Name: _____

Electricity part 8 AQA Triple Physics

Class: _____

Date: _____

Time: **72 minutes**

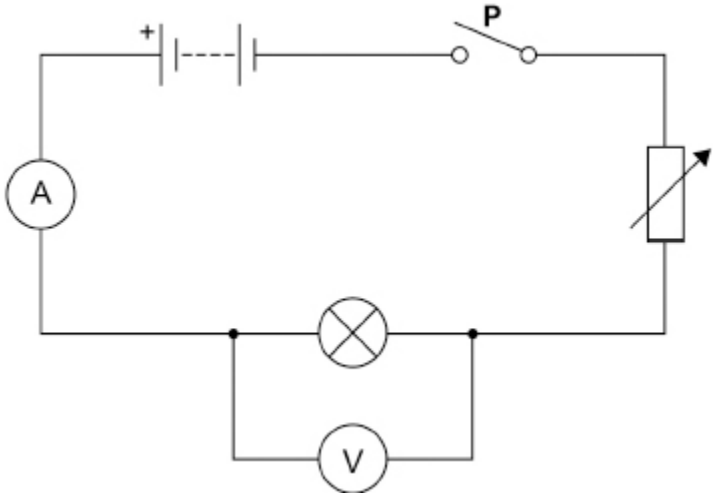
Marks: **68 marks**

Comments:

1. A student investigated how the current in a filament lamp varies with the potential difference across the lamp.

Figure 1 shows the circuit used.

Figure 1



(a) What is component **P**?

_____

(1)

(b) Complete the sentences.

Choose answers from the box.

charge	**current**	**energy**	**potential difference**	**power**

The ammeter in the circuit measures _____.

The voltmeter in the circuit measures _____.

(2)

(c) How will **increasing** the resistance of the variable resistor in **Figure 1** affect each of the following quantities?

Tick (✓) **one** box in **each** row.

Quantity	**Decreases**	**Stays the same**	**Increases**
Current in the circuit			
Potential difference across the lamp			
Total resistance of the circuit			

(3)

(d) A charge flow of 15 coulombs passed through the filament lamp in a time of 60 seconds.

Calculate the current in the lamp.

Use the equation:

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

Current = _____ A

(2)

(e) When the current in the filament lamp is 0.12 A, the potential difference across the lamp is 6.0 V.

Calculate the resistance of the filament lamp.

Use the equation:

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

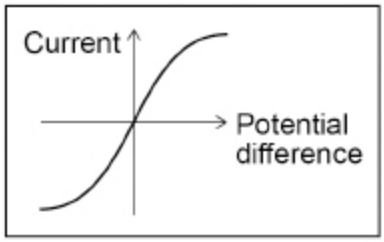
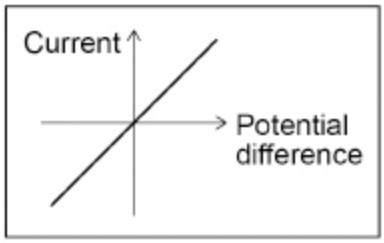
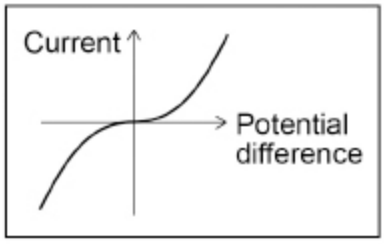
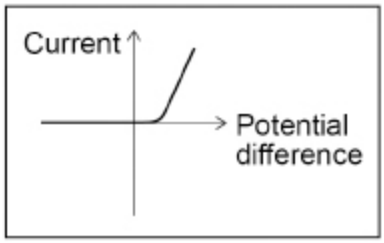
Resistance = _____ Ω

(2)

(f) The student repeated the investigation after replacing the lamp with a resistor at constant temperature and then a diode.

The student plotted a graph for each component.

Draw **one** line from each component to its graph.

Component	Graph
Diode	
Filament lamp	
Resistor	
	

(2)

(g) **Figure 2** shows an ammeter.

The ammeter is **not** connected to a circuit.

Figure 2

What type of error does the ammeter display?

Tick (✓) **one** box.

