Write your name here

Surname	Other names

Edexcel GCE

Centre Number	Candidate Number

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

New Template Exemplar
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 ▶

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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 quantities is a vector?

☒ **A** density

☒ **B** mass

☒ **C** strain

☒ **D** weight

(Total for Question 1 = 1 mark)

2 Two wires made of the same material but of different lengths and diameters are joined end to end and used to support a vertical load. If the weight of each wire is neglected, each wire must have the same

☒ **A** extension

☒ **B** strain

☒ **C** tensile force

☒ **D** tensile stress

(Total for Question 2 = 1 mark)

3 Newton's third law tells us that

☒ **A** actions usually have a reaction

☒ **B** weight and normal contact force are always equal and opposite

☒ **C** moving with constant velocity is the same as being at rest

☒ **D** forces always arise in pair

(Total for Question 3 = 1 mark)

4 An athlete throws a javelin. Just as it hits the ground the javelin has a horizontal velocity component of 20 m s^{-1} and a vertical velocity component of 10 m s^{-1}. The magnitude of the javelin's velocity as it hits the ground is

☒ **A** 10 m s^{-1}

☒ **B** 15 m s^{-1}

☒ **C** 22 m s^{-1}

☒ **D** 30 m s^{-1}

(Total for Question 4 = 1 mark)

In questions 5–6, which of the following statements best completes the sentence.

A decreases linearly from zero

B increases from zero to a maximum

C increases linearly from zero

D stays constant at a non-zero value

Choose the appropriate letter to indicate which statement best completes the sentence. Each answer may be used once, more than once or not at all.

5 If air resistance is neglected, the horizontal velocity component of an arrow fired from a bow ..... with distance travelled

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 5 = 1 mark)

6 The velocity of a ball bearing falling from rest through syrup ..... with distance fallen

☒ **A**

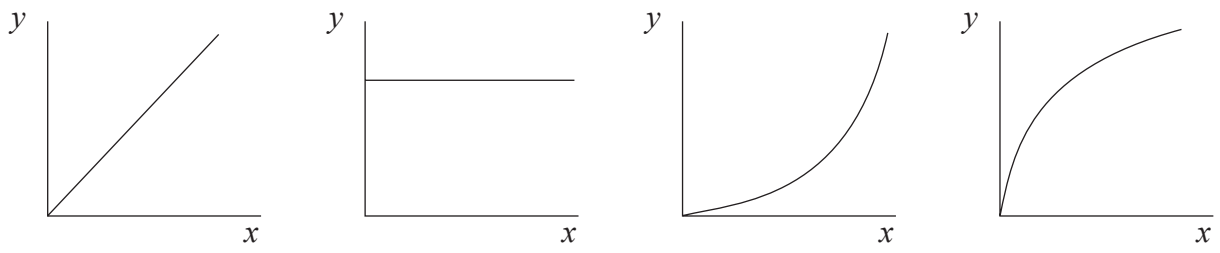
☒ **B**

☒ **C**

☒ **D**

(Total for Question 6 = 1 mark)

In questions 7–8, which of the following graphs best represents the quantities described when they are plotted on the *y*- and *x*-axes. Each graph may be used once, more than once or not at all.



A **B** **C** **D**

	Variable on *y*-axis	**Variable on *x*-axis**
7	The kinetic energy of a car accelerating uniformly from rest	Displacement from starting position

A ☒ **B** ☒ **C** ☒ **D** ☒

(Total for Question 7 = 1 mark)

8	The acceleration of a feather falling near to the Moon's surface	Height above the Moon's surface

A ☒ **B** ☒ **C** ☒ **D** ☒

(Total for Question 8 = 1 mark)

9 A shot putter launches the shot at an angle of 30° to the horizontal. The throw is repeated with the same launch speed, but this time at an angle of 40° to the horizontal. Which of the following is **not** correct?

☒ **A** The horizontal range is greater

☒ **B** The horizontal velocity component is increased

☒ **C** The maximum height reached is greater

☒ **D** The shot is in the air for longer

(Total for Question 9 = 1 mark)

10 Steel can be classified as a strong material. This is because

☒ **A** it is difficult to deform

☒ **B** it has a large ultimate tensile stress value

☒ **C** it has a large Young modulus value

☒ **D** it breaks shortly after its proportional limit

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

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SECTION B

Answer ALL questions in the spaces provided.

