Surname	Centre Number	Candidate Number
Other Names		0

GCSE

C420U10-1

S19-C420U10-1

PHYSICS – Component 1
Concepts in Physics

FOUNDATION TIER

WEDNESDAY, 22 MAY 2019 – AFTERNOON

2 hours 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**8**	
3.	**5**	
4.	**11**	
5.	**13**	
6.	**10**	
7.	**14**	
8.	**9**	
9.	**10**	
10.	**4**	
11.	**12**	
12.	**14**	
Total	**120**	

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ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

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. If you run out of space, use the continuation page at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

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 **9**(*a*).

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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Answer **all** *questions.*

1. This question is about mains electricity.

(a) The boxes on the left contain items found in a three-pin plug.

Draw 5 lines to join boxes on the left to the correct statement(s) about them on the right.

Each box may have **more than one line** drawn to or from it. [5]

Live wire	It is connected to the metal body of an appliance.
Neutral wire	It carries current away from an appliance.
Fuse	It normally carries no current.
Earth wire	The current to an appliance passes through it.

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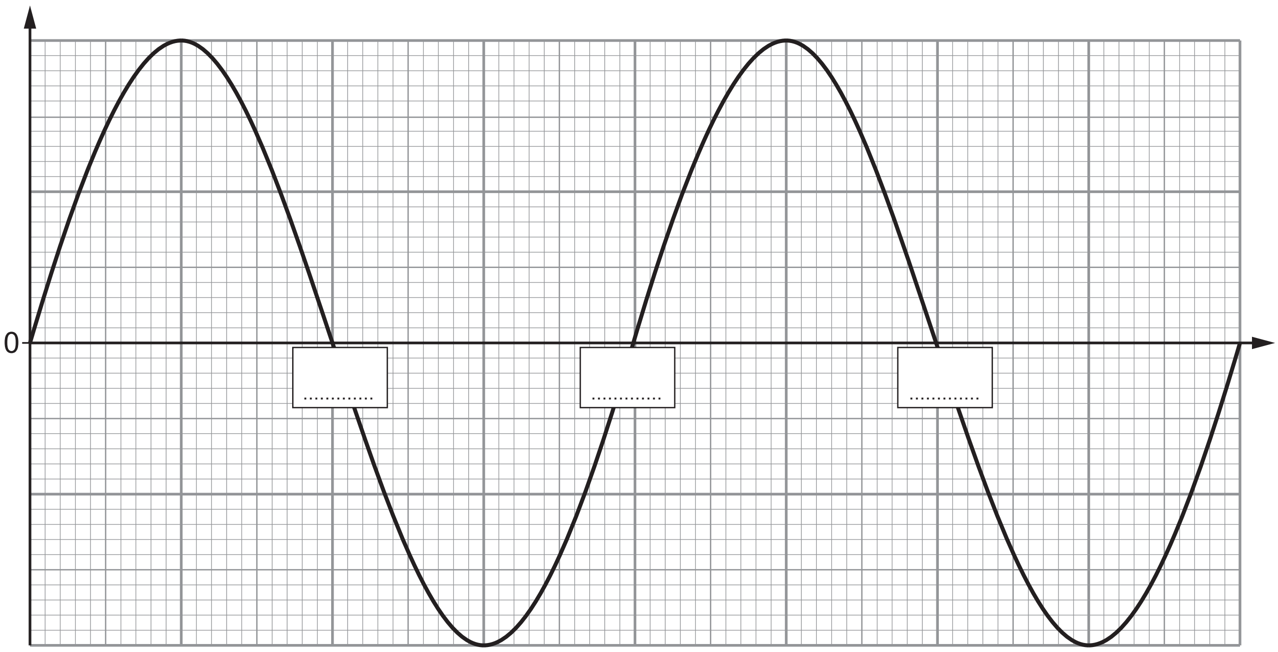
(b) The graph below shows how the mains voltage changes with time.



(i) State the name of this type of voltage. [1]

....

(ii) The mains voltage has a period of 0.02 s.
Use this information to write appropriate values in the **boxes on the grid**. [1]

(iii) State the value of the mains voltage in the U.K.

.... V [1]

(c) The mains frequency in the U.S.A is 60 Hz.

Use the equation:

$$\text{period} = \frac{1}{\text{frequency}} \quad \text{or} \quad T = \frac{1}{f}$$

to calculate its period. [2]

Period = ... s

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2. A student places a bar magnet beneath a sheet of paper and sprinkles iron filings on the paper. She gives the paper a gentle tap and the iron filings form a pattern.

(a) Draw the pattern around the bar magnet below.
(Your diagram should show at least **5** magnetic field lines.) [2]

(b) (i) Explain how the experiment can be improved to find the direction of the field. [2]

....

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....

(ii) Add arrows to **the diagram above** to show the direction of the field. [1]

(c) An iron bar is now placed near the magnet in the way shown below.

(i) State what is observed when the iron bar is placed near the magnet. [1]

....

