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**Pearson Edexcel GCE**

Centre Number

Candidate Number

# Physics
## Advanced Subsidiary
## Unit 1: Physics on the Go

Tuesday 24 May 2016 – Morning
**Time: 1 hour 30 minutes**

Paper Reference
**6PH01/01**

**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* ▶

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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** Newton's third law refers to two forces acting in a pair.

These forces

☐ **A** act in the same direction.

☐ **B** act on different objects.

☐ **C** are different types of force.

☐ **D** have different magnitudes.

**(Total for Question 1 = 1 mark)**

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**2** A brass trumpet was dropped on the floor. Due to the impact, a dent formed in the trumpet.

The dent was formed because brass is

☐ **A** brittle.

☐ **B** ductile.

☐ **C** malleable.

☐ **D** stiff.

**(Total for Question 2 = 1 mark)**

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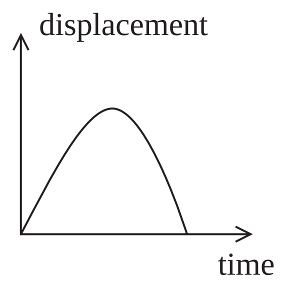
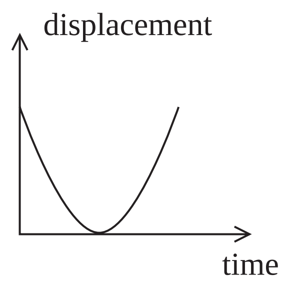
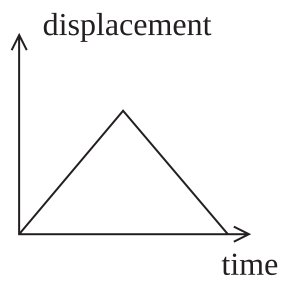
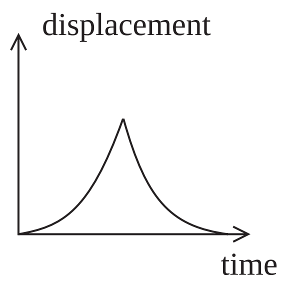
**3** A ball is dropped, bounces once and is then caught.

Which of the following is the correct displacement-time graph for the ball?

| | | | |
|---|---|---|---|
|  |  |  |  |
| **A** | **B** | **C** | **D** |

☒ **A**

☒ **B**

☒ **C**

☒ **D**

**(Total for Question 3 = 1 mark)**

**4** A hollow plastic sphere and a solid metal sphere with the same diameter are released from rest in a vacuum.

Which of the following will be the same for both spheres after they have fallen through the same height?

☒ **A** the change in gravitational potential energy

☒ **B** their kinetic energy

☒ **C** the resultant force acting on them

☒ **D** their velocity

**(Total for Question 4 = 1 mark)**

**5** A brick of mass 5.0 kg falls through water with an acceleration of 0.90 m $s^{-2}$.

Which of the following can be used to calculate the resistive force acting on the brick?

☒ **A** $5.0 \times (0.90 - 9.81)$

☒ **B** $5.0 \times (0.90 + 9.81)$

☒ **C** $5.0 \times 0.90$

☒ **D** $5.0 \times 9.81$

**(Total for Question 5 = 1 mark)**

**6** Select the row of the table that shows the correct SI base units for force and work done.

| | Force | Work done |
|---|---|---|
| ☒ **A** | kg $m^2$ $s^{-2}$ | kg $m^3$ $s^{-2}$ |
| ☒ **B** | kg m $s^{-2}$ | kg $m^2$ $s^{-2}$ |
| ☒ **C** | kg $m^2$ $s^{-2}$ | kg m $s^{-2}$ |
| ☒ **D** | kg m $s^{-2}$ | kg $m^3$ $s^{-2}$ |

**(Total for Question 6 = 1 mark)**

**7** A lift and its load have a combined mass of 650 kg. The lift moves the load upwards through a vertical height of 140 m in 25 s.

What is the approximate value of the power developed?

☒ **A** 900 000 W

☒ **B** 90 000 W

☒ **C** 40 000 W

☒ **D** 4000 W

**(Total for Question 7 = 1 mark)**

**8** An explorer walks 6 km due north from his camp and then 6 km due west.

What is the magnitude, in km, of the total displacement of the explorer?

