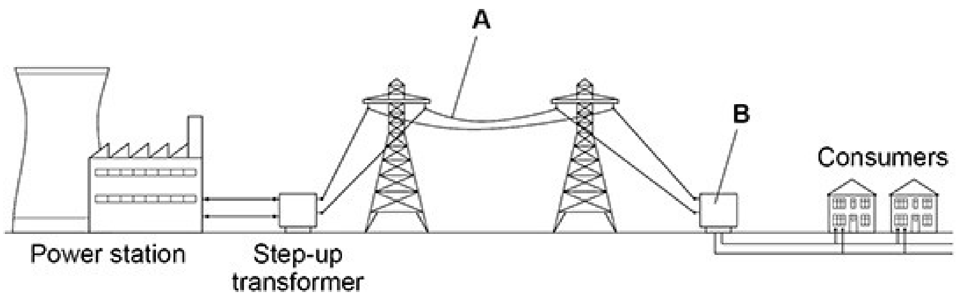
Questions are for both separate science and combined science students unless indicated in the question

1. The figure below shows part of the National Grid linking a power station to consumers.



(a) Name the parts of the figure above labelled **A** and **B**.

A ____

B ____

(2)

(b) Electricity is transmitted through **A** at a very high potential difference.

What is the advantage of transmitting electricity at a very high potential difference?

Tick (✓) **one** box.

A high potential difference is safer for consumers. ☐

Less thermal energy is transferred to the surroundings. ☐

Power transmission is faster. ☐

(1)

(c) The power station generates electricity at a potential difference of 25 000 V.

The energy transferred by the power station in one second is 500 000 000 J.

Calculate the charge flow from the power station in one second.

Use the equation:

$$\text{charge flow} = \frac{\text{energy}}{\text{potential difference}}$$

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____

____

Charge flow in one second = _______________ C

(2)

The electricity supply to a house has a potential difference of 230 V.

The table below shows the current in some appliances in the house.

Appliance	**Current in amps**
Dishwasher	6.50
DVD player	0.10
Lamp	0.40
TV	0.20

(d) Calculate the total power of all the appliances in the table above.
Use the equation:

$$\text{power} = \text{potential difference} \times \text{current}$$

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Total power = _______________ W

(3)

(e) Each appliance in the table above is switched on for 2 hours.

Which appliance will transfer the most energy?

Give a reason for your answer.

Appliance ____

Reason ____

____

____

(2)

(f) The average energy transferred from the National Grid every second for each person in the UK is 600 J. There are 32 000 000 seconds in one year. Calculate the average energy transferred each year from the National Grid for each person in the UK.

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Average energy transferred = _______________ J

(2)

(Total 12 marks)

2. A student investigated how the current in a circuit varied with the number of lamps connected in parallel in the circuit.

Figure 1 shows the circuit with three identical lamps connected in parallel.

Figure 1

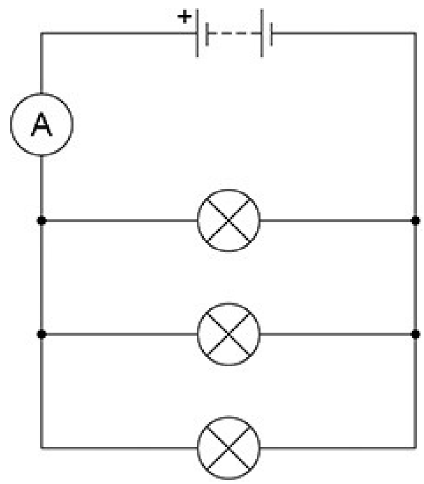
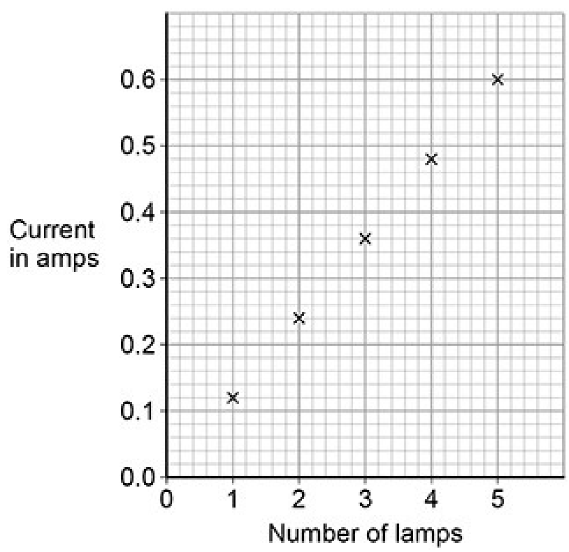


Figure 2 shows the results**.**

Figure 2



(a) Complete the sentences.

Choose answers from the box.

Each answer can be used once, more than once or not at all.

decreased	**stayed the same**	**increased**

As the number of lamps increased, the current ____________________.

As the number of lamps increased, the total resistance of the circuit

______________________ .

As the number of lamps increased, the potential difference across the battery

______________________ .

(3)

(b) When there were three lamps in the circuit the ammeter reading kept changing between 0.35 A and 0.36 A.

What type of error would this lead to?
Tick (✓) **one** box.

Random error ☐

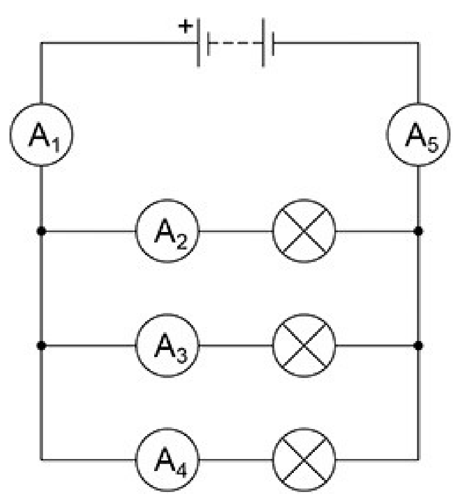
Systematic error ☐

Zero error ☐

(1)

Figure 3 shows a circuit with five ammeters and three identical lamps.

Figure 3



(c) Complete the table below to show the readings on ammeters A2 and A5.

Ammeter	A1	A_2	A3	A4	A_5
Current in amps	0.36		0.12	0.12	

(2)

(d) The resistance of one lamp is 15 Ω.

The current in the lamp is 0.12 A.

Calculate the power output of the lamp.

Use the equation:

power = (current)2 × resistance

____

____

____

Power = _______________ W

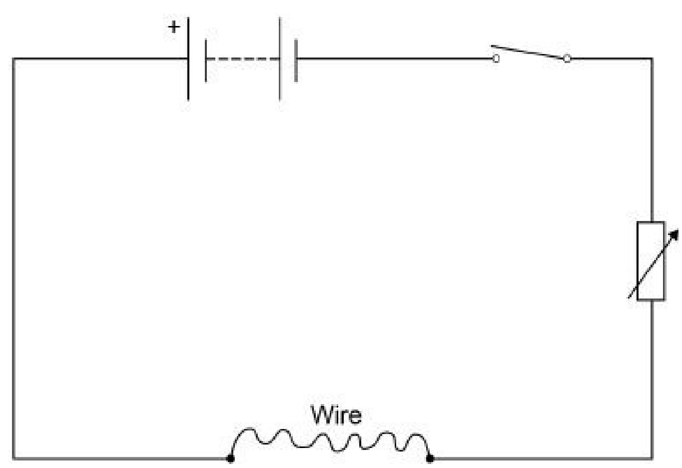
(2)

(Total 8 marks)

3. A student investigated how the resistance of a piece of nichrome wire varies with length.

Figure 1 shows part of the circuit the student used.