(ii) Describe the difference between the magnetic properties of the magnet and the iron bar. [2]

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3. *(a)* Choose a word from the list to complete each sentence below. [3]

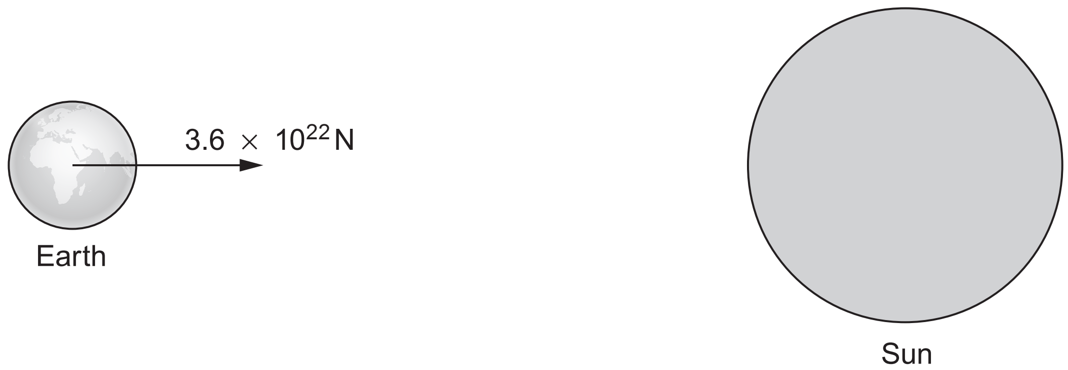
gravitational	electrostatic	magnetic	frictional	reaction

A/An .... force makes pieces of paper stick to a balloon after it has been rubbed against a cloth.

A/An .... force pulls the Earth to the Sun to keep it in orbit.

A/An .... force pushes up on a book that rests on a table.

(b) The diagram shows the force that the Sun applies to the Earth.



Show on the diagram, the force that the Earth applies to the Sun. [2]

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4. The table shows how the speed of surface water waves changes with the depth of water.

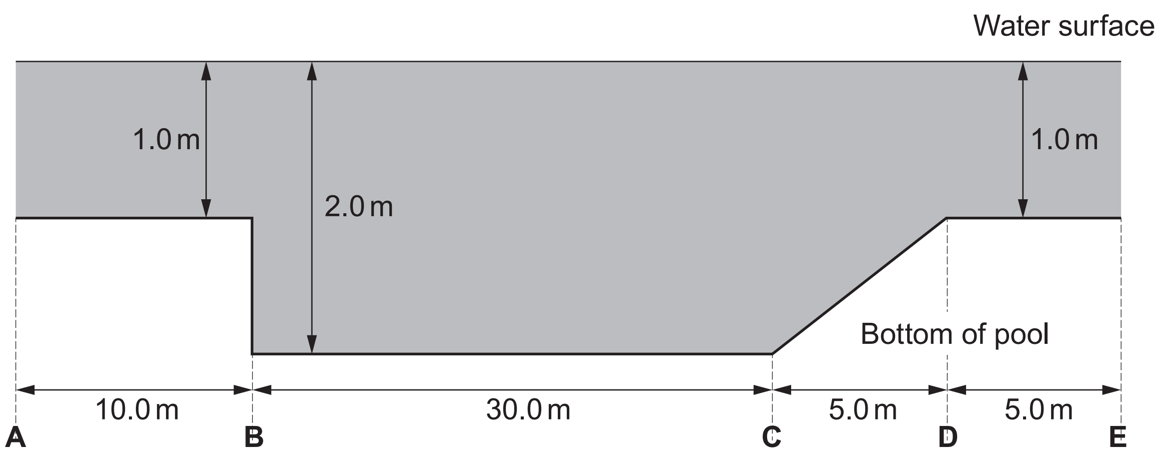
Depth of water (m)	Speed of water waves (m/s)
0.0	0.0
0.5	2.2
1.0	3.1
1.5	3.8
2.0	4.4
3.0	5.4

(a) Explain how the data in the table shows that the speed of the waves is **not** proportional to the depth of water. [1]

....

....

(b) Waves travel along the surface of an indoor wave pool that is 50 m long and takes the shape shown below. The diagram is not to scale.



(i) The **depth** of the water between **B** and **C** is 2.0 m.
State the speed of the water waves between **B** and **C**. [1]

Speed = ... m/s

(ii) Calculate the frequency of the waves between **B** and **C** given that their wavelength is 6.0 m. [3]

