Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number	Candidate Number

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Tuesday 19 May 2015 – Morning
Time: 1 hour 30 minutes

Paper Reference
WPH01/01

You must have:
Ruler, protractor

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*****) are ones where the quality of your written communication will be assessed – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- The list of data, formulae and relationships is printed at the end of this booklet.
- Candidates may use a scientific calculator.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

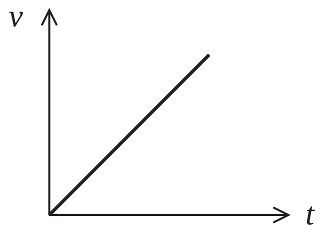
SECTION A

Answer ALL questions.

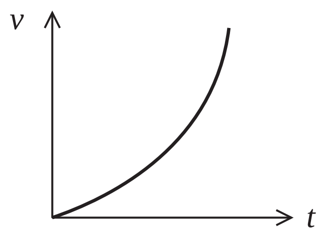
For questions 1–10, in Section A, select one answer from A to D and put a cross in the box ☒. If you change your mind, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 A moving object has uniform, non-zero acceleration.

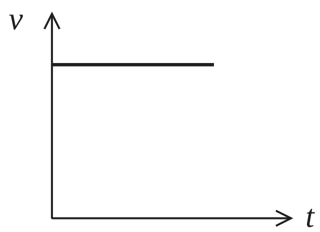
Which velocity-time graph correctly shows this?



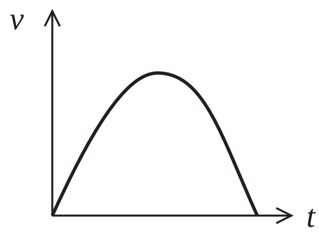
A



B



C



D

☐ **A**

☐ **B**

☐ **C**

☐ **D**

(Total for Question 1 = 1 mark)

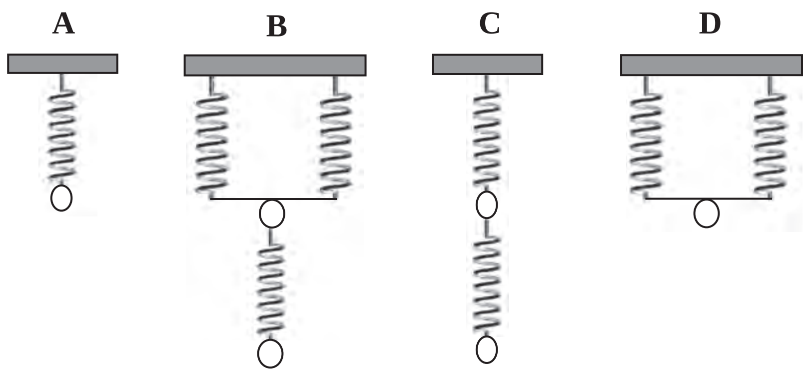
2 Physical quantities are either vectors or scalars.

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 2 = 1 mark)

3 The following arrangements all contain identical springs, shown unextended.



A mass *m* is added to the bottom of each arrangement. Which arrangement will produce the greatest total extension?

