Write your name here

Surname	Other names

Edexcel GCE

Centre Number | Candidate Number

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Wednesday 13 January 2010 – Morning
Time: 1 hour 30 minutes

Paper Reference
6PH01/01

You do not need any other materials.

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 ▶

N35080A

1/1/1/1/1/

N 3 5 0 8 0 A 0 1 2 8

edexcel
advancing learning, changing lives

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 scalar quantity?

☒ **A** displacement

☒ **B** force

☒ **C** time

☒ **D** velocity

(Total for Question 1 = 1 mark)

---

2 A substance which can undergo a large plastic deformation without cracking can be described as

☒ **A** brittle

☒ **B** hard

☒ **C** malleable

☒ **D** stiff

(Total for Question 2 = 1 mark)

---

3 A bus is travelling at a speed of 9.0 m s^{-1}. It then accelerates at a rate of 0.75 m s^{-2} for a time of 8.0 s. What is its final speed?

☒ **A** 6.0 m s^{-1}

☒ **B** 15 m s^{-1}

☒ **C** 17 m s^{-1}

☒ **D** 21 m s^{-1}

(Total for Question 3 = 1 mark)

---

4 Which of the following is not a SI base quantity?

☒ **A** force

☒ **B** length

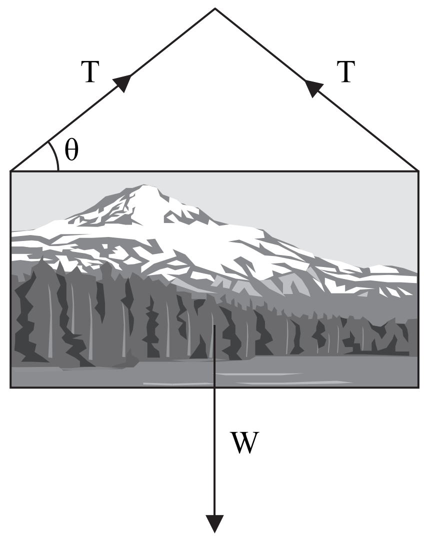
☒ **C** mass

☒ **D** time

(Total for Question 4 = 1 mark)

---

5 The diagram shows the forces acting on a picture, of weight W, suspended by a cord.
The tension in the cord is T.



Which of the following expressions shows the correct relationship between W and T?

☒ **A** $W = 2\ T \cos \theta$

☒ **B** $W = T \cos \theta$

☒ **C** $W = T \sin \theta$

☒ **D** $W = 2\ T \sin \theta$

(Total for Question 5 = 1 mark)

---

6 A person weighing 100 N stands on some bathroom scales in a lift. If the scales show a reading of 110 N, which answer could describe the motion of the lift?

☒ **A** Moving downwards and decelerating.

☒ **B** Moving downwards with a constant velocity.

☒ **C** Moving upwards and decelerating.

☒ **D** Moving upwards with a constant velocity.

(Total for Question 6 = 1 mark)

7 A spring extends by 9 cm when a force of 6 N is applied. The limit of proportionality is not exceeded.

Another identical spring is joined end to end with this spring and a force of 4 N is applied.

The extension for the pair of springs is

☒ **A** 3 cm

☒ **B** 6 cm

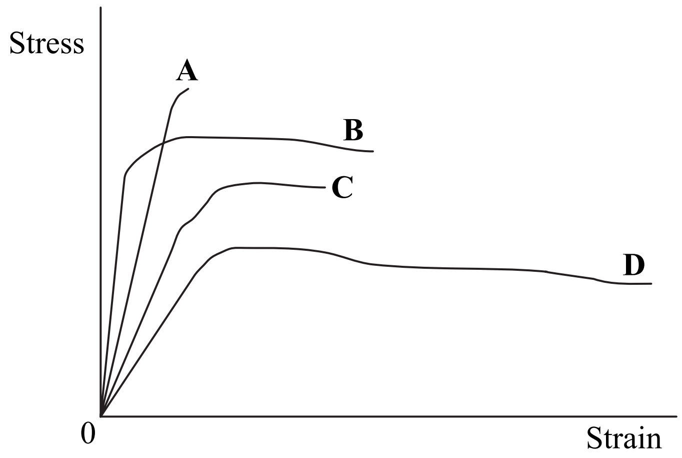
☒ **C** 12 cm

☒ **D** 18 cm

(Total for Question 7 = 1 mark)

Use the graph below for questions 8 and 9.

