Name: _____

Motion and SUVAT

Questions

**Date:**

**Time:**

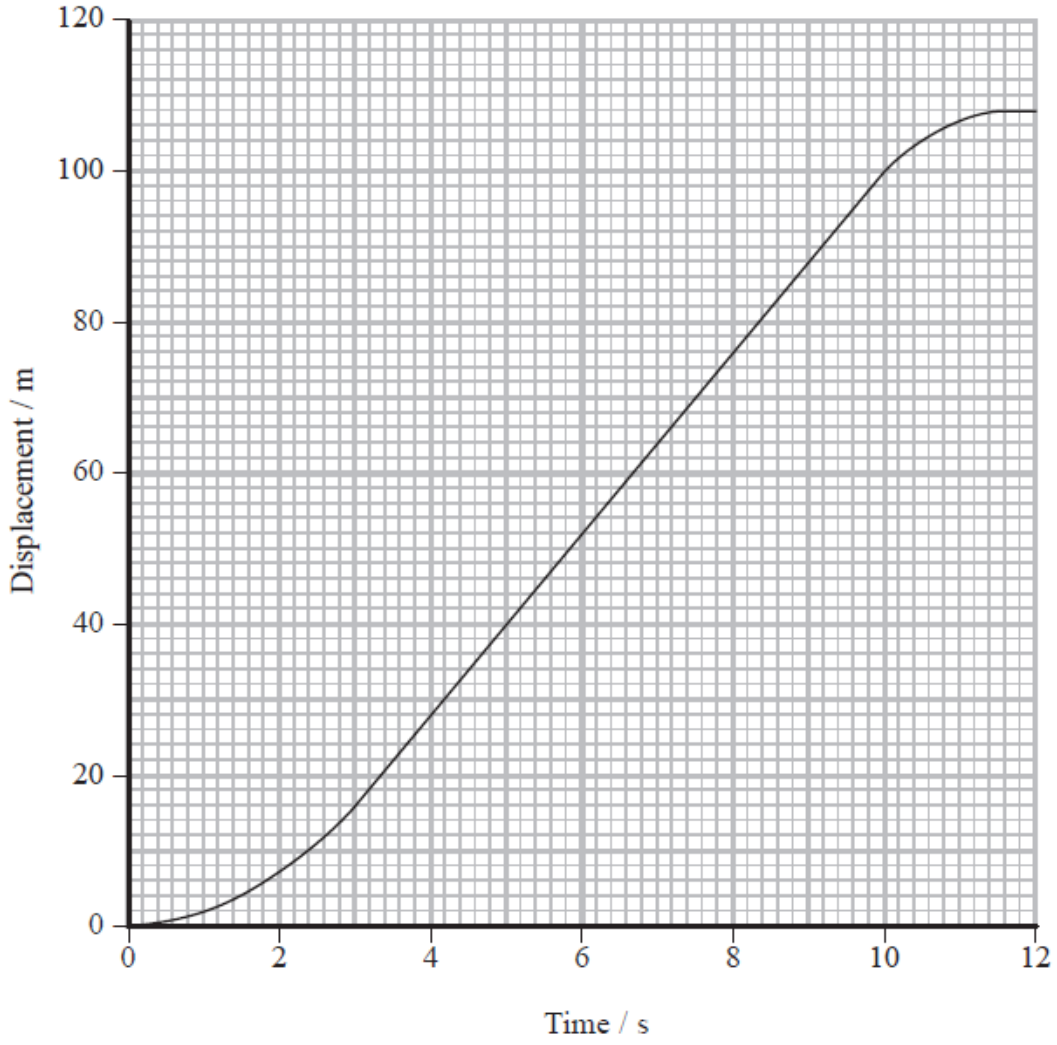
**Total marks available:**

**Total marks achieved: _____**

## Questions

Q1.

The graph is a displacement-time graph for a runner.




The velocity of the runner at 5 s is approximately

☒ **A** 8 m $s^{-1}$

☒ **B** 9 m $s^{-1}$

☒ **C** 12 m $s^{-1}$

☒ **D** 40 m $s^{-1}$

**(Total for question = 1 mark)**

Q2.

Which of the following can be used to determine the magnitude of velocity?

**(1)**

☒ **A** area under an acceleration-time graph

☒ **B** area under a velocity-time graph

☒ **C** gradient of an acceleration-time graph

☒ **D** gradient of a velocity-time graph

**(Total for question = 1 mark)**

Q3.

