Write your name here

Surname	Other names

Edexcel GCE

Centre Number | Candidate Number

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Monday 20 May 2013 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
6PH01/01R

You must have:
Ruler

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 ▶

P43321A

1/1/1/1/C2

P 4 3 3 2 1 A 0 1 3 2

PEARSON

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 Which of the following is a vector quantity?

☒ **A** kinetic energy

☒ **B** mass

☒ **C** power

☒ **D** velocity

(Total for Question 1 = 1 mark)

2 Which of these statements about work is **not** correct?

☒ **A** For work to be done a force must always be applied.

☒ **B** When work is done energy is transferred.

☒ **C** Work done is the product of force and distance moved perpendicular to the force.

☒ **D** Work done is a scalar quantity.

(Total for Question 2 = 1 mark)

3 Concrete pillars may be used to support heavy roofs.

Concrete is used because it has a

☒ **A** high compressive strength.

☒ **B** high tensile strength.

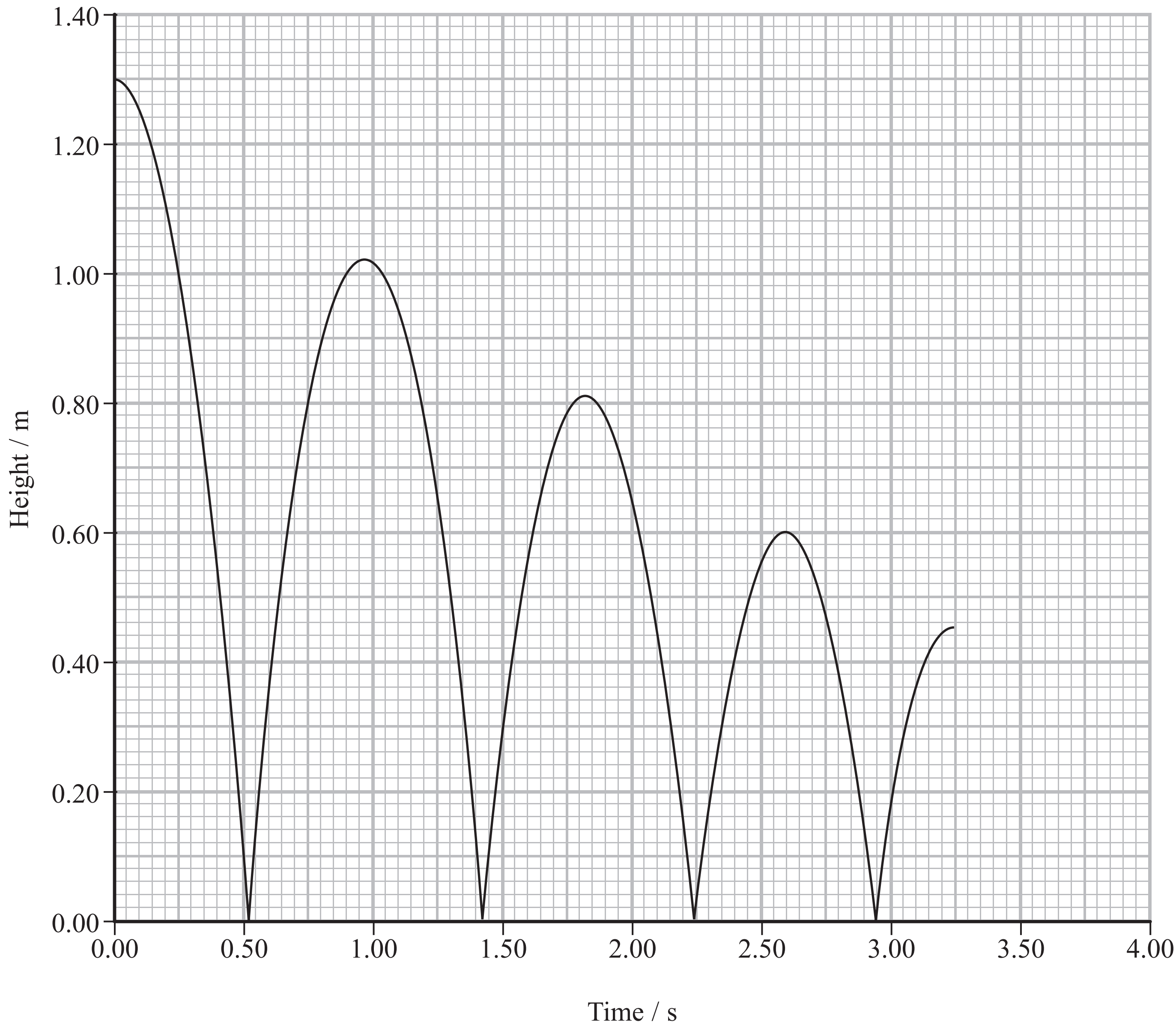
☒ **C** low stiffness.