The graph shows stress–strain curves for samples of four different materials.



8 Which material has the greatest strength?

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 8 = 1 mark)

---

9 Which material has the greatest value for the Young modulus?

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 9 = 1 mark)

---

10 The acceleration of free fall on a particular planet is 8.0 m s^{-2}. An object is dropped from a height and hits the ground after 1.5 s. From what height was it dropped?

☒ **A** 6.0 m

☒ **B** 9.0 m

☒ **C** 11 m

☒ **D** 12 m

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 A brochure states that a particular type of wood is "extremely tough and does not become brittle over time".

(a) Describe what is meant by the following terms

(2)

tough

....

....

brittle

....

....

(b) A cricket bat made of wood is found to have a dent after striking a cricket ball.

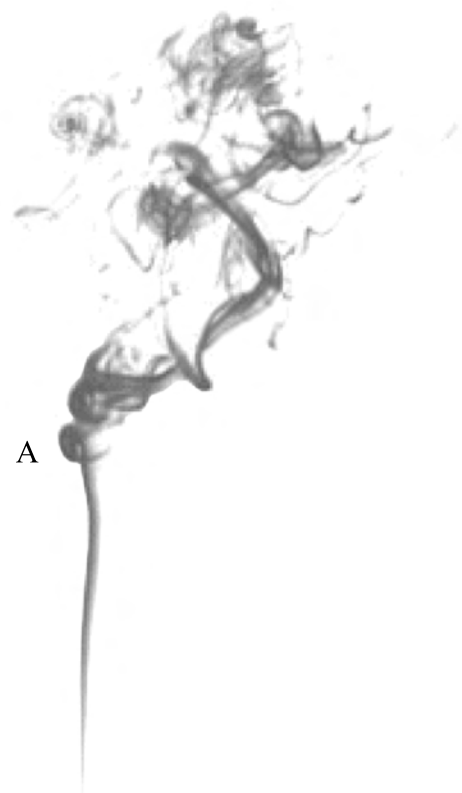
State the type of behaviour shown by the material of the cricket bat.

(1)

....

(Total for Question 11 = 3 marks)

12 The photograph shows some smoke rising.



At A, the type of fluid flow changes.

Label the type of fluid flow below and above A and describe each of them.

Below A ....

....

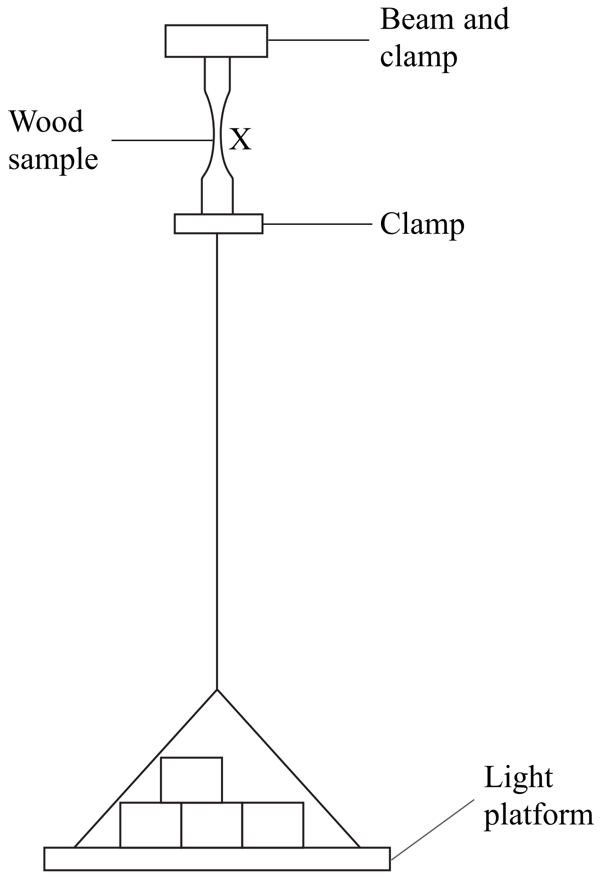
Above A..

