Write your name here

Surname	Other names

Edexcel GCE

Centre Number	Candidate Number

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Tuesday 13 January 2009 – Afternoon
Time: 1 hour 20 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 ▶

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 The table shows some physical quantities. Which row correctly identifies scalar and vector quantities?

		Scalar	Vector
☒	**A**	distance	acceleration
☒	**B**	time	speed
☒	**C**	velocity	force
☒	**D**	work	power

(Total for Question 1 = 1 mark)

2 A cyclist travelling at a speed of $4.2\ \mathrm{m\ s^{-1}}$ accelerates at $1.1\ \mathrm{m\ s^{-2}}$. In a time of 7.4 s the distance travelled is

☒ **A** 30 m

☒ **B** 35 m

☒ **C** 61 m

☒ **D** 91 m

(Total for Question 2 = 1 mark)

3 Which of these units is the same as the newton?

☒ **A** $\mathrm{kg\ m\ s^{-1}}$

☒ **B** $\mathrm{kg\ m\ s^{-2}}$

☒ **C** $\mathrm{kg\ m^2\ s^{-2}}$

☒ **D** $\mathrm{kg\ m^2\ s^{-3}}$

(Total for Question 3 = 1 mark)

4 A student is asked to determine the output of a motor as it lifts an object. He measures the height through which the object is raised, the time taken and the weight of the object.

To find the power he must calculate

☒ **A** height × weight × time

☒ **B** $\dfrac{\text{height} \times \text{weight}}{\text{time}}$

☒ **C** $\dfrac{\text{time} \times \text{weight}}{\text{height}}$

☒ **D** $\dfrac{\text{weight}}{\text{height} \times \text{time}}$

(Total for Question 4 = 1 mark)

5 A football is kicked at a speed of 12 m s^{-1} at an angle of 35° to the horizontal. The horizontal component of its velocity, in m s^{-1}, is given by

☒ **A** 12 cos 35°

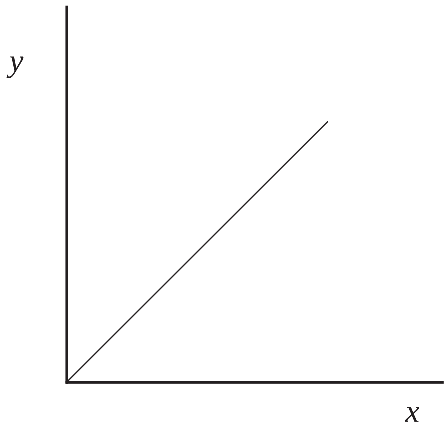
☒ **B** 12 sin 35°

☒ **C** $\dfrac{12}{\cos 35°}$

☒ **D** $\dfrac{12}{\sin 35°}$

(Total for Question 5 = 1 mark)

6 The diagram shows a graph plotted using the results from an experiment in which a metal wire was stretched.



The gradient of the graph equals the Young modulus of the metal.

Which row gives the correct labels for the axis?

		y	***x***
☒	**A**	extension	force
☒	**B**	force	extension
☒	**C**	strain	stress
☒	**D**	stress	strain

(Total for Question 6 = 1 mark)

7 A pigeon of mass 0.45 kg is flying with kinetic energy 58 J.
Its speed is

☒ **A** $8.0\ \mathrm{m\ s^{-1}}$

☒ **B** $11\ \mathrm{m\ s^{-1}}$

☒ **C** $16\ \mathrm{m\ s^{-1}}$

☒ **D** $22\ \mathrm{m\ s^{-1}}$

(Total for Question 7 = 1 mark)

8 A ball bearing is dropped through a liquid and its terminal velocity measured.
The experiment is repeated at a different temperature.

Which row could correctly describe this second experiment?

		Temperature	Viscosity	Terminal velocity
☒	**A**	lower	greater	faster
☒	**B**	lower	greater	slower
☒	**C**	higher	greater	slower
☒	**D**	higher	smaller	slower

(Total for Question 8 = 1 mark)

9 Velocity can be found from the

☒ **A** area under a displacement-time graph

☒ **B** area under a force-time graph

☒ **C** gradient of a displacement-time graph

☒ **D** gradient of an acceleration-time graph

(Total for Question 9 = 1 mark)

10 A freely falling object on Earth has a speed of $5.0\,\mathrm{m\,s^{-1}}$.

After falling a further 20 m its speed is

☒ **A** $15\,\mathrm{m\,s^{-1}}$

☒ **B** $20\,\mathrm{m\,s^{-1}}$

☒ **C** $25\,\mathrm{m\,s^{-1}}$

☒ **D** $45\,\mathrm{m\,s^{-1}}$

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 The Saturn V rocket used in NASA's space programme had a mass of 3.04×10^6 kg. It took off vertically with a thrust force of 3.40×10^7 N.