Figure 1



(a) Complete **Figure 1** by adding an ammeter and a voltmeter.

Use the correct circuit symbols.

(3)

(b) Describe how the student would obtain the data needed for the investigation.

Your answer should include a risk assessment for **one** hazard in the investigation.

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(6)

(c) Why would switching off the circuit between readings have improved the accuracy of the student's investigation?

Tick **one** box.

The charge flow through the wire would not change. ☐

The potential difference of the battery would not increase. ☐

The power output of the battery would not increase. ☐

The temperature of the wire would not change. ☐

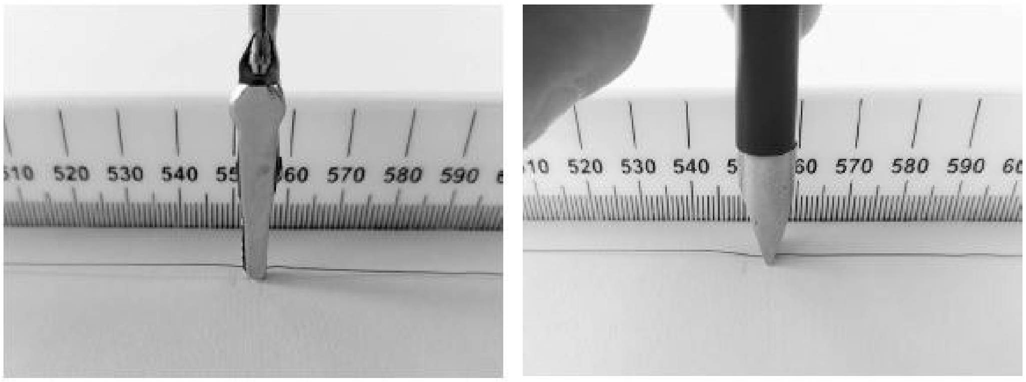
(1)

(d) The student used crocodile clips to make connections to the wire.

They could have used a piece of equipment called a 'jockey'.

Figure 2 shows a crocodile clip and a jockey in contact with a wire.

Figure 2



Crocodile clip **Jockey**

How would using the jockey have affected the accuracy and resolution of the student's results compared to using the crocodile clip?

Tick **two** boxes.

The accuracy of the student's results would be higher.	☐
The accuracy of the student's results would be lower.	☐
The accuracy of the student's results would be the same.	☐
The resolution of the length measurement would be higher.	☐
The resolution of the length measurement would be lower.	☐
The resolution of the length measurement would be the same.	☐

(2)
(Total 12 marks)

4. **Figure 1** shows a lift inside a building.

Figure 1

(a) The motor in the lift does 120 000 J of work in 8.0 seconds.

Calculate the power output of the motor in the lift.

Use the equation:

$$\text{Power output} = \frac{\text{work done}}{\text{time}}$$

____

____

____

____

Power output = ______________________ W

(2)

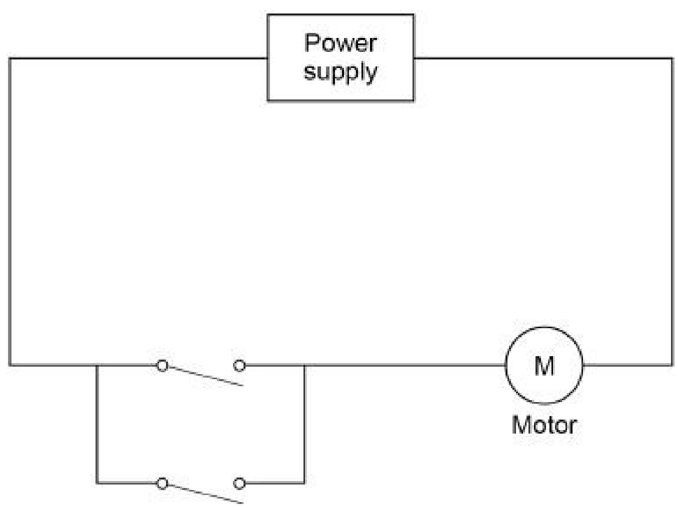
(b) The power input to the motor is greater than the power output.
Tick **two** reasons why.

Energy is transferred in heating the surroundings.	☐
Friction causes energy to be transferred in non-useful ways.	☐
The motor is connected to the mains electricity supply.	☐
The motor is more than 100% efficient.	☐
There are only four people in the lift.	☐

(2)

(c) **Figure 2** shows part of the circuit that operates the lift motor.

Figure 2



The lift can be operated using either of the two switches. Explain why.

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(2)

(d) Write down the equation that links gravitational field strength, gravitational potential energy, height and mass.

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____ **(1)**

(e) The lift goes up 14 m. The total mass of the people in the lift is 280 kg.

gravitational field strength = 9.8 N/kg Calculate the increase in gravitational potential energy of the people in the lift. Give your answer to 2 significant figures.

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Increase in gravitational potential energy = ______________________ J

(3)

(Total 10 marks)

5. **Figure 1** shows a student walking on a carpet. (separate only)

Figure 1

(a) The student becomes negatively charged because of the friction between her socks and the carpet.

Explain why the friction causes the student to become charged.(separate only)

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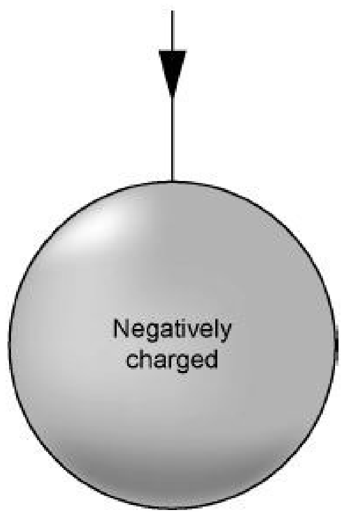
____ **(2)**

(b) The student's head is represented by the sphere in **Figure 2**.

The student is negatively charged. The arrow shows part of the electric field around the student's head.
Draw **three** more arrows on **Figure 2** to complete the electric field pattern. (separate only)

Figure 2



(1)

(c) The negatively charged student touches a metal tap and receives an electric shock.

Explain why. (separate only)

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____ **(3)**

(d) Some carpets have thin copper wires running through them. The student is less likely to receive an electric shock after walking on this type of carpet.

Suggest why.(separate only)

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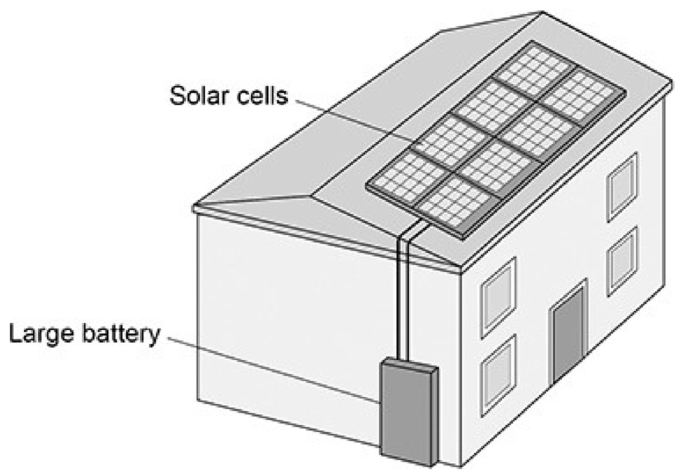
(2)

(Total 8 marks)

6. The figure below shows a house with a solar power system.

The solar cells generate electricity.