Frequency = ... Hz

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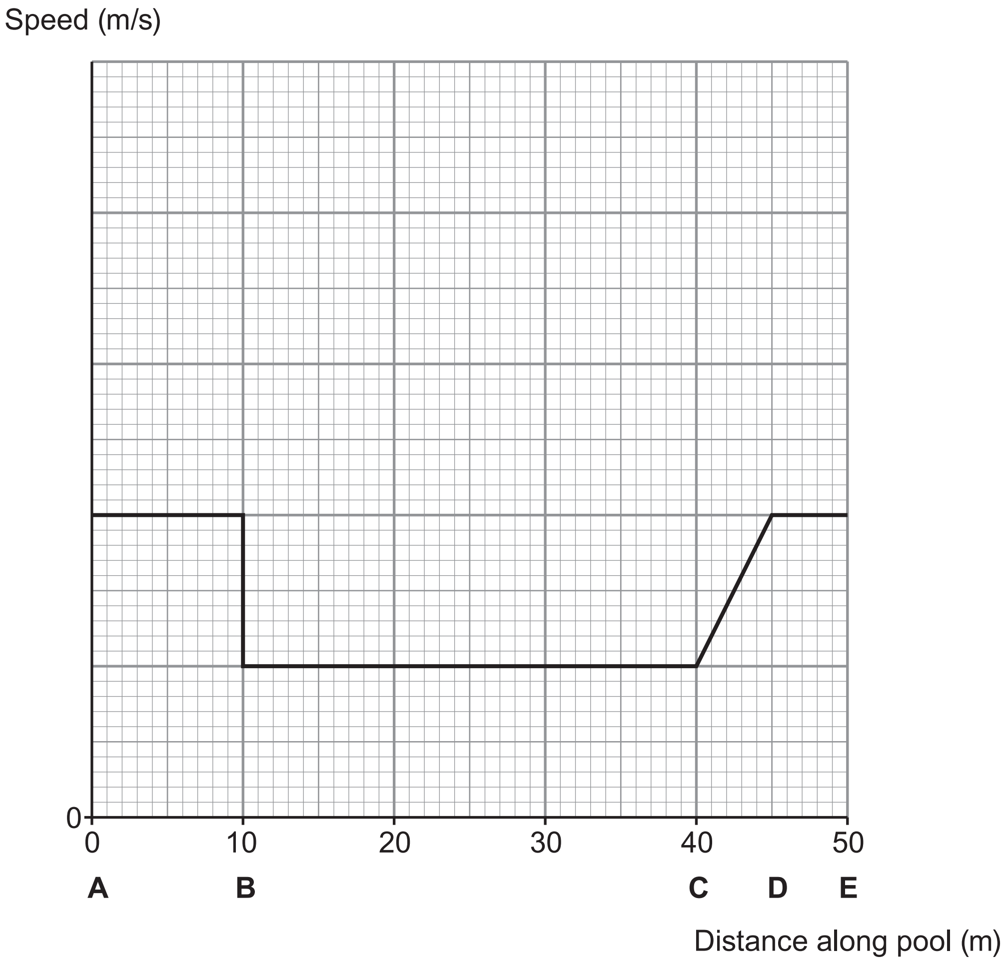
(iii) Calculate the number of full waves that fit into the distance between **B** and **C**. [1]

Number of waves = ...

(iv) Bradley claims that the speed of the water waves changes along the length of the pool in the way shown below. John tells him that the graph is wrong.
Draw the correct graph on the grid below. You should put a suitable scale on the speed axis. [5]



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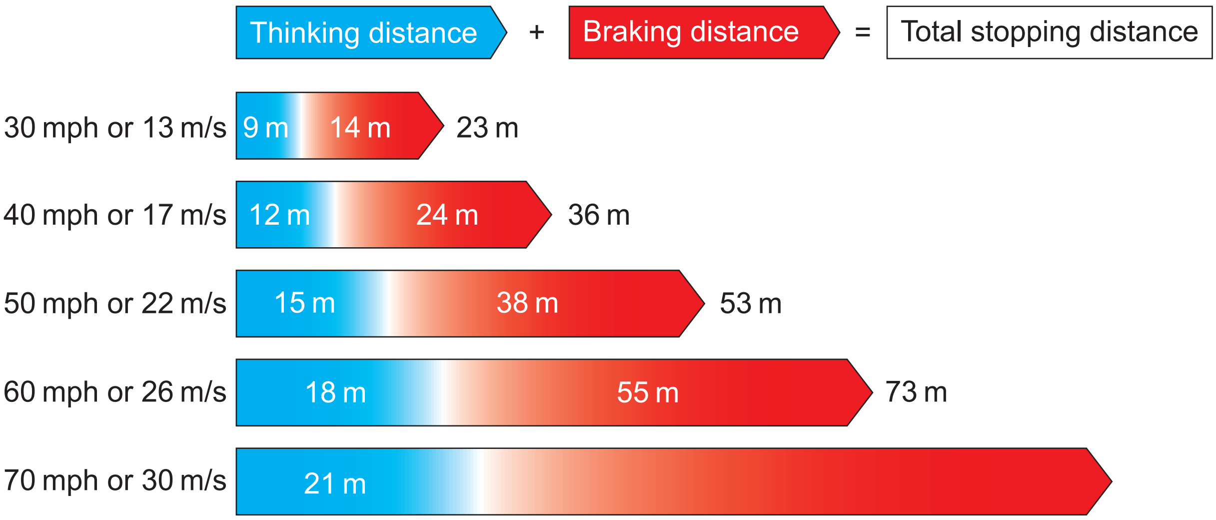
5. Various measures have been introduced to warn drivers about the dangers of travelling too close to the car in front.