....

(Total for Question 12 = 4 marks)

BLANK PAGE

13 A sample of wood is tested using the following arrangement.



The wood sample is clamped securely to a supporting beam. A light platform is suspended from the wood sample using another clamp.

The dimensions of the wood sample at X are known. Masses of 2 kg are added to the platform during the testing process.

(a) The wood sample breaks at X when the total suspended mass is 84 kg. The cross-sectional area at X is 1.3×10^{-5} m^2.

Show that the ultimate tensile strength is about 6×10^7 Pa.

(3)

....

....

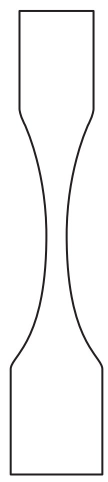
....

....

....

(b) Explain why this method of testing may produce a larger value than the true ultimate tensile strength.

(2)



(c) Explain why the wood sample used for this test has the shape shown.

(2)

(d) Samples of wood of the same type are not entirely uniform. What should be done to ensure reliable results are obtained when carrying out this test?

(1)

(Total for Question 13 = 8 marks)

BLANK PAGE

14 One account of the origin of the term *horsepower* is as follows.

In the eighteenth century, James Watt manufactured steam engines. He needed a way to demonstrate the benefits of these compared to the horses they replaced. He did some calculations based on horses walking in circles to turn a mill wheel.

Watt observed that a horse could turn the wheel 144 times in one hour. The horse travelled in a circle of radius 3.7 m and exerted a force of 800 N.

(a) Show that the work done by the horse in turning the wheel through one revolution was about 20 000 J.

(3)

....

....

....

....

(b) Calculate the average power of the horse in SI units.

(3)

....

....

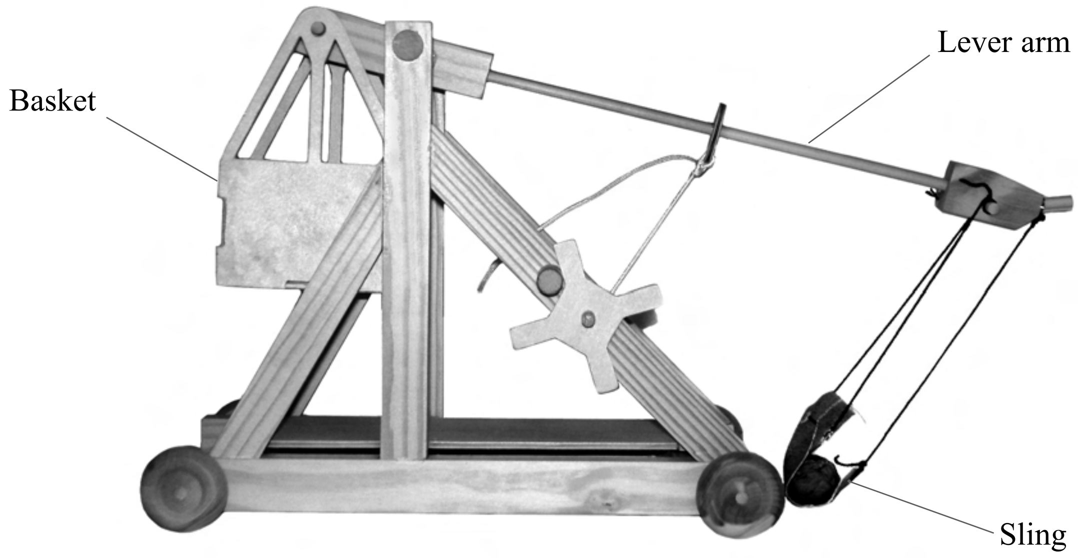
....

....

Average power = ...

(Total for Question 14 = 6 marks)

***15** The photograph shows a model of 'Warwolf', a siege engine used in the thirteenth century. It was used to attack castles by firing missiles from a sling.



To operate this model, coins are placed in the basket and a small projectile is placed in the sling. When the basket is released, it falls quickly, swinging the lever arm up and shooting the projectile from the sling.

(a) On one occasion the mass of coins placed in the basket is 0.41 kg. The basket falls through a vertical distance of 7.0 cm.

