Surname	Centre Number	Candidate Number
Other Names		2

GCE AS – NEW

B420U10-1

S17-B420U10-1

PHYSICS – AS component 1
Motion, Energy and Matter

TUESDAY, 23 MAY 2017 – MORNING

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**15**	
2.	**12**	
3.	**9**	
4.	**11**	
5.	**12**	
6.	**10**	
7.	**6**	
Total	**75**	

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ADDITIONAL MATERIALS

In addition to this paper, you will require a calculator and a **Data Booklet**.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The total number of marks available for this paper is 75.
The number of marks is given in brackets at the end of each question or part-question.
You are reminded to show all working. Credit is given for correct working even when the final answer is incorrect.
The assessment of the quality of extended response (QER) will take place in **Q7**.

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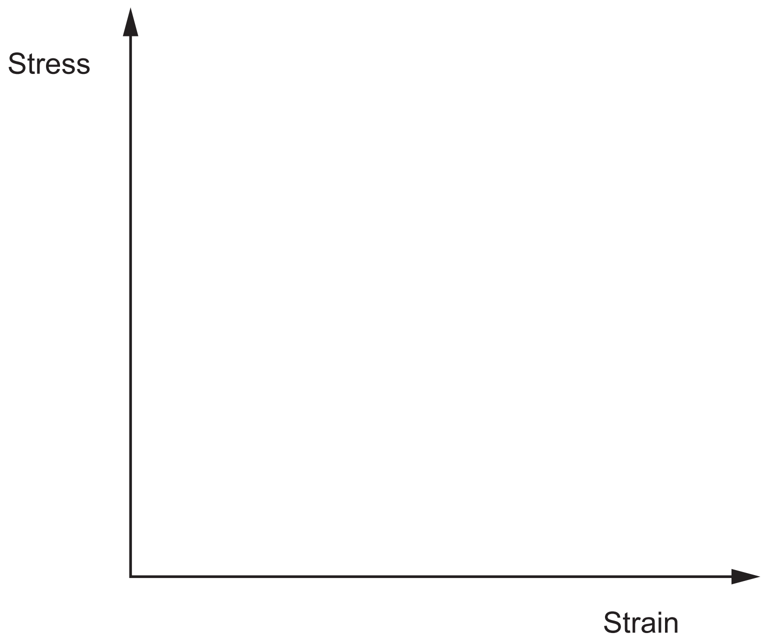
Answer **all** *questions.*

1. *(a)* Solid materials can be categorised into one of three different types. Complete the table describing the molecular structure of each type of solid. [3]

Type of solid	Arrangement of particles
Crystalline	....
....	Short range but no long range order Irregular
Polymeric	....

(b) Sketch on the axis below a typical stress-strain graph for a length of ductile metal wire when it is gradually loaded until it breaks.

Label, on your graph the:
- yield point;
- elastic limit;
- region over which Hooke's law is obeyed. [4]



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(c) (i) A **nylon** fishing line of negligible mass has a breaking stress of 60 MPa. Calculate the minimum diameter of line needed to lift a fish of mass 5.0 kg vertically out of the water. [4]

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(ii) When lifting the fish vertically 2.00 m of the line extends by 40 mm. Use this information to calculate a value for the Young modulus of the nylon line at breaking stress. [2]

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(iii) If the fish struggles the force on the line can be increased by a factor of ten. Calculate the minimum diameter of line now required to stop the line breaking. [2]

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2. *(a)* (i) Define velocity. [1]

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(ii) Give an example of a situation where an object has: [2]

I. a changing velocity but a constant speed;

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II. acceleration in the opposite direction to velocity.