THE HIGHWAY CODE

The Highway Code gives official information about thinking distance and braking distance and how they depend on speed. These are shown in the chart below.



(a) **CHEVRON SEPARATION**

A safety rule is used on motorways by using chevrons on the road at intervals of 40 m. The rule is intended to give enough **thinking distance** between the driver and the car in front.

The sign recommends keeping apart by **the gap between chevrons (40 m)**.

The rule takes no account of the vehicle's speed.

By comparing the two chevron rule with data in the Highway Code, explain whether the two chevron rule provides a suitable gap for a car travelling at 30 m/s (the U.K. speed limit of 70 mph). [2]

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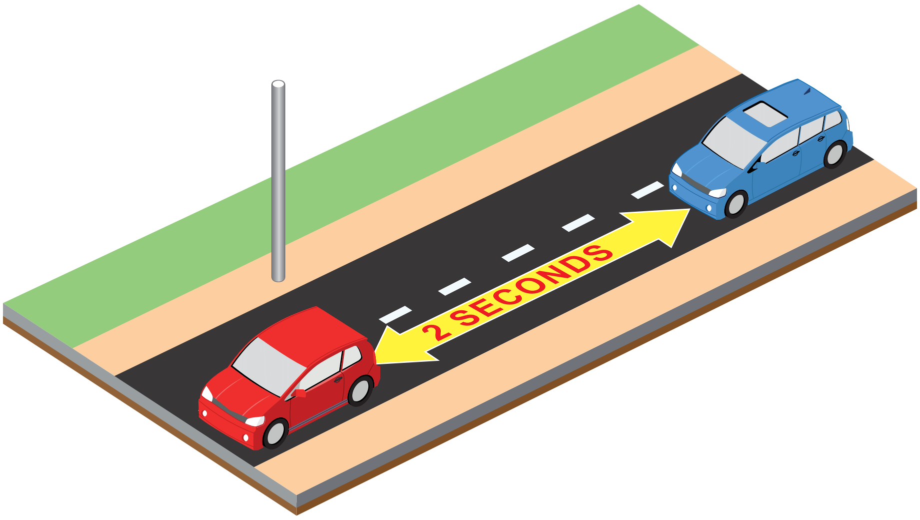
(b) **THE TWO SECOND RULE**
The two second rule can be used by drivers who want to keep at a safe distance behind the car in front.



Once the car in front passes a post, you are too close if your car reaches the post in less than two seconds. The rule intends to give enough **thinking time** behind the car in front. This rule also seems to take no account of the vehicle's speed.

(i) At 30 m/s the thinking distance is given as 21 m in the Highway Code. Calculate a value for a driver's reaction time from these figures. [2]

Reaction time = ... s

(ii) Explain whether the two second rule is suitable for a vehicle travelling at 30 m/s. [2]

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(c) A car is travelling at the speed limit of 30 m/s when the brakes are applied, bringing the car to a stop with a deceleration of 6 m/s^2.

(i) Use this information and the equation:

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time}} \quad \text{or} \quad a = \frac{\Delta v}{t}$$

to calculate the time taken for the car to stop. [2]

Time = ... s

(ii) I. Use your answer to *(c)*(i) and an equation from page 2 to calculate the braking distance. [2]

Braking distance = ... m

II. Use the information in the Highway Code to calculate the total stopping distance at 30 m/s. [1]

Total stopping distance = ... m

(iii) The mass of the car is 2 000 kg.
Calculate the force needed to bring the car to a stop in this instance. [1]

Force = ... N

(iv) State how a big lorry of much greater mass can also stop within the expected stopping distance when travelling at 30 m/s. [1]

....

....

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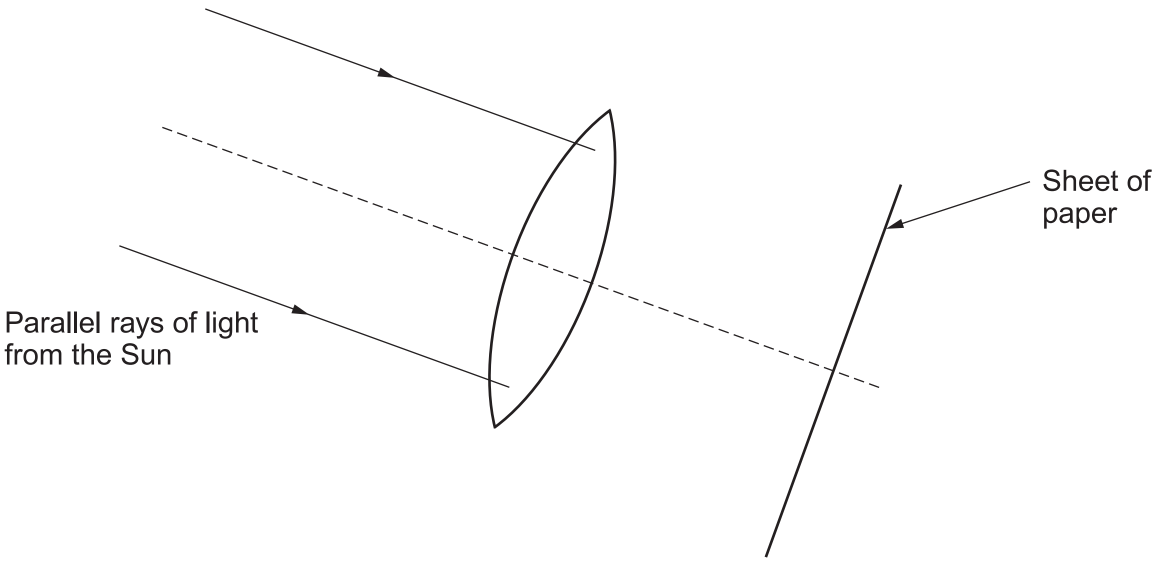
6. *(a)* A group of students is investigating a convex lens that is given to them by their teacher. They use the apparatus in the way shown below to find its focal length. Describe what happens to the path of the rays of light and how the focal length of the lens is found. [3]