(a) Show that the resultant force on the rocket is about 4×10^6 N.

(3)

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....

....

(b) Calculate the initial acceleration.

(2)

....

....

Initial acceleration = ...

(c) After 150 s the rocket reached a speed of 2390 m s^{-1}.

Calculate its average acceleration.

(2)

....

....

....

Average acceleration = ...

(d) Suggest why the initial acceleration and average acceleration are different.

(1)

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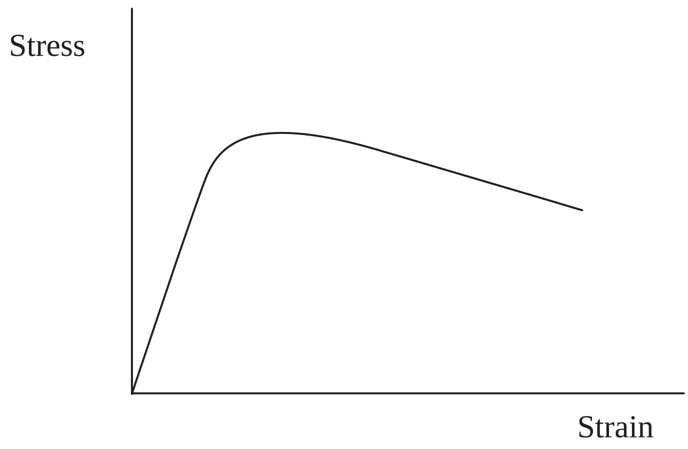
....

(Total for Question 11 = 8 marks)

12 The graph shows how stress varies with strain for a given material.



(a) Explain what is meant by each of the following terms

(3)

limit of proportionality (L)

....

....

tensile strength

....

....

yield point (Y)

....

....

(b) Using crosses and the letters shown above, mark the 'limit of proportionality' (L) and the 'yield point' (Y) on the graph.

(2)

(Total for Question 12 = 5 marks)

13 When a ball moves through air, the airflow is laminar around the front of the ball and turbulent behind it.

(a) State what is meant by

(2)

laminar flow

....

....

turbulent flow

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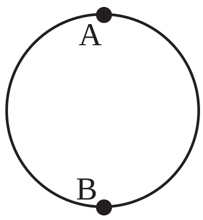
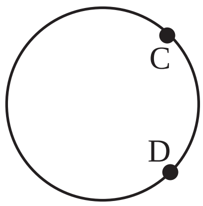
....

(b) The diagram shows a ball for which the airflow becomes turbulent beyond points A and B. Add to the diagram to show the airflow around the ball. The ball is moving to the left.

(2)



(c) It is suggested that 'dimples' on a golf ball decrease the area over which there is turbulent flow so it is only produced beyond points C and D.



Explain how decreasing the area over which there is turbulent flow would increase the range of a golf ball.

(2)

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(Total for Question 13 = 6 marks)

14 (a) What is meant by Newton's first law of motion?

(2)

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....

(b) Newton's third law identifies pairs of forces.

(i) State **two** ways in which the forces in a pair are identical.

(2)

....

....

(ii) State **two** ways in which the forces in a pair differ.

(2)

....

....

(iii) One of the forces acting on a car can be described as follows:

'The Earth exerts a downward gravitational force of 12 000 N on the car'.

Describe its Newton's third law pair force.

(2)

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....

(Total for Question 14 = 8 marks)

***15** You are asked to determine the acceleration of free fall at the surface of the Earth, *g*, using a free fall method in the laboratory.

(a) Describe the apparatus you would use, the measurements you would take and explain how you would use them to determine *g*.

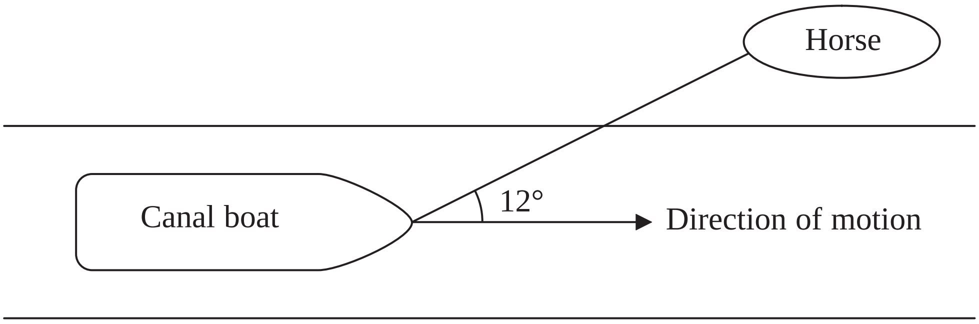
(6)

(b) Give **one** precaution you would take to ensure the accuracy of your measurements.

