Surname	Centre Number	Candidate Number
Other Names		2

GCE AS

B420U20-1

S18-B420U20-1

PHYSICS – AS component 2
Electricity and Light

FRIDAY, 18 MAY 2018 – MORNING

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**13**	
2.	**10**	
3.	**19**	
4.	**8**	
5.	**11**	
6.	**14**	
Total	**75**	

B420U201
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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 **Q5***(a)*.

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Answer **all** *questions.*

1. *(a)* Explain what is meant by a progressive wave. [2]

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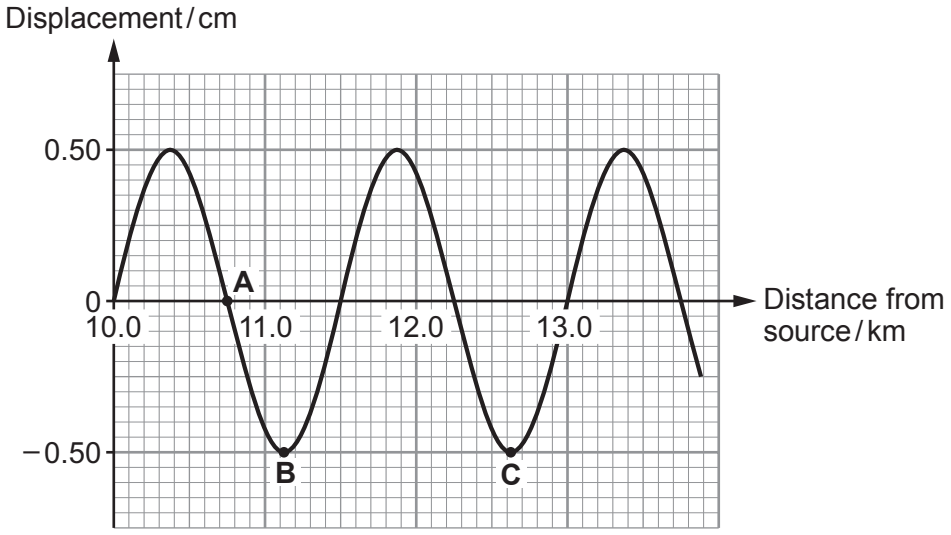
(b) Earthquakes produce seismic waves that travel through rock. The following graph shows the displacement at a given instant for a seismic wave.



(i) Determine the phase difference between: [2]

A and **B** .....

B and **C** .....

(ii) A geologist at a monitoring station notes that there are 50 complete cycles of the wave in a time interval of 20 s. Calculate the speed of the wave. [4]

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(c) A section of rock undergoes a tensile stress of 900 MPa during an earthquake. Calculate the tensile strain if the Young modulus is 70 GPa for rock. [3]

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(d) Explain how data obtained by geologists about earthquakes from various monitoring stations can benefit society. [2]

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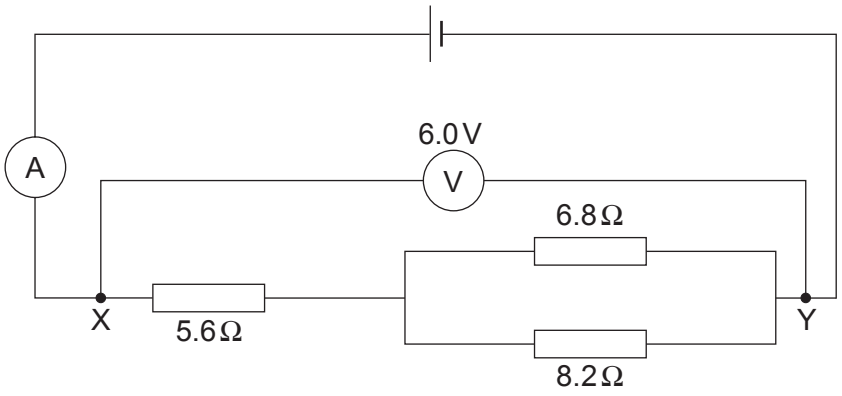
2. A circuit is set up as shown.