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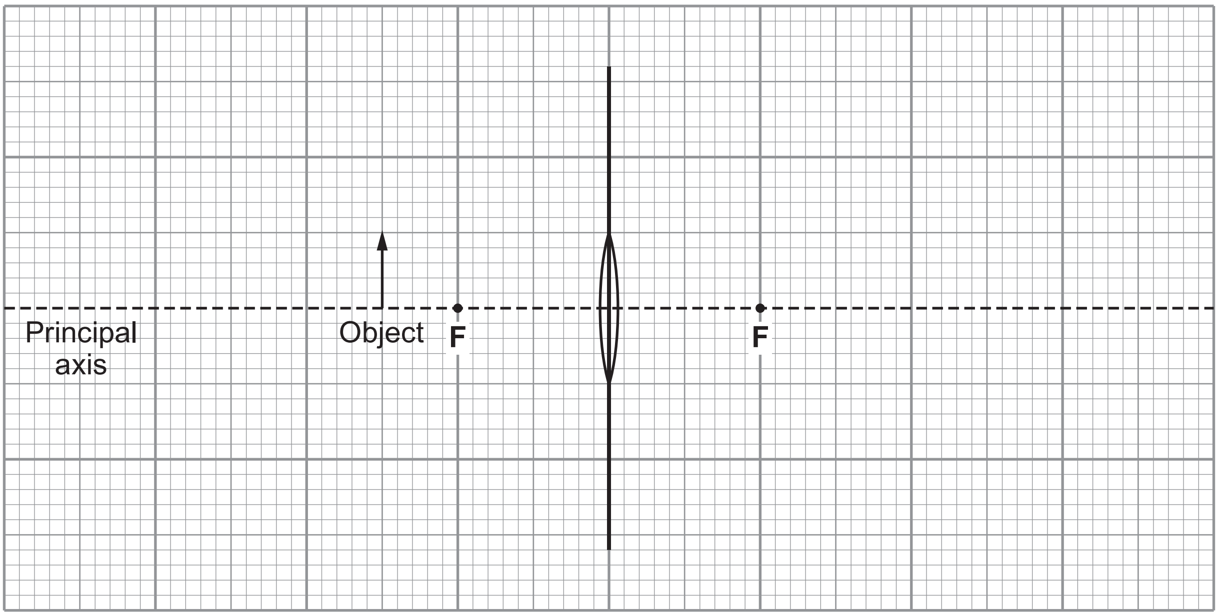
(b) The following diagram shows an object (pin) 1 cm high and placed 3 cm in front of a convex lens.
Using the grid below, **draw an accurate diagram** to find the distance of the image from the lens, its size, its nature and its orientation. [3]



Complete the list of the image properties below. [4]

Distance = ... cm

Size = ... cm

Nature = ...

Orientation = ...

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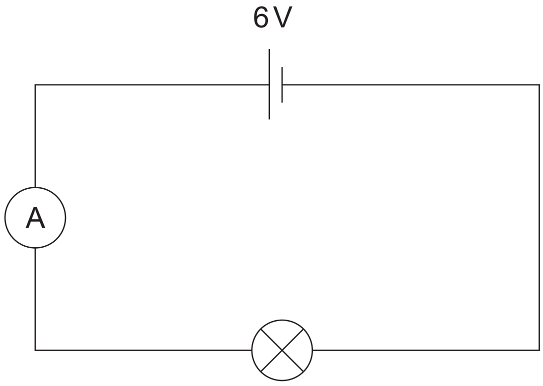
7. A group of students sets up the following circuit.
The reading on the ammeter is 0.3 A.



(a) (i) The cell has a potential difference of 6 V.