☒ **A** 12

☒ **B** $\sqrt{12}$

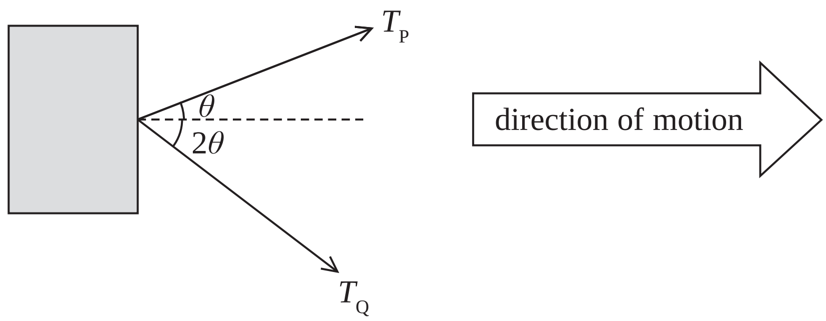
☒ **C** 72

☒ **D** $\sqrt{72}$

**(Total for Question 8 = 1 mark)**

**Questions 9 and 10 refer to the following information.**

A box is pulled along the floor using two identical ropes. The tensions in the ropes act in the directions shown and have magnitudes $T_P$ and $T_Q$. The box moves at a constant speed in the direction shown.




**9** The magnitude of the frictional force acting on the box is equal to

☒ **A** $T_P \sin\theta + T_Q \sin 2\theta$

☒ **B** $T_P \cos\theta + T_Q \cos 2\theta$

☒ **C** $T_P + T_Q$

☒ **D** zero

**(Total for Question 9 = 1 mark)**

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**10** $T_P = 85\,\text{N}$ and $\theta = 25°$. The box moves 15 m.

The work done by this force on the box could be calculated using

☒ **A** $85 \times \cos 25° \times 15$

☒ **B** $85 \times \sin 25° \times 15$

☒ **C** $\dfrac{85 \times 15}{\cos 25°}$

☒ **D** $\dfrac{85 \times 15}{\sin 25°}$

**(Total for Question 10 = 1 mark)**

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**TOTAL FOR SECTION A = 10 MARKS**

## SECTION B

**Answer ALL questions in the spaces provided.**

***11** A table tennis ball is held under water. When the ball is released it rises to the surface of the water.

Explain why.

**(3)**

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**(Total for Question 11 = 3 marks)**

**12** As part of the Apollo space missions to the Moon, astronauts were required to measure the mass of collected lunar rock samples using a spring balance.

The spring balance was calibrated to measure mass in the non-SI unit of the pound. The gravitational field strength on the Moon is 1/6th of that on Earth.

(a) A sample of lunar rock was observed to have a mass of 35 pounds.

Calculate the weight of the sample on the Moon.

1 pound = 0.45 kg

**(3)**

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Weight of sample on the Moon = ..............................................

(b) The sample measured in part (a) was brought to Earth.

Suggest how the measurements could be scaled so that the same spring balance could be used to measure the mass of the sample on Earth.

**(1)**

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(c) Instead of rescaling the spring balance for use on Earth, the spring could be replaced.

Suggest, with a reason, a difference between springs selected for use in spring balances on Earth and those for use on the Moon.

**(2)**

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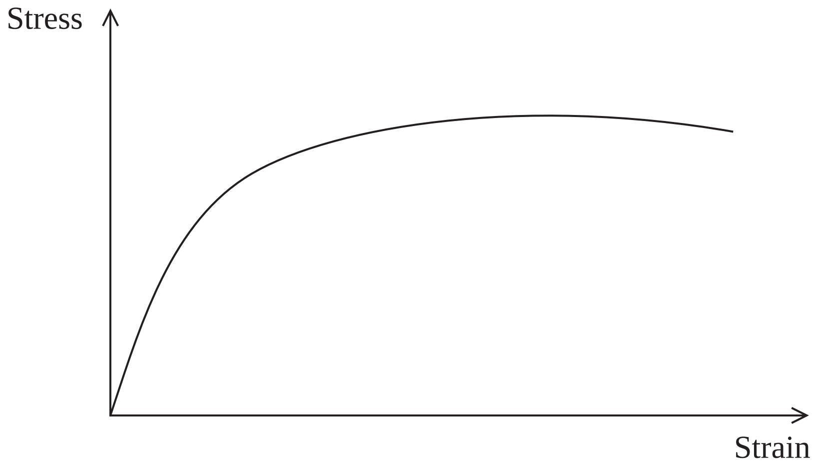
**(Total for Question 12 = 6 marks)**

**13** The stress-strain graph shows the behaviour of a wire whilst under tensile stress.




*(a) With reference to the shape of the graph, describe the behaviour of the wire under increasing stress. You may indicate on the graph the region you are describing.