The winner of a 400m race must have the greatest

**(1)**

☒ **A** acceleration.

☒ **B** average speed.

☒ **C** instantaneous speed.

☒ **D** maximum speed.

**(Total for question = 1 mark)**

Q4.

A student is asked to solve the following problem:

*An object is thrown upwards with a speed of 25 m $s^{-1}$. How high will it be when the speed is 12 m $s^{-1}$?*

Which equation will allow the problem to be solved in a single calculation?

☒ **A** $s = ut + ½ at^2$

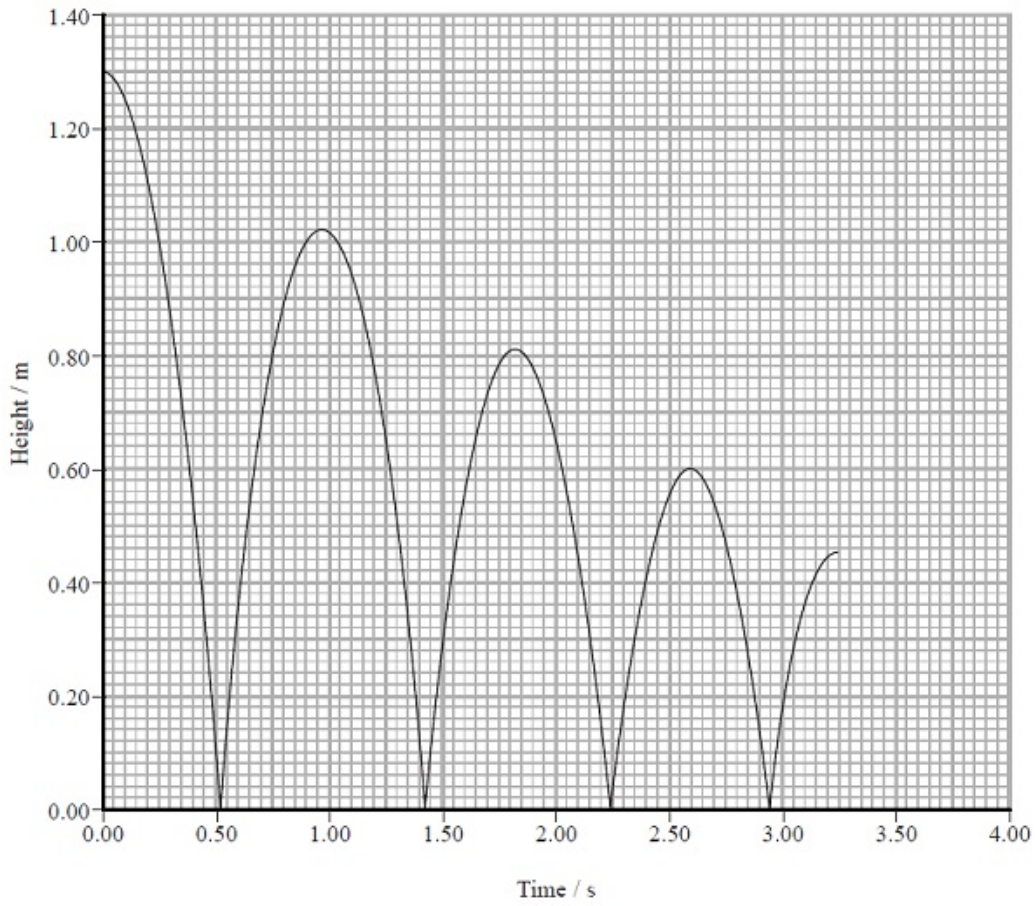
☒ **B** $s = (u + v)t/2$

☒ **C** $v = u + at$

☒ **D** $v^2 = u^2 + 2as$

**(Total for question = 1 marks)**

Q5. A ball is dropped from a height of 1.3 m. The graph shows how the height above the ground varies with time for several bounces.