☒ **D** low Young modulus.

(Total for Question 3 = 1 mark)

Questions 4, 5 and 6 refer to the graph below.

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.



4 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 4 = 1 mark)

5 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.

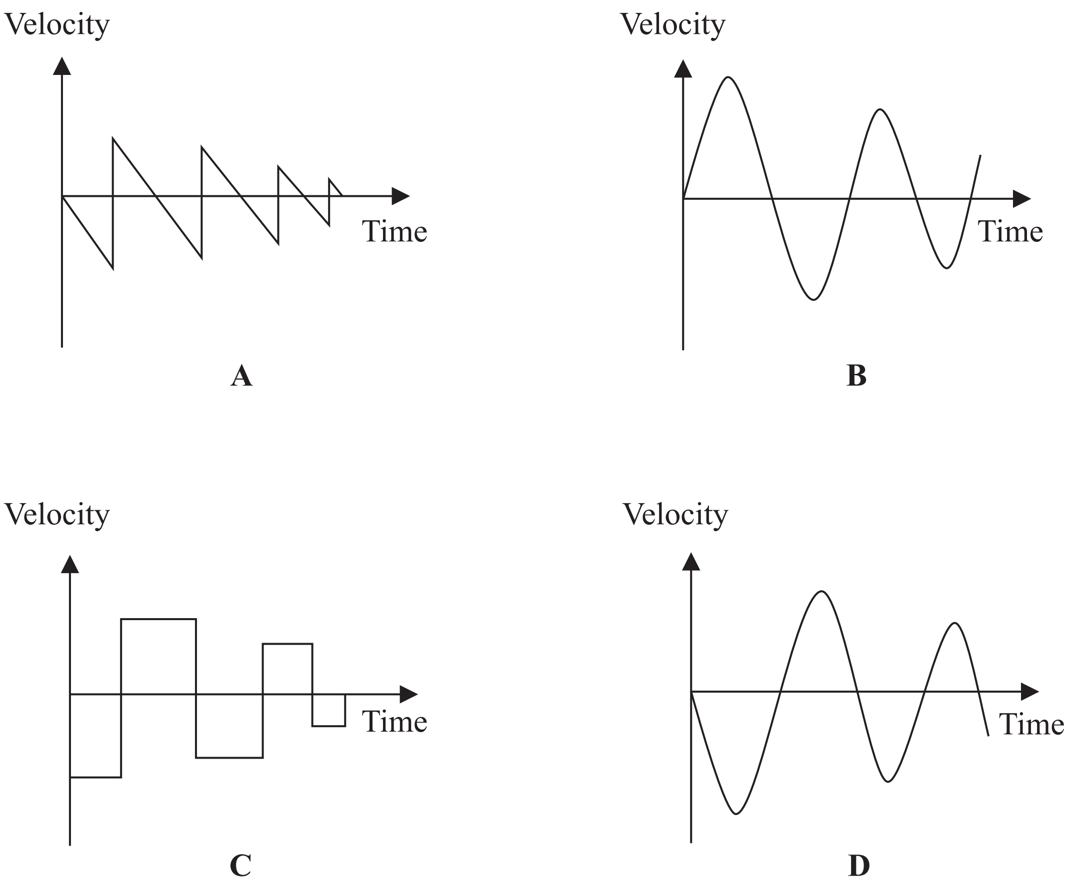
☒ **B** Divide the displacement at t = 2.5 s by 2.5 s.

☒ **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 5 = 1 mark)

6 Which of the following graphs could be the velocity-time graph for the ball?



☒ **A**

☒ **B**

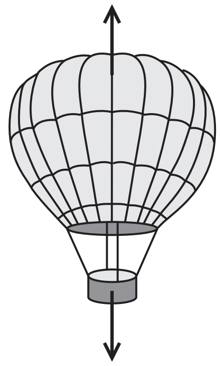
☒ **C**

☒ **D**

(Total for Question 6 = 1 mark)

Questions 7 and 8 refer to the diagram below.

The diagram shows the forces acting on a hot air balloon when at a constant height.