**(3)**

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(b) Describe how the graph could be used to determine the Young modulus for the wire.

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(c) On the axes above, sketch the graph for a brittle material with a greater Young modulus than the wire.

**(2)**

**(Total for Question 13 = 7 marks)**

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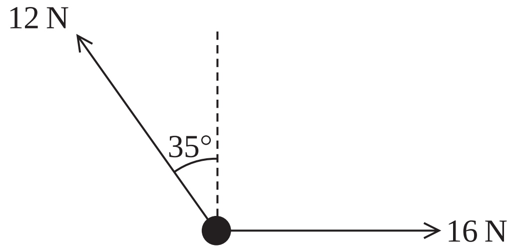
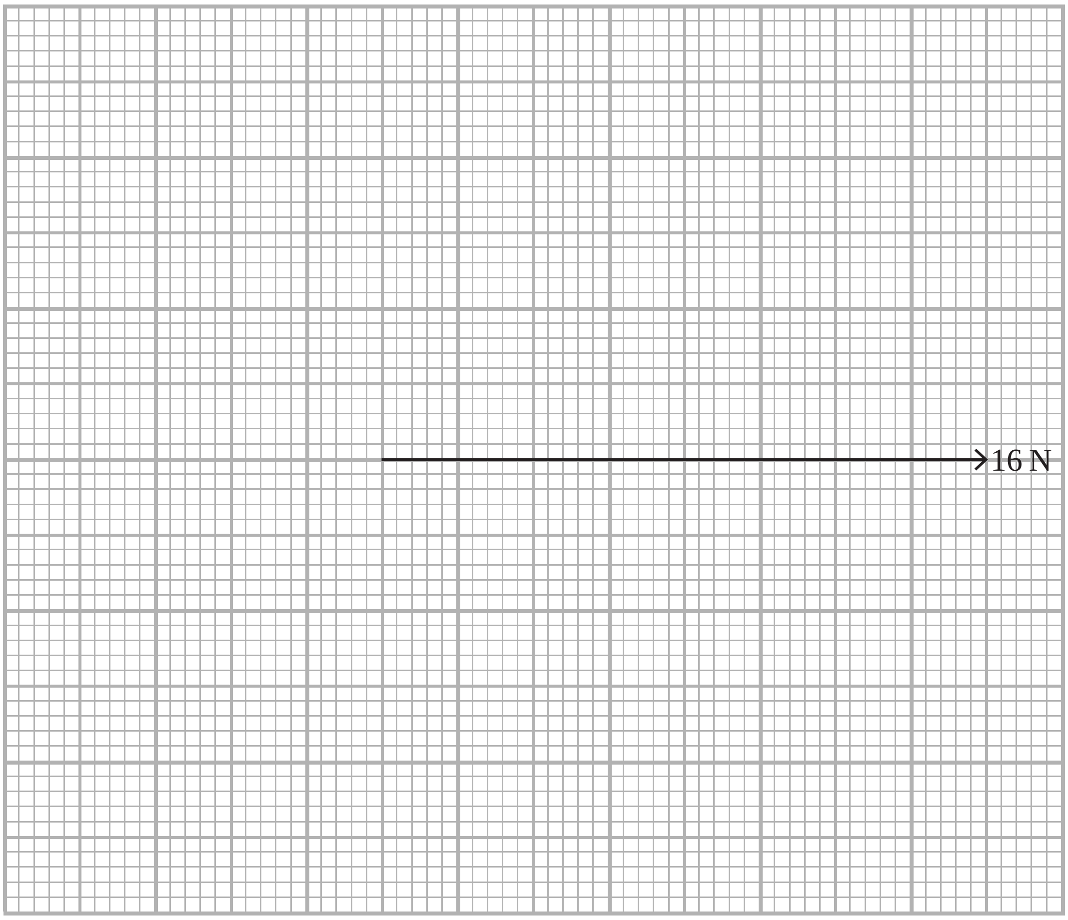
**14** (a) Two forces act on a body. The free-body force diagram is shown.