At 2.6 s the magnitude of the displacement from the starting position is

☒ **A** 0.20 m

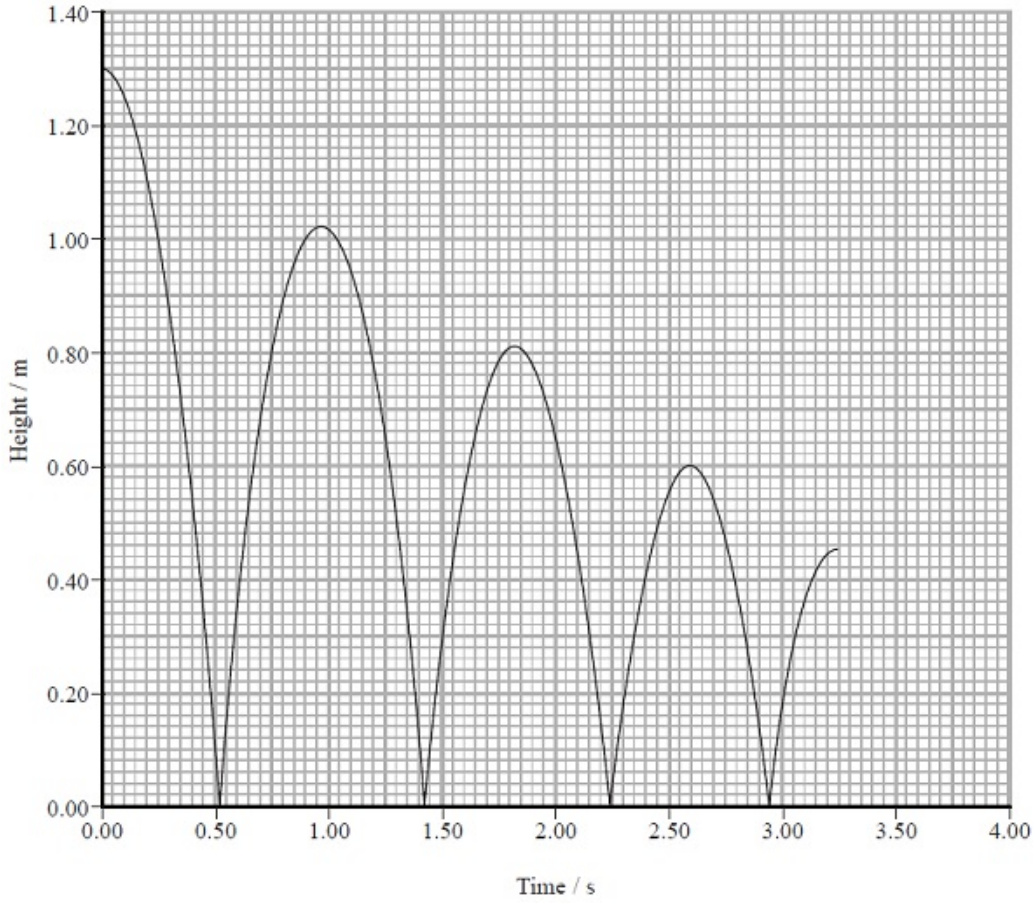
☒ **B** 0.60 m

☒ **C** 0.70 m

☒ **D** 1.30 m

**(Total for Question = 1 mark)**

Q6. A ball is dropped from a height of 1.3 m. The graph shows how the height above the ground varies with time for several bounces.




How can the velocity of the ball at time $t$ = 2.5 s be determined from the graph?

☒ **A** Calculate the area between the graph and the time axis up to $t$ = 2.5 s.

☒ **B** Divide the displacement at $t$ = 2.5 s by 2.5 s.

☒ **C** Divide the height at $t$ = 2.5 s by 2.5 s.

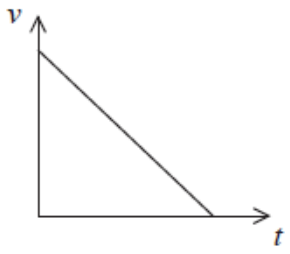
☒ **D** Draw a tangent to the graph at $t$ = 2.5 s and calculate its gradient.