When the electricity generated by the solar cells is not needed, the energy is stored in a large battery.



(a) The solar cells on the roof of the house always face in the same direction.

Explain **one** disadvantage caused by the solar cells only facing in one direction.

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(2)

(b) The mean current from the solar cells to the battery is 3.5 A.

Calculate the charge flow from the solar cells to the battery in 3600 seconds.

Use the equation:

charge flow = current × time

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____

Charge flow = _______________ C

(2)

(c) Write down the equation which links efficiency, total power input and useful power output.

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(1)

(d) At one time in the day, the total power input to the solar cells was 7500 W.

The efficiency of the solar cells was 0.16 Calculate the useful power output of the solar cells.

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Useful power output = _______________ W

(3)

(e) The wasted energy that is **not** usefully transferred by the solar cells is dissipated.

What happens to energy that has been dissipated?

Tick (✓) **one** box.

The energy becomes less useful. ☐

The energy is destroyed. ☐

The energy is used to generate electricity. ☐

(1)

(f) Why is it unlikely that all the UK's electricity needs could be met by solar power systems?

Tick (✓) **one** box.

A very large area would need to be covered with solar cells.	☐
Solar power is a non-renewable energy resource.	☐
The efficiency of solar cells is too high.	☐

(1)
(Total 10 marks)

7. The photograph below shows an electric car being recharged.

(a) The charging station applies a direct potential difference across the battery of the car.

What does 'direct potential difference' mean?

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(1)

(b) Which equation links energy transferred (E), power (P) and time (t)?

Tick (√) **one** box.

energy transferred = $\frac{\text{power}}{\text{time}}$ ☐

energy transferred = $\frac{\text{time}}{\text{power}}$ ☐

energy transferred = power × time ☐

energy transferred = power2 × time ☐

(1)

(c) The battery in the electric car can store 162 000 000 J of energy.

The charging station has a power output of 7200 W. Calculate the time taken to fully recharge the battery from zero.

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Time taken = _______________ s

(3)

(d) Which equation links current (I), potential difference (V) and resistance (R)?

Tick (√) **one** box.

$I = V \times R$ ☐

$I = V2\times R$ ☐

$R = I \times V$ ☐

$V = I \times R$ ☐

(1)

(e) The potential difference across the battery is 480 V.
There is a current of 15 A in the circuit connecting the battery to the motor of the electric car.

Calculate the resistance of the motor.

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Resistance = _______________ Ω

(3)

(f) Different charging systems use different electrical currents.

- Charging system **A** has a current of 13 A.
- Charging system **B** has a current of 26 A.
- The potential difference of both charging systems is 230 V.

How does the time taken to recharge a battery using charging system **A** compare with the time taken using charging system **B**?

Tick (✓) **one** box.

Time taken using system **A** is half the time of system **B**	☐
Time taken using system **A** is the same as system **B**	☐
Time taken using system **A** is double the time of system **B**	☐

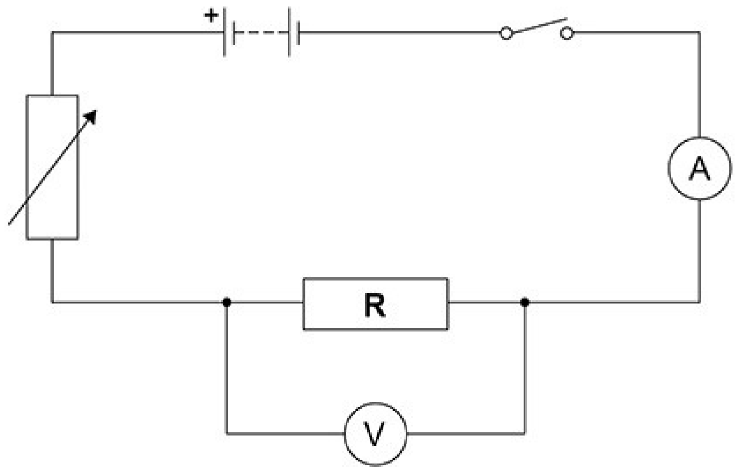
(1)
(Total 10 marks)

8. Student **A** investigated how the current in resistor **R** at constant temperature varied with the potential difference across the resistor.

Student **A** recorded both positive and negative values of current.

Figure 1 shows the circuit Student **A** used.

Figure 1



(a) Describe a method that Student **A** could use for this investigation.

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(6)

(b) Student **B** repeated the investigation. During Student **B**'s investigation the temperature of resistor **R** increased. Explain how the increased temperature of resistor **R** would have affected Student **B**'s results.

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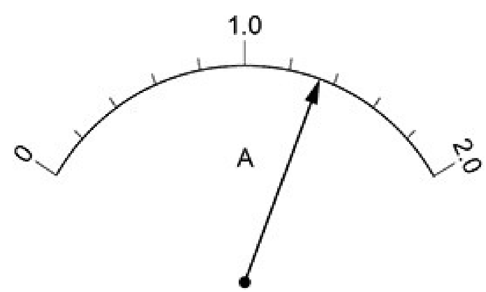
(2)

Figure 2 shows the scale on a moving coil ammeter at one time in the investigation.

Figure 2



(c) What is the resolution of the moving coil ammeter?

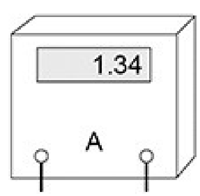
Resolution = __________ A

(1)

(d) Student **B** replaced the moving coil ammeter with a digital ammeter.

Figure 3 shows the reading on the digital ammeter.

Figure 3



The digital ammeter has a higher resolution than the moving coil ammeter. Give **one** other reason why it would have been better to use the digital ammeter throughout this investigation.

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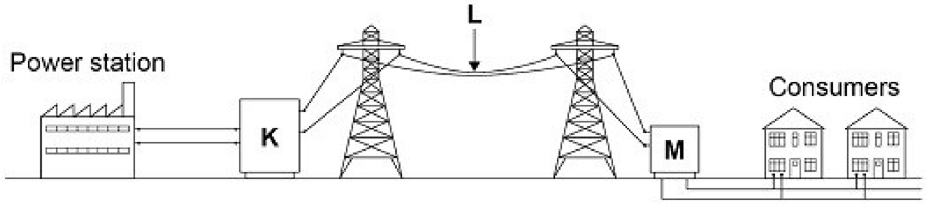
(1)
(Total 10 marks)

9. The diagram below shows how the National Grid connects power stations to consumers.



(a) Name the parts of the National Grid labelled K, L and M.