On the grid below, complete the scale diagram to determine the resultant force acting on the body.

**(3)**




Magnitude of resultant force = ........................................................

Angle of resultant force to 16 N force = ........................................................

(b) Force is a vector quantity.

(i) State what is meant by vector quantity.

**(1)**

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(ii) Give **two** further examples of vector quantities.

**(1)**

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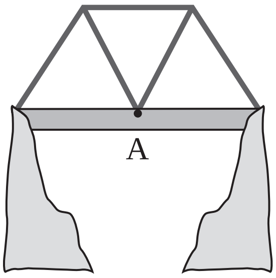
**(Total for Question 14 = 5 marks)**

**15** To increase the load that a bridge can withstand, some bridges have beams in a triangular design. These beams are called trusses.

A simple truss bridge is shown.




(a) A lorry stops at point A.

Draw a free-body force diagram for the forces acting on the bridge at point A.

**(3)**

(b) Explain why the structure of the bridge allows it to withstand greater loads.

**(2)**

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**(Total for Question 15 = 5 marks)**

**16** The viscosity of paint determines how smoothly and easily the paint can be applied. If the viscosity is too high, the finish will appear bumpy and if the viscosity is too low, the paint will run.

Paint viscosity too high

Paint viscosity too low

(a) State what is meant by viscosity.

**(1)**

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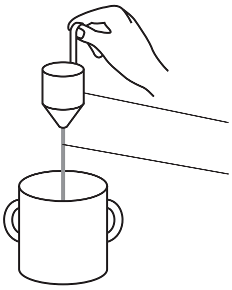
(b) Before paint is applied, its viscosity can be checked using a viscosity cup. A viscosity cup has a small hole at the bottom for the paint to drain through.




The cup is filled with the paint to a fixed level and the time for the paint to drain from the bottom of the cup is measured. The time to drain the cup can then be converted to a viscosity using a table supplied by the paint manufacturer.

(i) Explain why this method can be used to determine the viscosity of the paint.

**(2)**

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(ii) The time taken for the paint to drain from the cup was 17 s. The following day the same paint took 24 s to drain from the cup.

Suggest why the times were different.

**(1)**

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(c) The viscosity cup is a basic way of measuring viscosity.

Suggest **two** possible sources of error with this method and state how each error would affect the time being measured.

**(4)**

Error 1 ..............................................................................................................................................................

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Error 2 ..............................................................................................................................................................

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**(Total for Question 16 = 8 marks)**

**17** While playing golf, players use different golf clubs, depending on the distance the ball needs to travel. Different golf clubs produce different launch angles for the ball.

(a) A golf club strikes a ball. The ball leaves the golf club at an angle of 26° to the horizontal and at a speed of 35 m $s^{-1}$.

(i) Calculate the horizontal distance that the golf ball should travel before reaching the ground.

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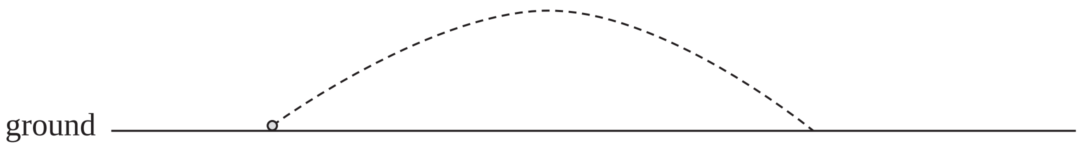
Horizontal distance = ..................................................

(ii) The path of the golf ball in (i) is shown below.




Add to the diagram to show the path the ball would have taken had it left the golf club, at the same speed, at an angle of 42° to the horizontal.

**(1)**

(b) The actual horizontal distance travelled by the ball is affected by air resistance and an upwards force caused by the spin of the ball as it moves through the air.

Explain how each of these forces would have affected the distance calculated in (a)(i) had they been considered.

**(4)**

Air resistance ..............................................................................................................