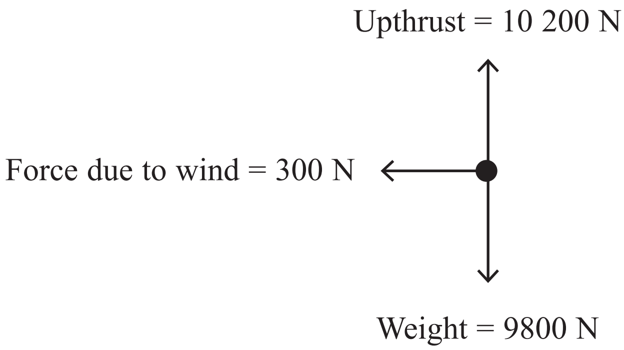


7 Select the row in the table that correctly describes the situation when the air in the balloon is heated.

	Observation	Reason
☒ **A**	Balloon rises	Weight > Upthrust
☒ **B**	Balloon falls	Weight > Upthrust
☒ **C**	Balloon rises	Weight < Upthrust
☒ **D**	Balloon falls	Weight < Upthrust

(Total for Question 7 = 1 mark)

8 Below is a free-body force diagram for the balloon when a wind is blowing.

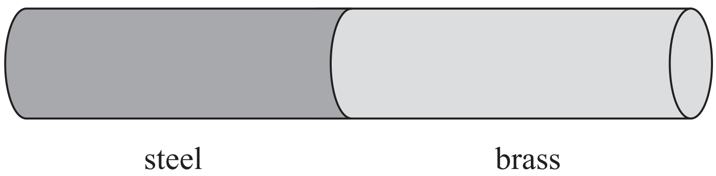


The magnitude of the resultant force acting on the balloon is

- ☒ **A** 400 N
- ☒ **B** 500 N
- ☒ **C** 700 N
- ☒ **D** 9 805 N

(Total for Question 8 = 1 mark)

9 A steel wire and a brass wire, with identical cross sectional areas and lengths, are fused together. The Young modulus for steel is approximately twice that of brass.



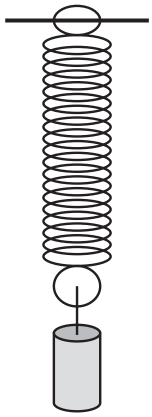
The combined wire is stretched.

The ratio $\frac{\text{extension of steel wire}}{\text{extension of brass wire}}$ is approximately

- ☒ **A** 2.0
- ☒ **B** 1.0
- ☒ **C** 0.50
- ☒ **D** 0.25

(Total for Question 9 = 1 mark)

10 A spring is suspended from a bar. When a load of 6.0 N is added to the bottom of the spring, its length changes from 0.040 m to 0.13 m.



To find the spring constant of the spring you would use

☒ **A** $\dfrac{0.13\,\text{m}}{6.0\,\text{N}}$

☒ **B** $\dfrac{6.0\,\text{N}}{0.13\,\text{m}}$

☒ **C** $\dfrac{6.0\,\text{N}}{0.090\,\text{m}}$

☒ **D** $\dfrac{0.090\,\text{m}}{6.0\,\text{N}}$

(Total for Question 10 = 1 mark)

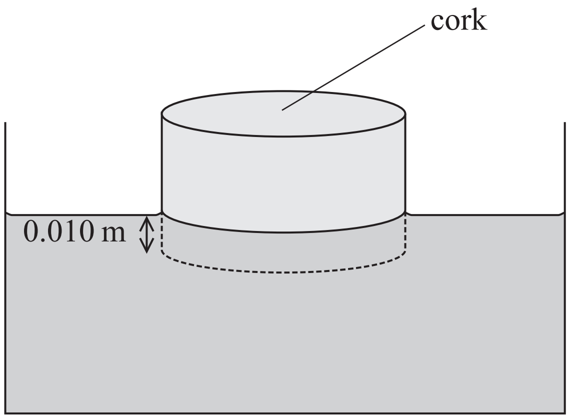
TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 A cylinder of cork of cross-sectional area 5.0×10^{-3} m^2 floats on water with its axis vertical. The length of the cork below the surface of the water is 0.010 m.

density of water = 1000 kg m^{-3}



(a) Show that the weight of water displaced by the cork is about 0.5 N.

(3)

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(b) State the weight of the cork and justify your answer.

(2)

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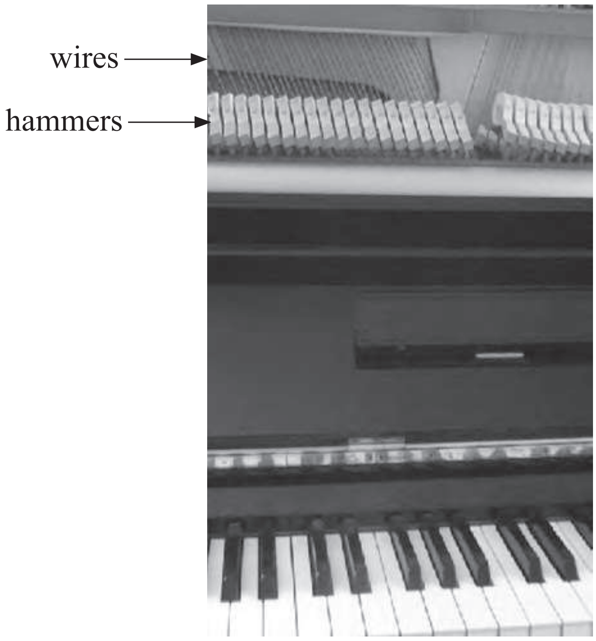
(Total for Question 11 = 5 marks)

12 When a note is played on a piano, a soft hammer is made to hit a wire. This causes the wire to vibrate creating a sound.

