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 23 May 2017 – Morning
Time: 1 hour 30 minutes

Paper Reference
WPH01/01

You must have:
Ruler and 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 on these questions with your spelling, punctuation and grammar, as well as the clarity of expression.*
- 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.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

1/1/1/1/

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** distance

☐ **B** speed

☐ **C** velocity

☐ **D** work done

(Total for Question 1 = 1 mark)

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2 Which of the following is the unit of upthrust?

☐ **A** $\mathrm{N\,m^{-2}}$

☐ **B** $\mathrm{N\,m^{-1}}$

☐ **C** $\mathrm{N\,m}$

☐ **D** N

(Total for Question 2 = 1 mark)

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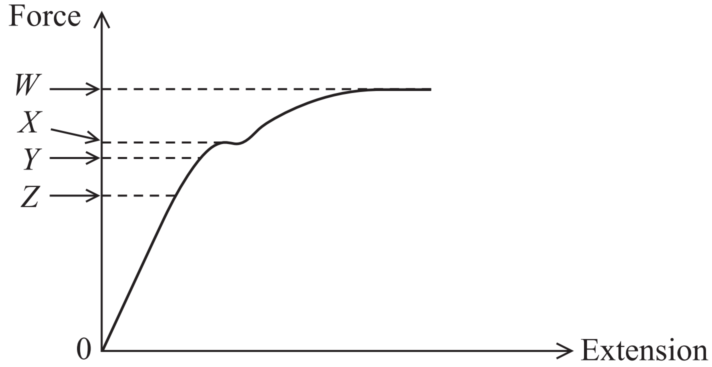
3 When a force is applied across the ends of a sample of wire, the wire extends until it fractures.

The force-extension graph for the sample of wire is shown.



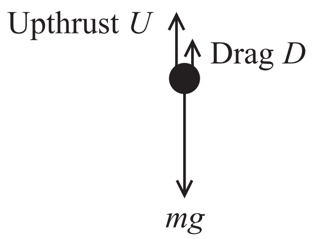
A force F is applied to an identical sample of the wire and then removed.

If the sample of wire is to return to its original length, what is the maximum force that can be applied?

- ☒ **A** W
- ☒ **B** X
- ☒ **C** Y
- ☒ **D** Z

(Total for Question 3 = 1 mark)

4 A small stone of mass m is dropped into a pond and accelerates downwards with an acceleration a. The free-body force diagram for the stone is shown.



Which of the following equations is correct for the stone?

- ☒ **A** $U + D - mg = 0$
- ☒ **B** $U + D - mg = ma$
- ☒ **C** $mg - U - D = 0$
- ☒ **D** $mg - U - D = ma$

(Total for Question 4 = 1 mark)

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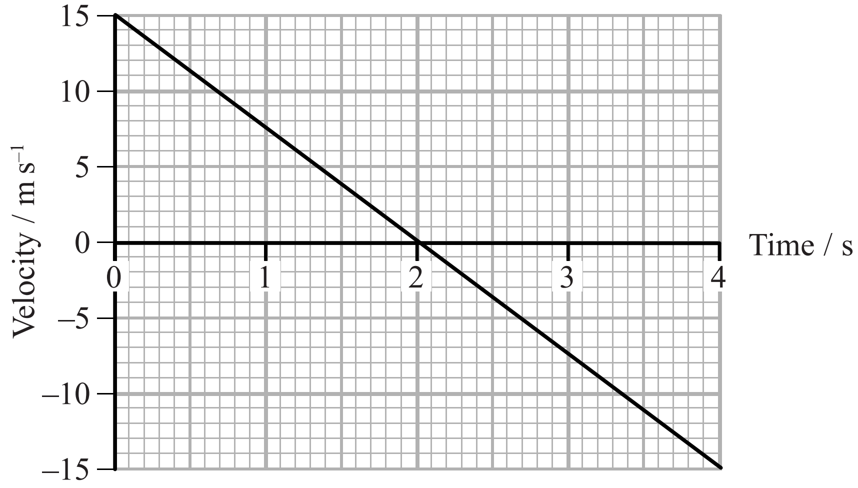
Questions 5 and 6 refer to the information below.

A student throws a ball vertically upwards and catches it after 4 s. The student's data is used to plot a velocity-time graph for the ball.



