Surname	Centre Number	Candidate Number
Other Names		0

GCSE

C420U20-1

S19-C420U20-1

FRIDAY, 14 JUNE 2019 – MORNING

PHYSICS – Component 2
Applications in Physics

FOUNDATION TIER

1 hour 15 minutes

	For Examiner's use only		
	Question	**Maximum Mark**	**Mark Awarded**
Section A	**1.**	**4**	
	2.	**16**	
	3.	**10**	
	4.	**4**	
	5.	**11**	
Section B	**6.**	**15**	
	Total	**60**	

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ADDITIONAL MATERIALS

In addition to this paper you will require a calculator, a ruler and a resource 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

This paper is in 2 sections, **A** and **B**.

Section **A**: 45 marks. Answer **all** questions. You are advised to spend about 50 minutes on this section.

Section **B**: 15 marks. Read the article in the resource booklet carefully then answer **all** questions. You are advised to spend about 25 minutes on this section.

The number of marks is given in brackets at the end of each question or part-question.

The assessment of the quality of extended response (QER) will take place in question **3*(b)***.

EQUATION LIST

final velocity = initial velocity + acceleration × time	$v = u + at$
distance = $\frac{1}{2}$ × (initial velocity + final velocity) × time	$x = \frac{1}{2}(u + v)t$
(final velocity)^2 = (initial velocity)^2 + 2 × acceleration × distance	$v^2 = u^2 + 2ax$
change in thermal energy = mass × specific heat capacity × change in temperature	$\Delta Q = mc\Delta\theta$
thermal energy for a change of state = mass × specific latent heat	$Q = mL$
energy transferred in stretching = $\frac{1}{2}$ × spring constant × (extension)^2	$E = \frac{1}{2}kx^2$
for gases: pressure × volume = constant (for a given mass of gas at a constant temperature)	pV = constant
potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil	$V_1I_1 = V_2I_2$

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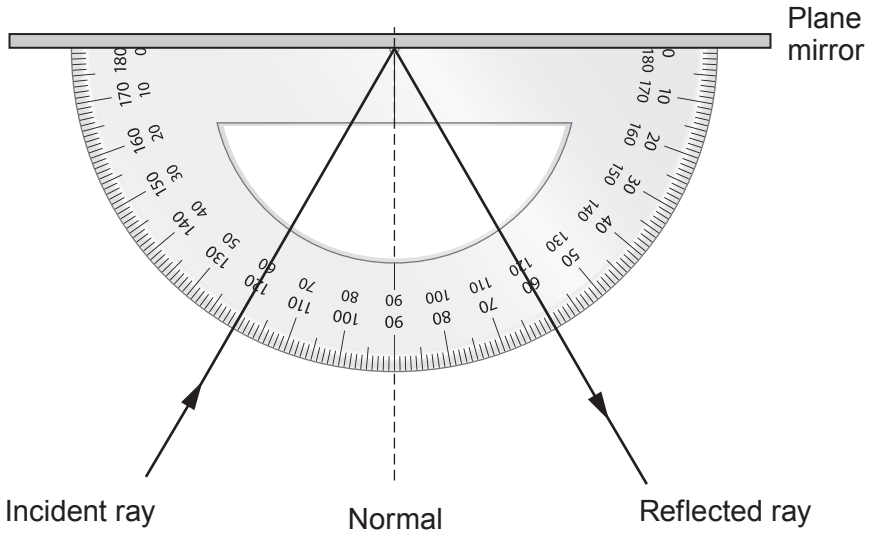
SECTION A

Answer **all** *questions*

1. Students investigate reflection using a plane mirror, a ray box, paper and a protractor. They shine a ray onto a mirror and draw in the position of the reflected ray as shown.



(a) (i) Use the information in the diagram to state the value of the angle of incidence. [1]

Angle of incidence = ... °

(ii) Use the information in the diagram to state the value of the angle of reflection. [1]

Angle of reflection = ... °

(b) (i) State **one** conclusion that can be made from these results. [1]

.....

.....

(ii) State what the students should do to confirm that the conclusion is valid. [1]

.....

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Turn over.

