Surname	Centre Number	Candidate Number
Other Names		2

GCE AS – NEW AS

B420U10-1

S16-B420U10-1

PHYSICS – Component 1
Motion, Energy and Matter

A.M. TUESDAY, 24 May 2016

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**11**	
3.	**13**	
4.	**10**	
5.	**9**	
6.	**11**	
7.	**11**	
Total	**75**	

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ADDITIONAL MATERIALS

In addition to this examination 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 given is incorrect.

The assessment of the quality of extended response (QER) will take place in **Q7*(b)***.

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Answer **all** *questions.*

1. *(a)* State the conditions necessary for a body to remain in equilibrium. [2]

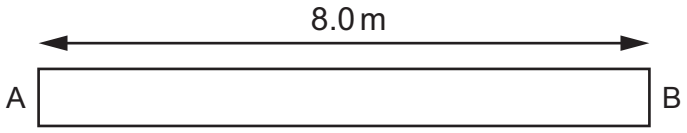
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(b) (i) Two men support a uniform plank of wood of length 8.0 m and of mass 30 kg. One man is 0.5 m from end **A** of the plank and the other 2.0 m from end **B**. **Show on the diagram** below all the forces acting on the plank. [2]



(ii) Starting by taking moments about a suitable point determine the force each man exerts on the plank. [4]

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(iii) If the man near end **A** moves a small distance towards end **B** what will happen to the size of the force exerted by each man? [1]

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(iv) Where would the man near end **A** have to support the plank to exert the same force as the man near end **B**? [1]

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2. *(a)* State the difference between vector and scalar quantities, giving one example of each. [2]

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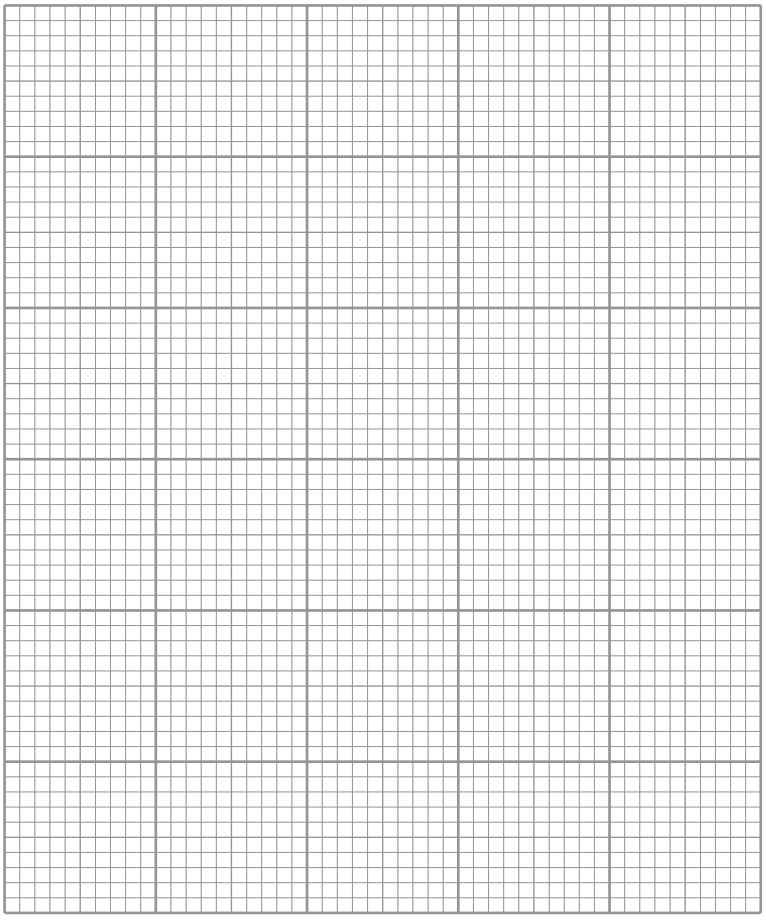
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(b) A water skier is towed behind a speed boat. The skier accelerates uniformly from rest with an acceleration of $1.4\,m\,s^{-2}$ for 8.0 s and then continues at a constant velocity for a further 20.0 s. The skier then lets go of the rope and decelerates uniformly to rest in a further 67 m.

(i) Draw a velocity-time graph for the skier's journey. Space is provided for your calculations. [4]



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(ii) Determine the total distance the skier travelled. [2]

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(c) Describe the resultant force acting on the skier during each stage of her motion. [3]

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3. *(a)* A paintball gun of mass 2.60 kg fires a pellet of mass 3.0×10^{-3} kg with velocity 85 m s^{-1}. Determine the recoil velocity of the gun. [2]

(b) The paintball gun is fired horizontally at a target 40 m away and the initial horizontal velocity of the paintball pellet is 85.0 m s^{-1}. Ignore the effects of air resistance.

(i) Determine how far the pellet has fallen by the time it reaches the target. [3]

(ii) Determine the angle between the pellet's velocity and the horizontal when it hits the target. [3]

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(c) Now considering the effect of air resistance.

