Name: _____

Year 11 Lecture 3 Follow-up Questions

Date:

Time: 45 minutes

Total marks available: 36

Total marks achieved: _____

Questions

Q1.

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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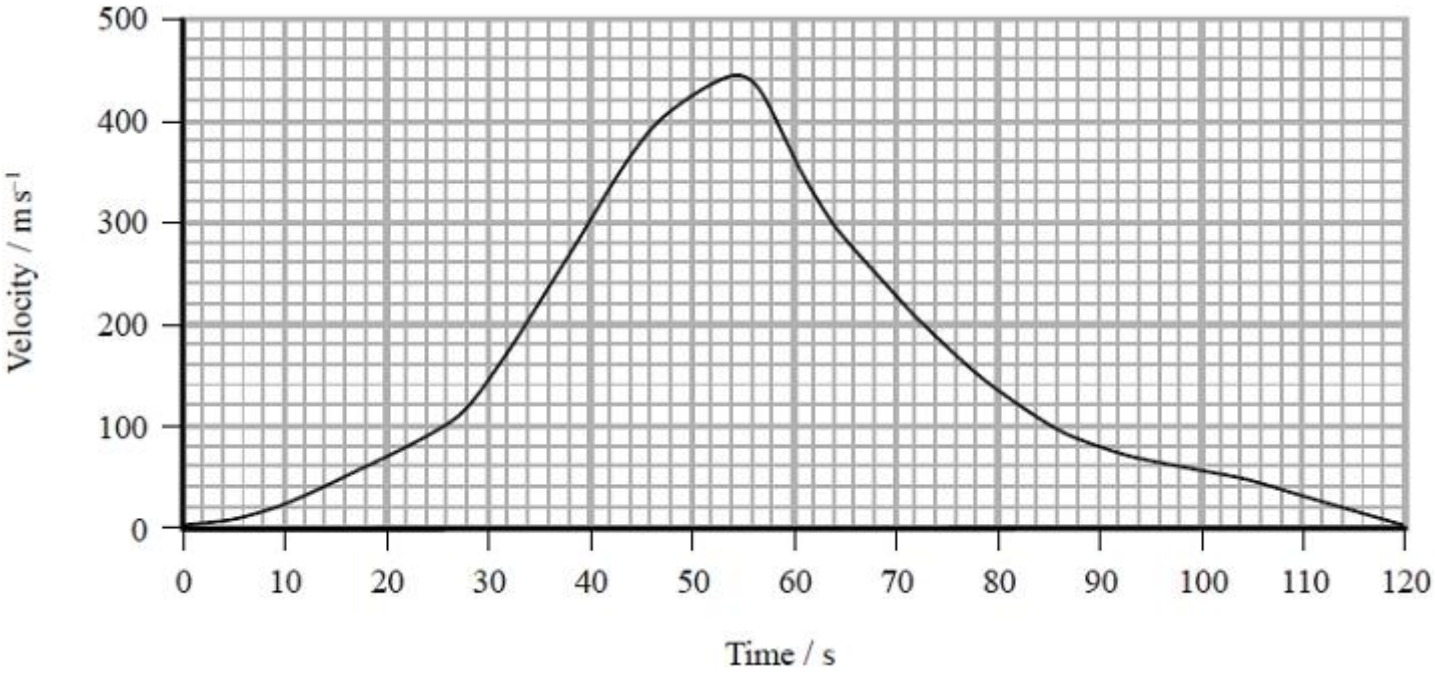
(Total for question = 7 marks)

Q2.

The world land speed record of 341 m s^{-1} was set in October 1997. In an attempt to break this record, a new supersonic car has been developed called the Bloodhound.

The developers of the Bloodhound have used computer modelling to produce a velocity-time graph for the predicted motion of the car, on a straight track, during the record attempt.



A track of length 23 km is available for the record attempt.

Determine whether this track is long enough.

(3)

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(Total for question = 3 marks)

Q3.

The photograph shows cars travelling on a straight section of a motorway.