A positive error ☐

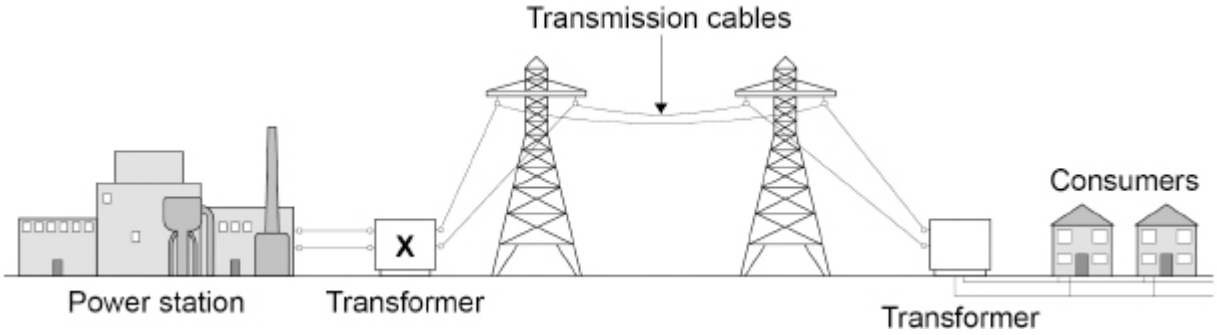
A random error ☐

A zero error ☐

(1)

(Total 13 marks)

2. The figure below shows how the National Grid connects a power station to consumers.



(a) Complete the sentences.

Transformer **X** causes the potential difference to _____.

Transformer **X** causes the current to _____.

(2)

Use the Physics Equations Sheet to answer parts (b) and (c).

(b) Which equation links current (*I*), power (*P*) and resistance (*R*)?

Tick (✓) **one** box.

$P = \frac{I}{R}$ ☐

$P = \frac{I}{R^2}$ ☐

$P = I^2 R$ ☐

$P = IR$ ☐

(1)

(c) A transmission cable has a power loss of 1.60×10^9 W.

The current in the cable is 2000 A.

Calculate the resistance of the cable.

_____

_____

_____

_____

_____

Resistance = _____ Ω

(3)

Use the Physics Equations Sheet to answer parts (d) and (e).

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

_____

(1)

(e) The total energy input to the National Grid from one power station is 34.2 GJ.

The National Grid has an efficiency of 0.992

Calculate the useful energy output from this power station to consumers in GJ.

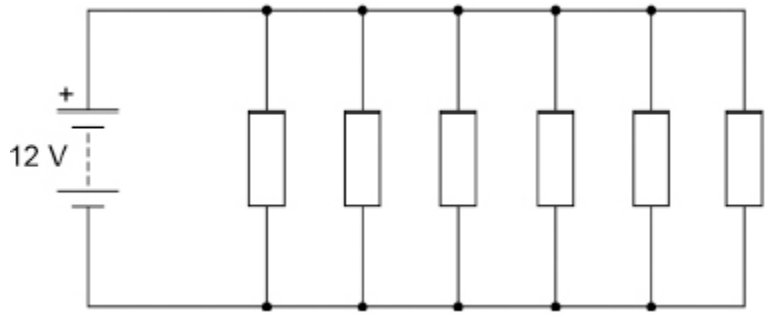
Useful energy output = _____ GJ

(3)

(Total 10 marks)

3. The figure below shows an electrical circuit used to heat the windscreen of a car.

Each resistor in the circuit represents a heating element.



(a) The 12 V battery supplies direct potential difference.

What is meant by 'direct potential difference'?

(1)

Use the Physics Equations Sheet to answer parts (b) and (c).

(b) Which equation links charge flow (Q), energy (E) and potential difference (V)?

Tick (✓) **one** box.

$E = \frac{V}{Q}$ ☐

$E = QV$ ☐

$E = \frac{Q}{V}$ ☐

$E = \frac{V^2}{Q}$ ☐

(1)

(c) Calculate the charge flow through the 12 V battery when the battery transfers 5010 J of energy.

_____

_____

_____

_____

_____

Charge flow = _____ C

(3)

(d) Ice forms on the windscreen at a temperature of 0 °C.

The electrical circuit transfers 5010 J of energy to the ice.

A mass of 0.015 kg of ice melts.

Calculate the specific latent heat of fusion of water.

Use the Physics Equations Sheet.

Specific latent heat of fusion of water = _____ J/kg

(3)

(e) The electrical circuit was left switched on while the ice changed from a solid to a liquid and increased in temperature to 5 °C.