5 Using the graph, what is the acceleration of the ball?

- ☒ **A** 7.5 m s^{-2}
- ☒ **B** −7.5 m s^{-2}
- ☒ **C** 3.8 m s^{-2}
- ☒ **D** −3.8 m s^{-2}

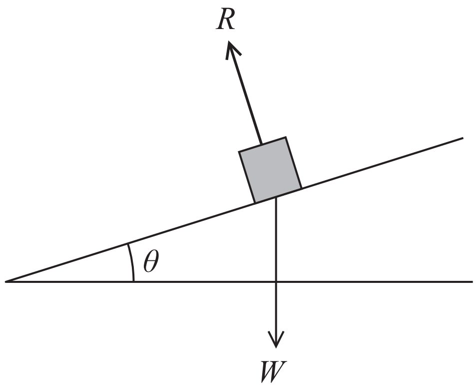
(Total for Question 5 = 1 mark)

6 Using the graph, what is the total distance travelled by the ball?

- ☒ **A** 0 m
- ☒ **B** 15 m
- ☒ **C** 30 m
- ☒ **D** 60 m

(Total for Question 6 = 1 mark)

7 An object of weight W is on a slope at an angle θ to the horizontal as shown. The normal contact force is R.



As θ increases, R will

☒ **A** decrease because $R = W\cos\theta$.

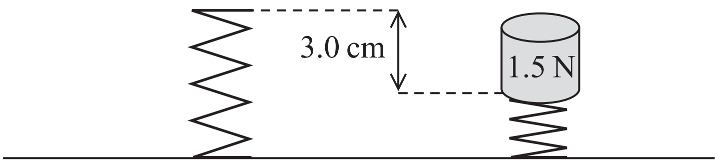
☒ **B** decrease because $R = W\sin\theta$.

☒ **C** increase because $R = W\cos\theta$.

☒ **D** increase because $R = W\sin\theta$.

(Total for Question 7 = 1 mark)

8 A cylinder of weight 1.5 N is placed on top of a vertical spring and the spring compresses by 3.0 cm as shown.



What is the spring constant of the spring?

☒ **A** $0.02\ \mathrm{N\ m^{-1}}$

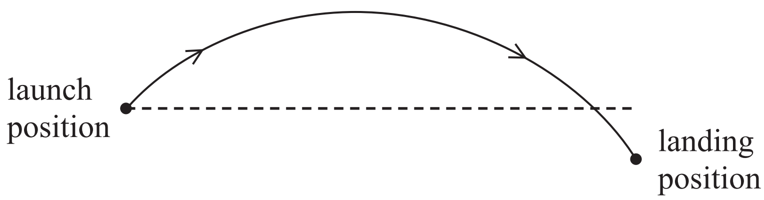
☒ **B** $0.5\ \mathrm{N\ m^{-1}}$

☒ **C** $2\ \mathrm{N\ m^{-1}}$

☒ **D** $50\ \mathrm{N\ m^{-1}}$

(Total for Question 8 = 1 mark)

9 The path of a projectile is shown.



The projectile landed at a height lower than the height from which it was launched.

Assuming there is no air resistance acting on the projectile, which of the following is a correct statement?

☒ **A** At the maximum height, the horizontal velocity is a minimum.

☒ **B** At the maximum height, the vertical velocity is a maximum.

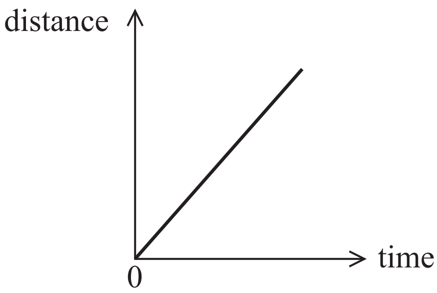
☒ **C** The initial horizontal velocity is equal to the final horizontal velocity.

☒ **D** The initial vertical velocity is equal to the final vertical velocity.