(1)

(Total for Question 15 = 7 marks)

16



A horse is pulling a canal boat using a rope at 12° to the direction of motion of the boat. The tension in the rope is 1150 N.

(a) The canal boat is moving at a steady speed. Calculate the resistive force opposing the boat's forward motion.

(2)

....

....

Force = ...

(b) Calculate the work done on the boat by the horse when the canal boat is towed 500 m along the canal.

(2)

....

....

Work = ...

(c) Explain why using a longer rope could allow the horse to do the same work while producing a lower tension in the rope.

(2)

....

....

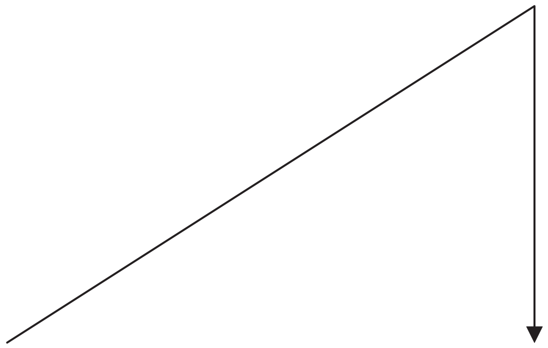
....

(Total for Question 16 = 6 marks)

***17** In the fifteenth century, an explanation of projectile motion went as follows:

When you throw an object you give it a force called impetus. It moves in a straight line until the impetus is used up. Then the object falls vertically to the ground.

The diagram shows the path described.



(a) Correct the diagram to show the path followed by a projectile according to modern observations. Assume it has the same initial direction.

(1)

(b) Explain why a projectile follows the path you have drawn. Your answer should include reference to horizontal velocity.

(3)

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(c) When a toy balloon is hit quickly up at an angle, it appears to follow a path similar to the one described by the fifteenth century explanation.

Explain why the balloon follows this path.

(3)

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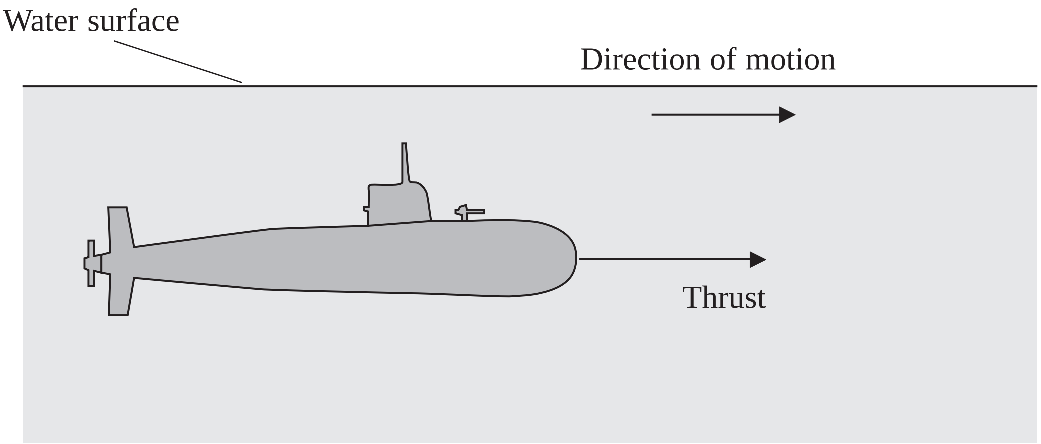
(Total for Question 17 = 7 marks)

***18** The diagram shows a submarine and one of the forces acting on it. The submarine moves at a constant depth and speed in the direction shown.



(a) Add labelled arrows to show the other **three** forces on the submarine.

(2)

(b) State **two** equations that show the relationship between the forces acting on the submarine.

(2)

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(c) The submarine has a volume of $7100\,m^3$.
Show that the weight of the submarine is about 7×10^7 N.

Density of sea water = $1030\,kg\,m^{-3}$

(2)

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....

....

N 3 4 4 3 1 R A 0 1 4 2 0

(d) The submarine can control its depth by changing its weight. This is done by adjusting the amount of water held in ballast tanks.

As the submarine dives to greater depths the increased pressure of the surrounding water produces a compressive strain.

(i) Explain what is meant by compressive strain.

(1)

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....

....

(ii) This decreases the volume of the submarine. Explain the action that should be taken to maintain a constant depth as the volume of the submarine is decreased.

(2)

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....

(iii) The submarine is made from steel. Suggest why a material, such as fibreglass, which has a much smaller Young modulus than steel would be unsuitable at greater depths.