Calculate the maximum amount of energy available to launch the projectile.

(2)

....

....

....

....

Energy = ...

(b) An energy conversion calculation predicts a projectile speed of 16 m s^{-1}. The projectile is observed to fly out of the sling at an angle of 40° to the horizontal.

Resolve this velocity into horizontal and vertical components.

(3)

Horizontal component = ...

Vertical component = ...

(c) The predicted range is 27 m. When measured, the range is found to be only 8 m.

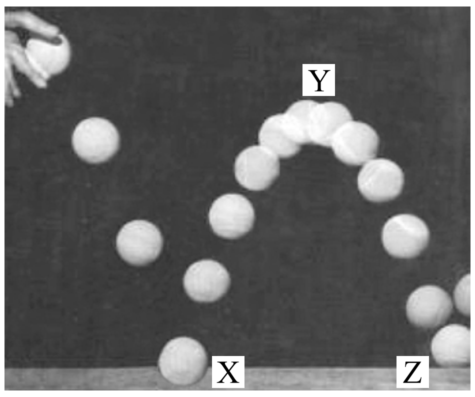
Air resistance and friction in the machine are possible reasons for the difference.

Without further calculation, explain another reason why the projectile does not go as far as predicted.

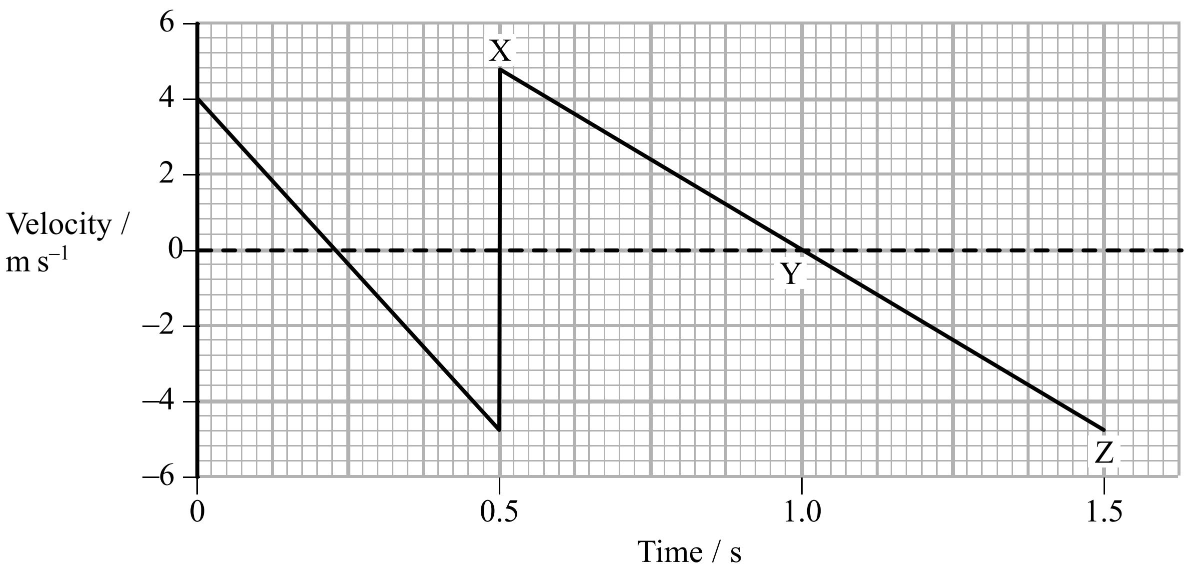
(2)

(Total for Question 15 = 7 marks)

***16** The photograph shows a sequence of images of a bouncing tennis ball.



A student plots the following graph and claims that it shows the vertical motion of the ball in the photograph.



(a) Without carrying out any calculations describe how the following can be found from the graph

(2)

(i) the vertical distance travelled by the ball between 0.5 s and 1.0 s

....

(ii) the acceleration at Y.

....

N 3 5 0 8 0 A 0 1 6 2 8

(b) The graph contains several errors in its representation of the motion of the ball.

Explain two of these errors.

(4)

Error 1

....

....

....

....

Error 2

....