The wires used in pianos are hard, stiff and have a high tensile strength.



(a) Explain the meaning of the terms hard, stiff and high tensile strength.

(i) Hard

(1)

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(ii) Stiff

(1)

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(iii) High tensile strength

(1)

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*(b) It is important that a piano wire has a high elastic limit.

Explain why this is important.

(3)

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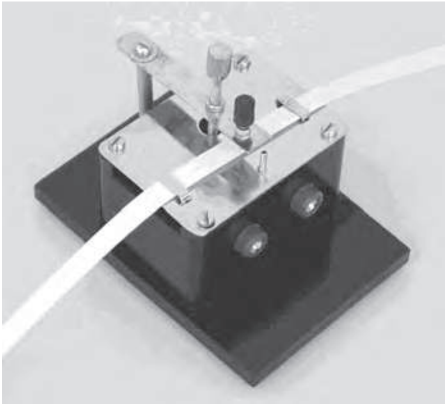
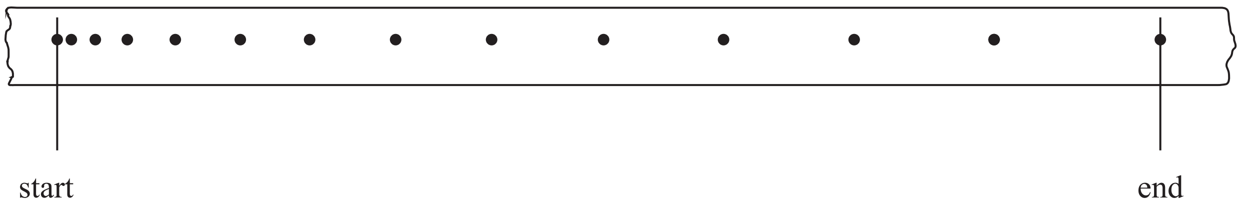
(Total for Question 12 = 6 marks)

13 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)

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

(2)

Average acceleration = ...

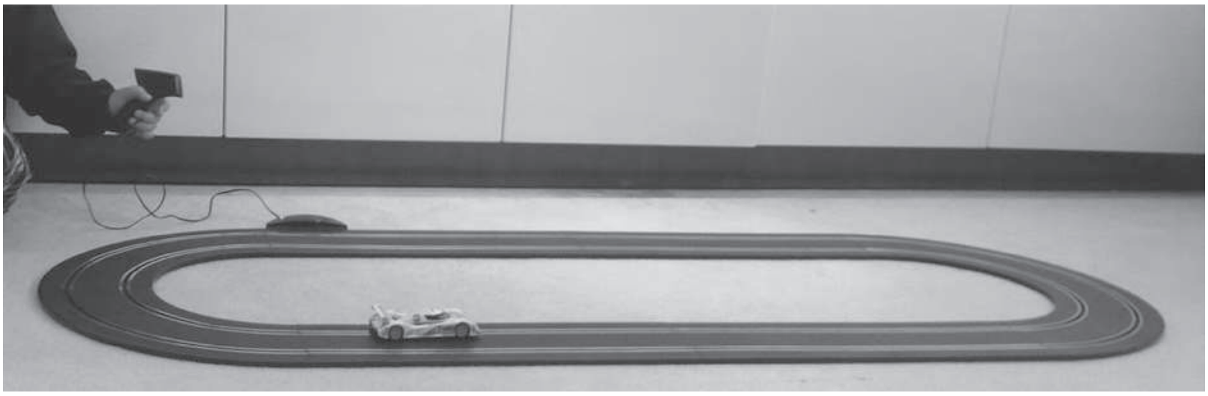
(b) Using a ticker tape timer is one method of measuring the speed of a moving object in a laboratory. Another method is to use a light gate with a data logger and computer.

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

(1)

(Total for Question 13 = 5 marks)

14 The picture shows a track for racing toy electric cars. A guide pin fits in a groove in the track to keep the car on the track. A small electric motor in the car is controlled, with a hand-controller, via contacts in the track.



A child places a car of mass 95 g on the track. She adjusts the controller to a power of 4.2 W so the car accelerates from rest for 0.40 s.

(a) (i) Show that the energy transferred by the motor in 0.40 s is about 2 J.

(2)

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(ii) Calculate the speed of the car at 0.40 s.

