Physics - Basics

Question Paper

Level	International A Level
Subject	Physics
Exam Board	Edexcel
Topic	Physics-Basics
Sub Topic	
Booklet	Question Paper

Time Allowed: **72 minutes**

Score: **/60**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 Physical quantities are either vectors or scalars.

Select the row of the table which correctly identifies vector and scalar quantities.

	Mass	Velocity	Displacement
☒ **A**	scalar	vector	scalar
☒ **B**	vector	scalar	vector
☒ **C**	vector	scalar	scalar
☒ **D**	scalar	vector	vector

(Total for Question 1 = 1 mark)

2 Which of the following SI units can **only** be used with a scalar quantity?

☒ **A** m

☒ **B** s

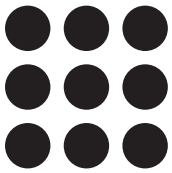
☒ **C** $m\ s^{-1}$

☒ **D** $m\ s^{-2}$

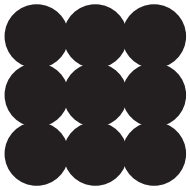
(Total for Question 2 = 1 mark)

3 Computer printers form an image by placing a series of correctly placed microscopic dots on to paper.

If the temperature of the ink is too high, the size of the dots will increase, producing a darker image.



correct temperature ink



temperature of ink too high

Select the row of the table that correctly describes the effect of the increase in temperature on the viscosity and flow rate of the ink.

	Viscosity of the ink	Flow rate of the ink
☒ **A**	increases	increases
☒ **B**	increases	decreases
☒ **C**	decreases	increases
☒ **D**	decreases	decreases

(Total for Question 3 = 1 mark)

4 Physical quantities are either scalars or vectors.

Select the row of the table which correctly identifies a scalar quantity and a vector quantity.

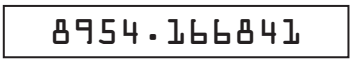
	Scalar	Vector
☒ **A**	force	velocity
☒ **B**	mass	time
☒ **C**	time	force
☒ **D**	velocity	mass

(Total for Question 4 = 1 mark)

5 A student takes measurements for a piece of copper wire.

Mass	0.00500 kg
Length	3.36 m
Diameter	0.00046 m

The student uses these values to calculate a value for the density of copper. The correctly calculated value of density is shown on the student's calculator as



The student should state the density as

☒ **A** 8954.166841 kg m^{-3}

☒ **B** 8950 kg m^{-3}

☒ **C** 8.95×10^3 kg m^{-3}

☒ **D** 9.0×10^3 kg m^{-3}

(Total for Question 5 = 1 mark)

6 Which of the following is a correct statement?

- ☒ **A** Weight is a base quantity.
- ☒ **B** Velocity is a base quantity.
- ☒ **C** Mass is a derived quantity.
- ☒ **D** Force is a derived quantity.

(Total for Question 6 = 1 mark)

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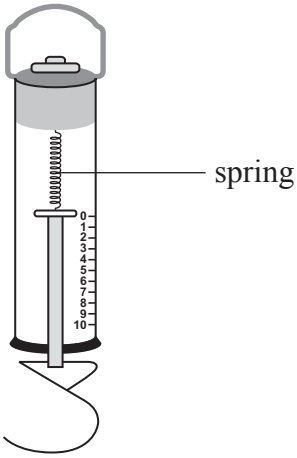
7 The main component of a newton meter is a calibrated spring.



The newton meter is to be used over a greater range of forces. Which of the following should be increased to allow this?

- ☒ **A** ductility of the spring wire
- ☒ **B** precision of the scale
- ☒ **C** stiffness of the spring
- ☒ **D** ultimate tensile strength of the spring

(Total for Question 7 = 1 mark)

8 In which of the following is a vector fully described?

☒ **A** A car travels north.

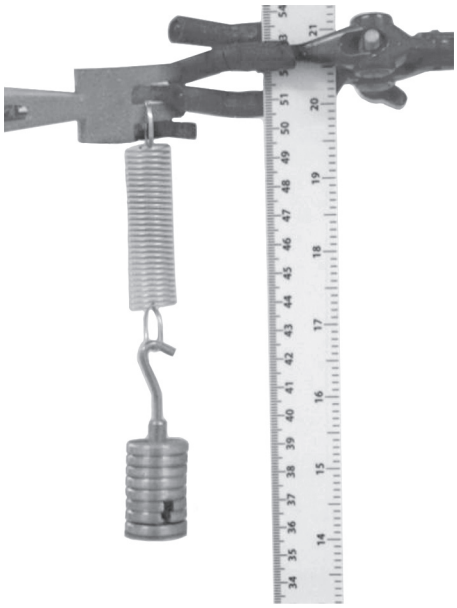
☒ **B** A crane moves a load 20 m east.