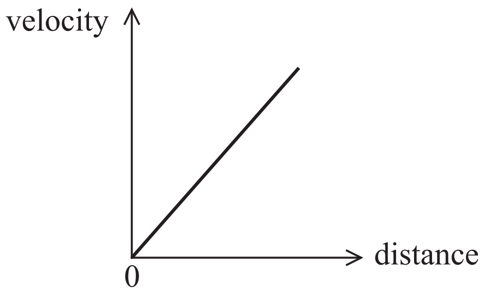
(Total for Question 9 = 1 mark)

10 A constant resultant force acts on an object.

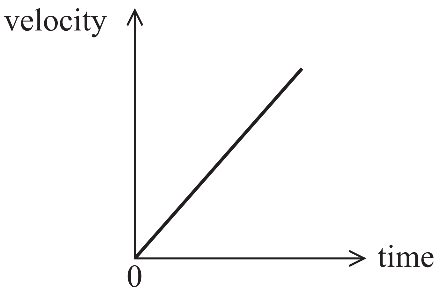
Which of the following graphs is correct for the motion of the object?



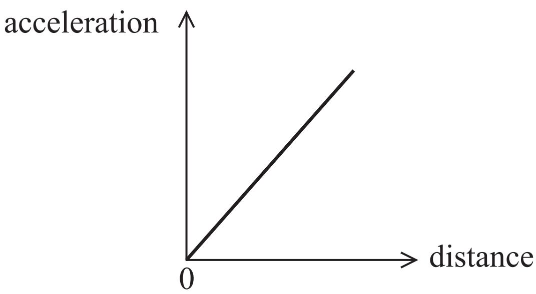
A



B



C



D

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

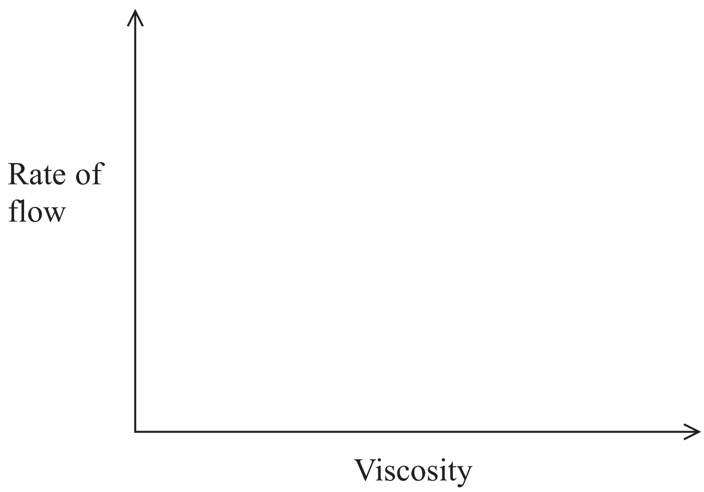
SECTION B

Answer ALL questions in the spaces provided.

11 The rate of flow of blood through arteries in the human body depends on the viscosity of the blood.

(a) Sketch, on the axes below, a possible graph to show how the rate of flow of blood varies with viscosity.

(1)



(b) When the temperature of the body is reduced, the heart has to do more work in order to pump blood through the arteries.

In terms of viscosity, explain why.

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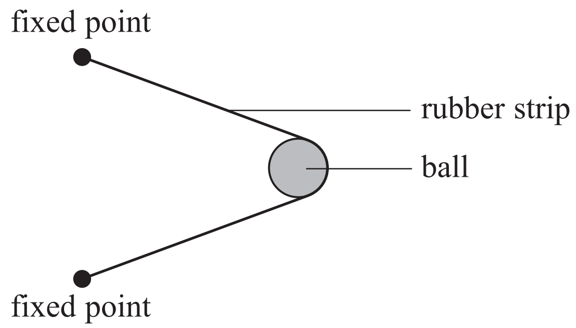
(Total for Question 11 = 4 marks)

12 A simple catapult consists of a rubber strip connected to two fixed points as shown. It is used to launch a ball of mass m. When pulled back, the rubber strip extends by Δx and has a tension T. When launched, the ball is given a velocity v.



(a) Describe, in terms of work done and energy transfers, what happens immediately after the rubber strip is released to launch the ball.

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(b) When the tension in the rubber strip is 3.5 N, the energy stored is 0.11 J.

Calculate the extension of the rubber strip.

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Extension = ...