**(Total for Question = 1 mark)**

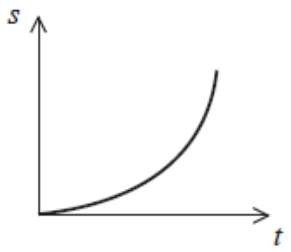
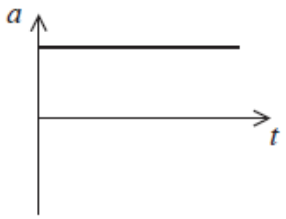
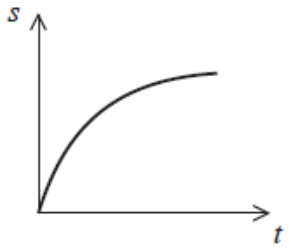
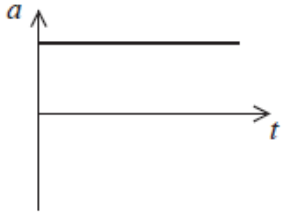
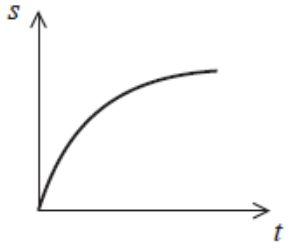
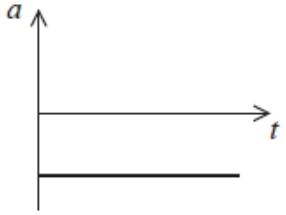
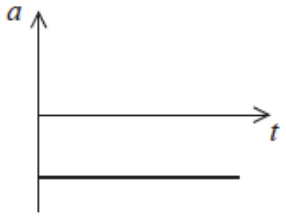
Q7.

A ball is rolled along a horizontal surface. Frictional forces slow the ball to rest.

The velocity-time graph for the ball is shown.



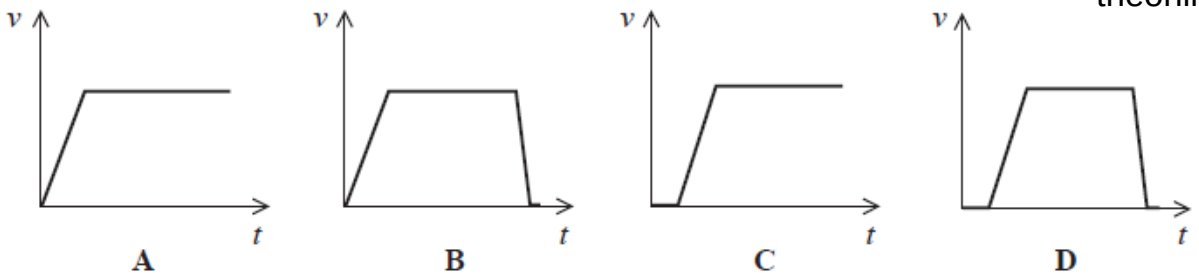
Select the row of the table that correctly gives the corresponding displacement-time and acceleration-time graphs for the ball.

| | Displacement-time graph | Acceleration-time graph |
|---|---|---|
| ☒ A |   |   |
| ☒ B |   |   |
| ☒ C |   |   |
| ☒ D |   |   |

**(Total for question = 1 mark)**

Q8.

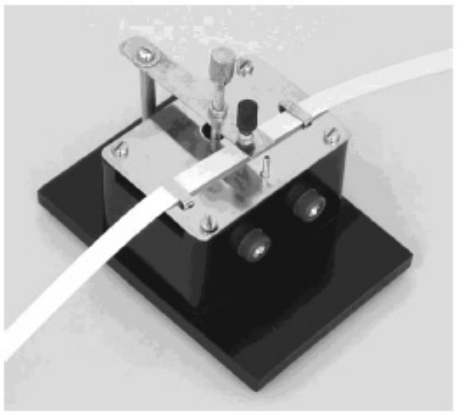
The velocity-time graph for the runner over the full 12 s is




- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

**(Total for question = 1 mark)**

Q9. A trolley moves down a ramp from rest. Attached to the trolley is a strip of paper which is pulled through a ticker tape timer. The ticker tape timer makes 50 dots each second on the strip of paper.



The strip of paper is shown below. The start and the end of the journey are indicated.


(a) (i) Using measurements from the tape show that the final velocity of the trolley is about 1 m $s^{-1}$

**(2)**

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(ii) Hence calculate the average acceleration of the trolley.

**(2)**

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Average acceleration = .....

(b) Using a ticker tape timer is one method of measuring the speed of a moving object in a laboratory. Another method is to use a light gate with a data logger and computer.

Suggest an advantage of using the light gate method rather than using a ticker tape timer.