Use the equation:

potential difference = current × resistance or $V = IR$

to calculate the resistance of the lamp. [2]

Resistance = ... Ω

(ii) Use the equation:

charge flow = current × time or $Q = It$

to calculate the charge flowing through the lamp in 2 minutes. [2]

Charge = ... C

(iii) Use the equation:

energy = charge flow × potential difference or $E = QV$

to calculate the energy transferred to the lamp in 2 minutes. [2]

Energy = ... J

(iv) State the source of this energy. [1]

....

Turn over.

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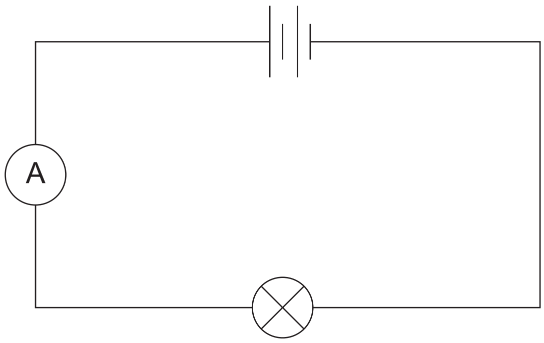
(b) The group sets up more circuits using identical lamps and cells. For each circuit, choose a word or phrase from the box to state the value of the current in that circuit.
Each phrase may be used once, more than once or not at all. [4]

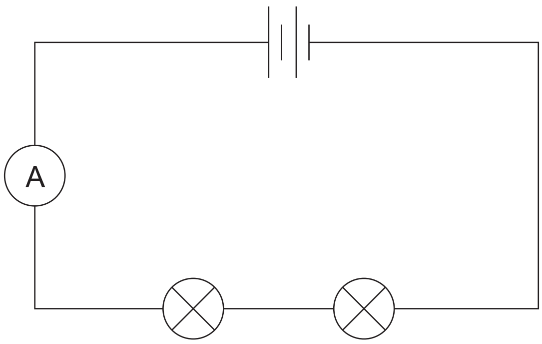
zero	less than 0.3 A	equal to 0.3 A	more than 0.3 A

(i)



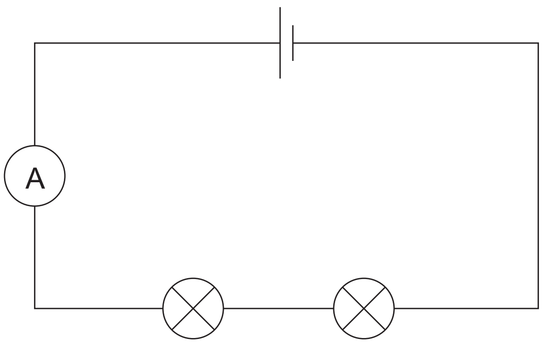
The current is ....

(ii)



The current is ....

(iii)



The current is ....

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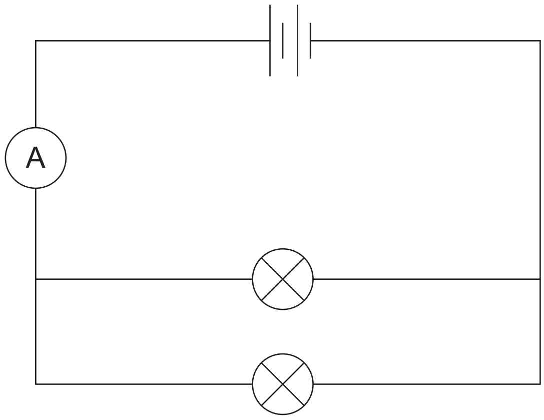
(iv)



The current is ....

(c) One of the group states that the power dissipated by the lamp in diagram **A** below is bigger than in the original circuit (shown as diagram **B** below).

Diagram **A**

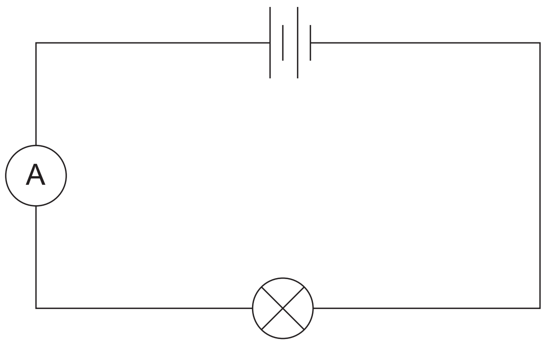
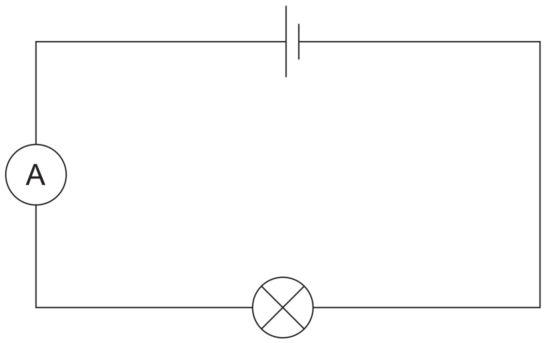


Diagram **B**



Explain whether you agree with this statement. [3]

