Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

C420UB0-1

S18-C420UB0-1

eduqas
Part of WJEC

PHYSICS – Component 2
Applications in Physics

HIGHER TIER

FRIDAY, 15 JUNE 2018 – MORNING

1 hour 15 minutes

	For Examiner's use only		
	Question	Maximum Mark	Mark Awarded
Section A	1.	15	
Section B	2.	5	
	3.	10	
	4.	8	
	5.	10	
	6.	12	
	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**: 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.

Section **B**: 45 marks. Answer **all** questions. You are advised to spend about 50 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 **5*(b)***.

EQUATION LIST

final velocity = initial velocity + acceleration × time	$v = u + at$
distance = ½ × (initial velocity + final velocity) × time	$x = \frac{1}{2}(u + v)t$
(final velocity)^2 = (initial velocity)^2 + 2 × acceleration × distance	$v^2 = u^2 + 2ax$
distance = initial velocity × time + ½ × acceleration × time^2	$x = ut + \frac{1}{2}at^2$
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 = ½ × spring constant × (extension)^2	$E = \frac{1}{2}kx^2$
force on a conductor (at right angles to a magnetic field) carrying a current = magnetic field strength × current × length	$F = BIl$
potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil	$V_1I_1 = V_2I_2$
$\frac{\text{potential difference across primary coil}}{\text{potential difference across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$	$\frac{V_1}{V_2} = \frac{N_1}{N_2}$
for gases: pressure × volume = constant (for a given mass of gas at a constant temperature)	pV = constant
pressure due to a column of liquid = height of column × density of liquid × gravitational field strength	$p = h\rho g$

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SECTION A

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

1. *(a)* Refer to **Diagram 1** to answer questions (i) to (iii).

(i) State how the diagram shows the Universe has changed over time. [1]

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(ii) Our Milky Way galaxy is labelled C. Compare how the distances of galaxies A and D from the Milky Way have changed from the early Universe to a later time. [2]

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(iii) Arrange galaxies A, B, D and E, in order of speed of travel away from C from fastest to slowest. [1]

Fastest .... Slowest

(iv) State which of the spectra in **Diagram 2** is emitted from galaxy E. [1]

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(b) Galaxy M87 shown below is classified as an elliptical galaxy class **E** sub-type **0**.

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Use the information in **Diagram 3** and **Table 1** to identify the class and sub-type of the galaxies shown in the diagrams below. [2]

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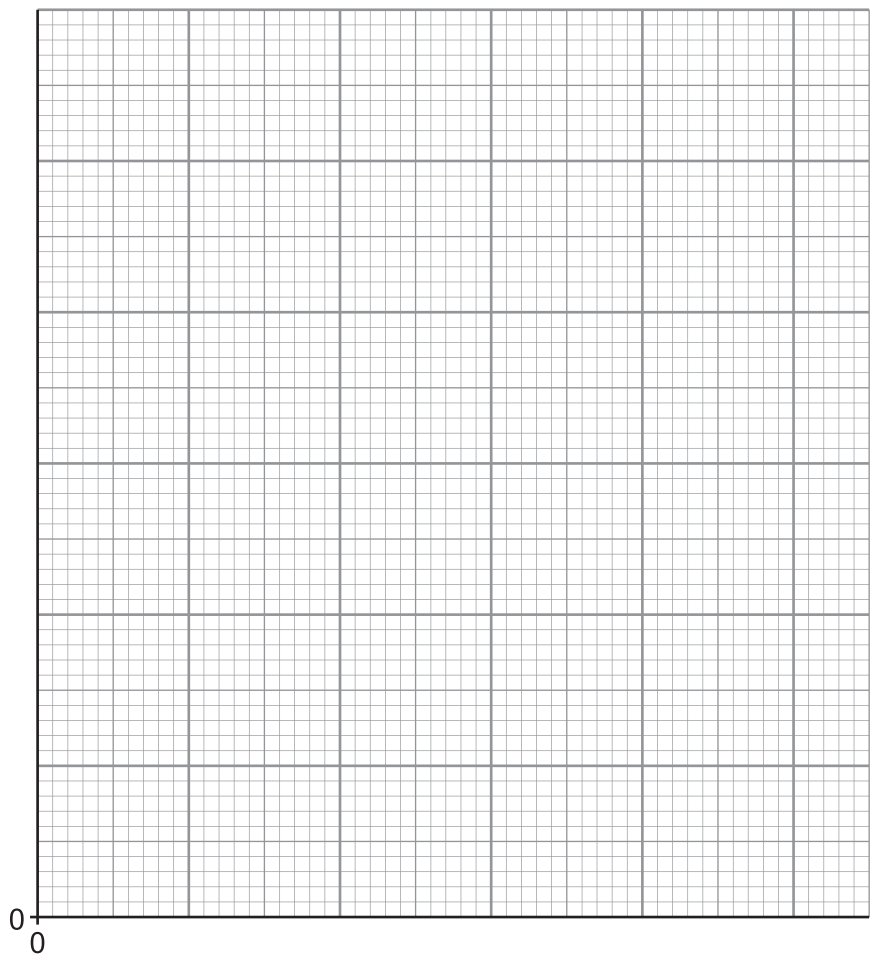
(c) (i) Use the data in **Table 2** to plot the points on the grid below and use your judgement to draw a suitable straight line of best fit. [4]