11 Complete the gaps in the following paragraph by selecting appropriate words from the following list.

compressive density energy force mass stiff tensile tough

Increasingly, drinks containers are made out of polymers rather than glass. A container made from a polymer such as polythene has several advantages over a glass container.

Polythene has low ..... , and so the ..... of the container is kept low. Polythene is also ..... and so can absorb a large amount of ..... before breaking. Glass is only strong under ..... forces but polythene is also strong under ..... forces.

(Total for Question 11 = 3 marks)

12 (a) Near schools the speed limit is 20 mph. It is claimed that reducing the speed limit from 30 mph (13.3 m s^{-1}) to 20 mph (8.9 m s^{-1}) halves the risk of serious injury in a car accident.

When a car is involved in a crash, the collision energy depends upon the car's speed just before impact.

(i) Determine $\frac{\text{kinetic energy of car travelling at 20 mph}}{\text{kinetic energy of car travelling at 30 mph}}$.

(1)

$\frac{\text{kinetic energy of car travelling at 20 mph}}{\text{kinetic energy of car travelling at 30 mph}}$ = ...

(ii) To what extent does your answer support the claim?

(2)

.....

.....

(b) A car of mass 1200 kg is in a crash. The front bumper of the car deforms, and the car is brought to rest from an initial speed of 10 m s^{-1} in a distance of 0.12 m.

By considering the work done on the car as it is brought to rest, calculate the average impact force that acts.

(3)

Average impact force = ...

(c) Modern cars include crumple zones to reduce the size of the impact force. Suggest how the crumple zones do this.

(1)

.....

.....

.....

(Total for Question 12 = 7 marks)

13 A skydiver accelerates towards the ground at 9.81 m s^{-2} at the instant that he leaves the aeroplane.

(a) Explain why his acceleration will decrease as he continues to fall.

(2)

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(b) The skydiver opens his parachute. Explain why he reaches a terminal velocity shortly afterwards.

(2)

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(c) The velocity at which he then hits the ground is similar to that achieved when falling freely from a height of 3 m. Calculate this velocity.

(2)

Velocity = ...

(Total for Question 13 = 6 marks)

***14** A sign at a railway station advises passengers to keep back from the platform edge. This is because passing trains may cause turbulence.

Explain what is meant by turbulent flow, and suggest why it is dangerous for passengers to stand near the edge of the platform.

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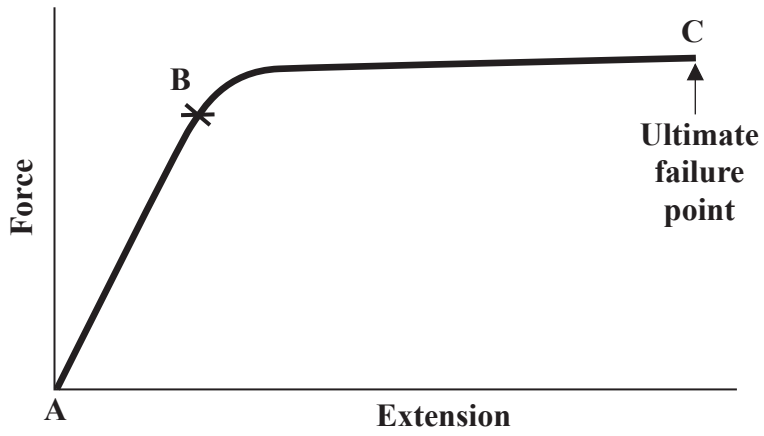
(Total for Question 14 = 3 marks)

15 The graph shows how a sample of material behaves when extended by a force.



(a) What does point **B** represent?

(1)

.....

(b) State the physical property represented by the gradient of the section **AB** of the graph.

(1)

.....

(c) Explain the significance of the area underneath the line from **A** to **C**.

(2)

.....

.....