☒ **C** A train travels at a rate of 35 m s^{-1}.

☒ **D** A lift moves upwards with a kinetic energy of 2.5 kJ.

(Total for Question 8 = 1 mark)

9 The apparatus shown can be used to determine the spring constant k of a spring.



*(a) Describe how the apparatus can be used to accurately obtain the measurements needed.

(4)

(b) Describe how the measurements would be used to determine a reliable value of k.

(3)

(c) State why it is important not to exceed the limit of proportionality of the spring.

(1)

(Total for Question 9 = 8 marks)

10 During the 17th century, the physicist Galileo carried out a series of experiments to investigate how gravity affected acceleration.

There were no accurate methods to measure short times, so Galileo used an object on a smooth inclined plane to increase the time taken for the object's motion.

(a) An object is released from rest and slides a distance s down a smooth inclined plane, as shown in diagram 1. This will take longer than releasing the object from rest and allowing it to fall freely through the same distance s, as shown in diagram 2.

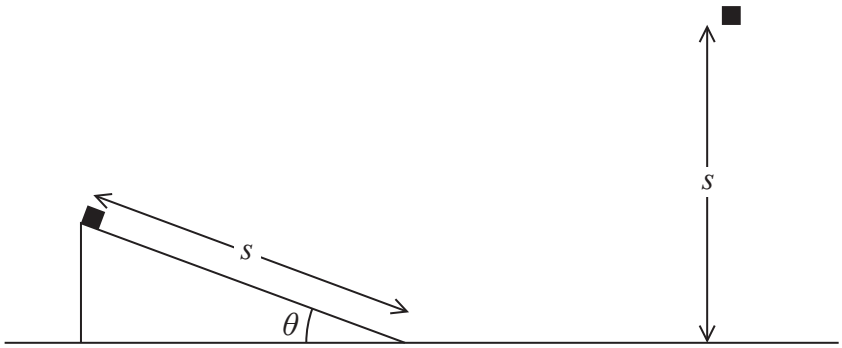


Diagram 1 Diagram 2

(i) Assuming that the frictional forces between the plane and the object are negligible, explain why the object in diagram 1 takes longer to travel distance s than the object in diagram 2.

(3)

(ii) Calculate the acceleration of the object in diagram 1 when $\theta = 35°$.

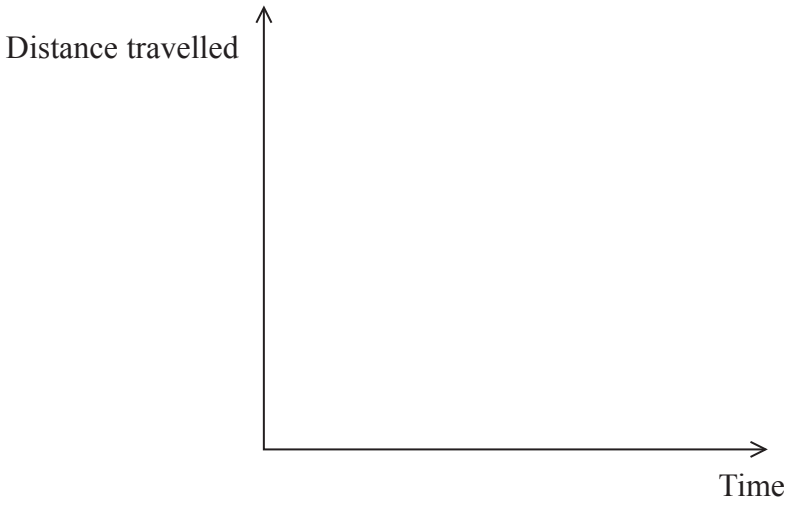
(2)

Acceleration = ...