☒ **A**

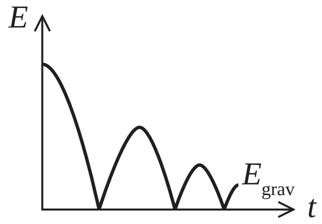
☒ **B**

☒ **C**

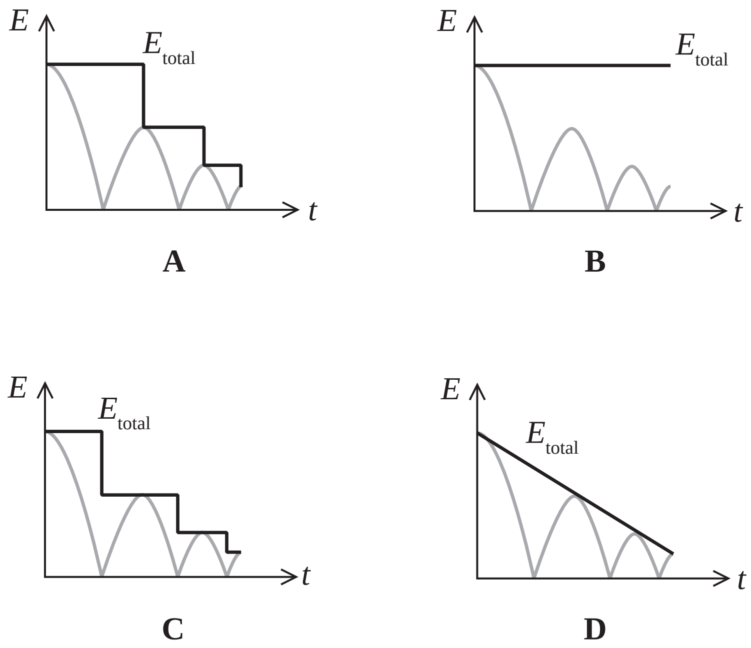
☒ **D**

(Total for Question 3 = 1 mark)

4 A ball is dropped and bounces three times before being caught. The following graph shows how the gravitational potential energy E_{grav} of the ball varies with time t.



Ignore the effects of air resistance. Select the graph that correctly shows how the total kinetic and potential energy E_{total} of the ball varies with time.



☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 4 = 1 mark)

5 A force is applied to a length of wire.

Which of the following statements is **not** correct for small deformations of the wire?

- ☒ **A** As the force applied increases, the extension increases.
- ☒ **B** The force applied is directly proportional to the extension.
- ☒ **C** The force applied is directly proportional to the original length.
- ☒ **D** The stress is directly proportional to the strain.

(Total for Question 5 = 1 mark)

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6 Aluminium can be used to produce thin sheets of food wrapping because it is

- ☒ **A** brittle.
- ☒ **B** ductile.
- ☒ **C** hard.
- ☒ **D** malleable.

(Total for Question 6 = 1 mark)

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7 A motor takes 10 minutes to lift a mass of 40 000 kg through a height of 5 m.

The minimum power of the motor in watts can be found using

- ☒ **A** $\dfrac{40\,000 \times 9.81 \times 5 \times 60}{10}$
- ☒ **B** $\dfrac{40\,000 \times 9.81 \times 5}{10 \times 60}$
- ☒ **C** $\dfrac{40\,000 \times 5 \times 60}{10}$
- ☒ **D** $\dfrac{40\,000 \times 5}{10 \times 60}$

(Total for Question 7 = 1 mark)

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8 A stone dropped into a well takes 1.5 seconds to reach the water.

Ignoring the effects of air resistance, what distance did the stone fall through?

☒ **A** 7 m

☒ **B** 11 m

☒ **C** 14 m

☒ **D** 22 m

(Total for Question 8 = 1 mark)

9 A swimmer jumps from a diving platform into a swimming pool. The swimmer is slowed to a stop by friction with the water.

The total work done by the water on the swimmer does **not** depend on

☒ **A** the mass of the swimmer.

☒ **B** the speed of the swimmer on entering the water.

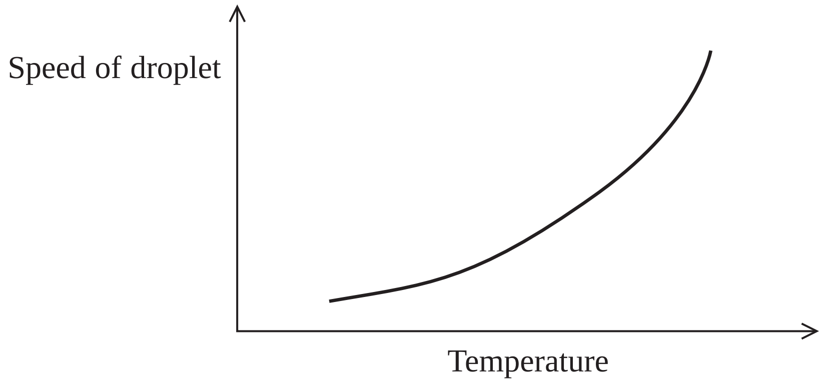
☒ **C** the depth of the swimming pool.

☒ **D** the height of the diving platform.

(Total for Question 9 = 1 mark)

10 A glue dispenser produces small droplets of glue. The glue dispenser contains a small heater.

The graph shows how the speed of a droplet leaving the dispenser varies with the temperature of the glue.



A higher temperature of glue is preferred because

☒ **A** the viscosity will be greater and the glue will flow at a greater speed.

☒ **B** the viscosity will be greater and the glue will flow at a lower speed.

