Surname	Centre Number	Candidate Number
Other Names		2

GCE AS – NEW AS

B420U20-1

S16-B420U20-1

PHYSICS – Component 2
Electricity and Light

P.M. THURSDAY, 9 June 2016

1 hour 30 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	8	
2.	9	
3.	9	
4.	9	
5.	14	
6.	14	
7.	12	
Total	75	

B420U201
01

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 **Q6*(a)***.

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Answer **all** *questions*

1. *(a)* State Ohm's law. [2]

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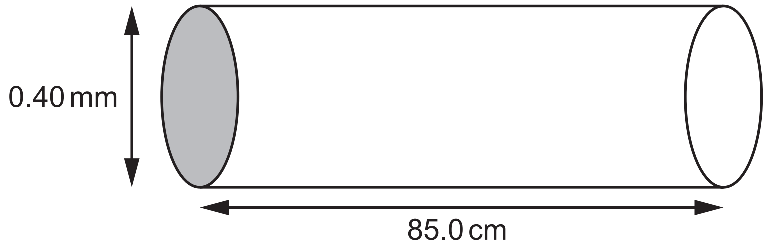
(b) (i) A metal wire has length 85.0 cm and diameter 0.40 mm. A potential difference of 9.0 V applied across the ends of the wire produced a current of 1.20 A. Calculate the resistivity of the metal. [3]



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(ii) George repeats the experiment with another wire made of the same metal but half the length and half the original diameter. George measures a current of 0.55 A when the pd is kept at 9.0 V. Evaluate whether this value agrees with the expected value. [3]

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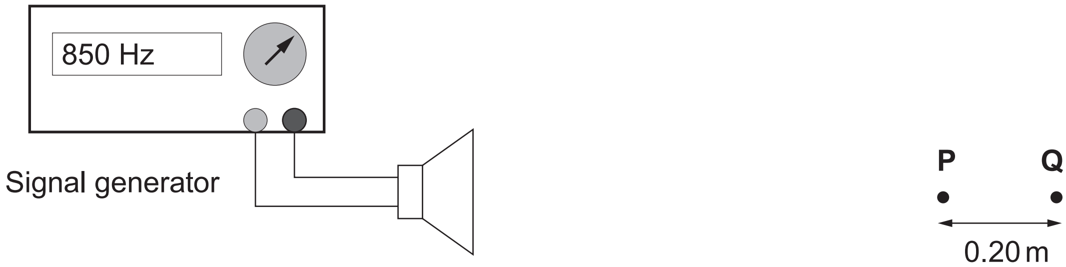
2. A loudspeaker is connected to a signal generator producing a sinusoidal output of frequency 850 Hz.



(a) Determine the phase difference between oscillations of the air at **Q** and at **P**. Take the speed of sound in air as $340\,\mathrm{m\,s^{-1}}$. [2]

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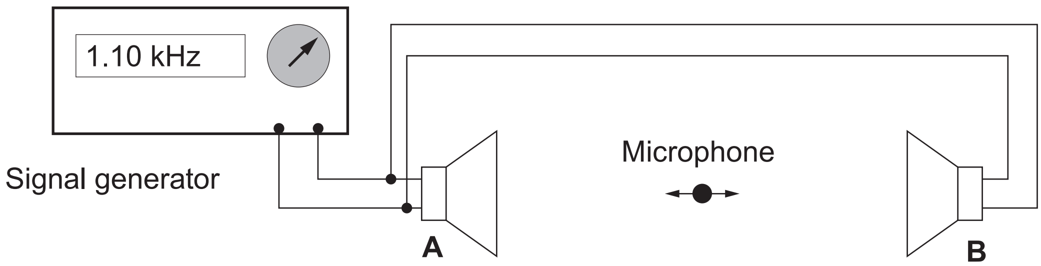
(b) A second loudspeaker is connected to the signal generator as shown below and the frequency of the signal generator is changed to 1.10 kHz.