**(1)**

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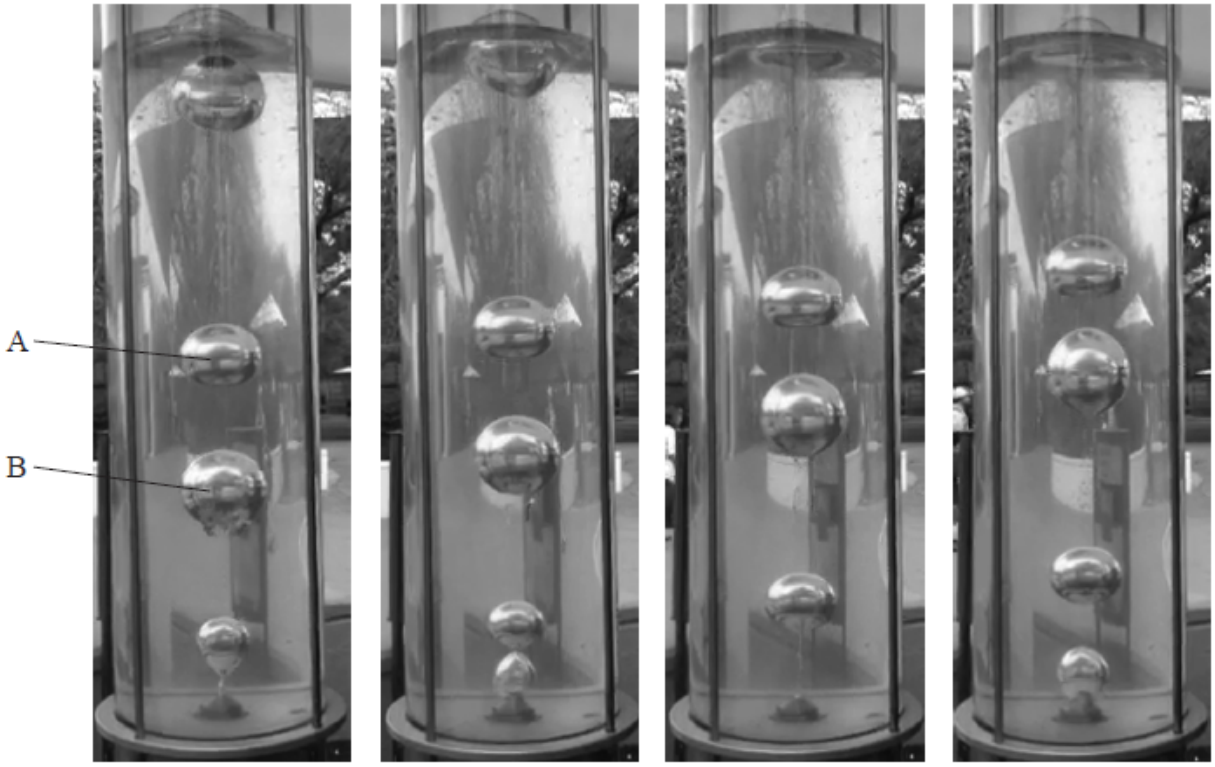
**(Total for Question = 5 marks)**

Q10.

An exhibit in a science museum requires the observer to use a pump to create air bubbles in a column of liquid. The bubbles then rise through the liquid.

The following photographs were taken at 0.33 s intervals.




Photograph 1
time = 0

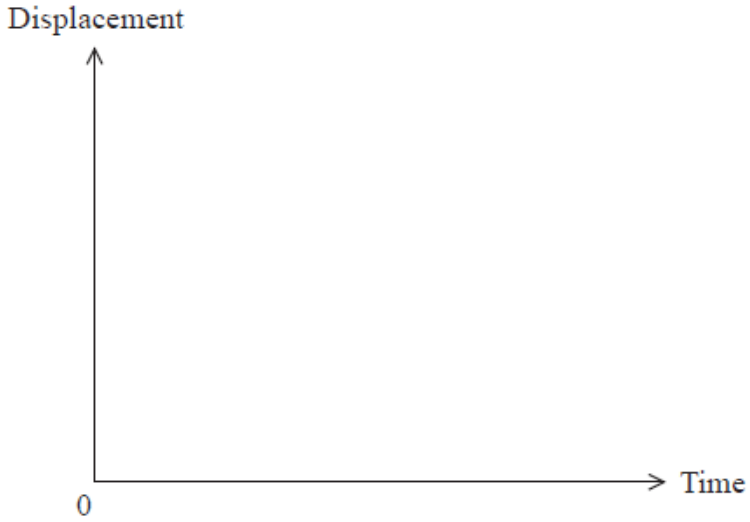
Photograph 2

Photograph 3

Photograph 4

(i) Sketch on the axes below two labelled lines to show how the displacements of the smaller bubble A and the larger bubble B vary with time over the four images.