(Total for Question 12 = 6 marks)

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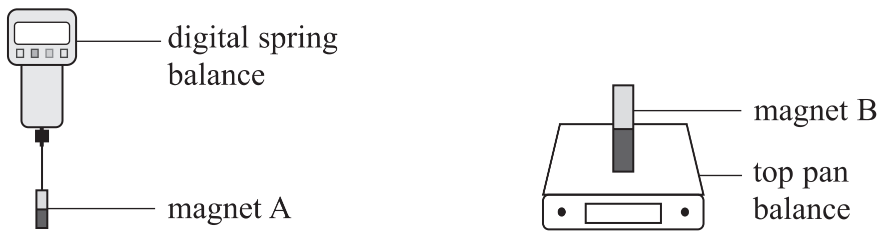
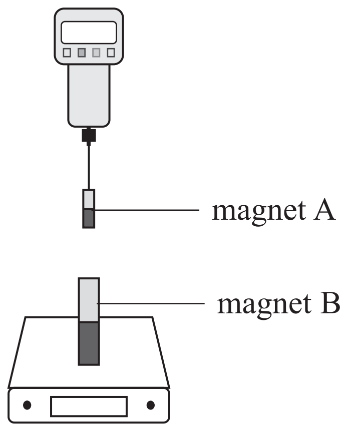
***13** A student has two magnets, A and B. Magnet A is smaller and weaker than magnet B.

The weight of magnet A is determined using a digital spring balance and the weight of magnet B is determined using a top pan balance as shown.



When magnet A is moved to a position just above magnet B there is an attractive force between the two magnets and the readings on the two balances change.



Explain how the readings on the two balances will change.

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(Total for Question 13 = 4 marks)

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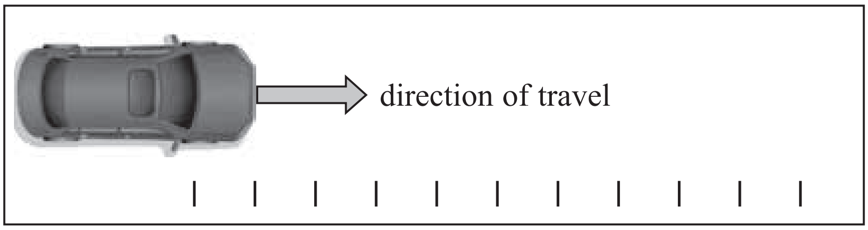
14 A camera may be used to determine if a car is exceeding the speed limit. The camera takes two photographs, at a time interval of 0.50 s, as the car travels over a set of equally spaced road markings as shown.



Measurements from the photographs enable the speed of the car to be calculated.

(a) Explain why the speed calculated is an average speed.

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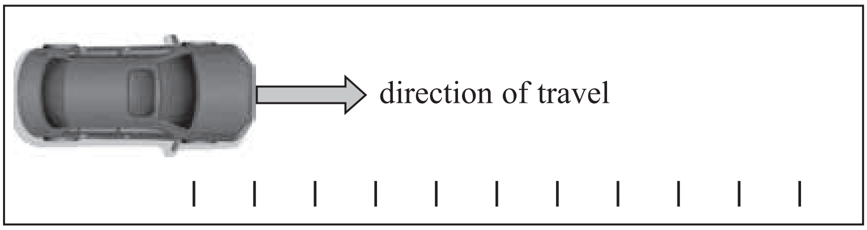
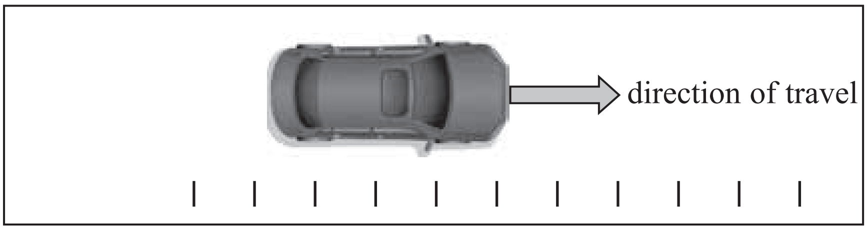
(b) The diagrams below show the positions of a car at a time interval of 0.50 s.

The markings are painted on the road at intervals of 1.52 m.



$t = 0$ s



$t = 0.50$ s

The speed limit is 50 km per hour.

Determine, using information from the diagrams, whether the car was exceeding the speed limit.