(i) Explain why a sequence of maximum and minimum signals is detected as the microphone is moved from loudspeaker **A** to loudspeaker **B**. [3]

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(ii) The microphone is positioned at a minimum near to loudspeaker **A**. It is then moved 60.0 cm towards **B** to another minimum position. Four successive maxima are detected. Determine a value for the speed of sound. [4]

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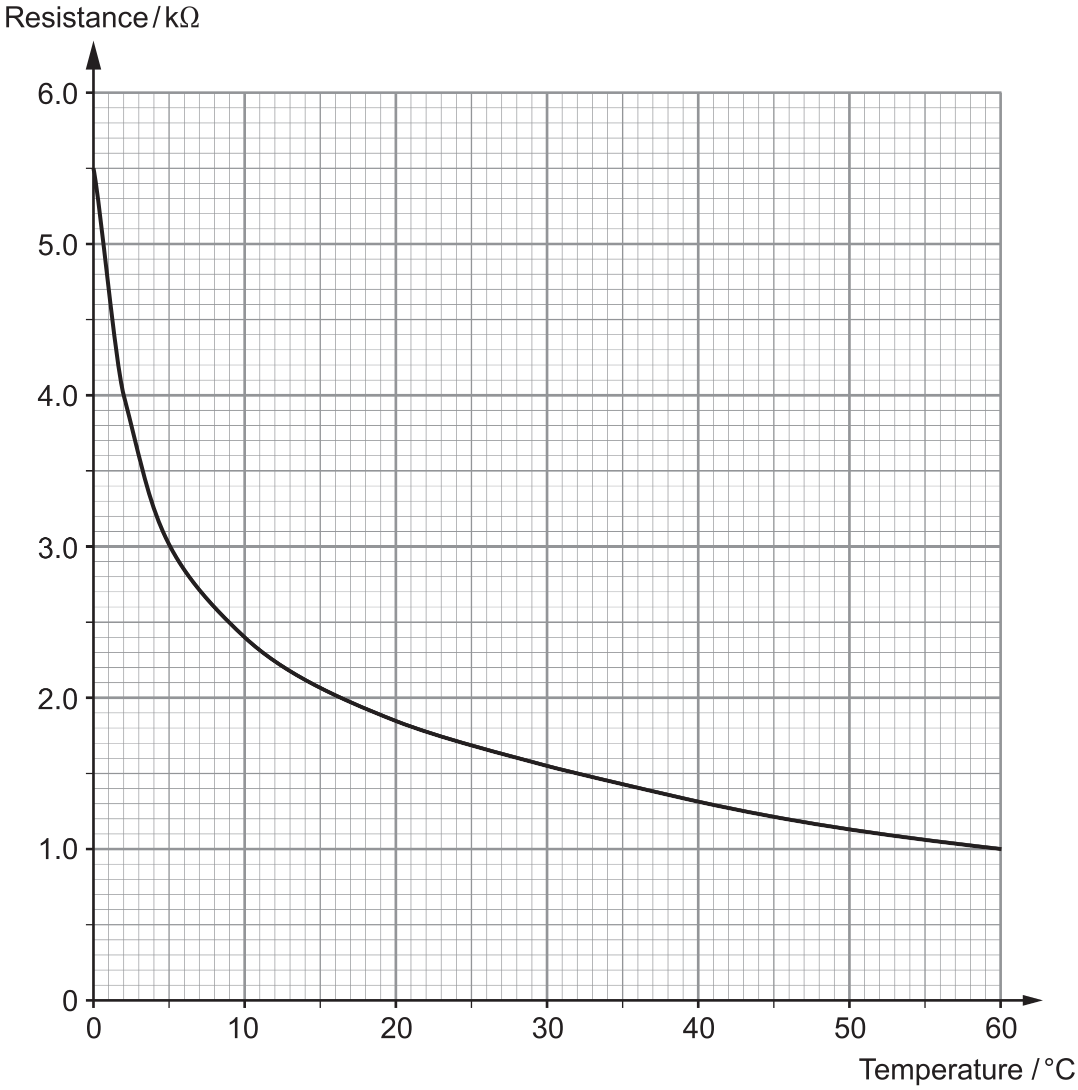
3. The following graph shows how resistance varies with temperature for a thermistor.