**(2)**




(ii) The photographs are at a scale of 1 to 12. By using measurements from the photographs, calculate the speed of bubble B between photographs 2 and 3.

**(4)**

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Speed of bubble B = .....

Q11. Queues of cars often form behind cyclists on narrow, rural roads.

Sometimes cars that would normally travel at 65 km hour$^{-1}$ may be limited to about 20 km hour$^{-1}$ by a cyclist.

(a) Show that 65 km hour$^{-1}$ is about 18 m s$^{-1}$.

**(1)**

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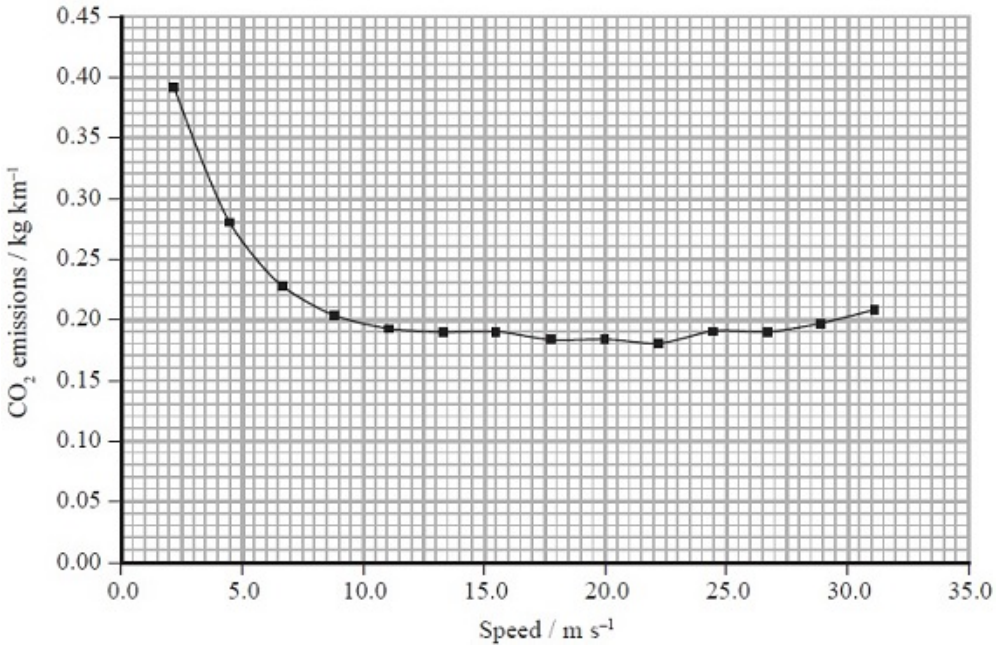
(b) The graph shows the amount of carbon dioxide emitted per kilometre by a typical car at different speeds.




During a 10 minute journey a cyclist, travelling at 5 m $s^{-1}$, has an average of three cars queuing behind him. The cars would otherwise be travelling at 18 m $s^{-1}$. The cars emit more carbon dioxide because they are travelling slowly.

(i) Calculate the extra carbon dioxide emitted by the 3 cars due to travelling at this reduced speed for 10 minutes.

**(4)**

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Extra carbon dioxide emitted = .....

(ii) If the cyclist had made the same journey in his car at 18 m $s^{-1}$, his car would have emitted 0.54 kg of carbon dioxide. Comment on the significance of this.