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(c) The position of the camera may result in an error in the calculated speed. Suggest why.

(1)

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(Total for Question 14 = 7 marks)

15 (a) A student investigated the motion of a small sphere falling through oil.

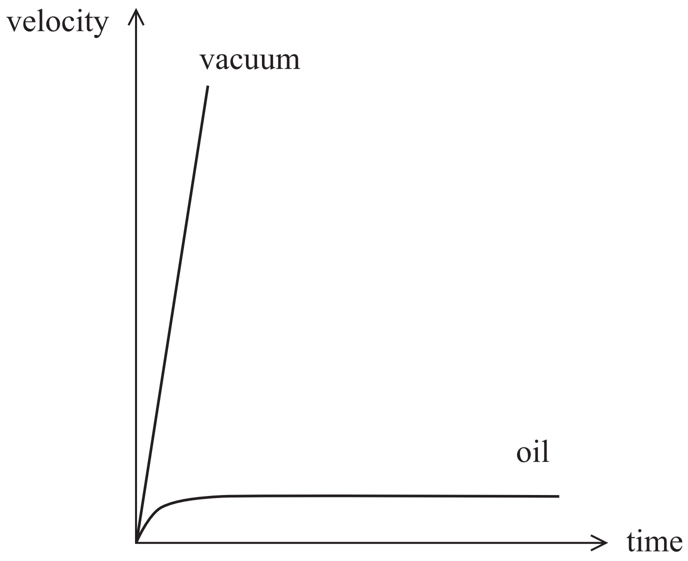
The sphere was released at the top of a cylinder containing oil and measurements were taken to enable the terminal velocity of the sphere to be determined.

Describe the apparatus the student should use and the measurements to be taken. The student does **not** have access to a motion sensor or a data logger. You may include a labelled diagram in your answer.

(5)

*(b) A teacher demonstrated the motion of a small sphere falling through a vacuum and through oil.

The teacher used a motion sensor and data logger connected to a computer.
The computer plotted graphs of velocity against time for the sphere as shown.



Explain the differences between the shapes of the graphs.