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Upwards force ..............................................................................................................

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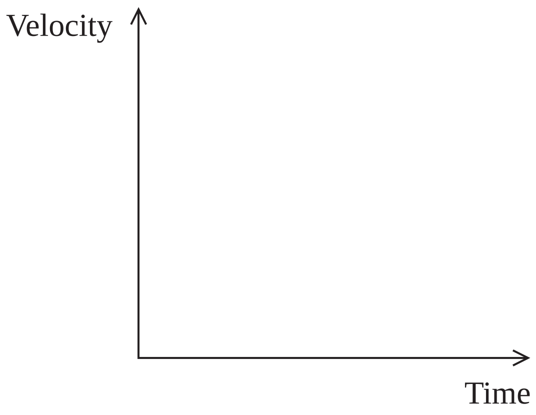
**(Total for Question 17 = 9 marks)**

**18** Raindrops reach terminal velocity within a few metres of starting to fall.

(a) (i) On the axes below, sketch a velocity-time graph for the motion of a raindrop.

**(2)**




(ii) Explain why terminal velocity is reached.

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(iii) Suggest why the upthrust acting on a raindrop is often considered to be negligible.

**(1)**

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(b) After reaching terminal velocity, a raindrop took 2.6 minutes to fall 1100 m to the ground.

(i) Calculate the terminal velocity of the raindrop.

**(2)**

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Terminal velocity = ..............................................................

(ii) Calculate the radius of the raindrop. You may assume that Stokes' law applies to the raindrop.

viscosity of air = $1.8 \times 10^{-5}$ Pa s
density of water = $1.0 \times 10^{3}$ kg m$^{-3}$

**(3)**

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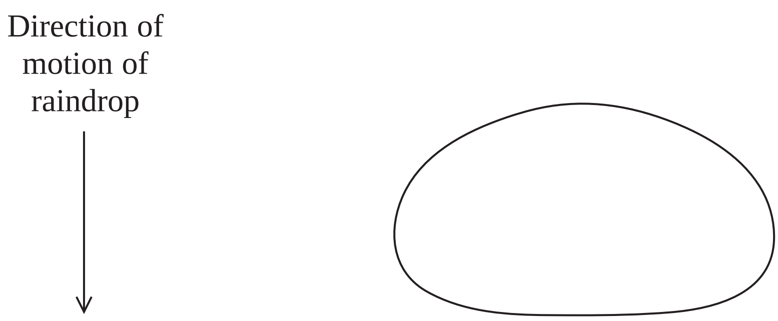
Radius of raindrop = ..............................................

(c) The shape of the raindrop depends on its velocity.

Once at terminal velocity the raindrop is flat at the bottom due to laminar air flow around it and remains curved at the top due to turbulent air flow.

Add to the diagram below to show the air flow around the falling raindrop.