(a) In the circuit shown, the potential difference between X and Y is 6.0 V. Explain what this statement means. [2]

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(b) (i) Determine the reading on the ammeter if it has an instrument resolution of ± 0.01 A. [4]

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(ii) Calculate the potential difference across the 8.2 Ω resistor. [2]

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(iii) Calculate the power dissipated in the parallel resistor combination. [2]

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3. *(a)* (i) State what is meant by the photoelectric effect. [1]

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(ii) Einstein's photoelectric equation may be written as:

$$E_{k\max} = hf - \phi$$

Explain this equation in terms of energy. [3]

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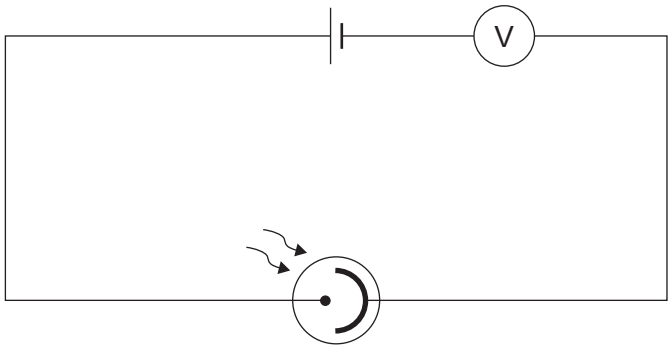
(b) Evaluate why the following circuit is incorrect and cannot be used to measure the maximum kinetic energy of the emitted electrons. [4]



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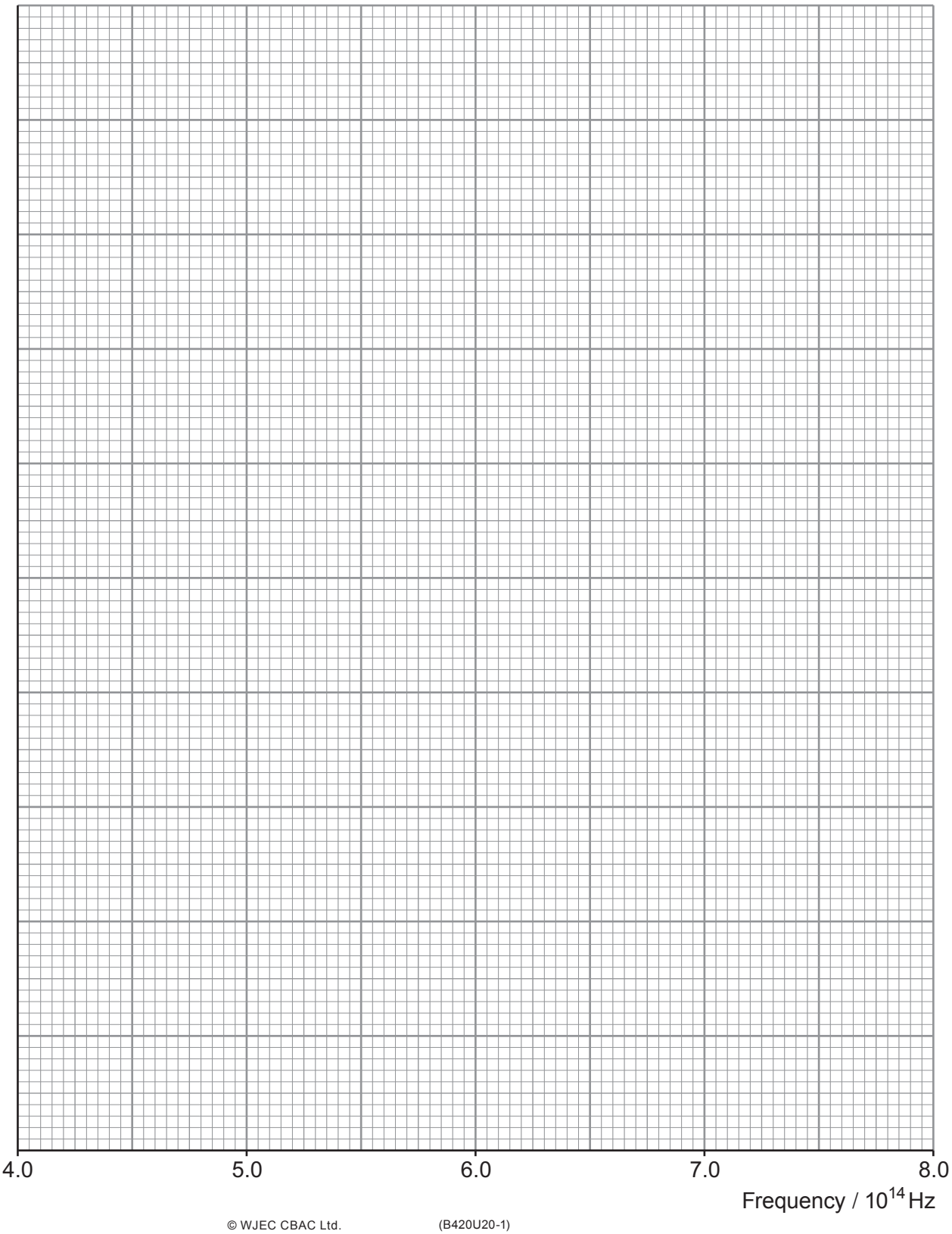
(c) Different frequencies of light are used with a **correct** circuit and the following results are obtained.