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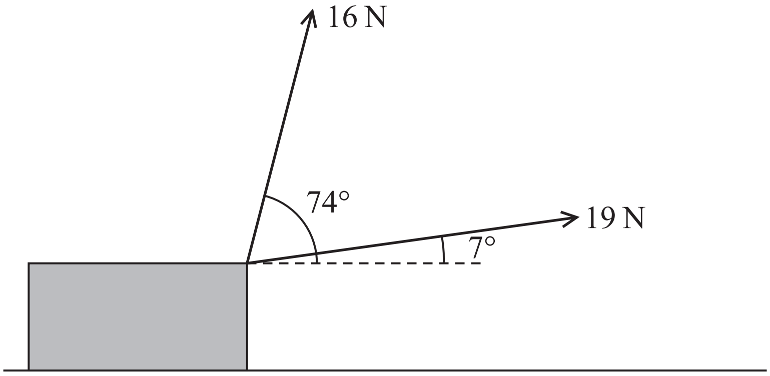
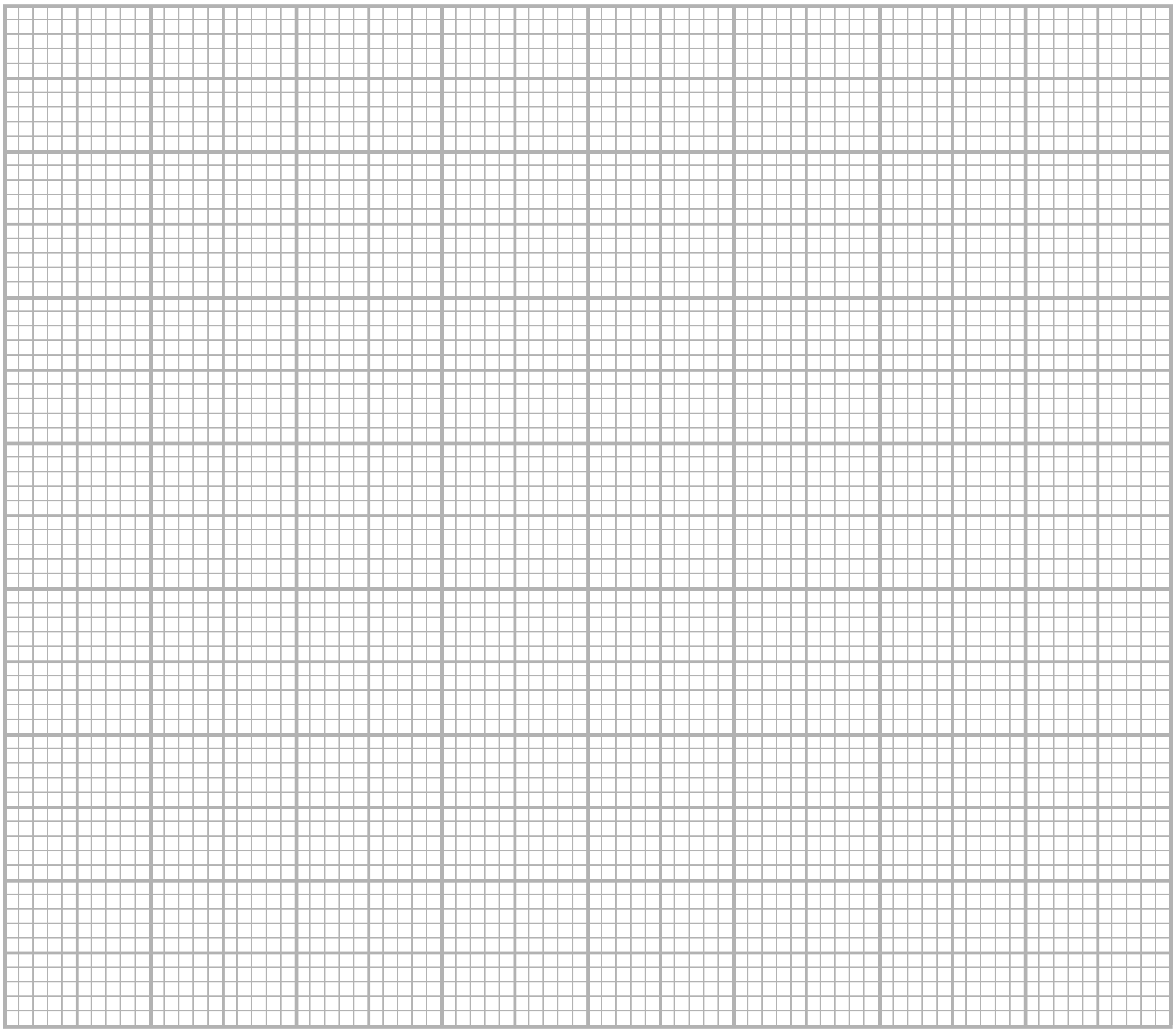
(Total for Question 15 = 11 marks)

16 (a) Forces of 19 N and 16 N act on a box at angles to the horizontal of 7° and 74° respectively, as shown.



Construct a scaled vector diagram on the graph paper to determine the resultant of the two forces.

(4)



Magnitude of resultant force = ...

Direction of resultant force to the horizontal = ...

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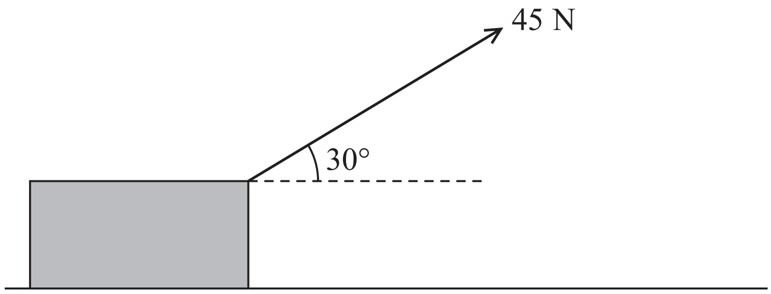
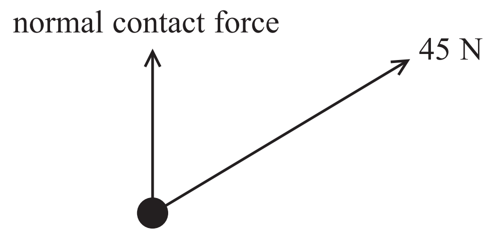
P 4 8 4 2 1 A 0 1 6 2 4

(b) A force of 45 N is applied to the box at an angle of 30° to the ground as shown.