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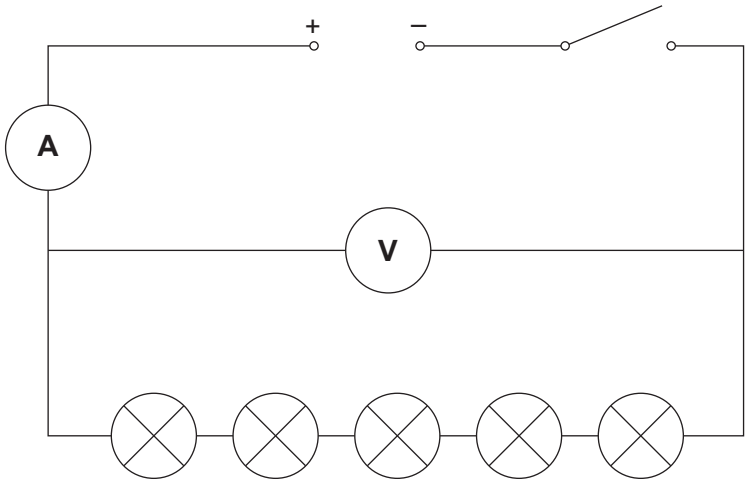
2. A class investigates how the number of identical lamps in a series circuit affects the resistance of the circuit. They set up the following circuit:



Their results are given in the table below:

Number of lamps	Potential difference (V)	Current (A)	Resistance (.....)
1	12.0	0.181	66
2	12.0	0.143	84
3	12.0	.....	103
4	12.0	0.098	122
5	12.0	0.086	140

(a) **Complete** the table by:

(i) adding the unit of resistance; [1]

(ii) calculating the current through 3 lamps using the equation: [2]

$$\text{current} = \frac{\text{potential difference}}{\text{resistance}}$$

Current = ... A

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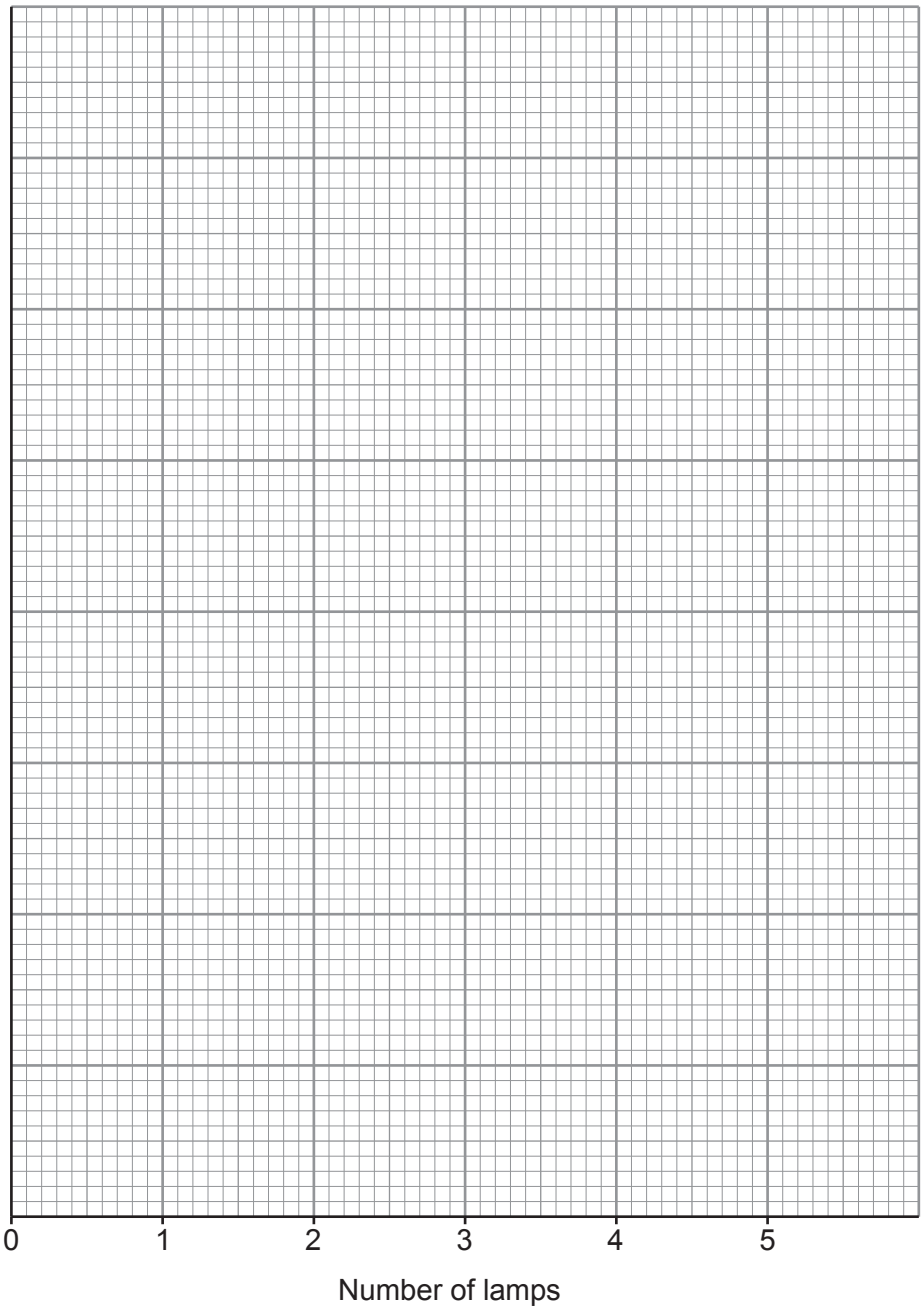
(b) (i) State the independent variable in the experiment. [1]

.....