(Total for Question 15 = 4 marks)

16 A raindrop has a radius of 0.70 mm. It is falling at terminal velocity through air.

(a) Show that the mass of the raindrop is approximately 1×10^{-6} kg.
Density of water = 1000 kg m^{-3}.

(2)

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(b) Ignoring any upthrust on the raindrop, calculate its terminal velocity.
Viscosity of air = 8.90×10^{-4} kg m^{-1} s^{-1}.

(2)

Terminal velocity = ...

(Total for Question 16 = 4 marks)

17 A student was asked the following question: "Describe the variation in energy of a bungee jumper from the moment that the jumper is released to the lowest point that the jumper reaches." As an answer the student wrote the following:

"Initially the jumper has gravitational potential energy, which is converted into elastic potential energy as the cord stretches. At the lowest point in the jump, all of the gravitational potential energy has been converted to elastic potential energy."

(a) Discuss the student's answer, highlighting any incorrect or missing physics.

(4)

(b) The bungee jumper has a mass of 80 kg and is in free fall through the air. At a particular instant the force of the air resistance acting on the bungee jumper is 285 N. Calculate the acceleration of the jumper.

(2)

Acceleration = ...

(Total for Question 17 = 6 marks)

18 An astronaut on the moon drops a hammer. The gravitational acceleration is 1.6 m s^{-2}.

(a) How long does the hammer take to fall 1.0 m from rest?

(2)

Time = ...

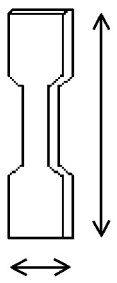
(b) Calculate the velocity of the hammer just before it hits the ground.

(2)

Velocity = ...

(Total for Question 18 = 4 marks)

19 A tensile tester connected to a datalogger is used to investigate the effect of applying forces to a range of materials.



The sample has approximate dimensions $x = 1$ cm, $y = 10$ cm. It is fixed into the frame and force applied from a hydraulic system. The datalogger records the extension of the sample and the applied force.

(a) State any measurements, other than the force, that you would need to calculate the stress in the sample and name an appropriate instrument that you could use to make these measurements.

(2)

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(b) Explain why access to a datalogger is useful when tensile testing is carried out.

(2)

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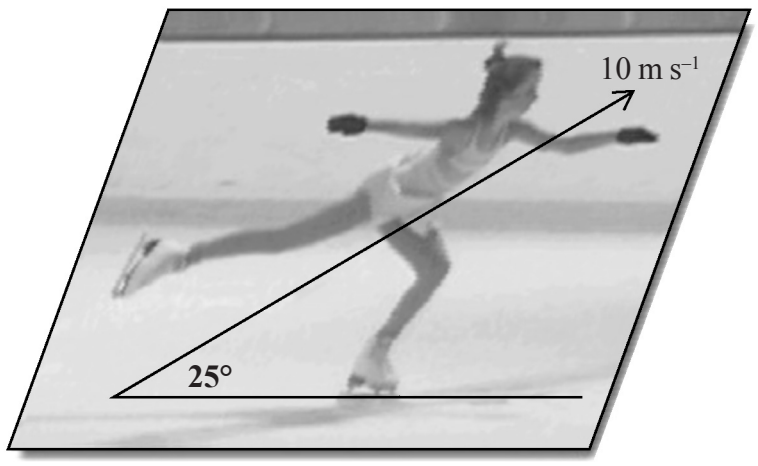
(Total for Question 19 = 4 marks)

20 Performing complex jumps is an important aspect of a figure skater's program. Jumps with great heights and jump distances tend to leave a better impression with the judges, resulting in better marks for the skater.

A skater of mass 60 kg leaves the ice with a velocity of 10 m s^{-1} at an angle of 25° to the horizontal.



(a) Show that the vertical component of the skater's velocity is approximately 4 m s^{-1}.

(2)

.....

.....

(b) Calculate the time taken to reach the top of the jump.

(2)

Time taken = ...

(c) Calculate the maximum height reached.

(2)

Maximum height = ...

(Total for Question 20 = 6 marks)

***21** (a) A chest expander is used to build up the chest muscles.

One type of expander consists of five identical springs as shown. A student disconnects one spring and finds that applying a force of 6 N to it causes an extension of 5 cm.