Frequency / 10^{14} Hz	5.1	6.0	6.9	7.5
$E_{k\max}$ / 10^{-19} J	0.36	0.93	1.50	1.95

(i) Plot $E_{k\max}$ (y-axis) against frequency (x-axis) on the grid below and draw a line of best fit through your data. [3]



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(ii) Explain whether or not your graph is in agreement with Einstein's photoelectric equation. [3]

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(iii) Calculate a value for the Planck constant using the gradient of your graph. [3]

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(iv) An answer can be considered to be accurate if it is within 5% of the accepted value for the Planck constant. Evaluate whether your answer for the Planck constant can be considered to be accurate. [2]

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4. *(a)* Define electric current. [1]

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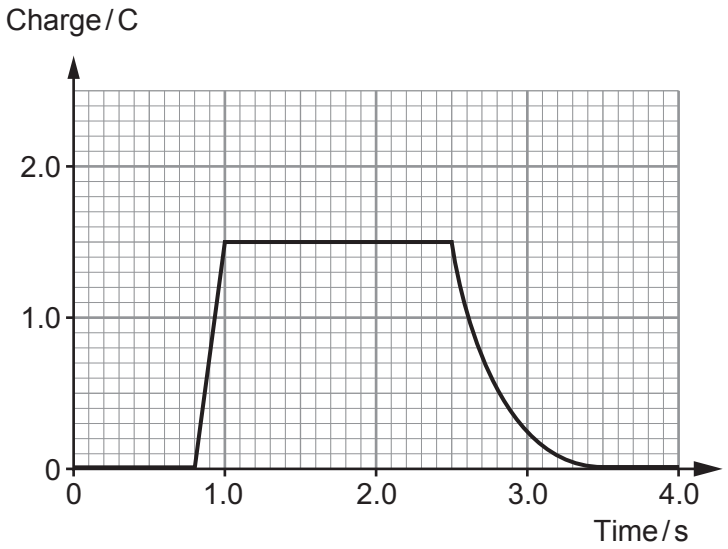
(b) The following graph shows how the **charge** that has passed a point in an electrical circuit varies with time.