(b) Galileo released a metal ball from rest so that it could roll down a smooth inclined plane. The time t taken to roll a distance s was measured. He repeated the experiment, each time recording the time taken to travel a different fraction of the distance s.

(i) On the axes below, sketch the distance-time graph that would be expected from these readings.

(2)



(ii) Write an expression for the time taken, in terms of t, for the ball to roll a distance $\frac{s}{2}$ from the top of the plane.

(1)

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Time taken = ...

(c) Galileo repeated his measurements many times and obtained similar results on each occasion. He did not have a stopwatch and had to measure times using his pulse. A human pulse is about one beat per second.

Comment on Galileo's method.

(2)

(d) Today, the acceleration of free fall can be found accurately by dropping a metal ball vertically and using ICT to collect data.

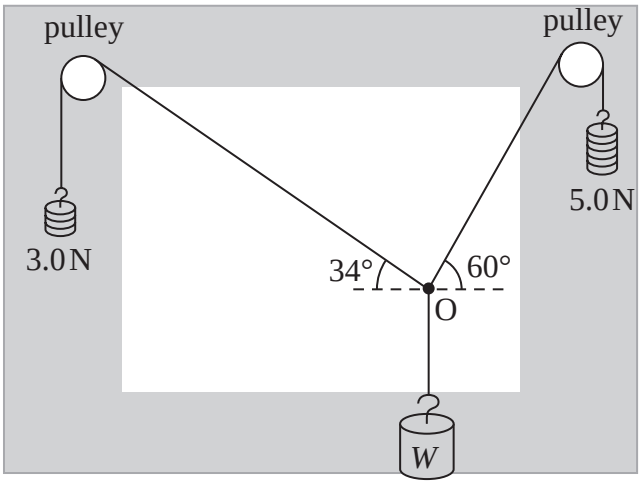
Suggest the apparatus required to take the measurements needed to calculate a value for the acceleration of free fall.

(2)

(Total for Question 10 = 12 marks)

11 The diagram shows the apparatus that can be used to determine the weight of a given body using vector addition.

Three pieces of string are tied together at point O. Two of the strings pass over frictionless pulleys and weights of 3.0 N, 5.0 N and an unknown weight *W* are attached as shown, so that the system is in equilibrium.

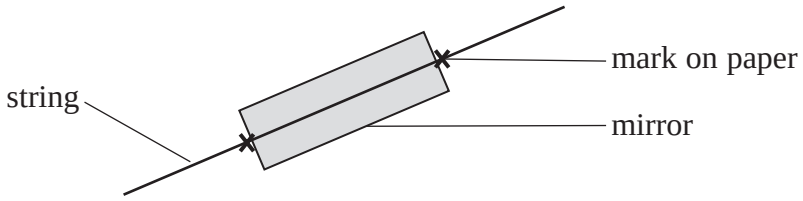


(a) Draw a scaled vector diagram, on the grid below, of the forces acting on point O. Use your diagram to determine the magnitude of the unknown weight *W*.

(4)

Magnitude of *W* = ...

(b) The angles are determined by marking the positions of the strings on a sheet of paper behind the strings. To improve accuracy, a mirror is placed behind each string.



Explain how the use of the mirror improves the accuracy of this experiment.

(2)

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(Total for Question 11 = 6 marks)

12 The aim of a high jump event is to jump over a horizontal bar at the greatest possible height without knocking the bar off. The Fosbury flop and Straddle jump are two styles of jump that can be used by athletes in high jump events.

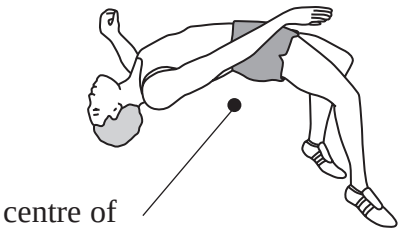
Fosbury flop

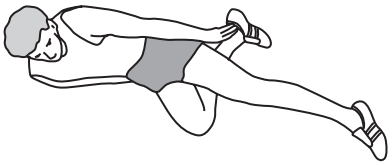
Straddle jump

(a) The diagrams below show the positions of the athletes as they pass over the bar. The approximate position of the centre of gravity of the athlete using the Fosbury flop has been drawn.

Mark the approximate position of the centre of gravity of the athlete using the Straddle jump.

(1)





*(b) Suggest, with an explanation, why most athletes prefer to use the Fosbury flop.