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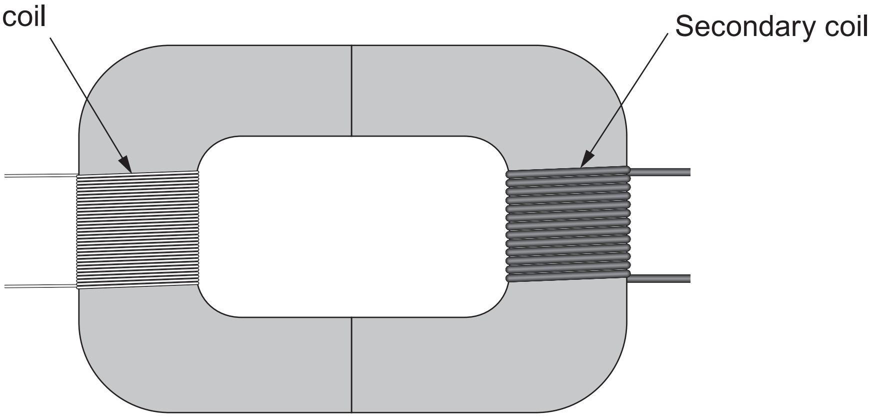
8. The diagram shows a transformer that can be made in a laboratory.



A group of pupils set up five transformers with the properties shown in the table below.

Transformer	Input to primary coil		Output from secondary coil	
	Potential difference (V)	Power (W)	Potential difference (V)	Power (W)
A	6.0	12	12.0	12
B	24.0	48	12.0	48
C	6.0	24	3.0	24
D	12.0	12	3.0	12
E	12.0	20	5.0	20

(a) Explain what the data tells you about the efficiency of the transformers. [2]

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(b) (i) Use the equation:

power = current × potential difference or $P = IV$

to calculate the current in the **secondary coil** of transformer **E**. [2]

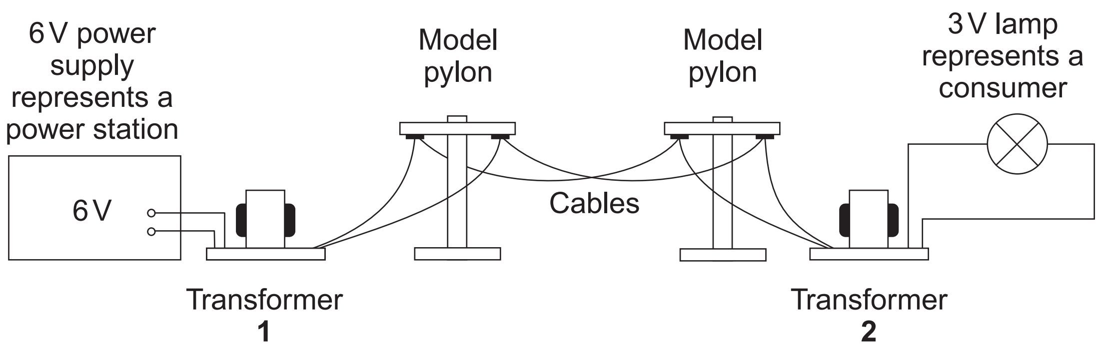
Current = ... A

(ii) State which transformers have the same values of current in their **primary coils**. [1]

.... and ....

(c) Transformers are widely used in the National Grid system in which electrical energy is transferred from power stations to consumers along overhead cables.

The group set up a model of the National Grid as shown in the diagram below.
They used two of the transformers from the table on the previous page to operate the 3 V lamp from the 6 V supply.



(i) State which transformer, **A, B**, **C**, **D** or **E** from the table they should choose for transformers **1** and **2**. [2]

Transformer **1**: .... Transformer **2**: ....

(ii) Give reasons for your choice. [2]

Reason for choice for transformer 1: ....

....

Reason for choice for transformer 2: ....

....

9

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9. *(a)* Describe how the Solar System was formed, including the formation of the Sun as well as the formation of the inner and outer planets, which you should name. [6 QER]

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(b) Describe the differences between comets and asteroids. [4]

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10. The model of the atom has changed over time. One model was proposed by Bohr.

(a) Describe the structure of the atom according to Bohr. [3]

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....

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....

(b) A typical diameter of an atom is 3.0×10^{-10} m. State a typical diameter of a nucleus. Give your answer in standard form. [1]