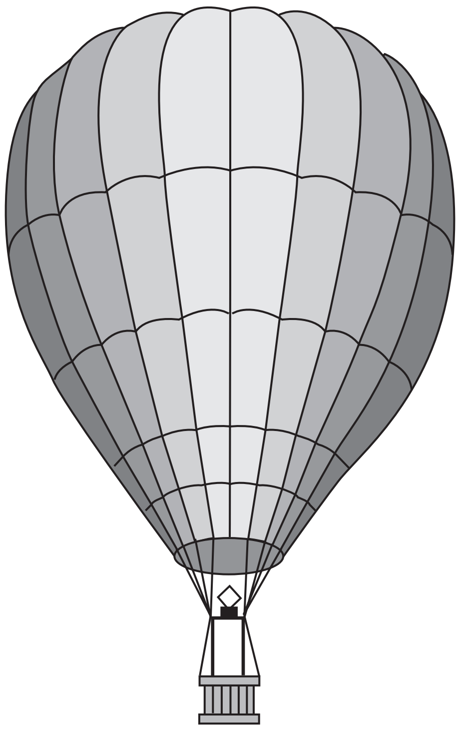
....

....

....

(Total for Question 16 = 6 marks)

17 A hot air balloon consists of an 'envelope' containing hot air, with a wicker basket suspended from it. The balloon flies because the heated air in the envelope is less dense than the surrounding air.



(a) The total volume of the hot air balloon is 2830 m^3. The total weight of the balloon, including the hot air in the envelope, is 33 100 N. The density of the surrounding air is 1.20 kg m^{-3}.

(i) Show that the resultant upward force on the balloon at the moment it is released is about 200 N.

(3)

....

....

....

(ii) Calculate the initial upward acceleration of the balloon. The mass of the balloon is 3370 kg.

(2)

....

....

....

Acceleration = ...

(iii) The balloon is rising through air of viscosity 1.8×10^{-5} kg m^{-1} s^{-1}, at a speed of 2.0 m s^{-1}.

The effect of viscous drag on the balloon is negligible provided the air flow around the balloon is laminar.

Justify the statement in bold with the aid of a calculation. You may treat the whole balloon as a single sphere of radius 8.8 m.

(3)

....

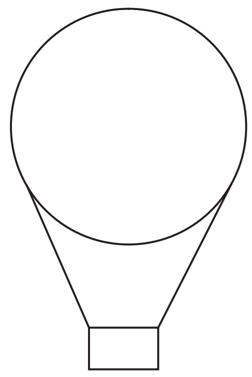
....

....

....

(b) Add labelled arrows to the diagram below to show the forces acting on a vertically ascending balloon.

(2)



(c) As the balloon rises the density of the surrounding air decreases. Explain why this density change limits the height to which the balloon will rise.

(2)

....

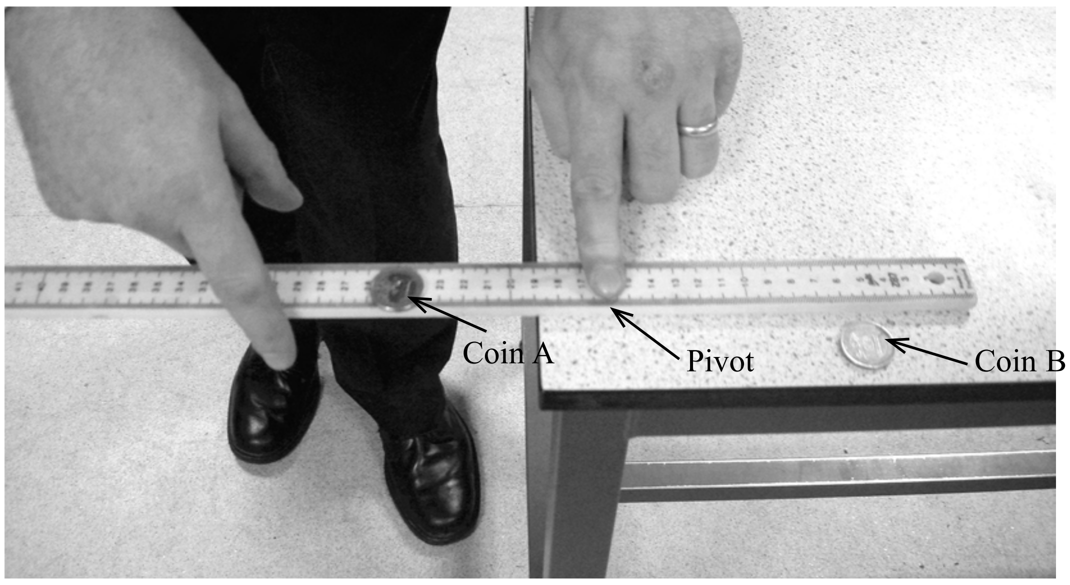
....