**(1)**

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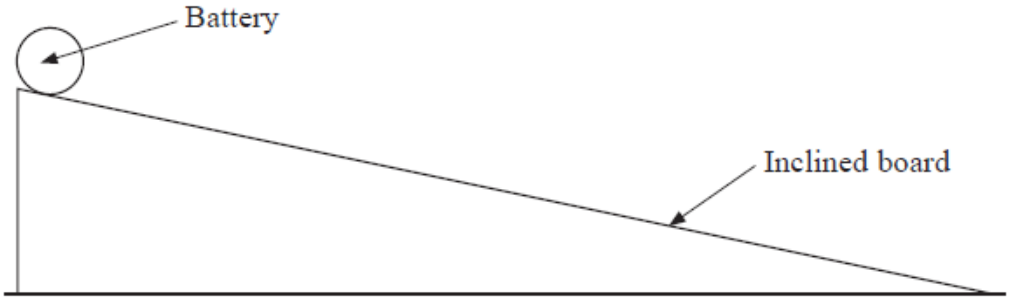
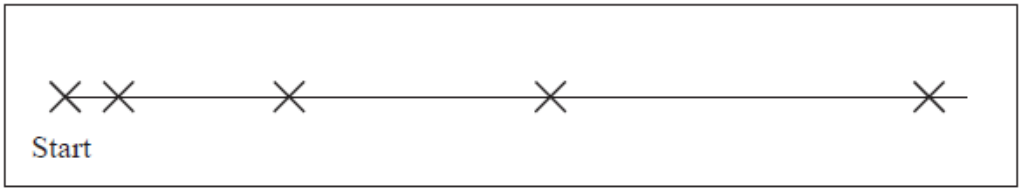
**(Total for Question = 6 marks)**

Q12.

A group of students was asked to find how the velocity of a cylindrical battery changes as it rolls down an inclined board.




The group marked the position of the battery on the board every second with an X.




(a) These markings were used to obtain the following results table.

(i) Complete the table.

**(3)**

| | | A | B |
|---|---|---|---|
| **Time / s** | **Distance from start position / m** | **Average velocity in previous second / m $s^{-1}$** | **Average velocity from the start / m $s^{-1}$** |
| 0.0 | 0.00 | 0 | 0 |
| 1.0 | 0.18 | 0.18 | 0.18 |
| 2.0 | 0.84 | | |
| 3.0 | 1.75 | | |
| 4.0 | 3.14 | 1.39 | 0.79 |

(ii) Justify which of the columns, A or B, gives a more accurate value for the velocity of the battery at the bottom of the inclined board.

**(1)**

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(b) The only two pieces of equipment that the students used were a measuring tape and a manual stopwatch.

Give a possible source of error and suggest changes to the equipment and method used to make the values in column A more accurate.

**(3)**

Source of error

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Changes

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**(Total for question = 7 marks)**

Q13.

A motorist received a speeding penalty notice, from the police, for a short journey along 120 m of road.

(a) The car's specification states that the minimum time for the car to accelerate from 0 to 60 miles per hour is 9.5 seconds.

Show that the maximum value for the average acceleration of the car over 9.5 s is about 3 m $s^{-2}$.

1 mile = 1600 m

**(2)**

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(b) The police recorded a maximum speed for the car of 20 m $s^{-1}$.

The motorist knows that the speed at the start and at the end of the 120 m journey was zero.

Assume that the car had:

- constant positive acceleration, equal to the value in part (a), for the first 60 m of the journey
- constant negative acceleration of the same magnitude for the final 60 m of the journey.

Determine whether the motorist should challenge the penalty notice.

**(3)**

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(c) Explain why the assumptions about the acceleration in (b) may not be correct in practice.

**(2)**

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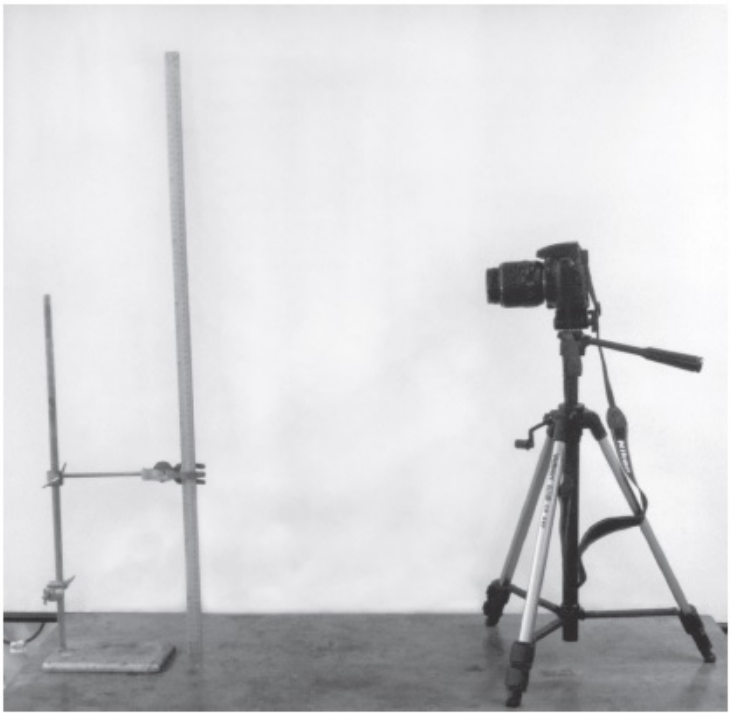
**(Total for question = 7 marks)**

Q14.