☒ **C** the viscosity will be lower and the glue will flow at a greater speed.

☒ **D** the viscosity will be lower and the glue will flow at a lower speed.

(Total for Question 10 = 1 mark)

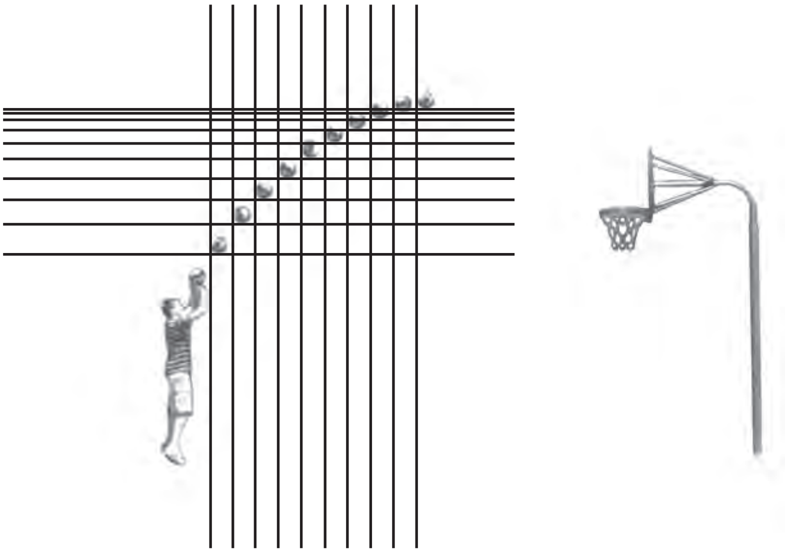
TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 A basketball is thrown towards a basket. The position of the ball at equal time intervals is shown in the photograph.

Vertical and horizontal lines have been added to the photograph to help identify the ball's horizontal and vertical position.



Suggest a reason for each of the following observations:

(a) the vertical lines are evenly spaced,

(1)

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....

(b) the horizontal lines become closer together.

(1)

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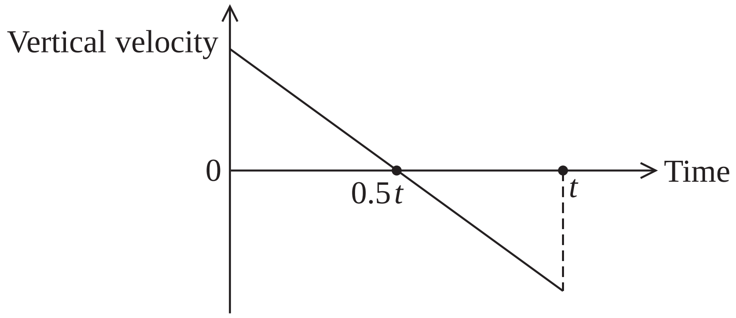
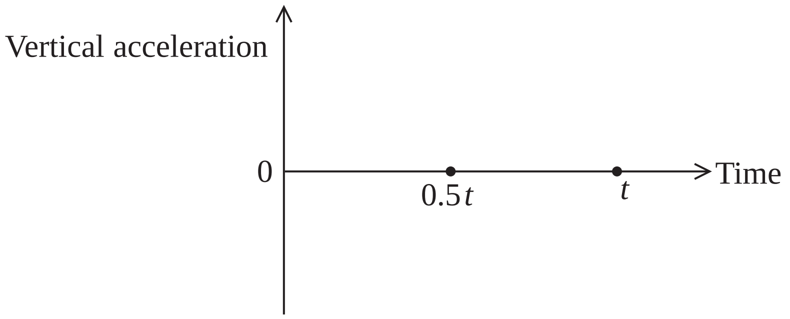
(Total for Question 11 = 2 marks)

12 A cricket ball is hit and travels across a field where it is caught at a time t. A graph of vertical velocity against time is shown.