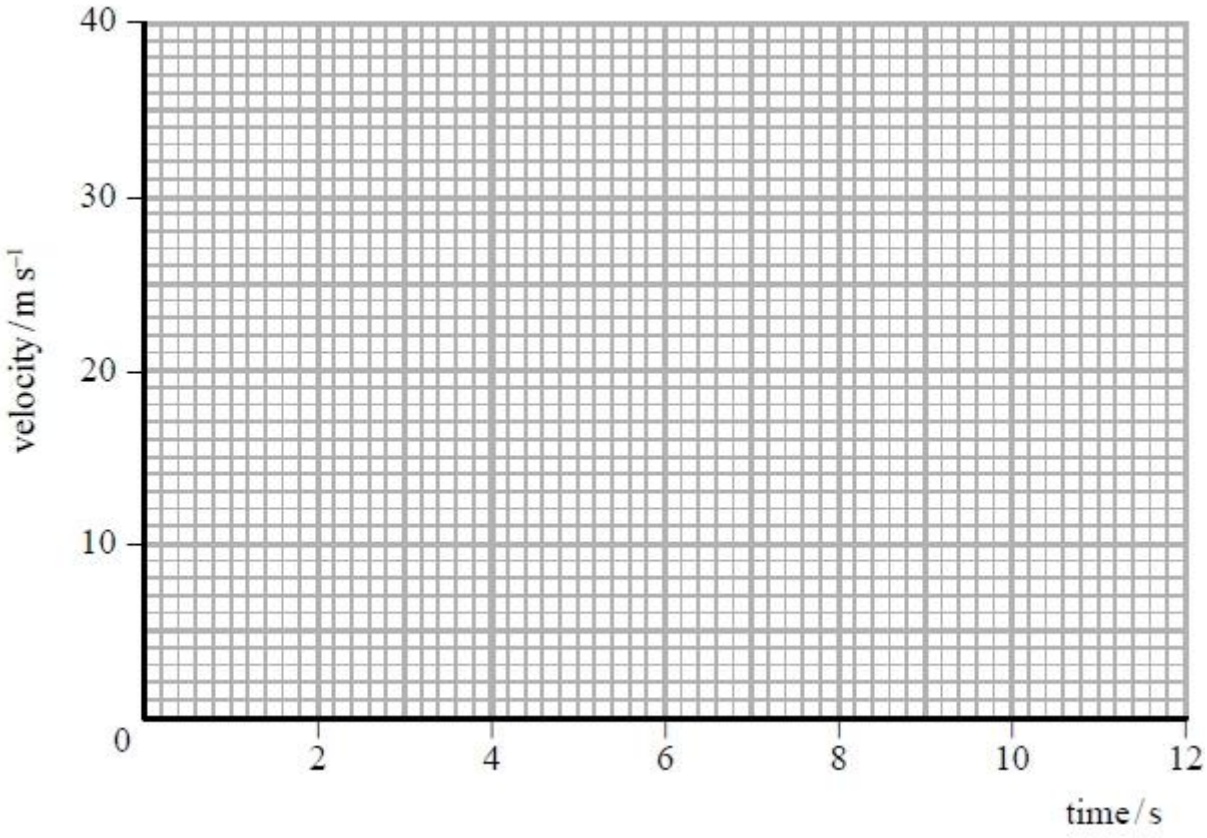
The maximum speed limit on a motorway in the U.K. is $31 ms^{-1}$.

(source: http://tracksideviews.com/tag/motorway/)

A car is travelling along the motorway at $31 ms^{-1}$. The driver sees stationary traffic 180 m ahead. After 0.6 s the driver reacts by applying a constant braking force that stops the car in 10 s.

(i) Draw a velocity-time graph of the car's motion, from the instant the driver sees the stationary traffic until the car stops.

(1)



(ii) Analyse the data to determine whether the car stops without colliding with the stationary traffic.

(2)

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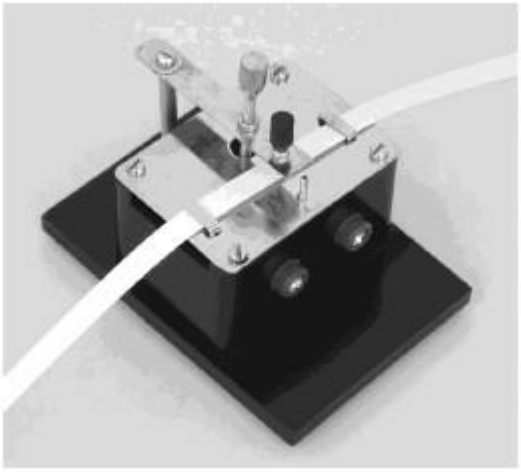
(Total for question = 3 marks)

Q4.

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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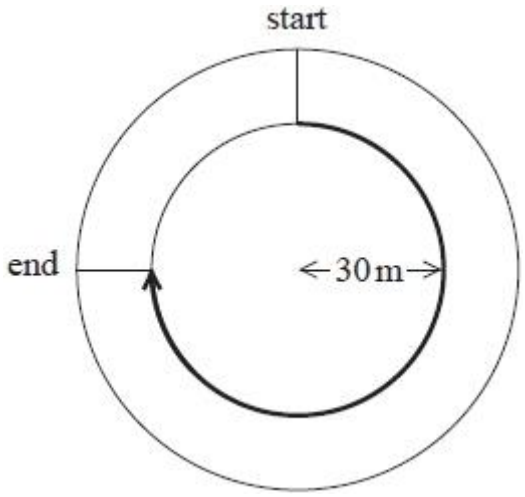
(Total for Question = 5 marks)

Q5.