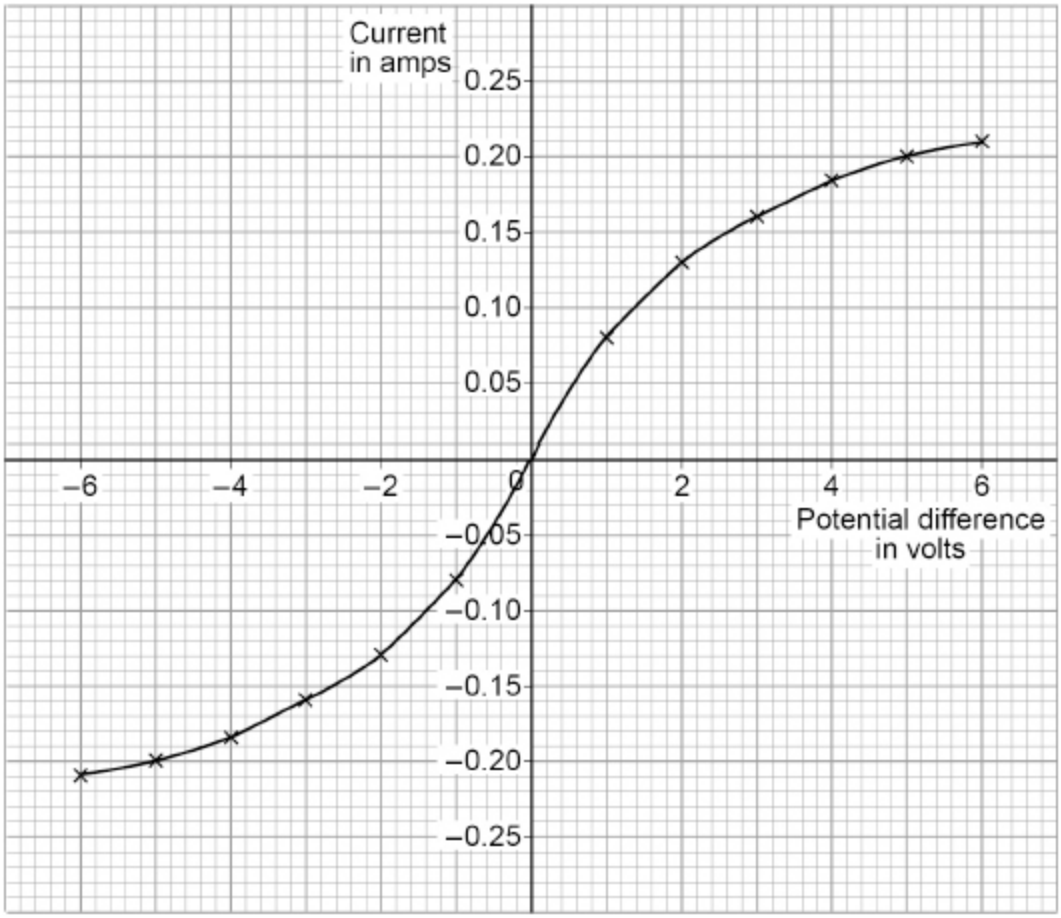
Explain the changes in the arrangement **and** movement of the particles as the ice melted and the temperature increased to 5 °C.

(6)

(Total 14 marks)

4. A student investigated how the current in a filament lamp varies with the potential difference across the filament lamp.

The figure below shows the results.



(a) Describe a method the student could use to obtain these results.

You should include a circuit diagram.

(6)

(b) Determine the resistance of the filament lamp when the potential difference across it is +3.0 V.

Use the Physics Equations Sheet.

Use the figure above.

Resistance = _____ Ω

(3)

(c) The current in the lamp is 0.21 A when the potential difference across the lamp is 6.0 V.

Calculate the energy transferred by the filament lamp in 30 minutes.

Use the Physics Equations Sheet.

Energy transferred = _____ J

(5)

(d) The power output of the lamp is 1.0 W when the potential difference across the lamp is 5.0 V.

A student predicts that the power output would be 4.0 W if the potential difference was doubled.

Explain why the student is **not** correct.