....

....

(Total for Question 17 = 12 marks)

18 The photograph shows a physics teacher carrying out a demonstration related to vertical motion.



A coin, A, is placed on top of the smooth ruler and another coin, B, is placed on the table.
One hand is acting as a pivot. The other hand gives the ruler a sharp horizontal tap.

Coin A falls vertically to the ground while coin B is pushed horizontally off the table. Both coins are heard to strike the floor at the same instant.

(a) Use Newton's first law to explain why the coin A has no horizontal motion.

(2)

....

....

....

....

(b) Explain how this demonstration shows the independence of vertical and horizontal motion.

(2)

....

....

....

....

(c) The table is 0.85 m high.

Show that the coin on the ruler strikes the ground with a speed of about 4 m s^{-1}.

(2)

....

....

....

(d) After 0.42 s the second coin lands at a horizontal distance of 1.1 m from the table.

Calculate the velocity at which the coin strikes the ground.

(5)

....

....

....

....

....

....

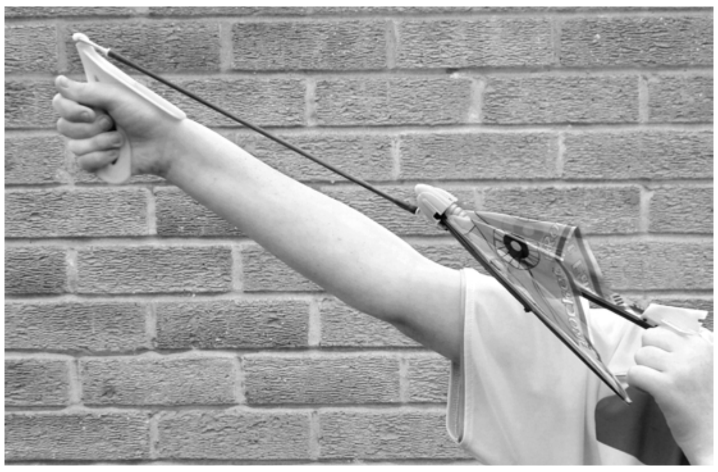
Magnitude of velocity = ...

Angle of velocity to horizontal = ...

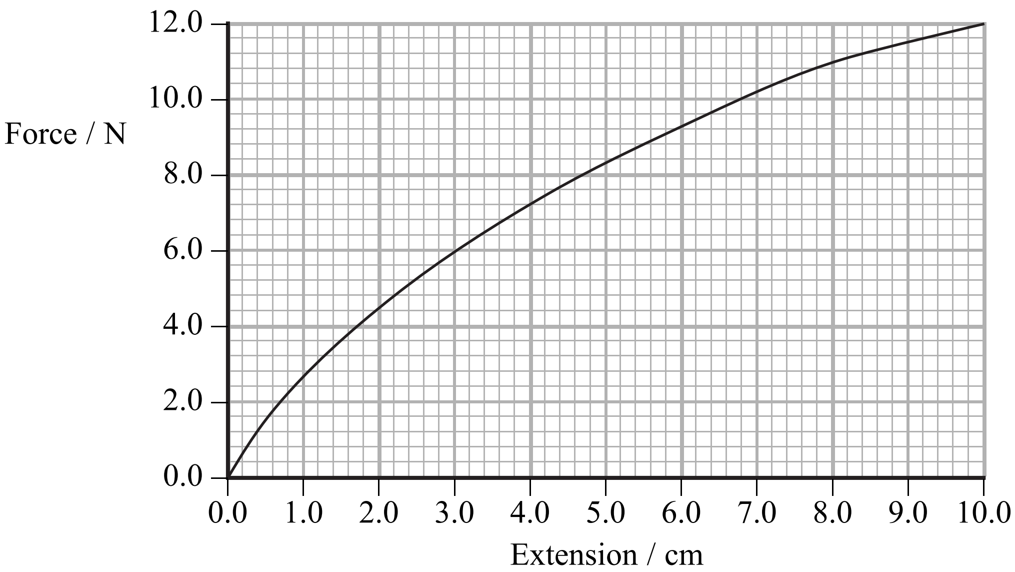
(Total for Question 18 = 11 marks)