(ii) State **one** controlled variable in the experiment. [1]

.....

(c) (i) Use the data to plot a graph of resistance against number of lamps on the grid below. [4]



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(ii) Describe the relationship between number of lamps and the resistance of the circuit. [2]

.....

.....

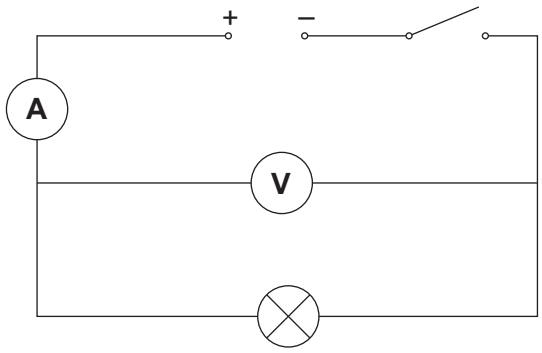
.....

(iii) Suggest a value for the resistance of the circuit if 6 lamps are connected in series. [1]

Resistance = ...

(d) The investigation can be extended to determine how the resistance of a parallel circuit is affected by the number of lamps in parallel.

(i) **Include a second lamp** connected in parallel on the circuit diagram below. [1]



(ii) Describe how you could carry out this new investigation. [3]

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3. *(a)* A group of students investigates the extension of a spring. They measure its initial length. They then apply a force to the spring and again measure the length.

Force (N)	2
Unstretched length of spring (cm)	2.5
Stretched length of spring (cm)	8.5

(i) Calculate the extension of the spring. [1]

Extension = ... cm

(ii) Use the equation:

$$\text{spring constant} = \frac{\text{force}}{\text{extension}} \quad \text{or} \quad k = \frac{F}{x}$$

to determine the spring constant of the spring in **N/m**. [3]

Spring constant = ... N/m

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(b) Hooke's law states that the extension of an elastic material is directly proportional to the force applied. Describe a method that the students could use to determine whether the spring obeys Hooke's law and explain how they should analyse their results. [6 QER]

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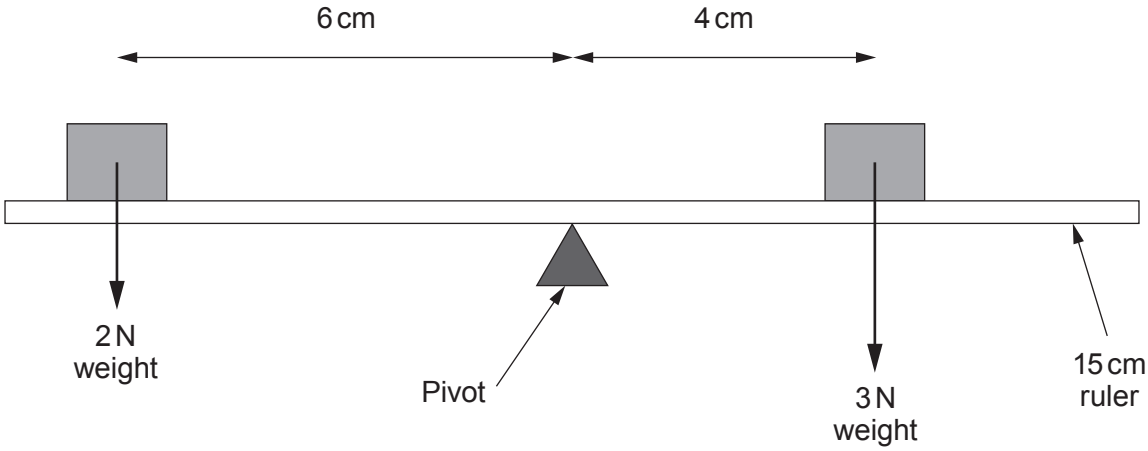
4. A class investigates the principle of moments. They set up the apparatus as shown in the following diagram and adjust the position of the 2 N weight until the ruler balances as shown.



(a) Sophie concludes that the ruler balances because the clockwise moment equals the anti-clockwise moment.

(i) State what is meant by the 'clockwise moment'. [1]

.....

.....

(ii) Show whether Sophie's conclusion is correct. [1]

.....

.....