(i) How would your answer to *(b)*(ii) differ? [2]

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(ii) If air resistance caused the final horizontal speed of the pellet to decrease to $30\,m\,s^{-1}$ find the mean force of air resistance acting on the pellet. Take the distance travelled by the pellet as 40.0 m. [3]

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4. When asked to determine the metal used to make a ball bearing, James decided to determine its density and compare it with known values for different metals.

(a) The diameter of the ball bearing was found to be 1.20 ± 0.01 cm. Determine the **percentage** uncertainty in this reading. [1]

(b) Calculate the volume of the ball bearing along with its **percentage** uncertainty. [3]

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(c) The mass of the ball bearing was found to be 6.9 ± 0.1 g. Use the table below to identify the material used to make the ball bearing. Justify your choice numerically. [3]

Material	Density / kg m^{-3}
Constantan	8 880
Steel	7 850
Zinc	7 140
Nichrome	8 410

(d) James's friend Annabel wanted to determine the metal of a wire and instead of obtaining its density; she obtained its resistivity using the following data.

length of wire = (3.600 ± 0.001) m
diameter of wire = (0.25 ± 0.01) mm
resistance of wire = (1.1 ± 0.1) Ω

Without calculating the resistivity, explain why this procedure leads to a far greater percentage uncertainty than that in part *(c)*. [3]

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5. *(a)* Most subatomic particles can be divided up into two groups – hadrons and leptons.

(i) State **one** difference between the two groups and give an example of a particle in each group. [2]

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(ii) Hadrons can be further divided into two groups – baryons and mesons. Describe the quark make-up of each. [1]

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(b) An isotope of carbon, ${}^{11}_{6}\mathrm{C}$ decays to emit a positron, e^{+}, and an unknown particle x as shown.

$$ {}^{11}_{6}\mathrm{C} \longrightarrow {}^{11}_{5}\mathrm{B} + \mathrm{e}^{+} + x $$

(i) A positron, e^{+}, is an antiparticle. Give **one** similarity and **one** difference between a particle and its antiparticle. [2]

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(ii) Identify particle x, explaining how you used the relevant conservation laws. [3]

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(iii) Which interaction is responsible for this decay? Give a reason for your answer. [1]

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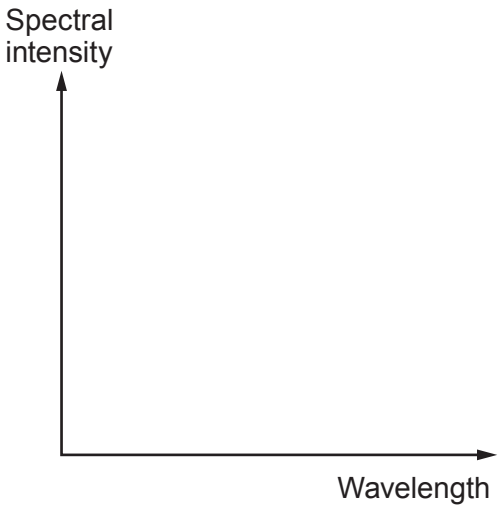
6. *(a)* The star Sirius has a surface temperature of 9700 K. Calculate the wavelength of the star's peak spectral intensity and sketch the spectrum on the axes below. [4]

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(b) (i) Name the region of the electromagnetic spectrum that contains this peak spectral intensity and use your answer to explain whether or not the Greek astronomer Ptolemy was correct when he described Sirius as red in appearance. [2]

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(ii) Calculate the photon energy for this peak spectral intensity. Give your answer in **electron volts**. [2]

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(c) The diameter of Sirius is 2.40×10^9 m. Use the peak wavelength to estimate the number of photons per second emitted by Sirius. [3]

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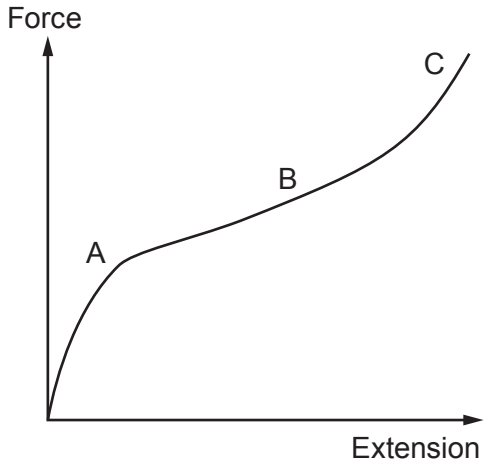
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7. *(a)* Define the Young modulus. [1]

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(b) A student, Chloe, obtains a graph of force against extension for the loading of a rubber band.



Describe and explain the variation of the Young modulus from the shape of the graph and explain this in terms of molecules. [6 QER]

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(c) **Add to the graph** opposite to show what would happen when Chloe unloaded the rubber band. Account for any differences between the two lines. [2]

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(d) Some plastic shopping bags are made of non-biodegradable polymers. Discuss whether or not there should be a charge for using non-biodegradable plastic bags. [2]

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END OF PAPER

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