(2)

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Speed = ...

(iii) Suggest why the actual speed of the car is less than the calculated speed.

(1)

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(b) At high speed the guide pin may become disengaged from the groove.

Use Newton's first law to explain why the car would then leave the track at a corner.

(2)

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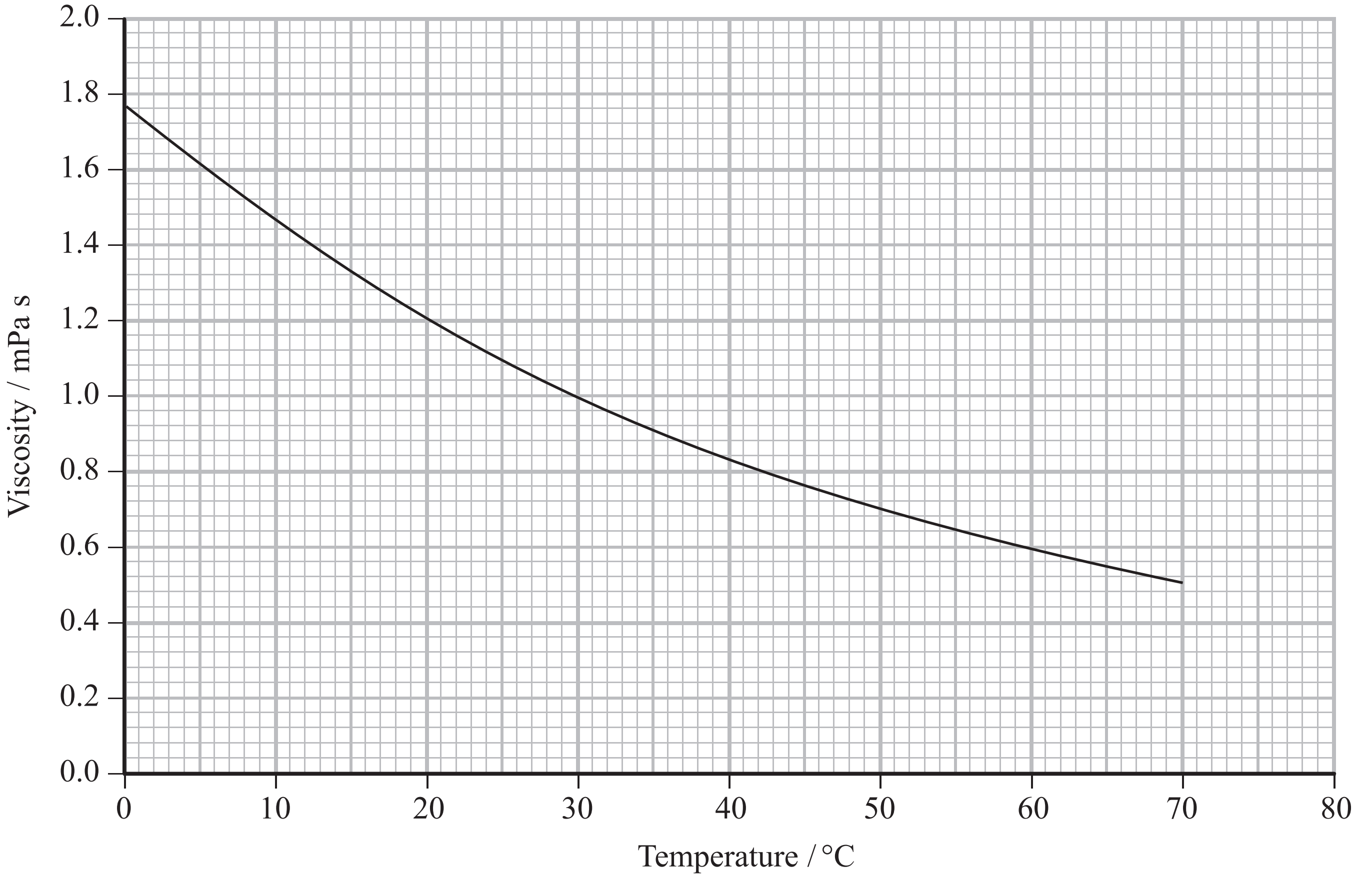
(Total for Question 14 = 7 marks)

15 The graph shows how the viscosity of ethanol varies with temperature.



(a) Describe how the viscosity of ethanol varies with temperature.

(2)

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(b) (i) Use Stoke's law to show that the SI unit of viscosity is Pa s.

(2)

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(ii) A small sphere is dropped into a large volume of ethanol at 24 °C.

Show that, if the drag were due to viscous forces alone, the terminal velocity would be about 4 ms^{-1}.