K = ____

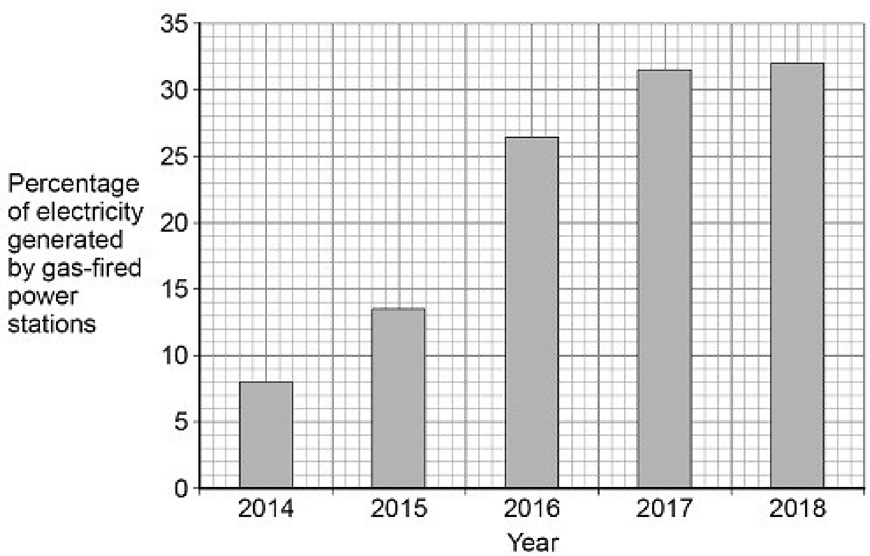
L = ____

M = ____

(3)

Figure 1 shows how the percentage of electricity generated by gas-fired power stations changed in the UK over 5 years.

Figure 1



(b) Calculate how many times greater the percentage of electricity generated by gas-fired power stations was in 2018 than in 2014.

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____

____

Number of times greater = _______________

(2)

(c) Explain **one** environmental effect of generating electricity using a gas-fired power station.

____

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(2)

(d) The UK government wants more electricity to be generated using renewable energy resources.

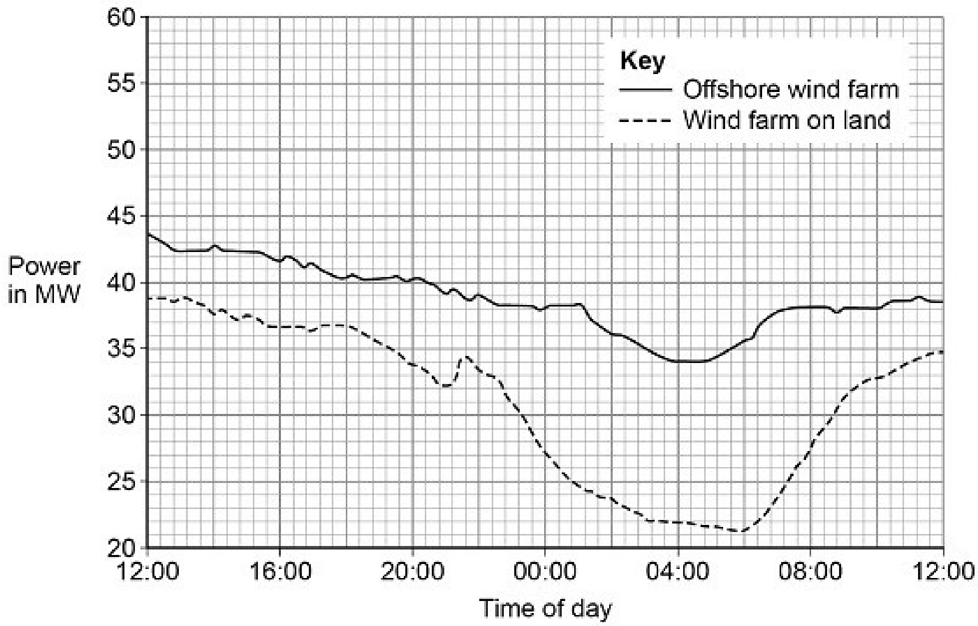
What is a renewable energy resource?
Tick (√) **one** box.

An energy resource that can be burned	☐
An energy resource that can be recycled	☐
An energy resource that can be replenished quickly	☐
An energy resource that can be reused	☐

(1)

(e) An offshore wind farm is a group of wind turbines that are placed out at sea. **Figure 2** shows the power output of an offshore wind farm compared with a wind farm on land for a 24-hour period.

Figure 2



Give **two** advantages of the offshore wind farm compared with the wind farm on land.

Use information from **Figure 2**.

1 ____

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2 ____

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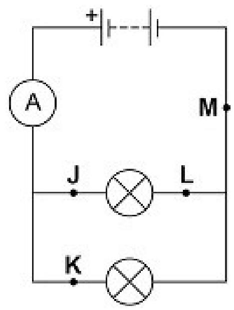
(2)
(Total 10 marks)

10. **Figure 1** shows a circuit diagram.

Figure 1



(a) In which position could a switch be placed so that both lamps can be switched on or off at the same time?

Tick (✓) **one** box.

J ☐ **K** ☐ **L** ☐ **M** ☐

(1)

(b) Draw the circuit symbol for a switch in the box below.

(1)

(c) In 30 seconds, 24 coulombs of charge flow through the battery.

Calculate the current in the battery.

Use the equation:

$$\text{current} = \frac{\text{charge flow}}{\text{time}}$$

____

____

____

____

Current = ___________________________ A

(2)

(d) There is a potential difference of 3.6 V across the battery.

Calculate the energy transferred by the battery when 60 coulombs of charge flows through the battery.

Use the equation:

energy transferred = charge flow × potential difference

____

____

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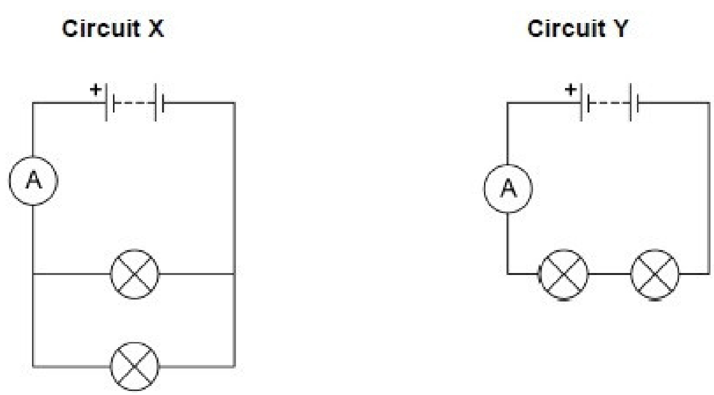
Energy transferred = ___________________________ J

(2)

A student built **Circuit X** and **Circuit Y** shown in **Figure 2**.

The components used in each circuit were identical.

Figure 2



(e) How would the reading on the ammeter in **Circuit Y** compare to the reading on the ammeter in Circuit X?

Tick (√) **one** box.

The reading in **Y** would be higher.	☐
The reading in **Y** would be lower.	☐
The readings would be the same.	☐

(1)

(f) How does the total resistance of **Circuit Y** compare with the total resistance of **Circuit X**?

Tick (√) **one** box.

The total resistance of **Y** is greater. ☐

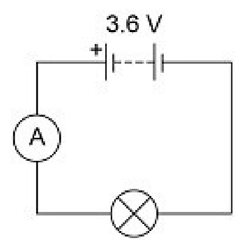
The total resistance of **Y** is less. ☐

The total resistance is the same. ☐

(1)

The student built another circuit which is shown in **Figure 3**.

Figure 3



(g) Write down the equation which links current, potential difference and resistance.

____

(1)

(h) There is a potential difference of 3.6 V across the lamp in **Figure 3**.
The current through the lamp is 0.80 A

Calculate the resistance of the lamp.

____

____

____

Resistance = ___________________________ Ω

(3)

(Total 12 marks)

11. The ancient Greeks thought that atoms were tiny spheres that could not be divided into anything smaller.

Since then, different discoveries have led to the model of the atom changing.

Some of the discoveries are given in the table below.

