
30.0	2.44	2.42	2.44	2.43
40.0	2.46	2.44	2.45	2.45
50.0	3.09	3.10	3.08	3.09
60.0	3.41	3.36	3.42	

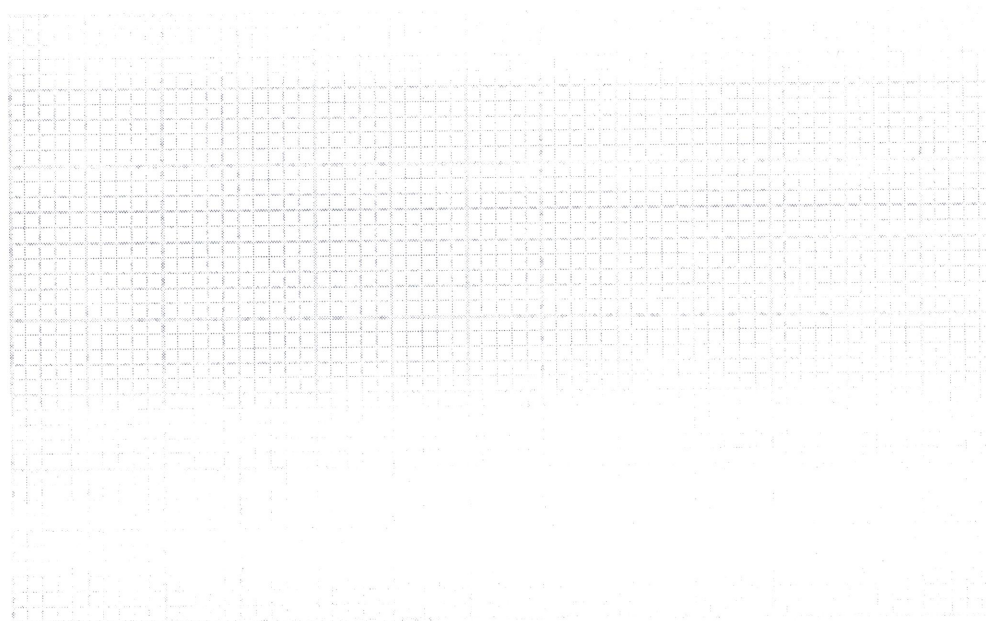
(i) Complete the table by calculating the missing average.

Give your answer to two decimal places.

(2)

(ii) Plot a graph to show how the average final speed changes with height.

(4)



(iii) Circle the anomalous point on the graph.

(1)

(iv) Add a curve of best fit to the graph.

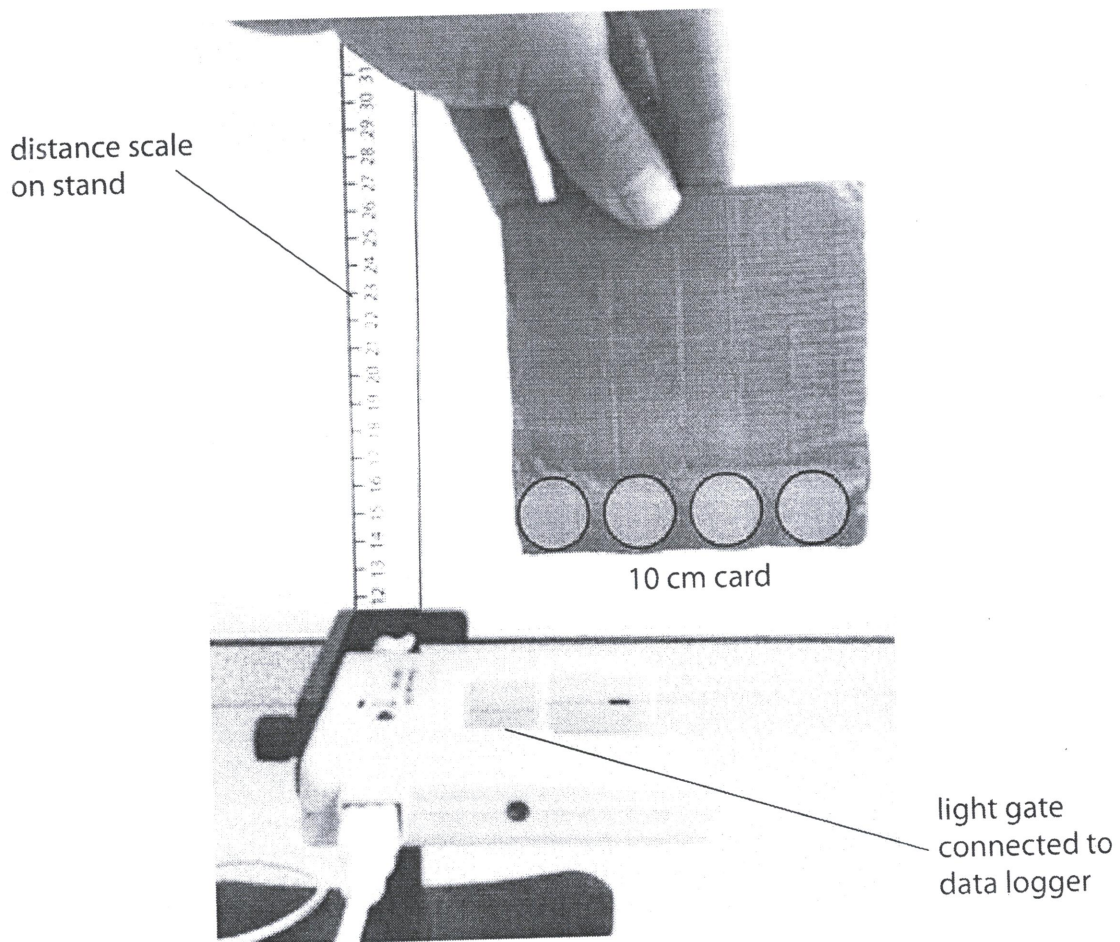
(1)

1PR-24-17

# Forces, Momentum, Collisions, Moments

(v) Describe the relationship between height and average final speed. (2)

(d) The photograph shows the student releasing a card.



Give two ways that the student could improve the accuracy of his measurements. (2)

1

2

(Total for Question 3 = 14 marks)

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DO NOT WRITE IN THIS AREA

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1 PR-34-17