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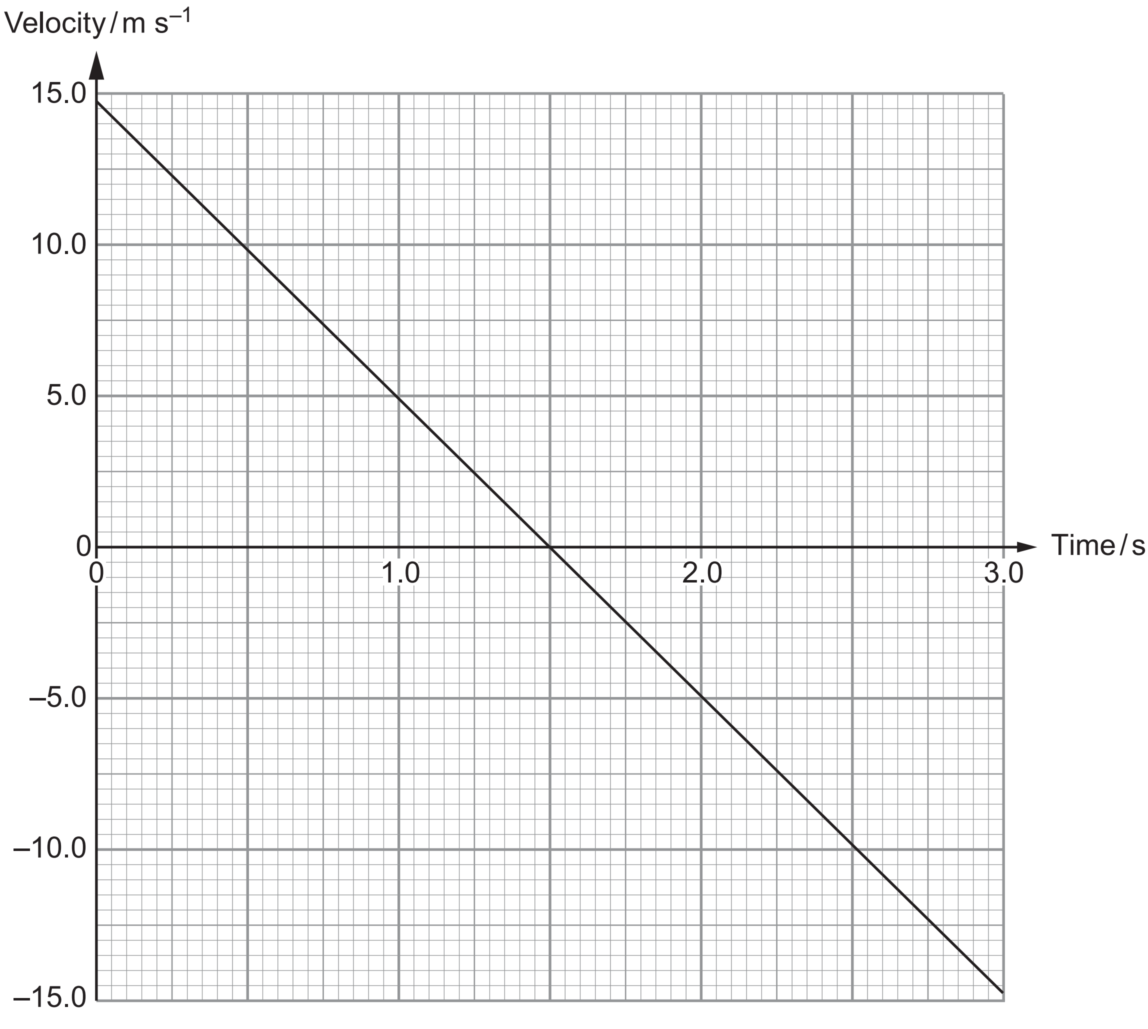
(b) Sarah throws a ball vertically upwards and catches it. A velocity-time graph for the flight of the ball is shown below. *Ignore the effects of air resistance.*



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(i) Calculate the acceleration due to gravity. [2]

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(ii) Calculate the maximum height of the ball from Sarah's hand. [2]

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(iii) State the displacement of the ball from Sarah's hand after 3 seconds. [1]