(b) The 2 N weight is left in the same position. The 3 N weight is replaced with a 5 N weight. Determine what distance the 5 N weight must now be placed from the pivot for the ruler to still balance. [2]

Distance = ... cm

4

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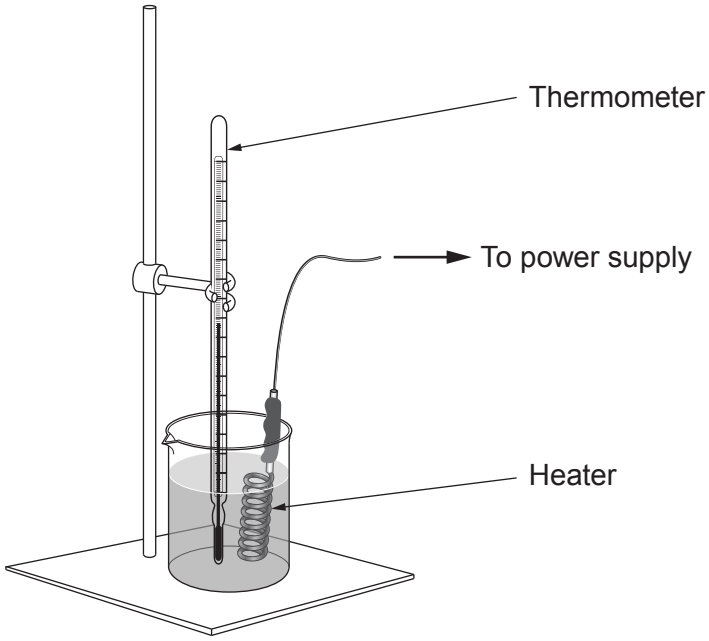
5. The specific heat capacity, c, of a substance can be calculated from the equation:

$$c = \frac{\Delta Q}{m\Delta\theta}$$

where: ΔQ = heat energy supplied (J)
m = mass (kg)
$\Delta\theta$ = temperature rise (°C)

(a) To determine the specific heat capacity of water, a class measures the temperature rise produced by a heater when heating a beaker of water for 8 minutes. Each group tests a different heater. Their results are given below.



	Heater 1	Heater 2	Heater 3
Mass of water (kg)	0.2	0.2	0.2
Power of heater (W)	18	25	50
Time (s)	480	480	480
Heat energy supplied by the heater (J)	8640		24000
Initial temperature of water (°C)	22	21	23
Final temperature of water (°C)	30	32	44
Calculated specific heat capacity (J / kg °C)	5400	5455	

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Use the data in the table to answer the following questions.

(i) Calculate the heat energy supplied by **Heater 2**. [2]

Energy supplied = ... J

(ii) Calculate the specific heat capacity of water using the data for **Heater 3**. [3]

Specific heat capacity = ... J / kg °C

(b) The true value of the specific heat capacity of water is 4 200 J / kg °C. The calculated values of specific heat capacity from this experiment are not accurate but they are reproducible. State what is meant by the terms:

(i) I. accurate; [1]

.....

II. reproducible. [1]

.....

(ii) Explain how the method could be improved to achieve a more accurate value for the specific heat capacity. You can assume that the values of mass, power and temperature are all measured accurately. [2]

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(c) William concludes that doubling the power of the heater doubles the temperature rise. Determine whether this conclusion is correct. [2]

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SECTION B

Read the article in the resource booklet carefully and answer **all** *the questions that follow.*

6. *(a)* Use the information in **Figures 1** and **2** to explain how the environment benefitted due to the changes in electricity generation methods between 2010 and 2015. [2]

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(b) Use the information in **Figure 3** to calculate the predicted drop in the power generated by **non-renewable** sources from 2010 to 2050. Assume that the total power generated in the U.K. remains at a constant 35 GW. [1]

Drop in power generation by non-renewable sources = ... GW

(c) A power station needs 55 000 tonnes of willow crop per year. Use the information in **Figure 4** to answer the following questions.

(i) Calculate the area of land needed to grow this amount of willow crop. [1]

Area = ... km^2

(ii) Calculate the energy content of 55 000 tonnes of willow crop. [1]

Energy content = ... units

(d) Use your knowledge and the information in **Figure 6** to describe the advantages of tidal water turbines compared to wind turbines. [3]

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(e) Use the information about solar panels on page 4 to answer the questions that follow.

(i) Use the equation:

$$\text{efficiency} = \frac{\text{output power transfer}}{\text{input power transfer}}$$

to calculate the efficiency of a solar panel in good sunlight. [2]

Efficiency = ...

(ii) Household voltage is 230 V. Use the equation:

$$\text{current} = \frac{\text{power}}{\text{voltage}} \quad \text{or} \quad I = \frac{P}{V}$$

to calculate the current that can be drawn from a solar panel of area 4 m^2 in good sunlight. [3]

Maximum current = ... A

(iii) Calculate the energy (Wh) produced by a 4 m^2 solar panel in 6 hours of good sunlight. Give your answer to 1 significant figure. [2]

Energy produced = ...Wh

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END OF PAPER