Answer the question with a cross in the box you think is correct (☒). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☒). An athlete runs a race around three quarters of a circular track of radius 30 m using the inside lane.



What is the magnitude of the displacement of the athlete at the end of the race?

- ☐ **A** 141 m
- ☐ **B** 47 m
- ☐ **C** 42 m
- ☐ **D** 30 m

(Total for question = 1 mark)

Q6.

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

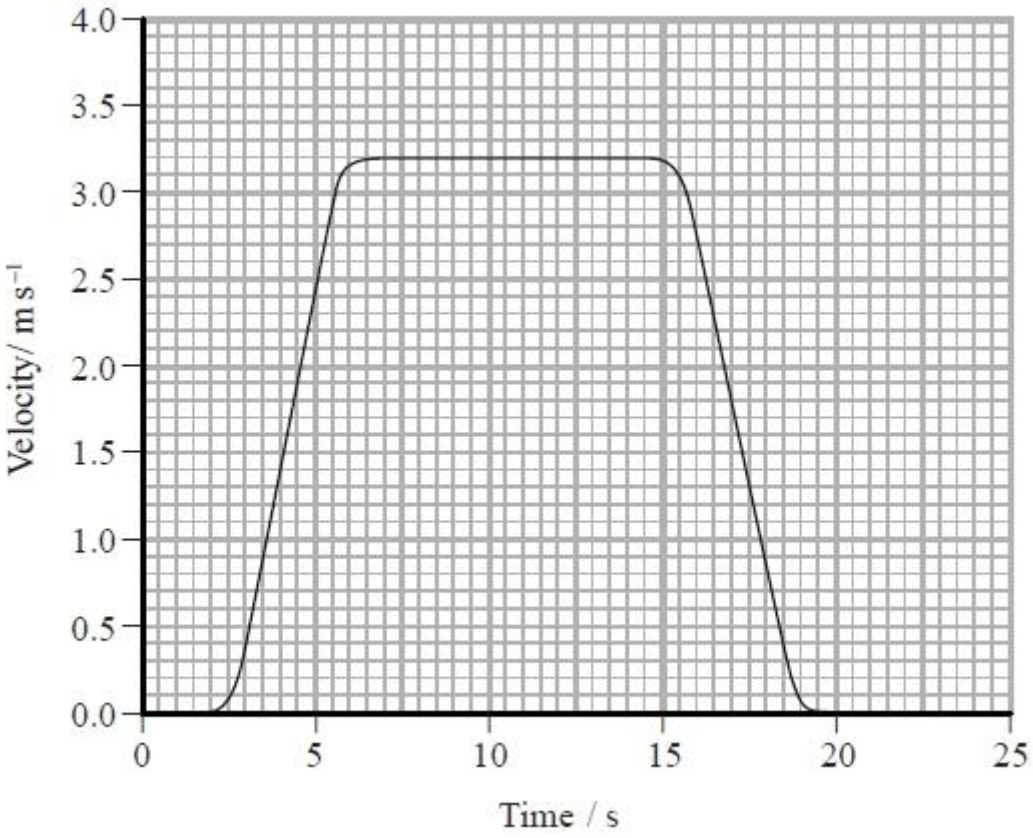
(1)

- ☒ **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)

Q7.

A lift moves upwards from the ground to the tenth floor of a building. The velocity-time graph for the lift is shown.



(i) Calculate the magnitude of the maximum acceleration of the lift.

(2)