_____

_____

_____

_____

_____

_____

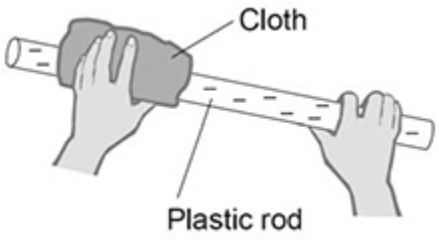
(2)

(Total 16 marks)

5. **Figure 1** shows a plastic rod being rubbed with a cloth.

The plastic rod becomes negatively charged.

Figure 1



(a) Complete the sentences.

Choose answers from the box.

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

electrons	**neutrons**	**protons**

The plastic rod becomes charged because it gains _____.

The cloth also becomes charged because it loses _____.

(2)

(b) What charge is left on the cloth?

Tick (✓) **one** box.

A negative charge ☐

A neutral charge ☐

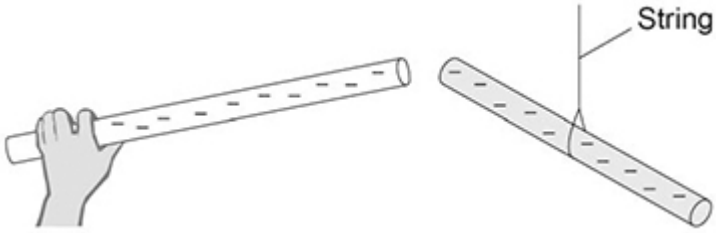
A positive charge ☐

(1)

(c) The negatively charged plastic rod is put near another negatively charged plastic rod that is hanging from a string.

Figure 2 shows the two rods.

Figure 2



What force is exerted on the two rods?

Tick (✓) **one** box.

Give a reason for your answer.

A force of attraction ☐

A force of repulsion ☐

There is no force ☐

Reason _____

_____

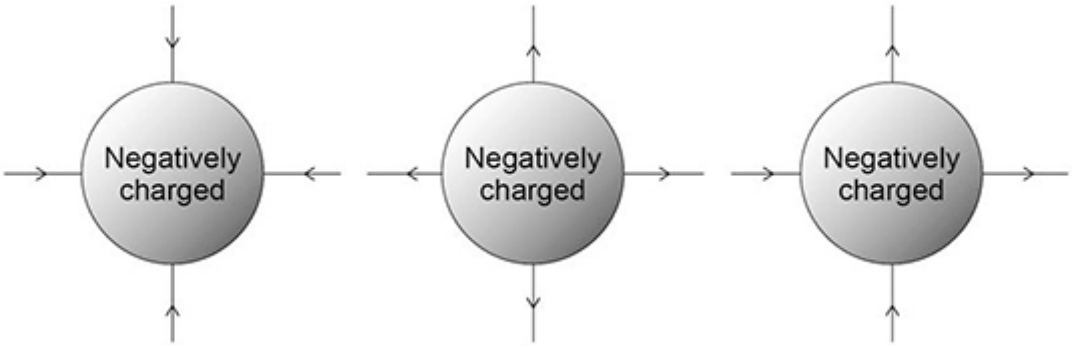
_____

(2)

(d) There is an electric field around any charged object.

Which diagram shows the electric field pattern around a negatively charged sphere?

Tick (✓) **one** box.



☐ ☐ ☐

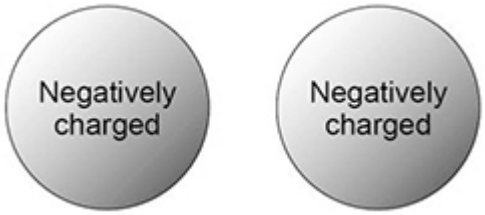
(1)

(e) In which position do two charged spheres experience the greatest electrostatic force?

Tick (✓) **one** box.

A 

☐

B 

☐

C 

☐

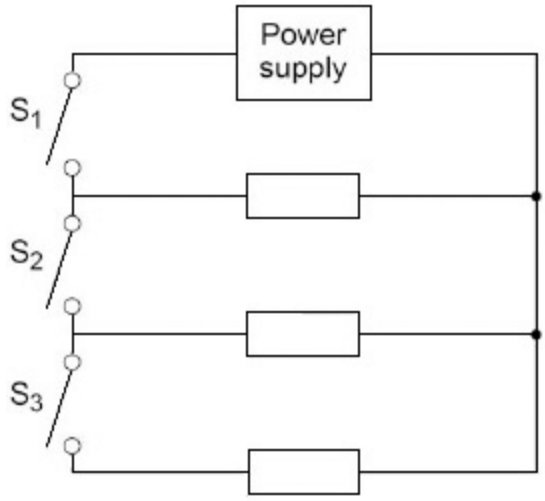
(1)

(Total 7 marks)

6. A hair dryer contains three heating elements.

The figure below shows the circuit diagram for the heating elements in the hair dryer.