(i) Calculate the force required to stretch a single spring by 50 cm, stating the assumption you have made.

(3)

Assumption:

.....

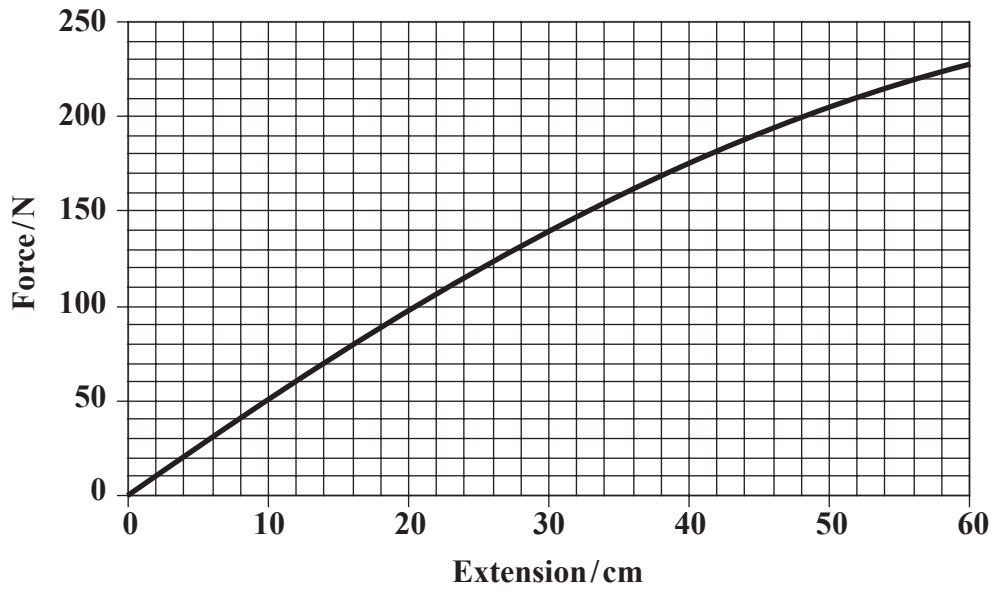
Force = ...

(ii) Calculate the work done when all five springs are stretched by 50 cm.

(2)

Work done = ...

(b) A different type of chest expander uses rubber cords instead of springs. The variation of restoring force with extension for this expander is shown.



(i) Use the graph to estimate the work done in extending the expander by 50 cm.

(3)

Work done = ...

(ii) When unloading the expander, it is found that at each extension the restoring force is always less than the loading force. Explain the significance of this, and describe what effect this would have on the rubber cords when performing a large number of repetitions with the expander.

(3)

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(Total for Question 21 = 11 marks)

***22** The photograph shows a climber abseiling down a rock face. At the instant shown the climber is in equilibrium.

(a) Explain what is meant by equilibrium in this context.

(1)

.....

.....

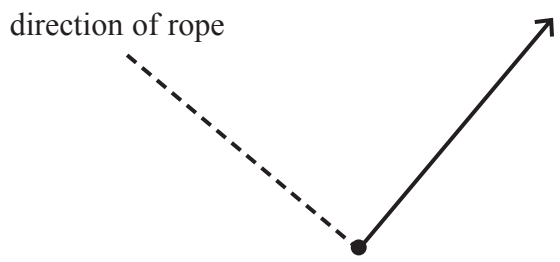
(b) The climber's mass is 65 kg. Calculate his weight.

(2)

Weight = ...

(c) (i) Below is an incomplete free-body force diagram for the climber.

(3)



One of the forces, which is assumed to be acting perpendicular to the rope is already shown. Label this force, and add labelled arrows to the diagram to represent the other two forces acting on the climber. Assume that the rope hanging down from the climber exerts a negligible force on him.

(ii) The rope is at an angle of 40° to the horizontal. Calculate the tension in the rope.

(2)

Tension in rope = ...

(d) The climber is wearing protective headgear in case of an accident. Describe the properties of a material suitable for the headgear, and explain why these properties are desirable.

(4)

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(Total for Question 22 = 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	$E_{el} = \frac{1}{2}F\Delta x$