The mass of an atom is concentrated in the nucleus.	**A**
Electrons orbit the nucleus at specific distances.	**B**
The nucleus contains neutrons.	**C**
The nucleus contains positively charged protons.	**D**

(a) Which discovery was the earliest?

Tick (√) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(b) Which discovery was the most recent?

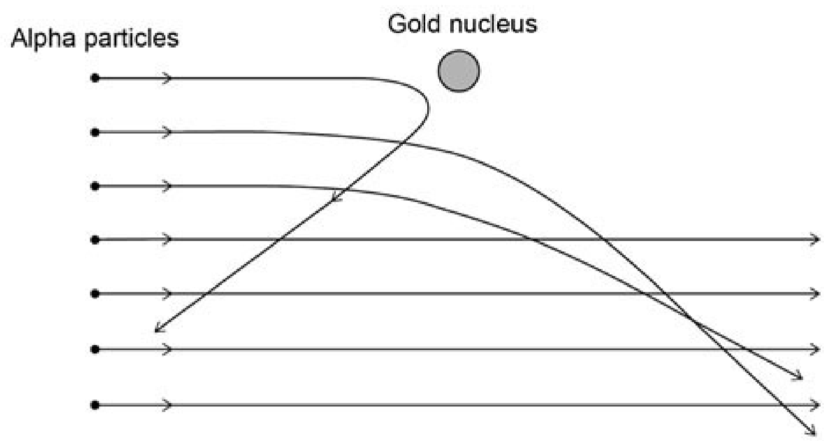
Tick (√) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(c) The alpha particle scattering experiment led to the nuclear model of the atom.

The figure below shows the paths of alpha particles travelling close to a gold nucleus.



Complete the sentences.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

attracts	decreases	does not change
increases	reflects	repels

Alpha particles and gold nuclei are both positively charged.

The gold nucleus ________________________________ the alpha particles.

As the alpha particle approaches the gold nucleus, the electric field strength

experienced by the alpha particle ________________________________.

As an alpha particle approaches the gold nucleus, the force

experienced by the alpha particle ________________________________.

(3)

(d) The results of the alpha particle scattering experiment were reproducible.

What does reproducible mean?

Tick (√) **one** box.

Another scientist repeats the experiment and gets the same results. ☐

Another scientist repeats the experiment and gets different results. ☐

The same scientist repeats the experiment and gets the same results. ☐

The same scientist repeats the experiment and gets different results. ☐

(1)
(Total 6 marks)

12. Light bulbs are labelled with a power input.

(a) What does power input mean?

Tick (√) **one** box.

The charge transferred each second by the bulb. ☐

The current through the bulb. ☐

The energy transferred each second to the bulb. ☐

The potential difference across the bulb. ☐

(1)

(b) Write down the equation which links current, potential difference and power.

____

(1)

(c) A light bulb has a power input of 40 W
The mains potential difference is 230 V

Calculate the current in the light bulb.

____

____

____

Current = ________________________________ A

(3)

The following table shows information about three different light bulbs.

Light bulb	**Total power input in watts**	**Useful power output in watts**	**Efficiency**
P	6.0	5.4	0.9
Q	40	2.0	0
R	9.0	**X**	0.0

5

(d) Write down the equation which links efficiency, total power input and useful power output.

0.3

____

0

(1)

(e) Calculate the value of **X** in the table above.

____

____

____

____

X = ___________________________ W

(3)

(f) In addition to power input, light bulbs should also be labelled with the rate at which they emit visible light. Suggest why.

____

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____

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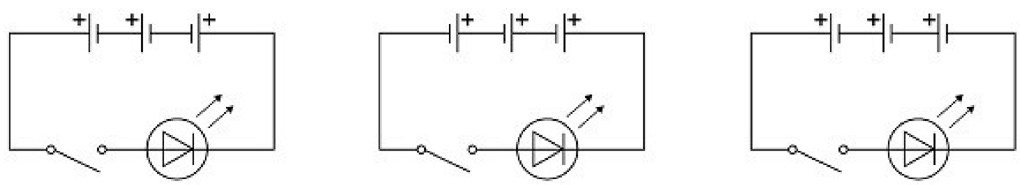
(2)
(Total 11 marks)

13. The photograph below shows an LED torch.

(a) The torch contains one LED, one switch and three cells.

Which diagram shows the correct circuit for the torch?

Tick (✓) **one** box.



☐ ☐ ☐

(1)

(b) Write down the equation which links charge flow (Q), current (I) and time (t).

____

(1)

(c) The torch worked for 14 400 seconds before the cells needed replacing.

The current in the LED was 50 mA. Calculate the total charge flow through the cells.

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____

____

Total charge flow = _______________ C

(3)

(d) When replaced, the cells were put into the torch the wrong way around.

Explain why the torch did not work.

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(2)

(e) Write down the equation which links efficiency, total power input and useful power output.

____

____

(1)

(f) The total power input to the LED was 0.24 W.

The efficiency of the LED was 0.75 Calculate the useful power output of the LED.

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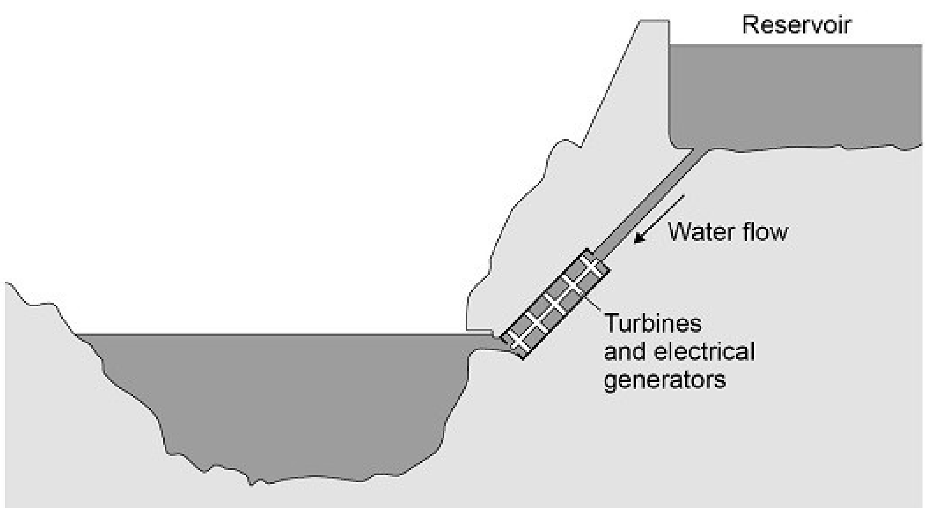
Useful power output = _______________ W

(3)

(Total 11 marks)

14. The diagram below shows a hydroelectric power station.



Electricity is generated when water from the reservoir flows through the turbines.

(a) Write down the equation which links density (*ρ*), mass (*m*) and volume (*V*).

____

(1)

(b) The reservoir stores 6 500 000 m3 of water. The density of the water is 998 kg/m3.

Calculate the mass of water in the reservoir.

Give your answer in standard form.

____

____

____

____

____

Mass (in standard form) = _______________ kg

(4)

(c) Write down the equation which links energy transferred (*E*), power (*P*) and time (*t*).

____

(1)

(d) The electrical generators can provide 1.5 × 109 W of power for a maximum of 5 hours.

Calculate the maximum energy that can be transferred by the electrical generators.