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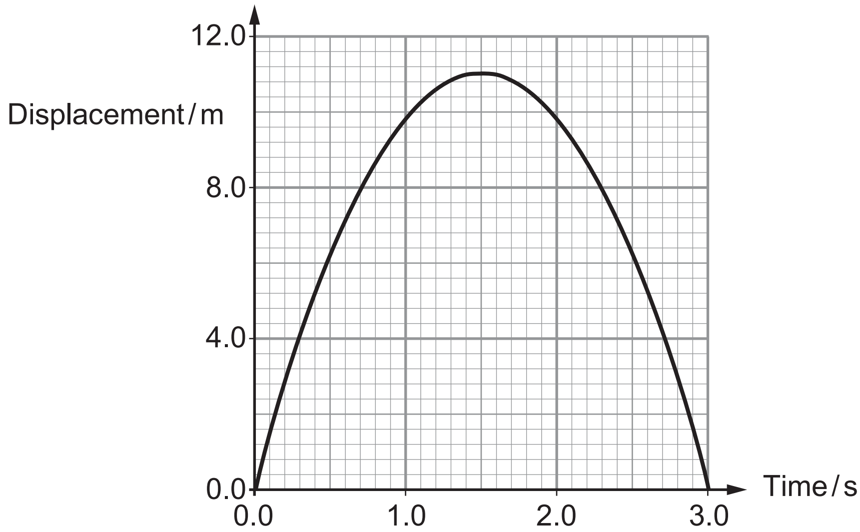
(c) When Sarah was asked to sketch a displacement-time graph for the flight of the ball from the time it was first thrown until it was caught, she sketched the shape shown below. Evaluate whether you think she was correct. Further calculations are not required. [4]



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3. When colliding two protons at very high energy the following interaction has been observed at the large hadron collider in CERN.

$$p + p \rightarrow {}^{2}_{1}H + e^{+} + x$$

(a) Use the conservation of lepton number and conservation of charge to identify the particle x. [3]

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(b) State which force is responsible for this interaction. Give your reasoning. [2]

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(c) State which of the above particles can be classed as: [2]

(i) a baryon;

....

(ii) an antiparticle.

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(d) At present, countries in Europe contribute to funding research at CERN. Evaluate whether or not the money could be better spent on humanitarian aid. [2]

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4. In this question the Sun and the star Vega can be considered to be *black bodies*.

(a) (i) Define a *black body*. [1]

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(ii) The surface temperature of the Sun is approximately 6 000 K and that of Vega approximately 10 000 K. Calculate the wavelength of peak spectral intensity for each star and name the region of the electromagnetic spectrum within which they lie. [3]

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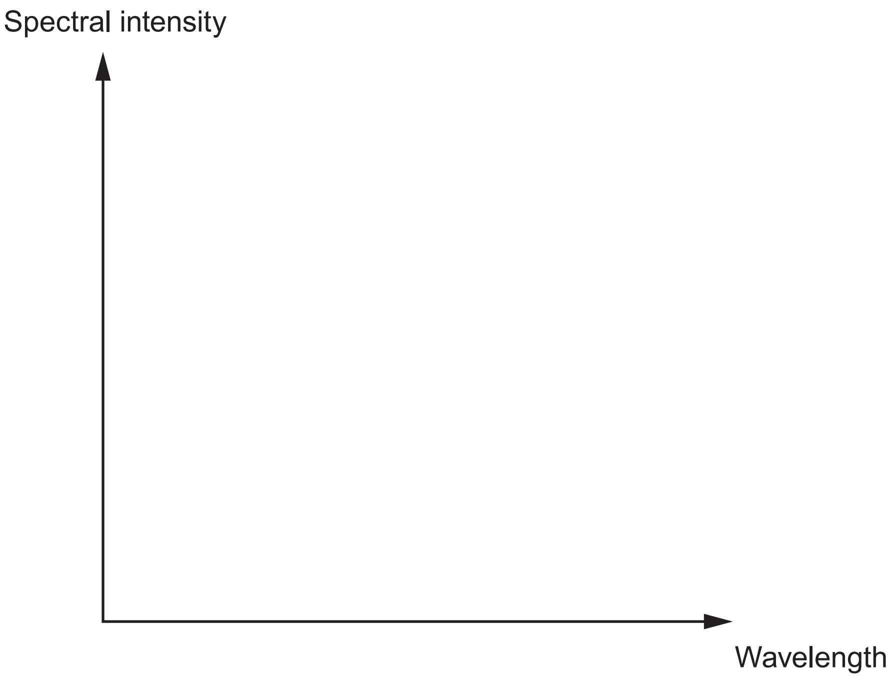
(iii) Sketch a black body spectrum for **each star** on the axis provided. [3]