Recession speed (km/s)



Distance (Mpc)

(ii) Use your graph to find a value of the Hubble constant. [2]

Hubble constant = ... km/s/Mpc

(iii) Explain why another person may arrive at a different value of the Hubble constant from the same plotted points. [2]

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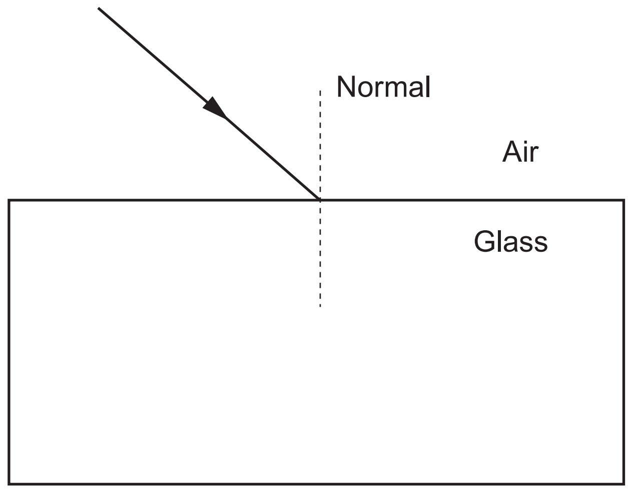
SECTION B

Answer **all** *questions*

2. Students investigate the path of light through a glass block.



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(a) **Complete the diagram** to show the path of the ray as it passes through and exits the block. [3]

(b) Explain why the ray refracts as it enters the block. [2]

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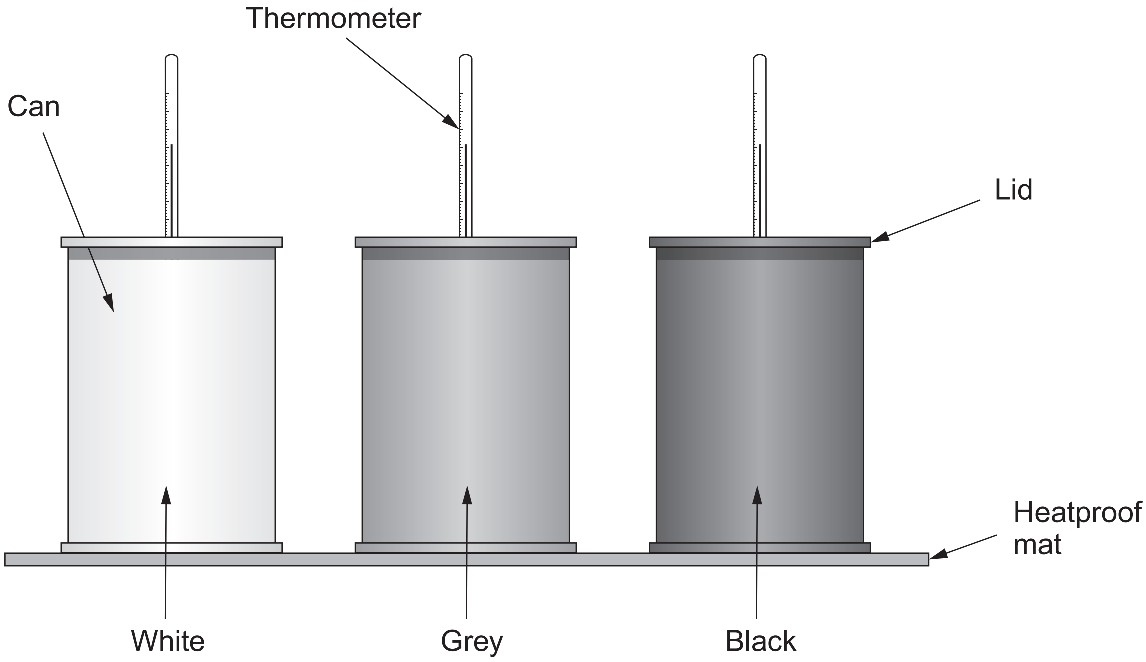
3. A group of students set up the following experiment to investigate the heat loss by infra-red radiation from identical cans painted different colours.