____

____

____

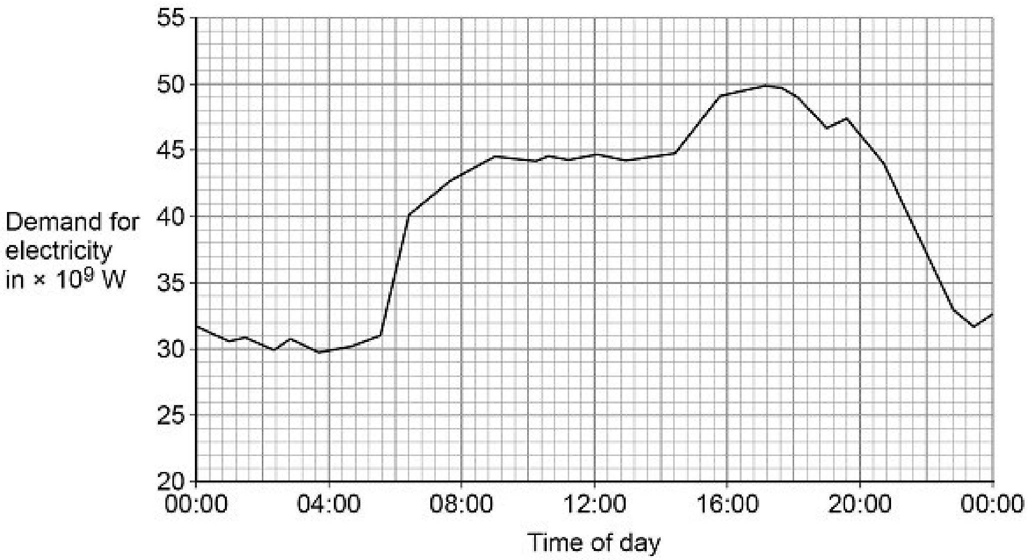
____

____

Energy transferred = _______________ J

(3)

(e) The graph below shows how the UK demand for electricity increases and decreases during one day.



The hydroelectric power station in the above diagram can provide 1.5 × 109 W of power for a maximum of 5 hours.

Give **two** reasons why this hydroelectric power station is not able to meet the increase in demand shown between 04:00 and 16:00 in above graph.

1 ____

____

____

2 ____

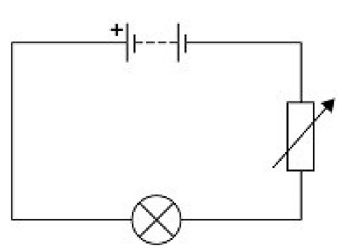
____

____

(2)
(Total 11 marks)

15. A student investigated how the current in a filament lamp varied with the potential difference across the filament lamp.

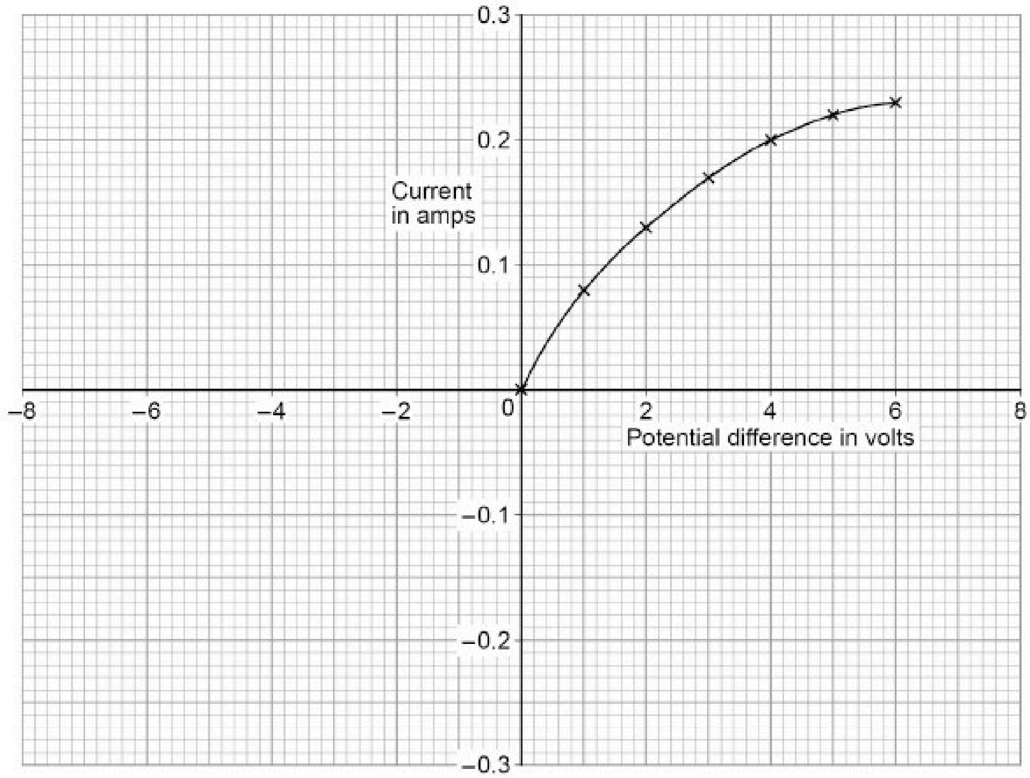
The diagram below shows part of the circuit used.



(a) Complete above diagram by adding an ammeter and a voltmeter.
Use the correct circuit symbols.

(3)

The graph below shows some of the results.



(b) The student reversed the connections to the power supply and obtained negative values for the current and potential difference.

Draw a line on the graph to show the relationship between the negative values of current and potential difference.

(2)

(c) Write down the equation which links current (I), potential difference (V) and resistance (R).

____

(1)

(d) Determine the resistance of the filament lamp when the potential difference across it is 1.0 V. Use data from the graph above.

____

____

____

____

Resistance = _______________ Ω

(4)

(e) A second student did the same investigation. The ammeter used had a zero error.

What is meant by a zero error?

____

____

(1)

(Total 11 marks)

16. A student heated water in an electric kettle.

(a) Water has a high specific heat capacity.

Complete the sentence.

Choose answers from the box.

°C	**J**	**kg**	**s**	**W**

The specific heat capacity of a substance is the energy needed to raise the

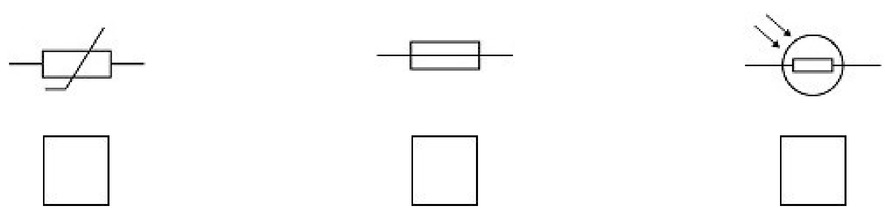
temperature of 1 __________ of the substance by 1 __________.

(2)

(b) The kettle circuit contains a thermistor which is used to switch the kettle off when the water reaches 100 °C.

What is the correct symbol for a thermistor?

Tick (√) **one** box.



(1)

(c) The resistance of the heating element in the kettle is 15 Ω.

The current in the heating element is 12 A.

Calculate the power of the heating element.