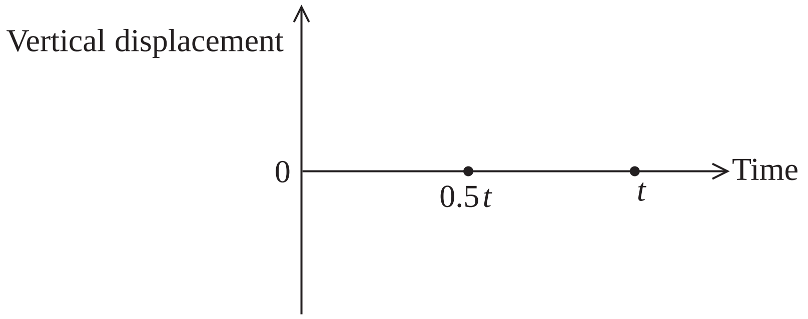
(a) On the axes below, sketch the corresponding graph of vertical acceleration against time for the motion of the cricket ball.

(2)



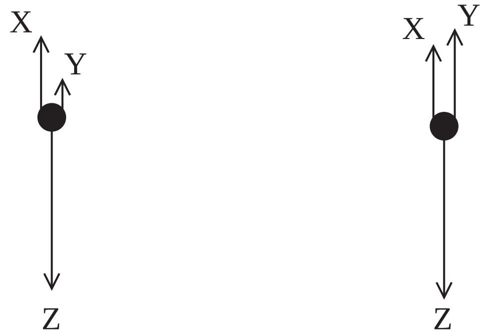
(b) On the axes below, sketch the corresponding graph of vertical displacement against time for the motion of the cricket ball.

(2)



(Total for Question 12 = 4 marks)

13 A small steel ball is released at the surface of some oil of known viscosity and begins to sink. The diagrams show the forces acting on the ball shortly after its release and when it has reached terminal velocity.



Steel ball shortly after release

Steel ball at terminal velocity

(a) Identify forces X, Y and Z.

(3)

X is ....

Y is ....

Z is ....

(b) A student uses Stokes' law to calculate force Y.

State the measurements the student should make to calculate force Y acting on the ball when it is moving at terminal velocity.

(2)

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(Total for Question 13 = 5 marks)

14 (a) A force is applied across the ends of a sample of wire. For small forces the deformation of the wire is elastic and for large forces the deformation is plastic.

Explain what is meant by the terms

(3)

elastic deformation ....

....

....

plastic deformation ....

....

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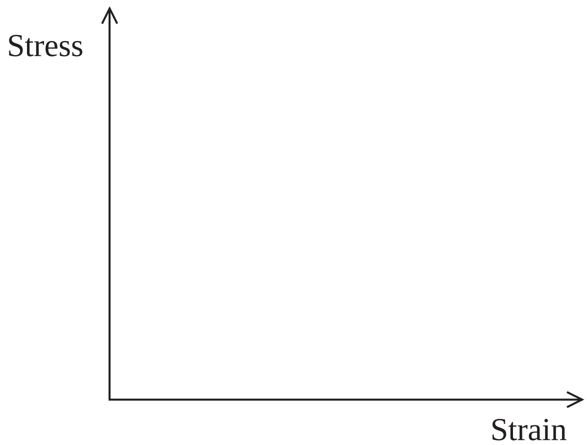
(b) Copper is a ductile material. This makes copper suitable for the production of wires.

(i) On the axes below, sketch the stress-strain graph for copper.

(2)



(ii) With reference to your graph, state why copper is a suitable material for the production of wires.

(1)

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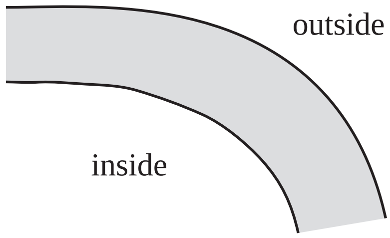
(Total for Question 14 = 6 marks)

15 Along a river there are changes in the speed of the water due to natural obstacles such as bends and rocks.

(a) At a bend, the water on the inside of the bend is shallower than the water on the outside of the bend.



Suggest why the speed of the water is lower at the inside of the bend than at the outside of the bend.