(i) Describe how the **current** varies from t = 0 to t = 2.5 s giving appropriate values. [4]

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(ii) Calculate the **current** when t = 3.0 s. [3]

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5. *(a)* Explain how a 3 level laser operates, explaining also why a 2 level laser is not possible. [6 QER]

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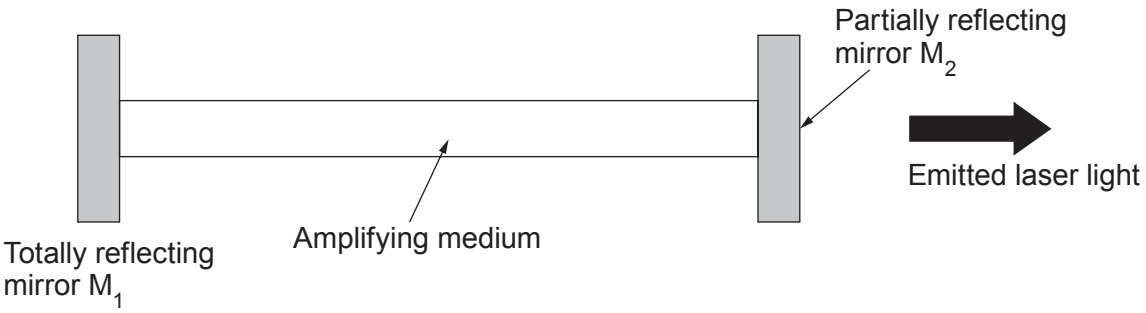
(b) The simplified diagram shows the cavity of a laser.



(i) The wavelength of light from the laser is 633 nm. Calculate the energy of a photon of light emitted by the laser. [2]

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(ii) The power output of the laser is 1.0 mW. Mirror M_2 transmits 1 in 500 photons. Determine the number of photons per second incident on mirror M_2. [3]

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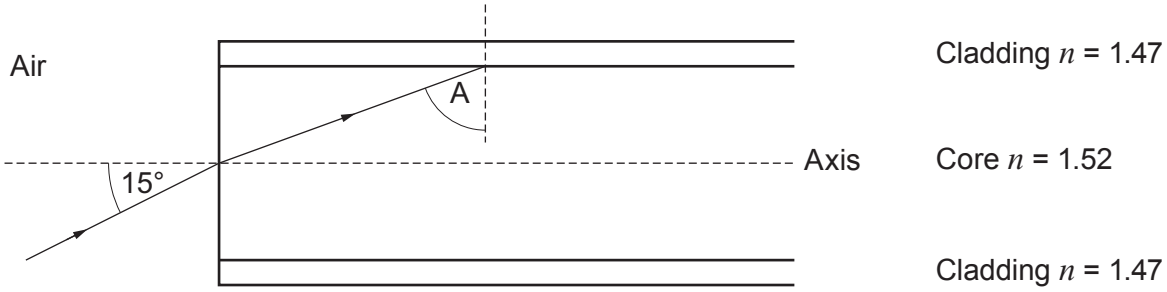
6. *(a)* A multimode optical fibre has a core made of glass of refractive index 1.52. The cladding is made of a material with refractive index 1.47.



(i) Calculate the critical angle for the core-cladding boundary. [2]

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(ii) A beam of light enters the optical fibre from air at an angle of 15° as shown. Calculate angle A. [3]

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(iii) A technician states that the beam of light entering the fibre from air at an angle of 15° will not travel down the optical fibre. Evaluate whether the technician is correct. [2]

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(b) Calculate the time taken for the light to travel along **the axis** of a straight optical fibre of length 15 km. [3]

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(c) (i) State how the paths of light in monomode and multimode optical fibres differ. [1]

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(ii) Explain the advantage of monomode optical fibres over multimode optical fibres for communicating a rapid sequence of data encoded as light pulses. [3]

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END OF PAPER