Assume that upthrust is negligible.

radius of sphere = 5.0×10^{-4} m

room temperature = 24 °C

mass of sphere = 4.0×10^{-6} kg

(3)

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*(c) Diesel is used as the fuel in some vehicles. Diesel is not renewable, so alternatives are being researched. Biodiesel is a fuel made from vegetable oil; biodiesel on its own is not suitable for use in vehicles.

The table gives some information about diesel, biodiesel and ethanol.

	Viscosity / mPa s at 0 °C	**Viscosity / mPa s at 40 °C**	**Energy / MJ kg^{-1}**	**Freezing point / °C**
Diesel	4.9	2.6	43	–30
Biodiesel	17.3	4.6	39	–12
Ethanol	1.8	0.9	27	–114

Blends of biodiesel with ethanol are being researched as a renewable alternative to diesel fuels for use in vehicles all year round.

Using the information in the table, suggest why these blends are being researched.

(3)

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(Total for Question 15 = 10 marks)

16 The photograph shows an athlete performing a long jump.

At take-off his horizontal speed is 8.0 m s^{-1} and his vertical speed is 2.8 m s^{-1}.

(a) Show that the total time the athlete spends in the air is about 0.6 s.

Assume that his centre of gravity is at the same height at take-off and landing.

(3)

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(b) Calculate the horizontal distance jumped by the athlete.

(2)

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Horizontal distance = ...

(c) In reality, when the athlete lands his centre of gravity is 50 cm lower than its position at take-off.

Calculate the extra horizontal distance this enables the athlete to jump.

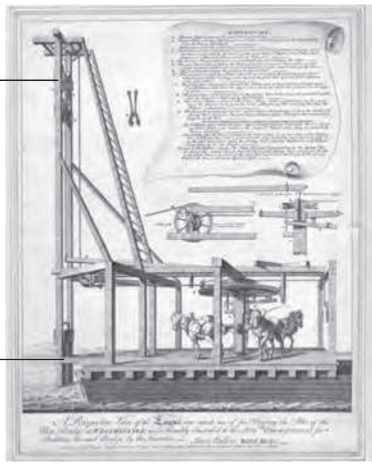
(4)

Extra horizontal distance = ...

(Total for Question 16 = 9 marks)

17 Pile drivers have been used for centuries to push piles into the ground for use as foundations of buildings and other structures. A large mass (the driver) is raised and then dropped onto an object (the pile) which is pushed into the ground.

The picture shows the pile driver that was used to build a London bridge in the 17th century.



(a) (i) The driver on the pile driver above had a mass of 810 kg and could be dropped a maximum distance of 6.0 m onto the pile.

Show that the energy transferred from the driver is about 50 kJ.

(2)

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(ii) In one instance, 40% of this energy is used usefully to drive in the pile. The pile moves 0.20 m into the ground.

Determine the average resistive force acting on the pile as it moves through the ground.

(3)

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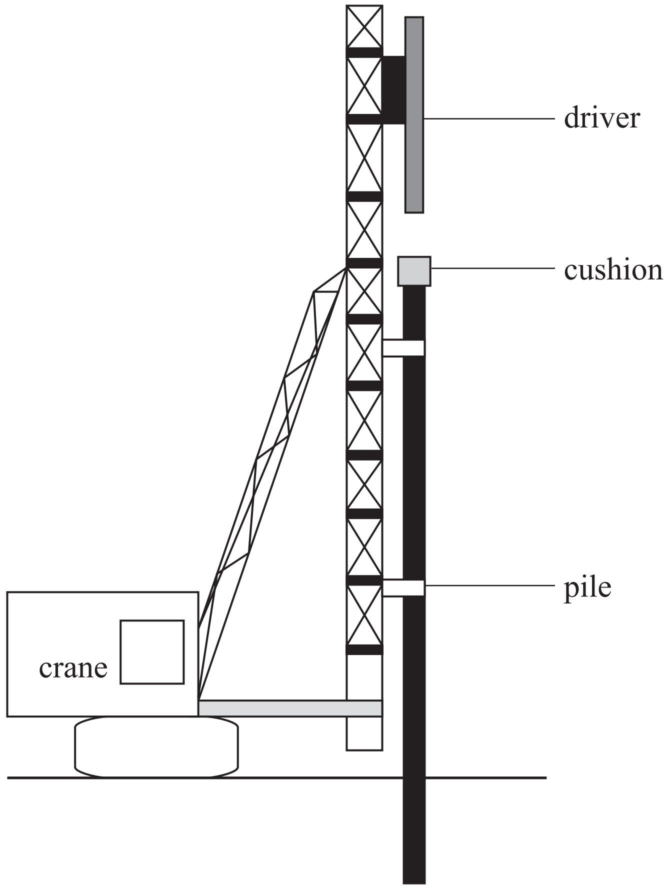
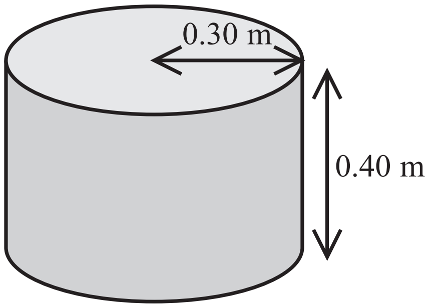
Average resistive force = ...