(2)

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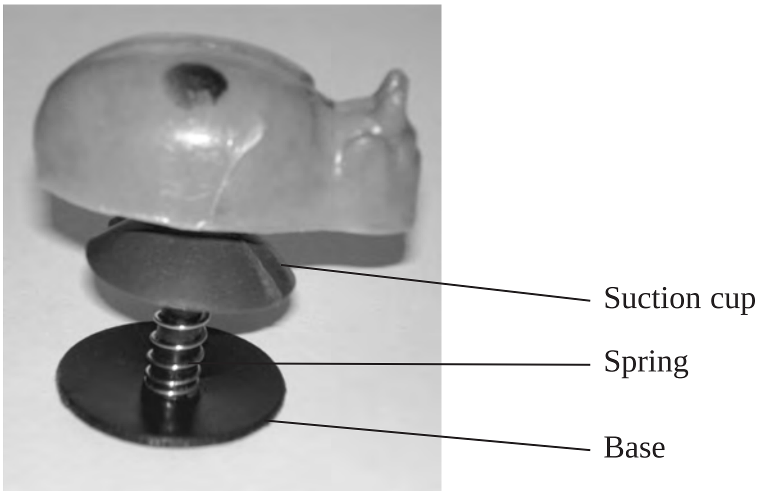
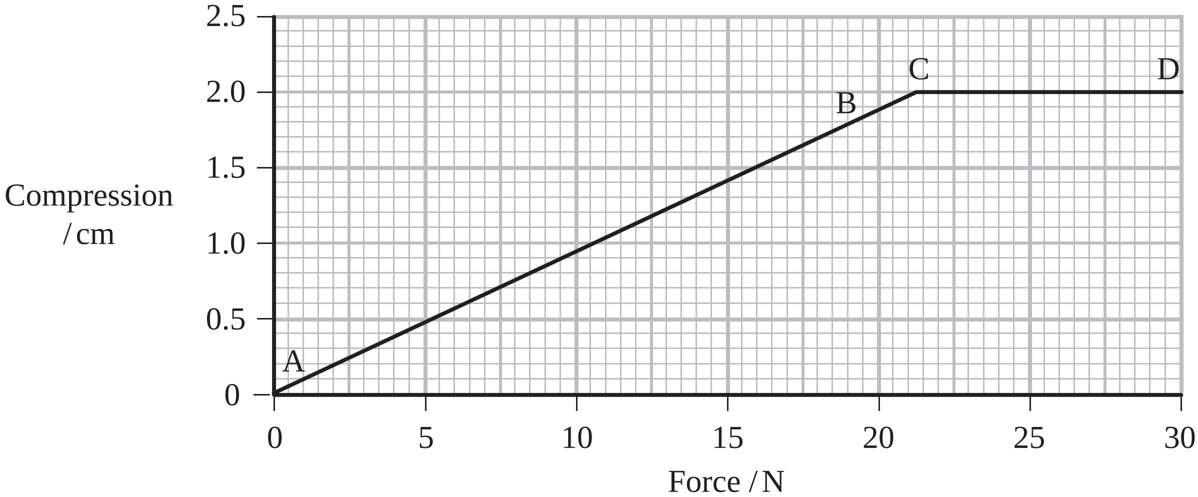
(Total for Question 18 = 11 marks)

19 The picture shows a jumping toy on which a student carries out some experiments.



The top of the toy is pushed down, compressing the spring. The suction cup adheres to the base and holds the toy down. After a short time, the suction cup leaves the base, causing the toy to jump.

A compression–force graph is obtained for the spring in the toy.



(a) (i) Explain the shape of section AB of the graph.

(1)

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....

(ii) Explain why section CD of the graph is horizontal.

(1)

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(b) Show that the stiffness of the spring is about 1000 N m^{-1}.

(2)

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....

(c) As the suction cup is about to leave the base the compression of the spring is 0.018 m.

(i) Calculate the energy stored in the spring at this stage.

(2)

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....

....

Energy stored = ...

(ii) Calculate the maximum possible height reached by the toy.

Mass of toy = 7.3×10^{-3} kg

(2)

....

....

....

Height = ...

(iii) State an assumption made in your calculation.

(1)

....

....

(d) The student uses a camera to video the movement of the toy in front of a metre rule. The video is then used to find the maximum height reached by the toy.

(i) Explain the advantage of using the video camera over making observations just by eye.

(2)

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(ii) The student repeats this procedure several times and records the following data:

0.45 m, 0.44 m, 0.36 m, 0.46 m, 0.45 m.

mean maximum height = 0.45 m

Why is the student justified in using 0.45 m as the mean?

(1)

....

....

(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	$g = 9.81\ \text{m s}^{-2}$	(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	$E_{el} = \frac{1}{2}F\Delta x$