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(b) The radius of Vega is approximately 2.71 times that of the Sun.
Determine the ratio:

$$\frac{\text{total power output of Vega}}{\text{total power output of Sun}}$$

[4]

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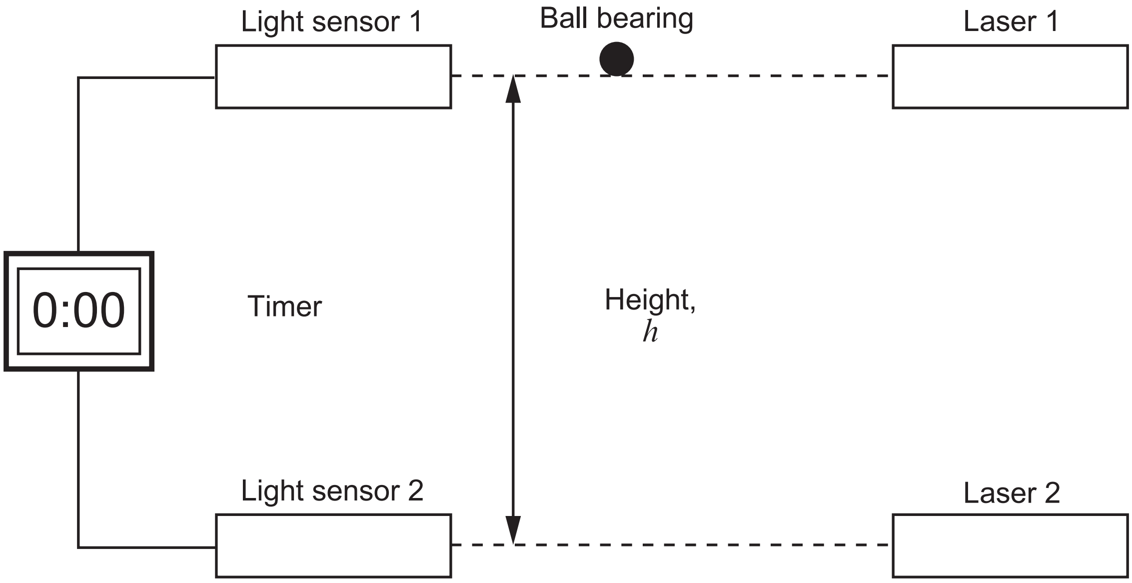
5. George attempts to determine the acceleration due to gravity using the following apparatus. The ball bearing starts from rest just above the top beam of light. When the ball bearing cuts the top beam it starts the timer and when it breaks the bottom beam it stops the timer.



(a) (i) The vertical distance, h, between the two light beams was measured using a metre ruler of resolution 1 cm and was found to be 1.25 m. Determine the **percentage** uncertainty in this result. [1]

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(ii) The time, t, taken to fall through the distance, h, was measured three times and the following results were obtained.

Time 1 / s	Time 2 / s	Time 3 / s
0.51	0.53	0.50

Determine the mean time taken for the ball bearing to fall along with its **percentage** uncertainty. [2]

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(iii) Use the equation:

$$h = \frac{gt^2}{2}$$

to determine a value for the acceleration due to gravity along with its **absolute** uncertainty. [4]

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(iv) State why the value you obtained in *(a)*(iii) is less than 9.81 $\mathrm{m\,s^{-2}}$. [1]

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(b) (i) Annabel suggests that the experiment would be more accurate if times were obtained for the ball bearing to fall different vertical distances and a graph was drawn. Do you believe Annabel is correct? Justify your answer. [2]