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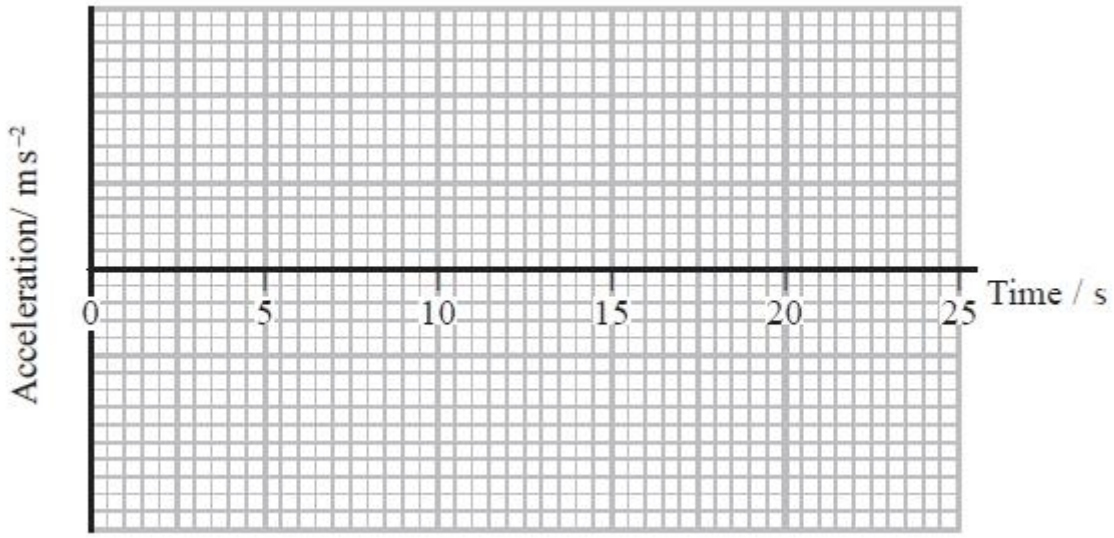
Maximum acceleration = ...

(ii) Sketch the corresponding acceleration-time graph on the axes below.

(3)



Q8.

Which of the following is **not** a vector quantity?

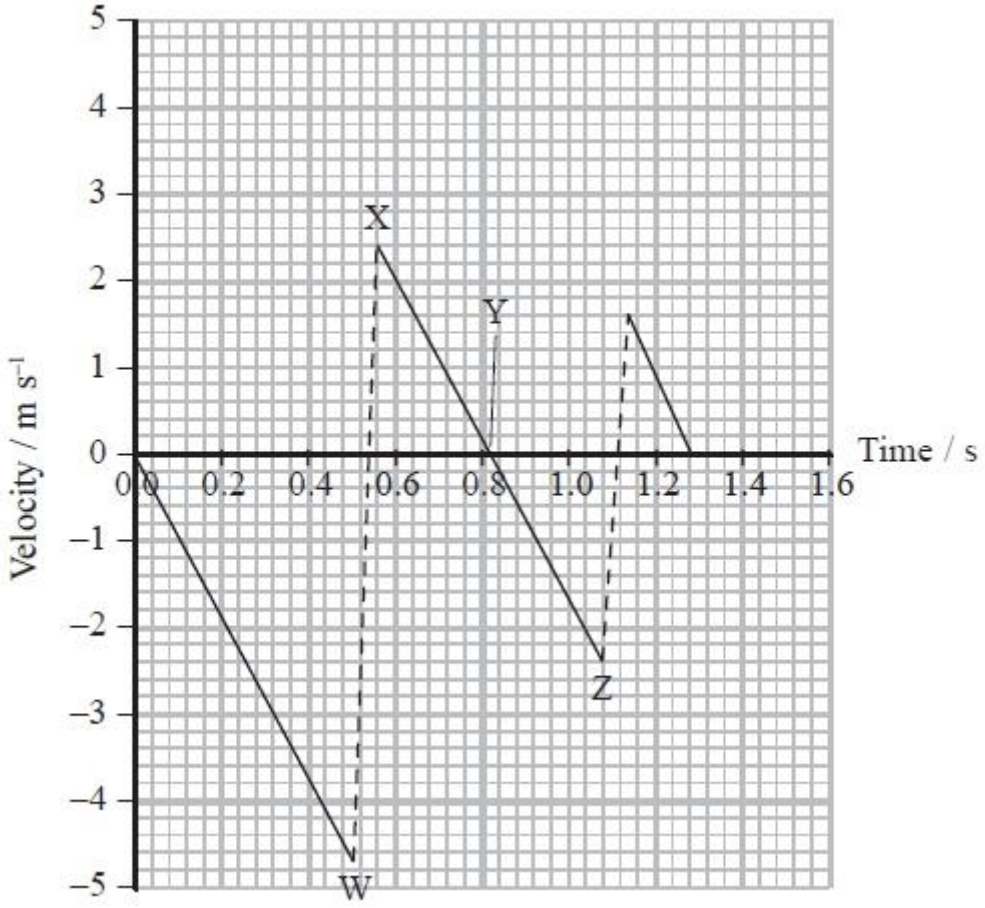
(1)

- ☒ **A** acceleration
- ☒ **B** distance
- ☒ **C** momentum
- ☒ **D** velocity

(Total for question = 1 mark)

Q9.

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)