BLANK PAGE

***19** The photograph shows a long rubber band being used to launch a model aeroplane.



The following graph shows force against extension for the rubber band.



(a) Explain whether the rubber band obeys Hooke's law.

(2)

....

....

....

(b) Use the graph to show that the elastic strain energy stored in the rubber band when it has an extension of 10.0 cm is less than 0.8 J.

(3)

....

....

....

(c) The rubber band is extended by 10.0 cm before being released to launch the aeroplane. Calculate the maximum possible initial speed of the aeroplane.

Mass of aeroplane = 0.027 kg

(3)

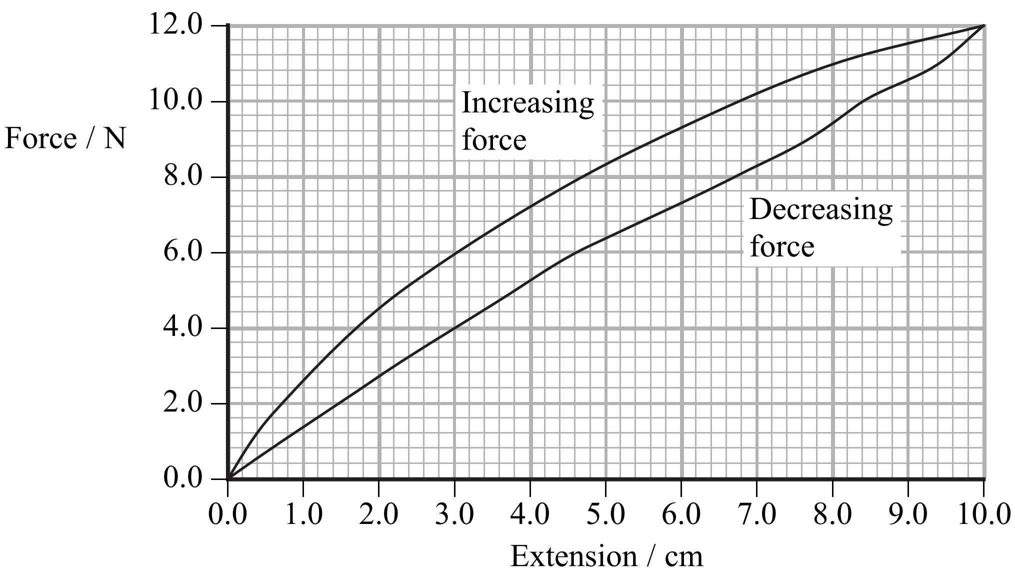
....

....

....

Speed = ...

(d) The following graph shows two lines. Measurements were obtained by increasing the force on the band to 12 N and then decreasing the force.



(i) Describe the energy transfers taking place when the force on the band is increased and then decreased.

(2)

....

....

....

....

(ii) The maximum speed of the aeroplane will be less than that calculated in (c). Without further calculation use the graph to explain this.

(3)

....

....

....

....

....

(Total for Question 19 = 13 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	$v = u + at$ $s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
Forces	$\Sigma F = ma$ $g = F/m$ $W = mg$
Work and energy	$\Delta W = F\Delta s$ $E_k = \frac{1}{2}mv^2$ $\Delta E_{grav} = mg\Delta h$

Materials

Stokes' law	$F = 6\pi\eta rv$
Hooke's law	$F = k\Delta x$
Density	$\rho = m/V$
Pressure	$p = F/A$
Young's modulus	$E = \sigma/\varepsilon$ where Stress $\sigma = F/A$ Strain $\varepsilon = \Delta x/x$
Elastic strain energy	$E_{el} = \frac{1}{2}F\Delta x$

BLANK PAGE

BLANK PAGE