P 4 3 3 2 1 A 0 2 2 3 2

(b) In order to protect the driver on modern pile drivers, a cushion made of wood is placed on the pile.



The cushion is a cylindrical piece of wood of Young modulus = 120 MPa



The cushion is compressed when hit by the driver.

(i) The maximum compressive force applied to the wood during impact is 7.0×10^5 N. Show that the compression of the cushion is about 0.01 m.

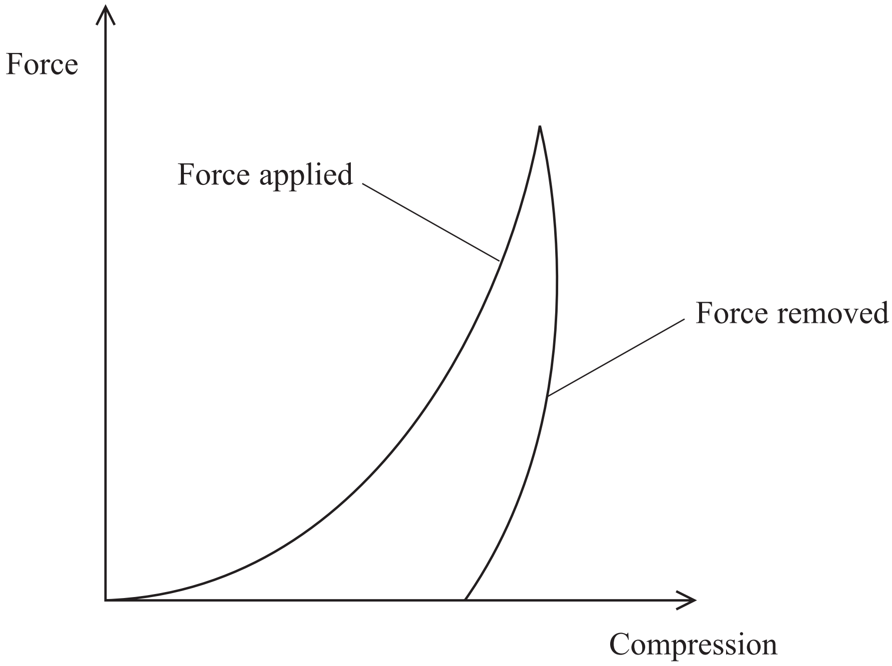
(3)

(ii) Calculate the energy stored in the cushion under compression.

(2)

Energy stored = ...

*(iii) The graph shows how the compression of the wooden cushion varies with force, as the force is applied and removed during an impact.



Use the graph to explain the following:

1. the wooden cushion has to be replaced after a few hundred impacts,

(2)

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2. with each impact the temperature of the wooden cushion rises slightly.

(1)

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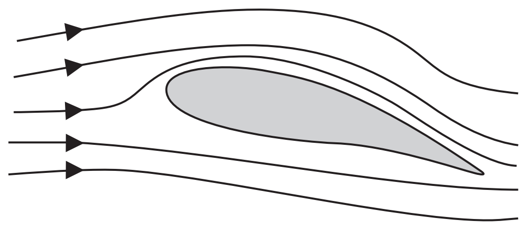
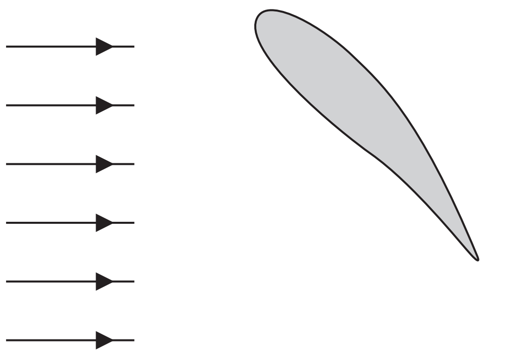
(Total for Question 17 = 13 marks)

18 The cross section of the wing of a bird is an aerofoil shape.



Direction of flight

In order to fly higher, a bird can tilt its wings more. If it tilts them too much, as shown in the diagram below, the air flow above the wing becomes turbulent.