(a) Explain how the graph shows that the thermistor is not a metal. [1]

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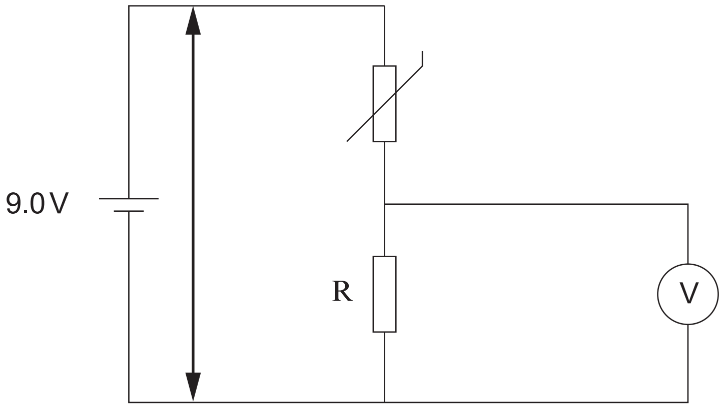
(b) Richard sets up a temperature sensing circuit using the thermistor from part *(a)*. A constant 9.0 V supply is applied as shown.



(i) Explain how the reading on the voltmeter changes as the temperature increases. [3]

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(ii) Determine the value of R for the voltmeter to read 6.0 V when the temperature is 35 °C. [3]

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(iii) Richard replaces the voltmeter with a 6.0 V bulb expecting it to light with full brightness when the temperature is 35 °C. Explain why the bulb does not operate as expected. [2]

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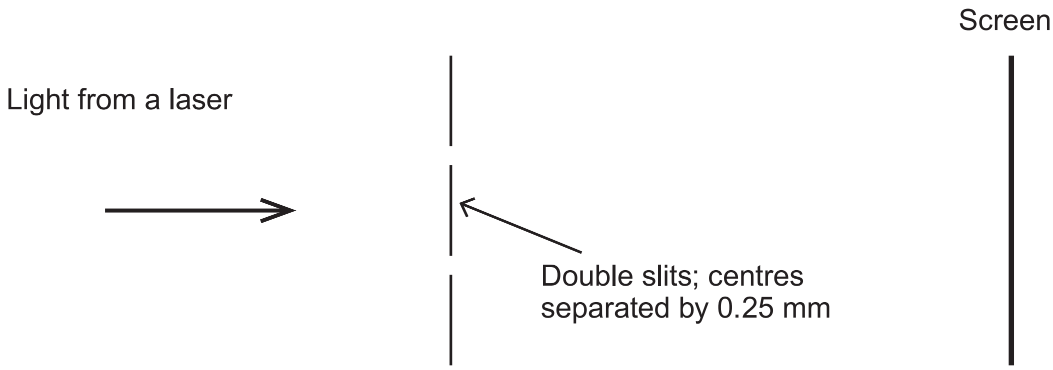
4. A Young's double slit experiment is set up as shown below. Alternate bright and dark fringes are seen on the screen.



(a) Explain why the bright fringes are seen. [3]

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(b) A student, Muneebah, varies the distance from the slits to the screen and measures the spacing of the fringes. The data are given in the following table.

Distance to the screen / m	**Mean fringe spacing / × 10^{-3} m**
1.00	2.4
2.00	4.8
3.00	7.4
4.00	10.0
5.00	12.6
6.00	15.5

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(i) Use the data to plot a graph of mean fringe spacing (y-axis) against distance to the screen (x-axis). [3]

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(ii) Use your graph to determine the wavelength of the laser light (the distance between the centres of the double slits is 0.25 mm). Show your workings clearly and give your answer to an appropriate number of significant figures. [3]