Method

- Place all the cans onto a heatproof mat.
- Pour some hot water into each can and put on the lid.
- Record the temperature every minute for 8 minutes.



Their results are given in the table.

Time (minutes)	Temperature of water (°C)		
	White can	Grey can	Black can
0	86	80	75
1	80	75	71
2	78	73	68
3	77	71	67
4	76	70	66
5	75	68	65
6	74	66	64
7	73	65	63
8	72	64	62

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(a) Compare the mean rate of temperature drop in the first 2 minutes for each of the three cans. [2]

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(b) Explain, using the data in the table, which can appears to lose the most energy during the 8 minutes of the experiment. [2]

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(c) Explain whether your answer to *(b)* is supported by theory. [2]

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(d) Identify **two** possible sources of inaccuracy in the experiment and suggest an improvement for each one. [4]

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4. A teacher demonstrates static electricity to her class. One plastic rod is charged. It is then placed on a coulombmeter, which measures charge, as shown in the picture below.

(a) Suggest how the teacher could have charged the rod and explain why it acquires a positive charge. [3]

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(b) The charged rod can be discharged by placing it in contact with a piece of metal which is earthed. The rod discharges completely in 0.1 μs. Use the reading from the coulombmeter to calculate the mean current during this time. [3]

Mean current = ... A

(c) The teacher demonstrates to her students how the charged rod can attract small pieces of paper. Explain why the rod attracts the paper from a distance. [2]

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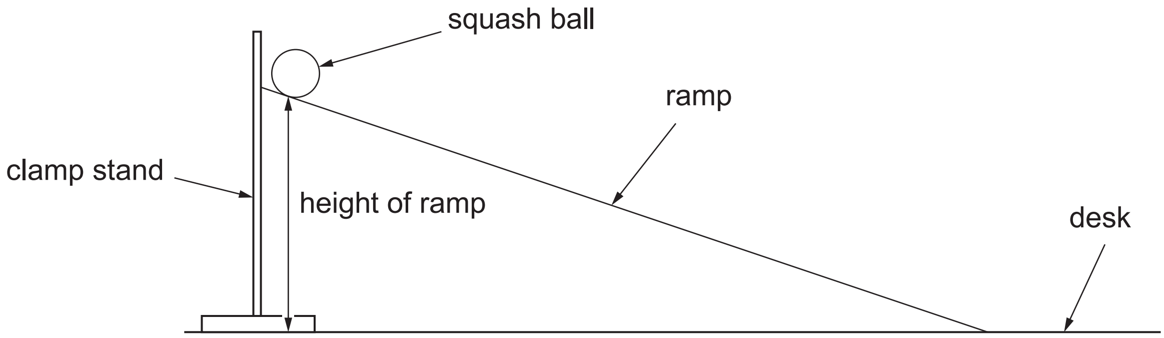
5. A Physics practical aims to investigate the relationship between the acceleration of a squash ball travelling down a ramp and the height of the ramp. Students are given a ramp, a stopwatch, a squash ball and a ruler.