Typical diameter of a nucleus = ... m

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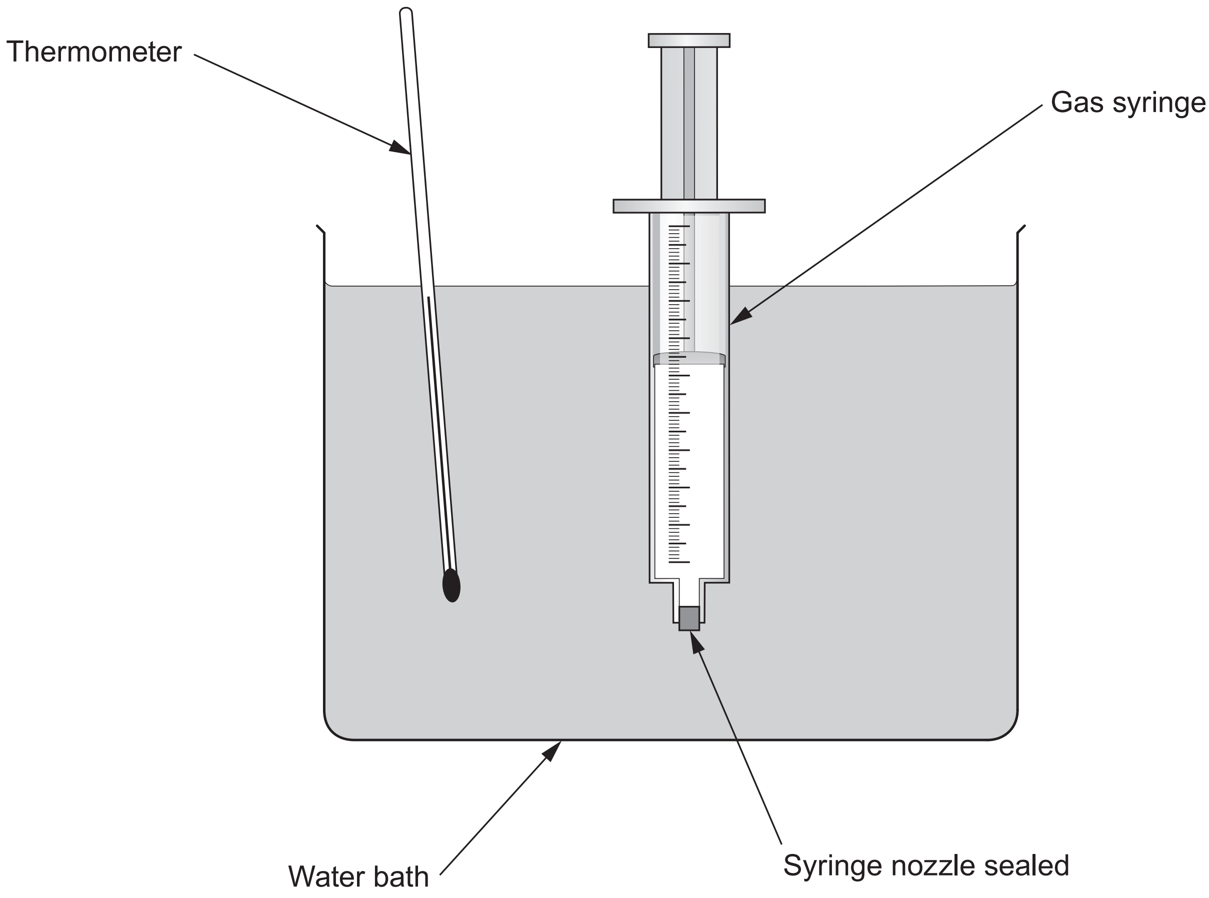
11. The volume a gas occupies varies according to the conditions. The apparatus shown in the diagram is used to investigate the variation of the volume of a gas with temperature.



(a) (i) Describe how a series of readings of volume and temperature can be obtained in this investigation. [3]

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....

(ii) Name the independent variable in this investigation. [1]

....

(iii) Name **one** controlled variable. [1]

....

(b) The results from the investigation are shown in the table.

Temperature (°C)	Volume (cm^3)
20	54
25	55
30	56
40	58
45	59
50	60

(i) It is claimed that the volume of the gas in cm^3 is proportional to its temperature in °C. Use the data in the table and the grid below to explain whether you agree with this claim. [5]

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(ii) Explain, in terms of molecules, why the volume changes as the temperature increases. [2]

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12. A passenger jet aeroplane has a mass of 450 000 kg. To take-off, it accelerates 950 m along a runway from rest. Its take-off velocity is 80 m/s. It reaches a cruising height of 9.2 km.

(a) (i) Use the equation:

$$\text{kinetic energy} = 0.5 \times \text{mass} \times (\text{velocity})^2 \qquad \text{or} \qquad KE = \frac{1}{2}mv^2$$

to calculate the gain in kinetic energy of the aeroplane as it accelerates from rest to its take-off velocity. [3]

Gain in KE = ... J

(ii) Use the equation:

$$\text{work done} = \text{force} \times \text{distance} \qquad \text{or} \qquad W = Fx$$

to calculate the mean resultant force acting on the aeroplane as it accelerates along the runway. [3]

Mean resultant force = ... N

(iii) It is stated that the thrust produced by the engines must be greater than the mean resultant force. Explain whether you agree with this statement. [2]

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(b) (i) Calculate the gain in potential energy of the aeroplane as it rises off the runway to its cruising height. (g = 10 m/s^2). [3]

Gain in potential energy = ... J

(ii) The aeroplane takes 20 minutes to rise to its cruising height. Calculate the power developed by the lifting force. [3]

Power = ... W

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END OF PAPER

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For continuation only.