(1)

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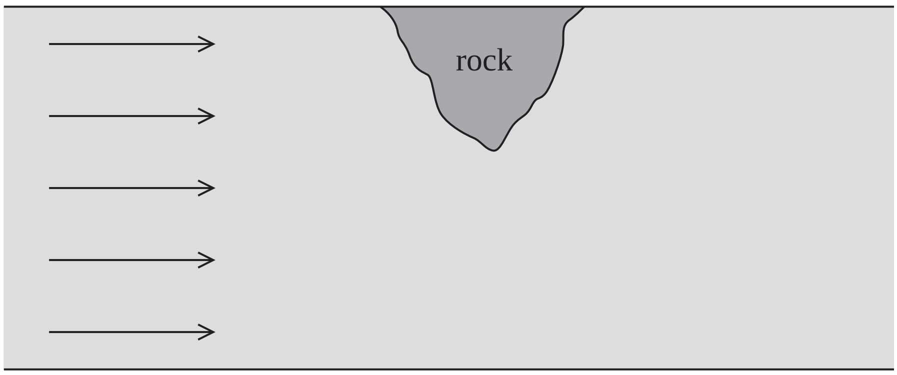
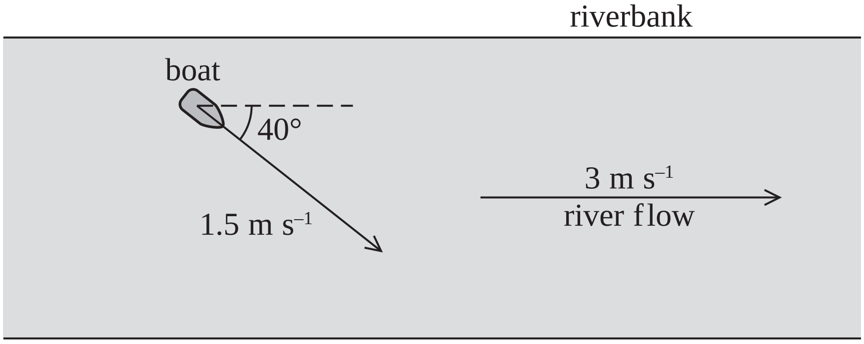
(b) On a straight section of the river, the water becomes very turbulent around a large rock. Complete and label the diagram below to show the flow of the water around the rock.

(2)



(c) The river is flowing at a speed of 3 m s^{-1}. A boat is pointed at an angle of 40° to the riverbank and paddled at a speed of 1.5 m s^{-1}, as shown in the diagram.



In the space below, draw a vector diagram to scale and use it to determine the magnitude of the actual velocity of the boat.

(3)

Magnitude of actual velocity = ...

(Total for Question 15 = 6 marks)

16 A passenger in an airport pulls a suitcase at a constant speed with a force of 80 N at an angle of 65° to the horizontal.

(a) (i) Show that the horizontal component of the applied force is about 30 N.

(2)

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(ii) Hence calculate the work done on the suitcase in pulling it a distance of 320 m.

(2)

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Work done = ...

(iii) Show that the vertical component of the applied force is about 70 N.

(2)

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(iv) State why no work is done in a vertical direction even though there is a component of the applied force in the vertical direction.

(1)

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*(b) Explain how the magnitude and angle of the applied force must change in order to make the suitcase accelerate horizontally.

(4)

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(Total for Question 16 = 11 marks)

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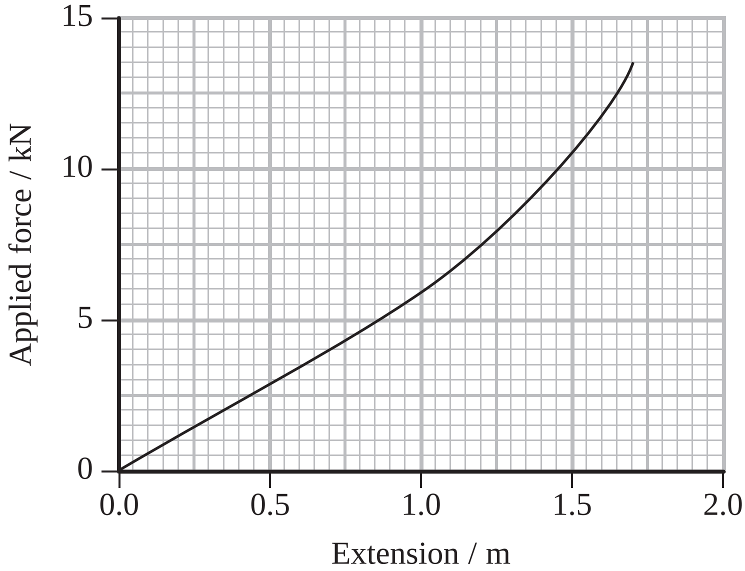
17 (a) The force-extension graph obtained when stretching a nylon rope is shown below.