In the figure the heating elements are represented by resistor symbols.



(a) Complete the sentence.

The three resistors in above diagram are connected in _____ with the power supply.

(1)

(b) Which switch must always be closed for the hair dryer to work?

Tick (✓) **one** box.

S_1 ☐

S_2 ☐

S_3 ☐

(1)

(c) Which switches must be closed for the hair dryer to work at maximum power output?

Tick (✓) **one** box.

S_1 and S_2 ☐

S_1 and S_3 ☐

S_1, S_2 and S_3 ☐

(1)

Use the Physics Equations Sheet to answer parts (d) and (e).

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

_____

(1)

(e) The heating elements have a maximum power output of 1200 W.

The energy transferred to the heating elements to reach normal operating temperature is 3600 J.

Calculate the time taken for the heating elements to reach normal operating temperature at maximum power output.

_____

_____

_____

_____

_____

_____

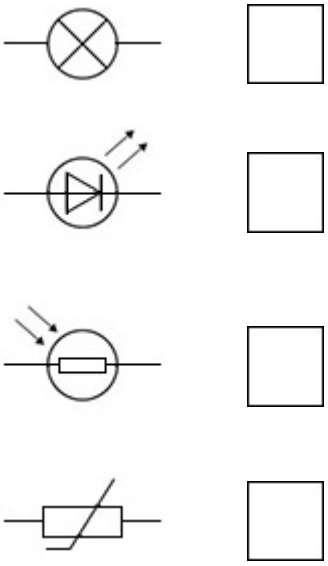
Time = _____s

(3)

(f) The hair dryer has LEDs to indicate the power setting.

What is the circuit symbol for an LED?

Tick (✓) **one** box.



(1)

(Total 8 marks)

1.

(a) switch

1

(b) current

1

potential difference

allow p.d.

allow voltage

1

in this order only

(c)

Quantity	Decrease	Stay the same	Increase
Current in the circuit	✓		
Potential difference across the lamp	✓		
Total resistance of the circuit			✓

any extra tick in a row negates the mark for that row

3

(d) $\text{current} = \frac{15}{60}$

1

current = 0.25 (A)

1

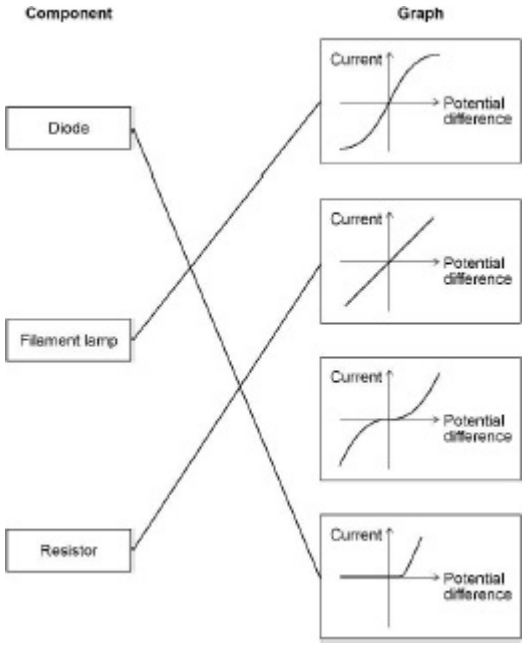
(e) $R = \frac{6.0}{0.12}$

1

R = 50 (Ω)

1

(f)



2 marks for all 3 correct

1 mark for 1 or 2 correct

additional line from a box on the left negates the mark for that box

2

(g) a zero error

1

[13]

2. (a) increase

must be in this order

1

decrease

1

(b) $P = I^2R$

1

(c) $1.60 \times 10^9 = 2000^2 \times R$

1

$$R = \frac{1.60 \times 10^9}{2000^2}$$

1

$R = 400\ (\Omega)$

1

(d) $\text{efficiency} = \dfrac{\text{useful energy output}}{\text{total energy input}}$

or

$\text{efficiency} = \dfrac{\text{useful output energy transfer}}{\text{total input energy transfer}}$

1

(e) $0.992 = \dfrac{\text{useful energy output}}{34.2}$

1

useful energy output = 0.992 × 34.2

1

useful energy output = 33.9 (GJ)

allow a correct answer given to more than 3 s.f.