A student carries out an experiment to find the acceleration of free fall.



(a) In this experiment the student releases a small steel ball in front of a metre rule and uses a video camera to record its motion. The camera captures 30 images per second, which may be played back one image at a time.

(i) Explain how the acceleration of free fall could be determined using the recording.

**(4)**

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(ii) Describe a systematic error which could arise.

**(1)**

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(b) Describe one property of the steel ball that makes it suitable to use in this experiment and explain why this property makes it suitable.

**(2)**

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(c) Explain an advantage of using a video camera to take measurements for this experiment rather than using a stopwatch.

**(2)**

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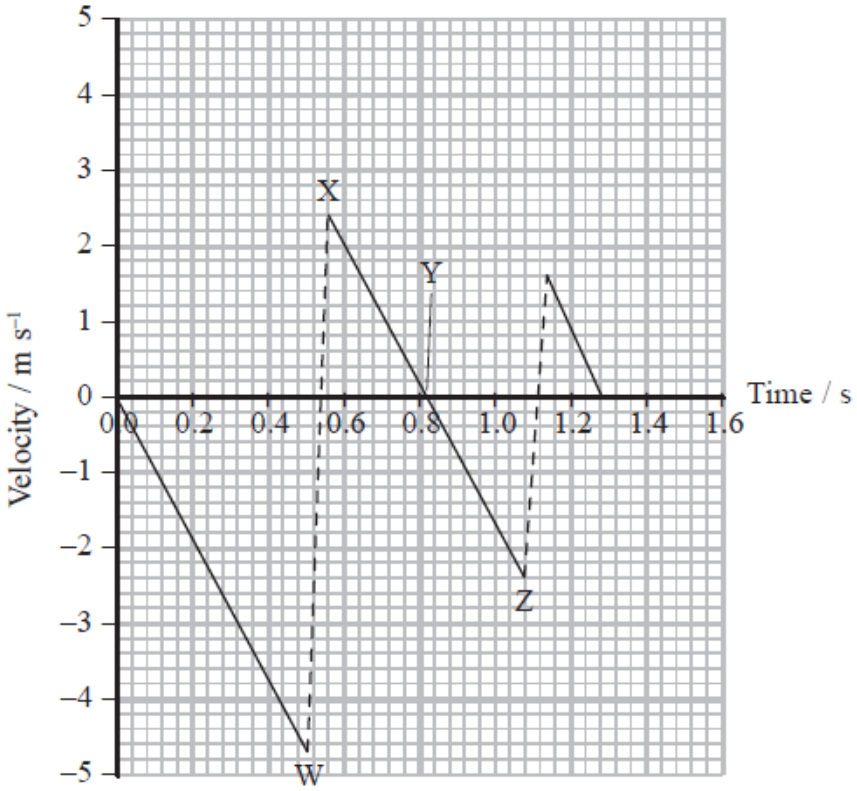
**(Total for question = 9 marks)**

Q15.

A basketball is dropped vertically onto the horizontal ground and bounces twice before being caught. The graph shows how the velocity of the basketball varies with time.




(a) Suggest why the downward sloping lines are all parallel.

**(1)**

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(b) (i) State the reason for the upwardly sloping dotted lines.

**(1)**

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(ii) Describe how the gradient of the dotted lines would change if the basketball was not fully inflated.

**(1)**

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(c) Calculate the initial height through which the basketball fell.

**(2)**

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Height = .....

(d) (i) Show that the kinetic energy of the basketball at X is about 1 J.

mass of ball = 0.4 kg

**(2)**

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(ii) Hence calculate the height of the basketball at Y.

**(2)**

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Height = .....

(e) The velocity of the basketball on impact at W is greater than the velocity on impact at Z.

State a reason for the difference in velocities at W and Z.

**(1)**

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