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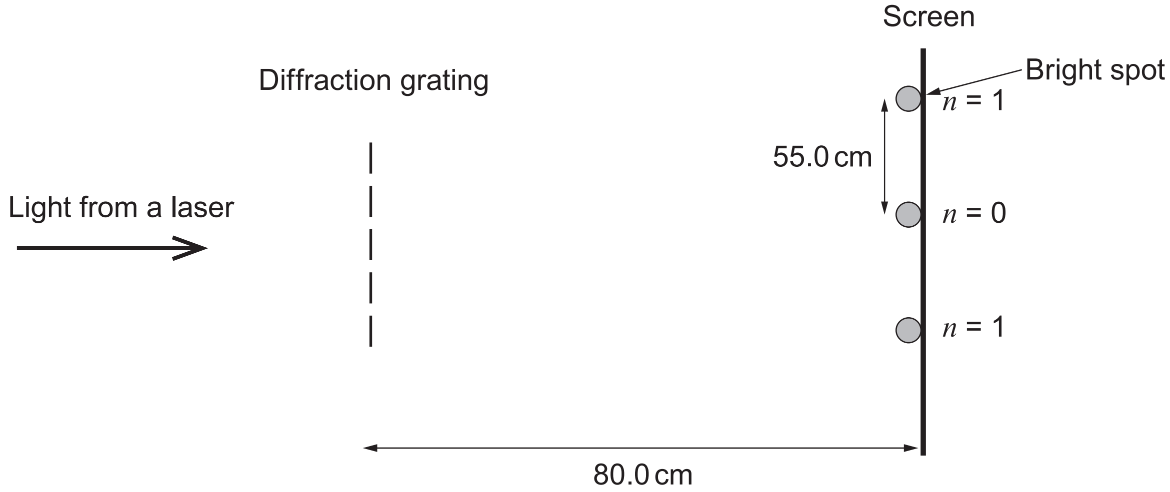
5. A diffraction grating has 900 lines mm^{-1}. Light from a laser is directed at right angles to the grating as shown in the diagram below. A screen is placed 80.0 cm away from the grating to display the interference pattern produced.



(a) Determine the wavelength of the light if the distance between the two adjacent bright spots shown is 55.0 cm. [4]

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(b) Light from the Sun has intensity 1.36 $kW\,m^{-2}$ on Earth and light from a standard laboratory laser has intensity 1.0 $mW\,mm^{-2}$.
Discuss with the aid of a calculation, whether students should wear protective goggles while using a standard laboratory laser. [4]

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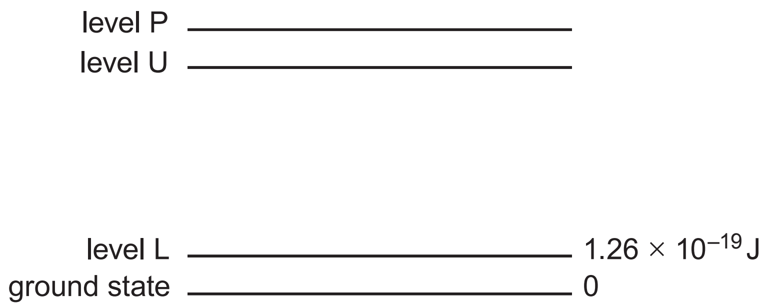
(c) A diagram of a simplified energy level system is shown below for a different laser from that of part *(a)*.



(i) Describe how a photon is created by stimulated emission involving level **U** and level **L**. [3]

(ii) Determine the energy of level **U** given that the wavelength of the light from the laser is 5.90×10^{-7} m. [3]

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6. *(a)* Explain in detail how you would carry out an experiment based on angles to determine the refractive index of glass in the form of a rectangular block. [6 QER]

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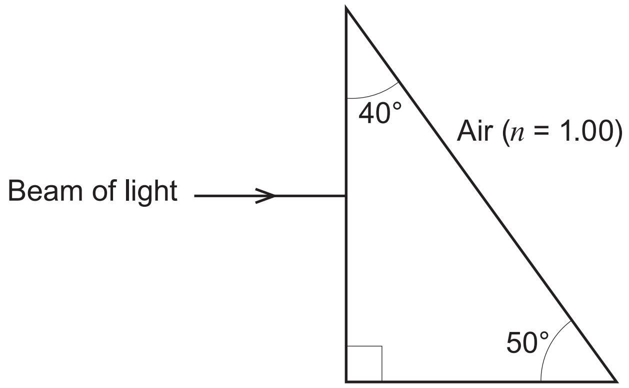
(b) A narrow beam of light is incident normally on a glass prism of refractive index 1.52.