1

[10]

3. (a) polarity of the potential difference doesn't change

allow direction of the potential difference doesn't change

1

(b) $E = QV$

1

(c) $5010 = Q \times 12$

1

$Q = \dfrac{5010}{12}$

1

Q = 417.5 (C)

allow 418 (C)

1

(d) $5010 = 0.015 \times L$

1

$L = \dfrac{5010}{0.015}$

1

L = 334 000 (J/kg)

1

(e) **Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.

5-6

Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.

3-4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1-2

No relevant content

0

Indicative content

- particles in a solid are in a regular pattern
- particles in a liquid are in a random arrangement

- particles in a solid are vibrating about fixed positions
- particles in a liquid are moving freely

- as the ice changes to water the temperature remains constant
- because as the ice changes to water the potential energy of the particles increases

- as the water warms the particles move faster
- so the kinetic energy of the particles increases

- internal energy is the total kinetic and potential energy of all the particles

ignore any references to density of ice vs liquid water
ignore any references to spacing of particles

[14]

4. (a) **Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.

5-6

Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.

3-4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1-2

No relevant content

0

Indicative content

- ammeter in series with filament lamp
- current measured with an ammeter
- voltmeter in parallel with filament lamp
- p.d. measured with a voltmeter
- variable resistor (or variable power pack or variable number of cells) used to vary current in and p.d. across filament lamp
- range of p.d. of 0 to 6 V
- interval of p.d. of 1 V
- reverse connections to power supply to obtain negative values
- take repeat readings and calculate a mean
- discard anomalies

Indicative content may be seen in a circuit diagram.

Level 3 answer: needs to include a circuit which would work (if included) and a method to obtain negative values.

(b) $3.0 = 0.16 \times R$

allow a correct substitution of an incorrect value of I in the range 0.15 (A) to 0.17 (A)

1

$$R = \frac{3.0}{0.16}$$

allow a correct rearrangement of an incorrect value of I in the range 0.15 (A) to 0.17 (A)

1

$R = 18.75\ (\Omega)$

allow 19 (Ω)

allow 18.8

1

(c) $t = 1800$ (s)

1

$Q = 0.21 \times 1800$

all subsequent marks can score if an incorrectly / not converted value of t is used

1

$Q = 378$ (C)

1

$E = 378 \times 6.0$

1

$E = 2268$ (J)

allow an answer to 2 or 3 s.f.

OR

$P = 0.21 \times 6.0$ (1)

$P = 1.26$ (W) (1)

$t = 1800$ (s) (1)

all subsequent marks can score if an incorrectly / not converted value of t is used

$E = 1.26 \times 1800$ (1)

$E = 2268$ (J) (1)

allow an answer to 2 or 3 s.f.

1

(d) (for the power to quadruple) the current and the p.d. would both need to double

1

(but the current doesn't double) because the resistance of the filament lamp increases

or

(but the current doesn't double because the graph shows that) current is not proportional to p.d.

allow the graph does not show direct proportionality

ignore the graph is not a straight line

ignore the graph is not linear

1

[16]

5. (a) electrons

1

electrons

1

(b) a positive charge

1

(c) a force of repulsion

1

the rods have the same charge

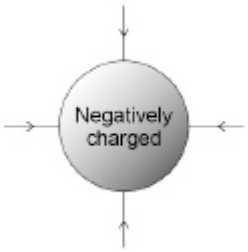
or

the rods are both negatively charged

dependent on scoring first marking point

1

(d)



1

(e)

A

1

[7]

6. (a) parallel

1

(b) S_1

1

(c) S_1, S_2 and S_3

1

(d) energy transferred = power × time
or
$E = P \times t$

1

(e) $3600 = 1200 \times t$

1

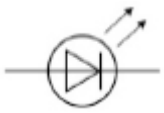
$$t = \frac{3600}{1200}$$

1

$t = 3$ (s)

1

(f)



1

[8]