Use the graph to determine the work done in extending the rope by 1.5 m.

(3)

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Work done = ...

(b) Kinetic towing of cars is a method that can be used when it is difficult for a towing car to achieve sufficient grip, such as in snow or sand.

A nylon strap is connected, with a lot of slack, between the two cars. The towing car drives forward and the strap must become stretched before it is able to pull the trapped car free.

trapped car

towing car

nylon strap

*(i) Explain why, even if the towing car had then stopped, the trapped car would still begin to move.

(2)

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(ii) The nylon strap used for kinetic towing typically has a breaking strain of 25%. Steel cables, often used for towing cars along roads, typically have a breaking strain of 0.02%.

It can be assumed that the nylon strap and the steel cable both obey Hooke's law. Show that, for the same pulling force and just before breaking, a nylon strap can store over 1000 times more energy than a steel cable of identical initial length and cross sectional area.

(3)

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P 4 4 9 2 3 A 0 1 8 2 8

(iii) Suggest why steel cables are **not** suitable for kinetic towing of cars.

(1)

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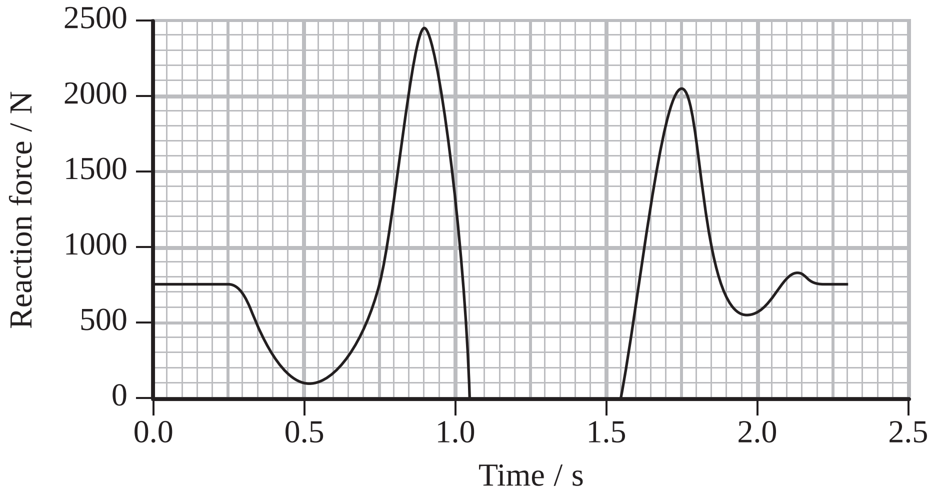
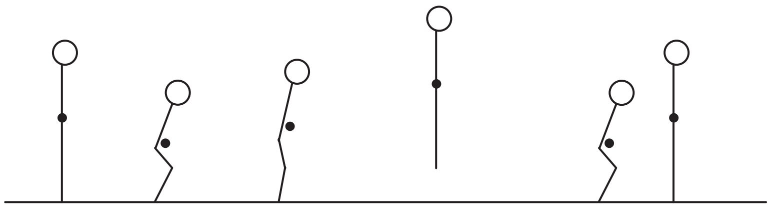
(Total for Question 17 = 9 marks)

18 An athlete bends his knees and then springs up into a vertical jump. The graph below shows how the reaction force from the ground on the athlete varies with time.

The diagram below the graph shows the position of the athlete at the corresponding times as he completes his jump.





(a) Show that the mass of the athlete is about 80 kg.

(2)

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(b) The small dot on each diagram of the athlete represents his centre of gravity.

(i) State what is meant by centre of gravity.

(1)

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P 4 4 9 2 3 A 0 2 0 2 8

(ii) Between 0.25 s and 0.75 s the athlete bends his knees. As a result of this, his centre of gravity moves lower.

Explain how the graph shows that an acceleration is produced as the athlete bends his knees.

(2)

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*(c) In order to jump, the athlete pushes down on the ground between 0.75 s and 1.05 s.

With reference to Newton's laws, explain why the athlete must push down on the ground.

(3)

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(d) The maximum reaction force was reached at t = 0.9 s. Calculate the acceleration of the athlete at this point.

(3)

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Acceleration = ...

(e) The athlete was in the air for 0.50 s.

(i) Calculate the height jumped by the athlete.

(2)

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Height = ...