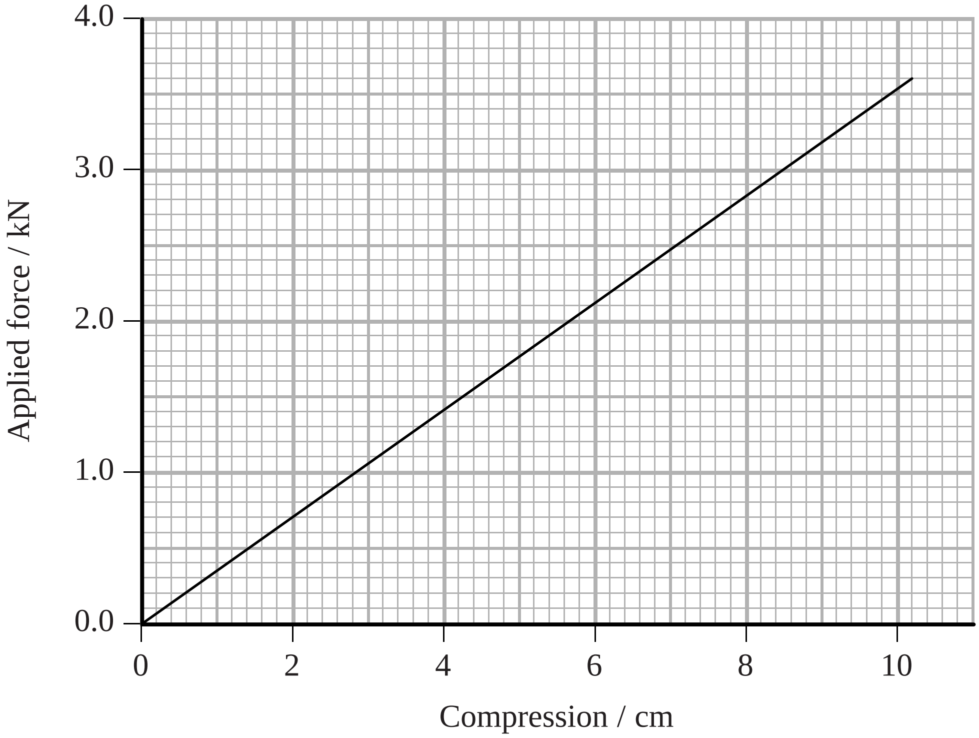
**(2)**




**(Total for Question 18 = 13 marks)**

**19** A pogo stick is a toy used for jumping up and down. The pogo stick contains a spring which is under compression.

(a) The force-compression graph for the spring from the pogo stick is shown.




Determine the spring constant for the spring.

**(2)**

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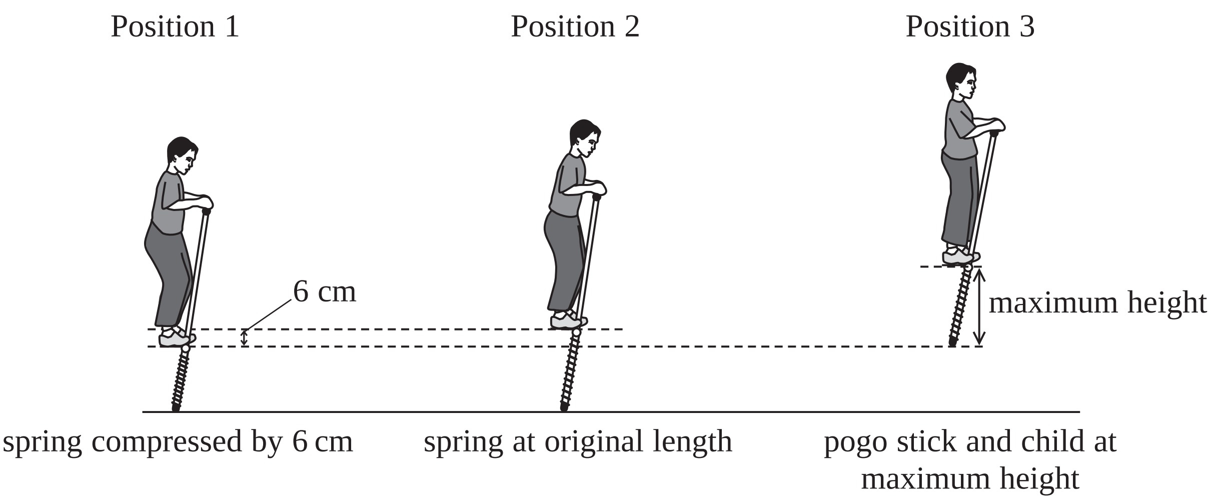
Spring constant = ..............................................

(b) Inside the pogo stick the spring is compressed by 3 cm. A child jumps onto the foot rest of the pogo stick and the spring is compressed by a further 6 cm. The pogo stick and child move up to a maximum height at position 3.




(i) Use the graph to show that the work done by the child on the spring is about 130 J.

**(3)**

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(ii) When the spring is at its original length, as shown in position 2, the child is at his maximum speed.

State the energy transfers that occur as the child moves upwards from position 1 to position 2.

**(2)**

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(iii) By considering the energy transfers as the child moves upwards from position 1 to position 2, calculate the maximum speed of the child.

mass of child and pogo stick = 35 kg.

**(4)**

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Maximum speed = ........................................................

*(c) Between positions 1 and 2 the pogo stick is pushing down on the ground.

With reference to Newton's laws of motion, explain how this downward force causes the child and pogo stick to rise.

**(3)**

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**(Total for Question 19 = 14 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 $E_{el} = \tfrac{1}{2}F\Delta x$

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