(i) **Draw on the diagram** the continuation of the beam through the prism and out into the air through the hypotenuse. [2]

(ii) Calculate the angle through which the beam is deviated from its original direction. [3]

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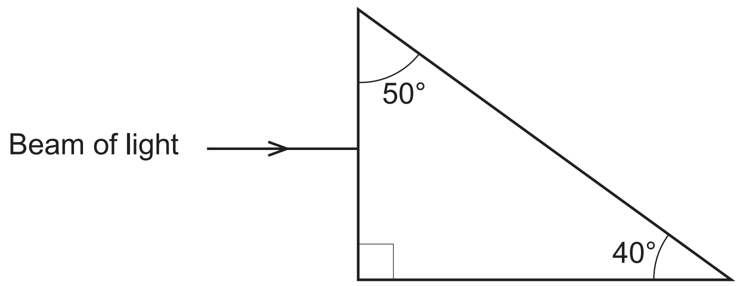
(iii) The prism is placed so that light is incident upon it as shown below. Explain with the aid of a calculation how the light passes through the prism now. [3]



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7. A satellite is orbiting the Earth.

(a) (i) Any charge carried by the satellite could affect its sensitive electronic circuits. Satellites therefore need to be designed to minimise photoelectric emission from their surfaces. Explain what is meant by the photoelectric effect. [2]

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(ii) The satellite is coated with platinum, which has a work function of 5.24×10^{-19} J. Determine the longest wavelength of incident sunlight that can eject an electron from the platinum. [3]

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(b) The satellite has a panel of solar cells of area $16.4\,m^2$ perpendicular to the Sun's light rays.

(i) Determine the number of photons incident on the solar cells per second if the intensity of the light rays incident on the panel is $1.39 \times 10^3\ W\,m^{-2}$ and the mean wavelength of light is 5.50×10^{-7} m. [3]

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TURN OVER FOR THE REST OF THE QUESTION

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(ii) Hence or otherwise determine the pressure exerted by the photons on the solar panel. Assume that the panel absorbs all the photons. [2]

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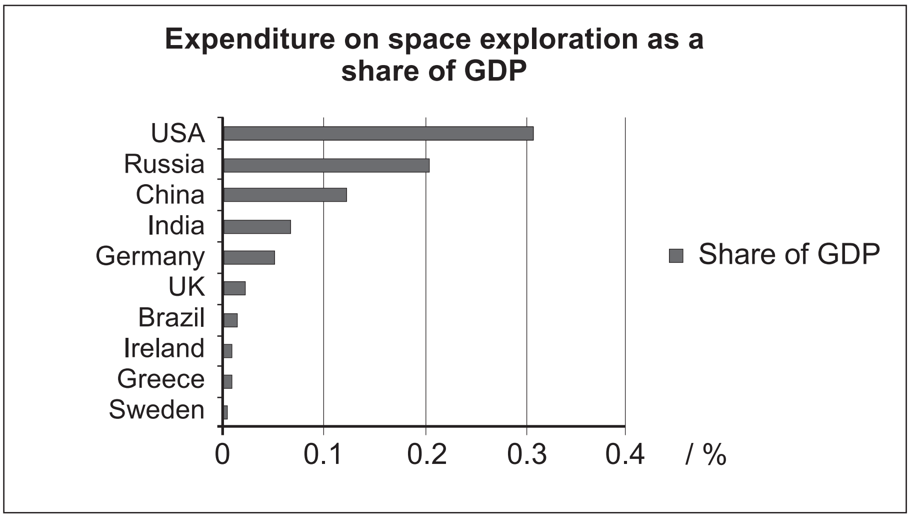
(c) Discuss any ethical issues that can arise from continuing to develop satellite technology and space exploration in general by referring to the following information. [2]



Data Source – OECD 2009

GDP means Gross Domestic Product which in simple terms is a measure of a country's economy.

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END OF PAPER