(a) State **two** controlled variables in this experiment and explain why they must be controlled. [4]

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(b) The apparatus is set up as shown in the diagram above. Write a plan for this experiment which should include a clear, detailed method followed by the steps you would take to analyse the data. [6 QER]

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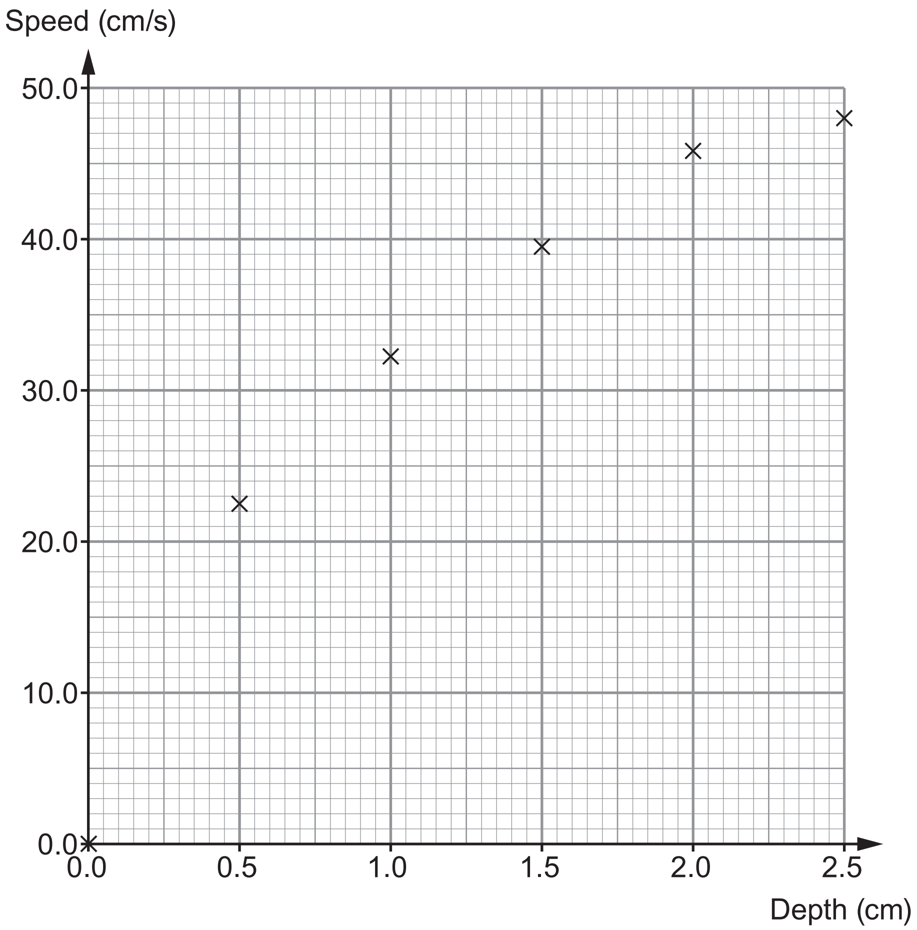
6. In an investigation the speeds of water waves are determined by timing how long it takes waves to travel 3 lengths of a plastic tray. The depth of the water is changed to investigate its effect on wave speed. The results are plotted on the grid below.

Depth of water (cm)	Time taken for waves to travel 120 cm (s)			Mean time (s)	Speed of water waves (cm/s)
	Trial 1	Trial 2	Trial 3		
0.5	5.41	5.33	5.24	5.33	22.5
1.0	3.71	3.82	3.65	3.73	32.2
1.5	2.98	2.99	3.12	3.03	39.6
2.0	2.63	2.62	2.61	2.62	45.8
2.5	2.40	2.52	2.58	....	48.0

(a) **Complete the table** by calculating the mean time for a depth of 2.5 cm. [1]
Space for working:

(b) (i) **Complete the graph** by drawing a suitable line. [1]



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(ii) Describe the relationship between the depth of the water and the speed of the waves. [2]

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(c) Theory suggests that if the depth of the water is doubled the speed should increase by a factor of $\sqrt{2}$. Use the data to investigate this theory. [2]

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(d) (i) Helen suggests that the mean time for a depth of 2.5 cm will have the largest percentage uncertainty. Explain why this is a sensible suggestion. [2]

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(ii) Comment on whether Helen's suggestion is supported by the data. [1]

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(e) (i) The speed of water waves, v, can be calculated from the equation:

$$v = \sqrt{g\,h}$$

where h = water depth (m) and g = acceleration due to gravity, 10 m/s^2
Calculate the expected wave speed **in m/s** for a depth of 2.5 cm. [2]

Wave speed = ... m/s

(ii) Explain whether the data collected at 2.5 cm are accurate. [1]

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END OF PAPER