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(ii) Explain which graph should be drawn to determine g and how it can be used to find a value for g. [2]

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6. *(a)* Explain, with the aid of a diagram, what is meant by the *moment* of a force about a point. [2]

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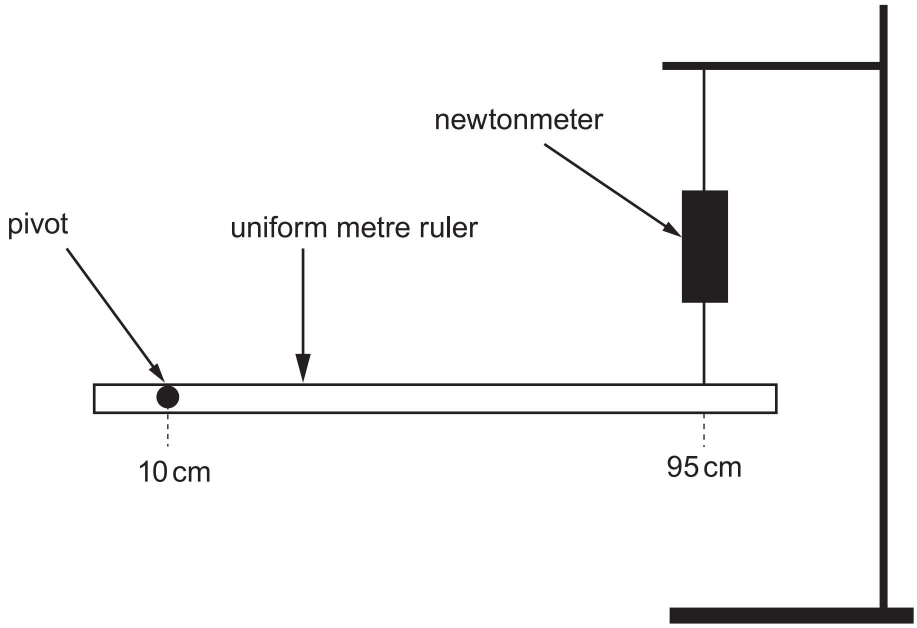
(b)



(i) A uniform metre ruler is pivoted at the 10 cm mark and the other end is supported by a newtonmeter attached to the 95 cm mark. The ruler balances horizontally when the newtonmeter reads 0.8 N. Determine the **mass** of the ruler to an appropriate number of significant figures. [3]

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(ii) A mass of 0.5 kg is now added at the 70 cm mark on the ruler and the ruler is adjusted to be horizontal once more.

I. How could you check the ruler is horizontal? [1]

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II. What is the new reading on the newtonmeter when the ruler is horizontal? [2]

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(c) If a uniform metre ruler of greater mass than the one in part *(b)* were used, describe how you could alter the apparatus so the ruler is horizontal once more. Explain your reasoning. [2]

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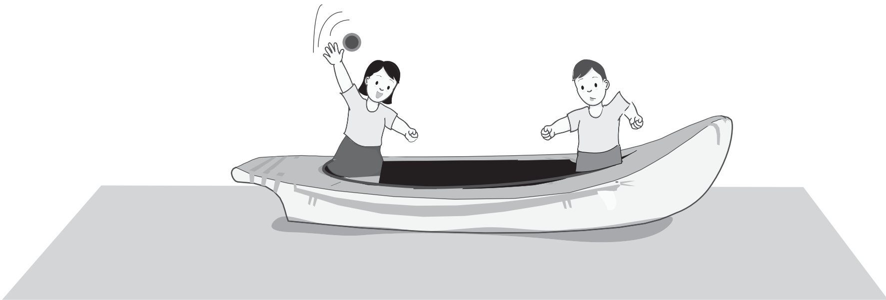
7. Louise and Ryan stand a few metres apart on a stationary boat. Louise throws a heavy ball to Ryan who catches it. Describe and explain the motion of the **boat** from the moment Louise starts to throw the ball until just after the ball is caught by Ryan. *Ignore all resistive forces*.

[6 QER]



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