(i) Complete the free-body force diagram for the box. Assume the surface of the ground is not smooth.

(2)



(ii) Determine the normal contact force of the ground on the box.

mass of box = 4.0 kg

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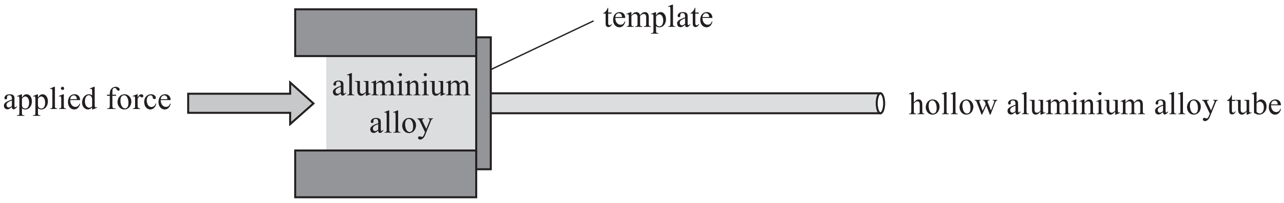
Normal contact force = ...

(Total for Question 16 = 10 marks)

17 A bicycle frame consists of hollow tubes made from an aluminium alloy.

(a) To produce the tubes, the aluminium alloy is pushed through a template as shown.



State and describe the property of the aluminium alloy that allows it to undergo this process.

(2)

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(b) A bicycle manufacturer gives the following data for the mechanical properties of an aluminium alloy used in their frames.

Yield point	276 MPa
Tensile strength	310 MPa
Strain on fracture	0.12

(i) State what is meant by

(3)

yield point ....

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tensile strength ....

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(ii) A tube made from this alloy has an original length of 80 cm.

Calculate the length of the tube at fracture.

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Length of tube = ...

(c) Bicycle frames can also be made from an alloy of steel. The density of the steel alloy is greater than the density of the aluminium alloy.

Explain why a bicycle with an aluminium alloy frame is better for racing.

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(Total for Question 17 = 11 marks)

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18 In an investigation of the jump of fleas, measurements were taken from a high speed video.

The body of a flea can provide a maximum power of 660 watts per kilogram.

(a) A flea of mass 0.70 mg takes 0.85 ms to take-off from rest.

(i) Show that the maximum velocity of the flea is about 1 m s^{-1}.

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(ii) Calculate the average acceleration of the flea at take-off.

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Average acceleration = ...

(b) The measurements were repeated with many fleas. The average initial velocity of the fleas at take-off was 1.2 m s^{-1} at 39° to the horizontal.

Calculate the average horizontal distance that a flea would travel.

(4)

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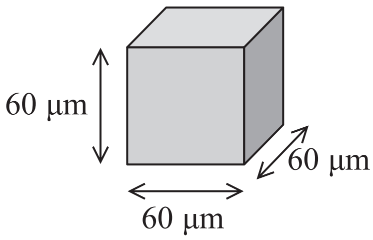
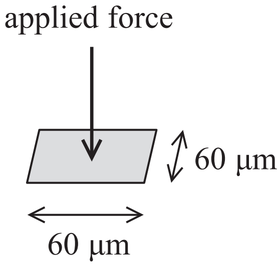
Average horizontal distance = ...

(c) When a flea jumps, some of the energy comes from the leg muscles and some from compressible pads behind the back legs. The pads are made from a protein called resilin.

Before jumping the pads are compressed. On take-off the pads expand rapidly, transferring energy to the back legs of the flea.

You can assume that each pad is a cube of sides 60 μm which fully compresses until the depth of the pad is negligible.





(i) For a particular jump, the total energy transferred from the pads and the leg muscles was 0.80 μJ.

Calculate the percentage of the energy for the jump that comes from the 2 pads.

Young modulus of resilin = 1.8×10^6 Pa
strain = 1.0

(5)

Percentage of energy = ...

(ii) Suggest two properties of resilin that make it suitable to assist with the jump.

(2)

(Total for Question 18 = 17 marks)

TOTAL FOR SECTION B = 70 MARKS
TOTAL FOR PAPER = 80 MARKS

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