Direction of flight

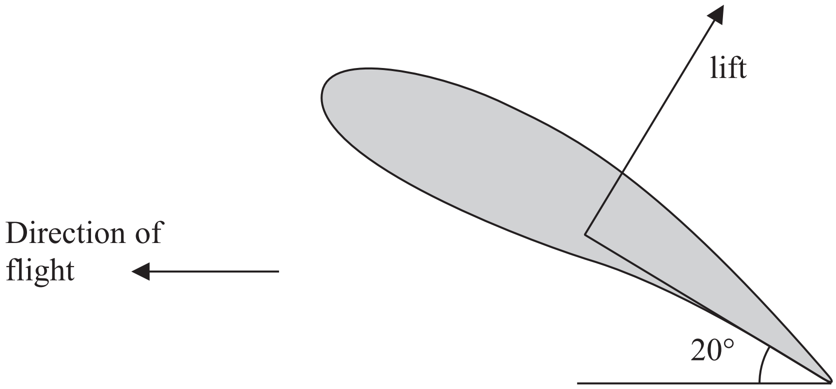
(a) Complete the diagram above to show the airflow around the wing.

(2)

(b) The tilting of the wing results in the air exerting a force on the wing which is called lift. The lift force acts perpendicular to the wing.

The total vertical component of the lift produced by both wings when tilted at an angle of 20° to the horizontal is enough to keep the bird flying at a constant height.

mass of bird = 0.063 kg



(i) Show that the total lift acting on the bird is about 1 N.

(3)

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(ii) Assuming that the only forces acting on the bird are the weight and lift, calculate its acceleration at this instant.

(3)

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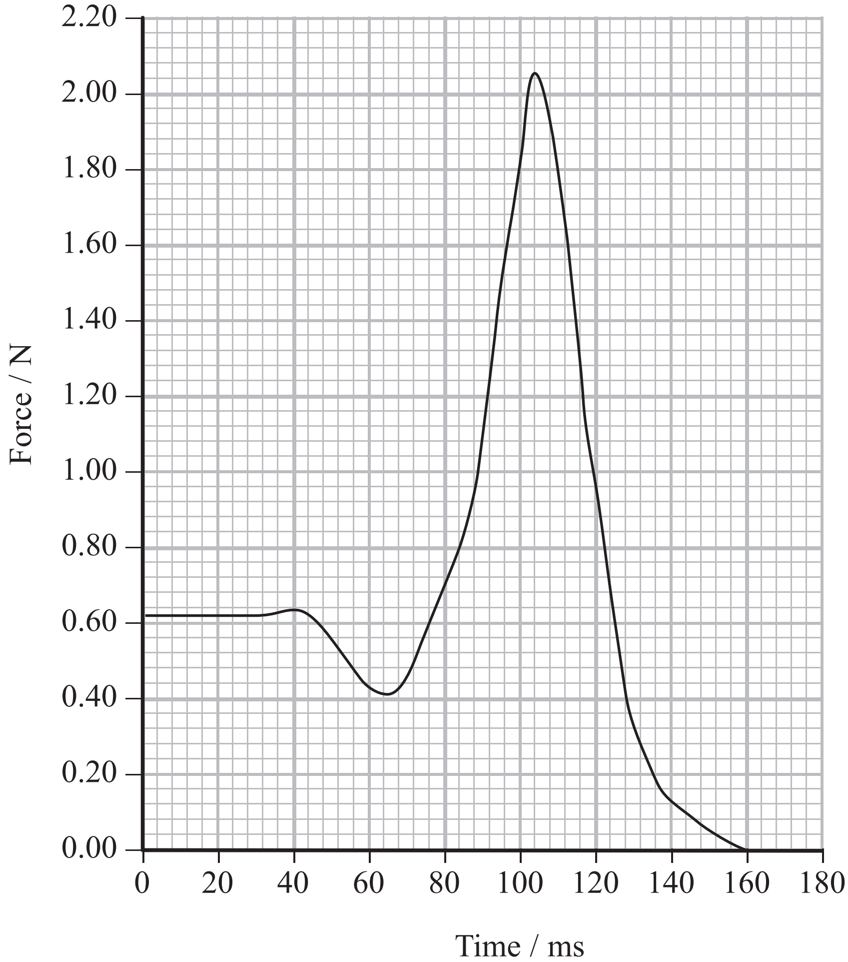
Acceleration = ...

(c) When some birds take off from the ground there is no lift initially. These birds push off from the ground with their legs.

The following graph shows the downward force exerted by the leg on the ground during take off.



(i) With reference to Newton's laws explain how the downward force from the leg enables the bird to take off.

(4)

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(ii) Use the graph to calculate the maximum acceleration of the bird during take off.

mass of bird = 0.063 kg

(3)

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Maximum acceleration = ...

(Total for Question 18 = 15 marks)

TOTAL FOR SECTION B = 70 MARKS

TOTAL FOR PAPER = 80 MARKS

List of data, formulae and relationships

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

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