(3)

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(Total for Question 12 = 4 marks)

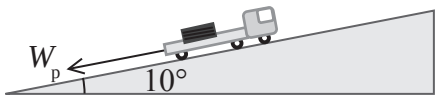
13 An escape lane is an emergency area placed next to a steep, downhill section of a road. It allows vehicles with brake failure to slow down and stop away from the other traffic.

One type of escape lane uses a gravity ramp. These are built with an upwards gradient to slow the vehicle.

(a) Explain how using the ramp enables a vehicle to stop.

(2)

(b) An escape lane consists of a ramp at an angle of 10° to the horizontal and is 180 m in length. A lorry of mass 2.8×10^3 kg enters the escape lane due to brake failure.



(i) Show that the component of the weight of the lorry parallel to the ramp is about 5×10^3 N.

(3)

(ii) The lorry uses the full length of the ramp while stopping and the frictional force of the road surface can be assumed to be negligible.

Calculate the maximum work done on the lorry bringing it to rest.

(2)

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Maximum work done on the lorry = ...

(iii) Calculate the maximum speed of the lorry so that it could be stopped by the ramp.

(2)

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Maximum speed of the lorry = ...

(c) Another type of escape lane uses a mechanical-arrestor system. This uses a series of steel nets set up along an escape lane to stop a vehicle. The nets are connected to the barriers at the sides of the escape lane using long steel strips that extend beyond their elastic limit as the vehicle slows down.

(i) State one advantage of building a mechanical-arrestor escape ramp compared to a gravity ramp.

(1)

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(ii) Suggest why it is necessary for the steel strips to extend beyond their elastic limit.

(2)

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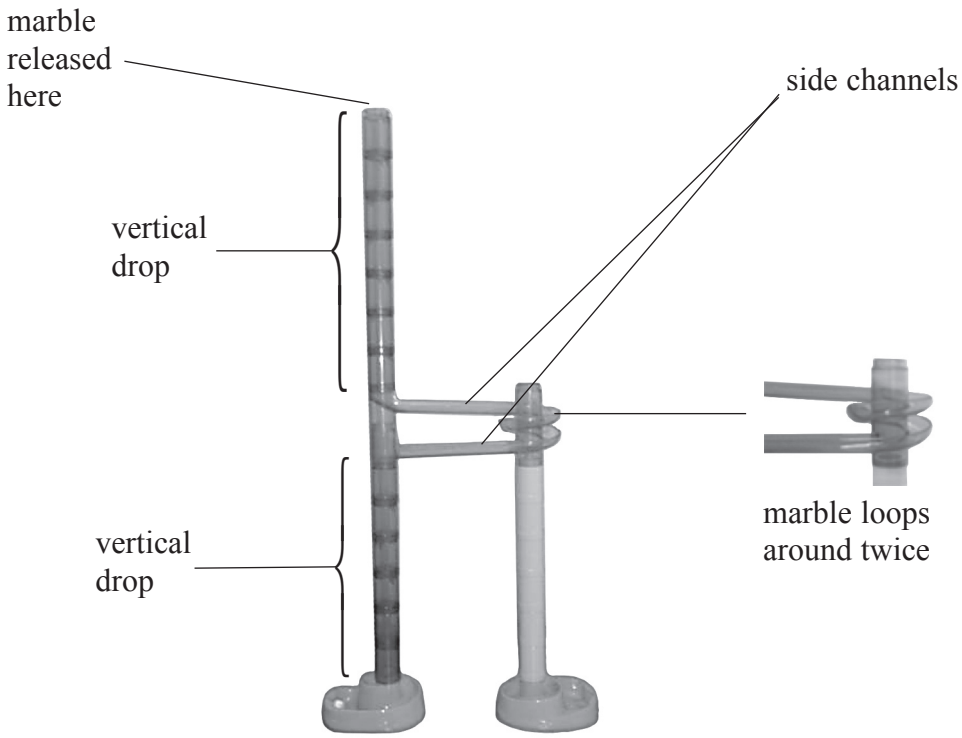
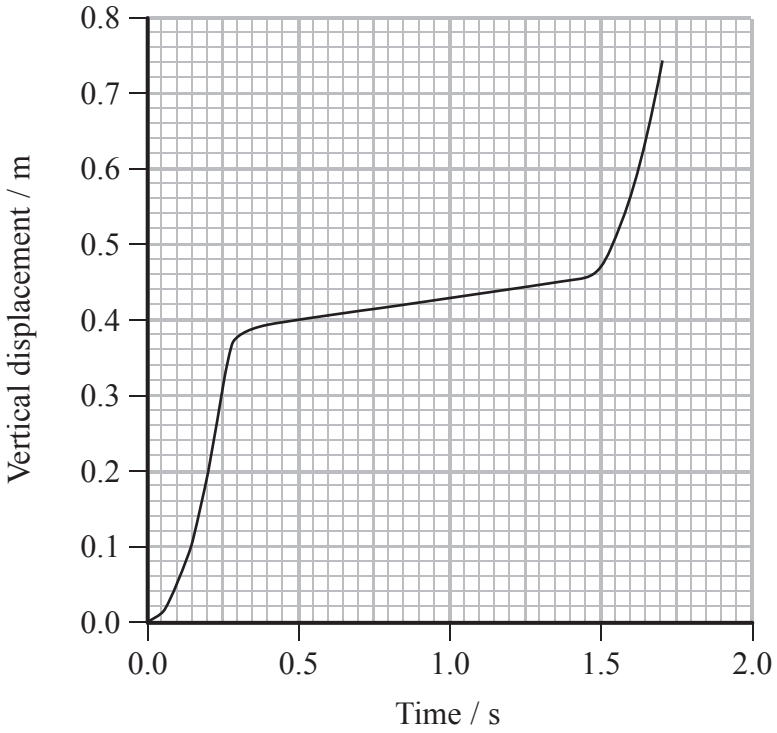
(Total for Question 13 = 12 marks)