(ii) Calculate the speed of the athlete on leaving the ground.

(2)

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Speed = ...

(Total for Question 18 = 15 marks)

19 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.

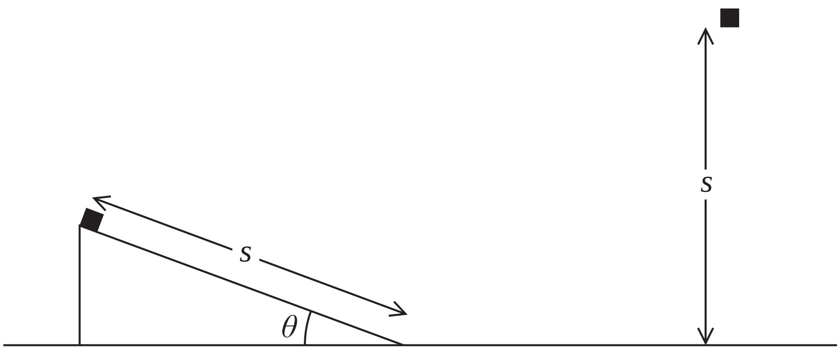

Diagram 1 Diagram 2

(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)

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

(2)

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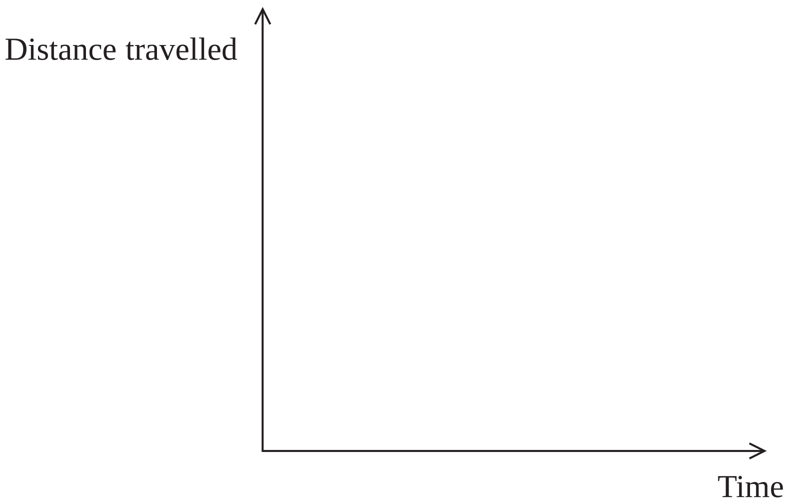
Acceleration = ...

(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)

....

....

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)

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(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)

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(Total for Question 19 = 12 marks)

TOTAL FOR SECTION B = 70 MARKS

TOTAL FOR PAPER = 80 MARKS

List of data, formulae and relationships

Acceleration of free fall	$g = 9.81\ \mathrm{m\ s^{-2}}$	(close to Earth's surface)
Electron charge	$e = -1.60 \times 10^{-19}\ \mathrm{C}$	
Electron mass	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$	
Electronvolt	$1\ \mathrm{eV} = 1.60 \times 10^{-19}\ \mathrm{J}$	
Gravitational field strength	$g = 9.81\ \mathrm{N\ kg^{-1}}$	(close to Earth's surface)
Planck constant	$h = 6.63 \times 10^{-34}\ \mathrm{J\ s}$	
Speed of light in a vacuum	$c = 3.00 \times 10^{8}\ \mathrm{m\ s^{-1}}$	

Unit 1

Mechanics

Kinematic equations of motion

$$v = u + at$$
$$s = ut + \tfrac{1}{2}at^2$$
$$v^2 = u^2 + 2as$$

Forces

$$\Sigma F = ma$$
$$g = F/m$$
$$W = mg$$

Work and energy

$$\Delta W = F\Delta s$$
$$E_k = \tfrac{1}{2}mv^2$$
$$\Delta E_{grav} = mg\Delta h$$

Materials

Stokes' law $F = 6\pi\eta rv$

Hooke's law $F = k\Delta x$

Density $\rho = m/V$

Pressure $p = F/A$

Young modulus $E = \sigma/\varepsilon$ where
Stress $\sigma = F/A$
Strain $\varepsilon = \Delta x/x$

Elastic strain energy $E_{el} = \tfrac{1}{2}F\Delta x$

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