Use the equation:

power = (current)2 × resistance

____

____

____

____

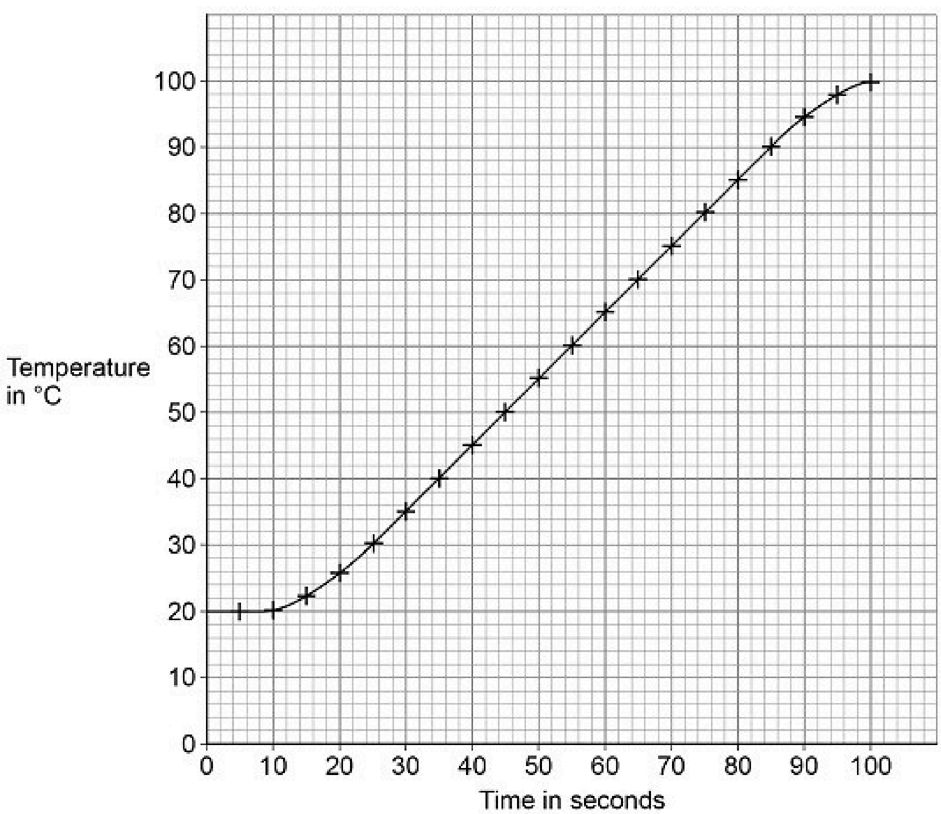
____

Power = _______________ W

(2)

The student investigated how quickly the kettle could increase the temperature of 0.50 kg of water.

The graph below shows the results of the investigation.



(d) The temperature of the water did **not** start to increase until 10 seconds after the kettle was switched on.

What is the reason for this?
Tick (✓) **one** box.

Energy is transferred from the surroundings to the kettle.	☐
The charge flows slowly through the kettle circuit.	☐
The heating element in the kettle takes time to heat up.	☐
The power output of the kettle increases slowly.	☐

(1)

(e) Describe a method the student could have used to obtain the results shown in the graph.

____

____

____

____

____

____

____

____

____

____

____

____

(6)

(f) The mass of water in the kettle was 0.50 kg.

The temperature of the water increased from 20 °C to 100 °C. specific heat capacity of water = 4200 J/kg/°C Calculate the energy transferred to the water. Use the Physics Equations Sheet.

____

____

____

____

____

Energy = _______________ J

(3)

(g) The water in the kettle boiled for a short time before the kettle switched off.

During this time 5.0 g of water changed to steam. specific latent heat of vaporisation of water = 2 260 000 J/kg Calculate the energy transferred to change the water to steam. Use the Physics Equations Sheet.

____

____

____

____

____

Energy = _______________ J

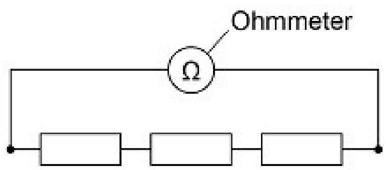
(3)

(Total 18 marks)

17. A student investigated how the total resistance of identical resistors connected in series varied with the number of resistors.

The student used an ohmmeter to measure the total resistance of the resistors.

The diagram below shows the student's circuit with 3 resistors.



The student repeated each reading of resistance three times.

The table below shows the student's results for 3 resistors in series.

Number of resistors	Total resistance in Ω			
	Reading 1	Reading 2	Reading 3	Mean
3	35.9	36.0	36.1	36.0

(a) Calculate the mean resistance of 1 resistor.

____

____

____

Resistance = _______________ Ω

(2)

(b) What was the resolution of the ohmmeter the student used?

Tick (√) **one** box.

0.1 Ω ☐ 0.2 Ω ☐ 1.1 Ω ☐ 36.0 Ω ☐

(1)

(c) How do the results show that the student's measurements were precise?

Tick (√) **one** box.

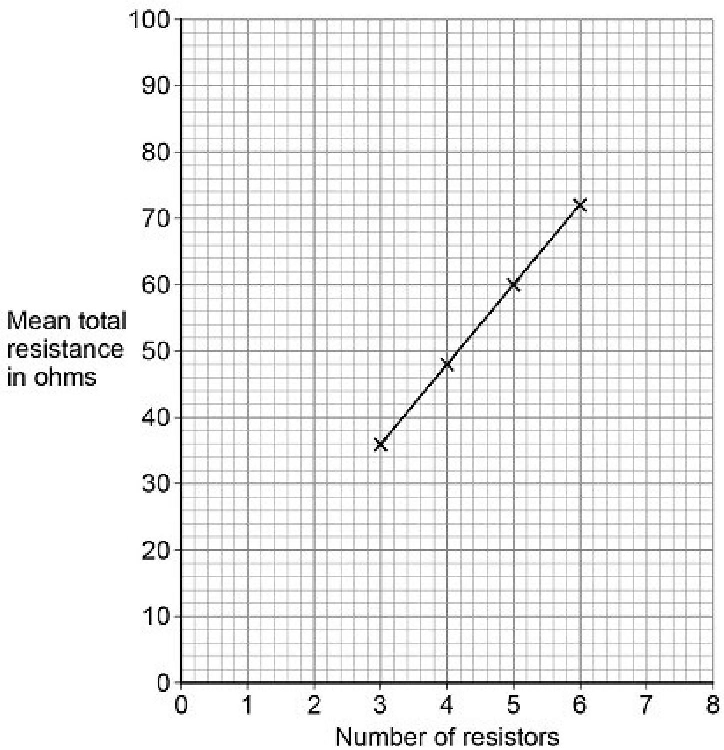
The measurements are accurate. ☐

The measurements are grouped closely together. ☐

The measurements are reproducible. ☐

(1)

The graph below shows the results.



(d) How do the results show that the total resistance is directly proportional to the number of resistors?

Tick (√) **one** box.

The results give a line with a positive gradient. ☐

The results give a straight line that would go through the origin. ☐

The results show a linear relationship. ☐

(1)

(e) Predict the mean total resistance of 7 resistors.
Use the graph above.

Mean total resistance of 7 resistors = _______________ Ω

(1)

(f) Some resistors are connected in series with a battery.

When more resistors are added in series, the total resistance increases.

Complete the sentences.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

decreases	**increases**	**remains the same**

When the number of resistors increases, the potential difference across each

resistor _______________.