14 The photograph shows a marble game.



A marble was released and its motion was recorded using a digital video camera. The data was uploaded to a computer and then analysed using a motion capture programme. The following vertical displacement-time graph was obtained.



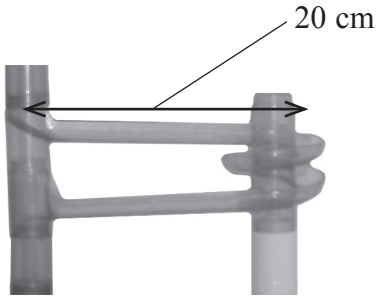
(a) (i) While the marble is in the side channels its speed remains constant.

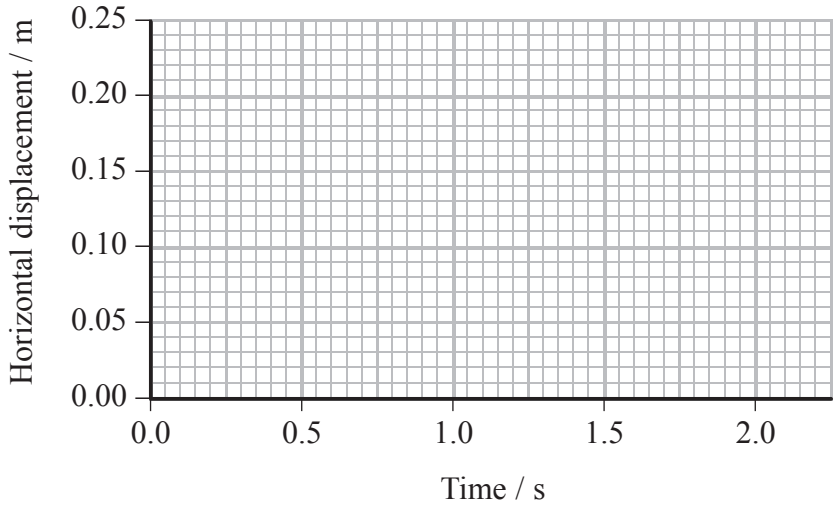
Use the graph to show that the vertical velocity is about 0.06 m s^{-1}.

(2)

(ii) On the axis below sketch the displacement-time graph for the horizontal displacement of the marble.

(4)





(iii) State the average horizontal velocity of the marble.

(1)

(b) Measurements of the displacement of the marble and time taken could have been made using a rule and stopwatch.

Explain the advantages of using the digital video camera compared with a rule and stopwatch to obtain the data.

(3)

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(Total for Question 14 = 10 marks)