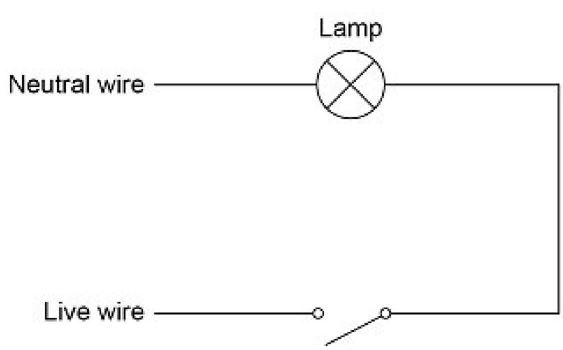
When the number of resistors increases, the current in the circuit

_______________________________.

(2)

(Total 8 marks)

18. The diagram shows part of a lighting circuit in a house.



(a) What is the frequency of the ac mains electricity supply in the UK?

Tick (√) **one** box.

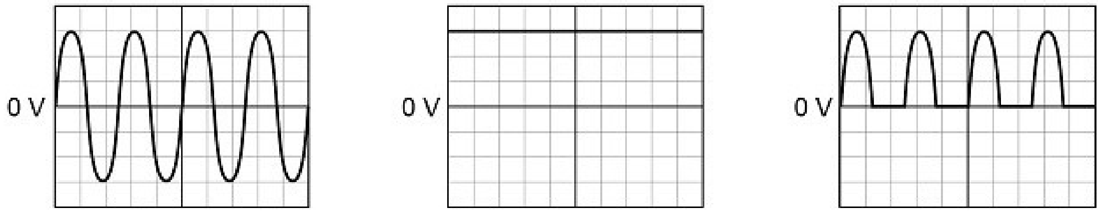
20 Hz ☐ 50 Hz ☐ 60 Hz ☐ 100 Hz ☐

(1)

(b) The mains electricity supply has an alternating potential difference.

Which diagram shows an alternating potential difference?

Tick (✓) **one** box.



☐ ☐ ☐

(1)

(c) The potential difference across the lamp is 230 V.

The current in the lamp is 0.020 A.

Calculate the power output of the lamp.

Use the equation:

power = potential difference × current

____

____

____

Power = _______________ W

(2)

(d) The potential difference across the lamp is 230 V.

Calculate the energy transferred by the lamp when 180 C of charge flows through the lamp.

Use the equation:

energy transferred = charge flow × potential difference

____

____

____

Energy transferred = _______________ J

(2)

(e) An electrician needs to replace the light switch in the diagram above.

Describe the possible hazard and the risk to the electrician of changing the light switch.

Hazard

____

____

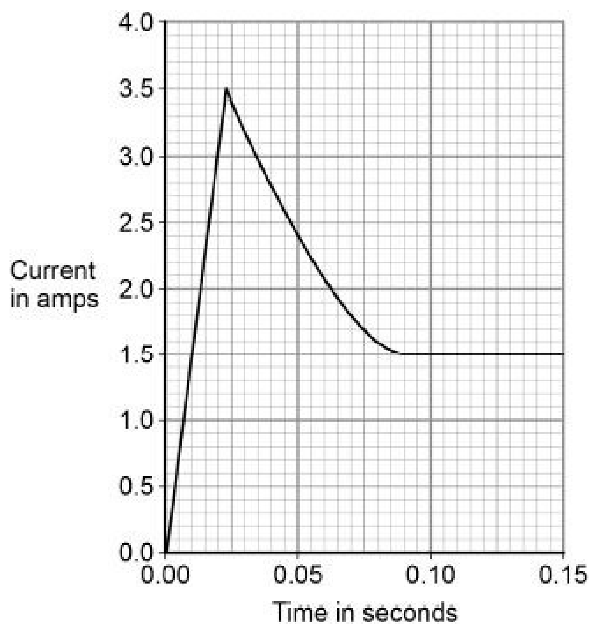
Risk

____

____

(2)
(Total 8 marks)

19. The graph below shows how the current through a filament lamp changes after the lamp is switched on.



(a) The normal current through the filament lamp is 1.5 A.

For how many seconds is the current through the filament lamp greater than 1.5 A?

Tick **one** box.

0.01 s ☐

0.08 s ☐

0.09 s ☐

0.14 s ☐

(1)

(b) Why might the filament inside a lamp melt when the lamp is first switched on?

____

____

(1)

(c) The lamp is connected to a 24 V power supply. The current through the lamp is 1.5 A.

Calculate the power of the lamp.

Use the equation:

power = potential difference × current

____

____

____

____

Power = ______________________ W

(2)

(d) LED lamps are much more efficient than filament lamps.

What does this statement mean?

Tick **one** box.

LED lamps have a similar power output to filament lamps.	☐
LED lamps waste a smaller proportion of the input energy than filament lamps.	☐
LED lamps have a higher power input than filament lamps.	☐
LED lamps waste a larger proportion of the input energy than filament lamps.	☐

(1)

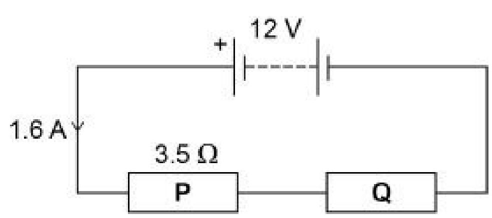
(Total 5 marks)

20. (a) Draw a diagram to show how 1.5 V cells should be connected together to give a potential difference of 4.5 V.

Use the correct circuit symbol for a cell.

(2)

A student built the circuit shown in the diagram below.



(b) Calculate the total resistance of the circuit in the diagram above.
Use the equation:

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

____

____

____

____

Total resistance = ___________________________ Ω

(2)

(c) The resistance of **P** is 3.5 Ω.

Calculate the resistance of **Q**.

____

____

____

____

Resistance of **Q** = _________________________ Ω

(1)

(d) The student connects the two resistors in the diagram above in parallel.

What happens to the total resistance of the circuit?

Tick **one** box.

It decreases ☐

It increases ☐

It does not change ☐

(1)

Give a reason for your answer.

____

____

____

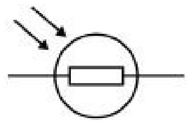
____

(1)
(Total 7 marks)

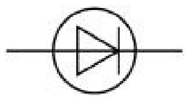
21. The plug of an electrical appliance contains a fuse.

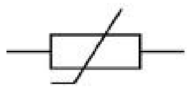
(a) What is the correct circuit symbol for a fuse?

Tick **one** box.

 ☐

 ☐

 ☐

 ☐

(1)

(b) The appliance is connected to the mains electrical supply. The mains potential difference is 230 V.

Calculate the energy transferred when 13 C of charge flows through the appliance.

Use the equation:

energy transferred = charge flow × potential difference

____

____

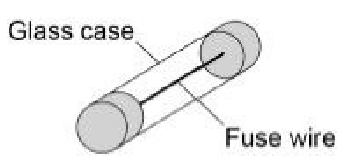
____

____

Energy transferred = ________________________ J

(2)

The diagram below shows the structure of a fuse.



(c) Write down the equation that links charge flow, current and time.

____

(1)

(d) The fuse wire melts when 1.52 coulombs of charge flows through the fuse in 0.40 seconds.

Calculate the current at which the fuse wire melts.

____

____

____

____

Current = ________________________ A

(3)

(e) The mass of the fuse wire is 0.00175 kg. The specific latent heat of fusion of the fuse wire is 205 000 J/kg. Calculate the energy needed to melt the fuse wire. Use the Physics Equations Sheet.

____

____

____

____

Energy = ________________________ J

(2)

(Total 9 marks)