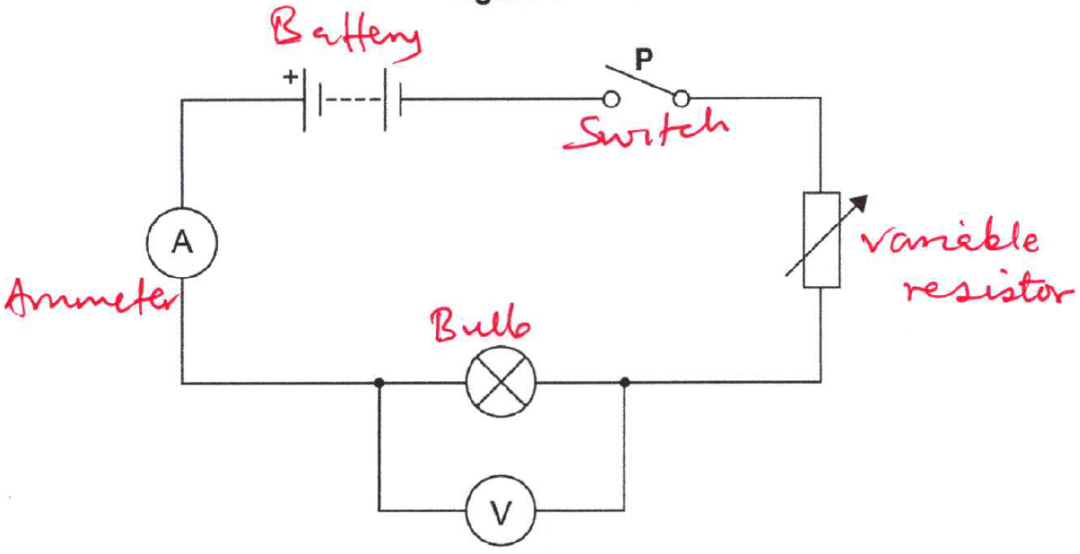
Electricity – GCSE Physics Paper 1

1. No.1

0 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



0 1 . 1 What is component **P**?

[1 mark]

Switch

0 1 . 2 Complete the sentences.

Choose answers from the box.

[2 marks]

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

The ammeter in the circuit measures current .

The voltmeter in the circuit measures potential difference. .

0 1 . 3 How will **increasing** the resistance of the variable resistor in **Figure 1** affect each of the following quantities?

[3 marks]

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			✓

0 1 . 4 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:

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

[2 marks]

$I = \frac{15}{60} = 0.25\text{A}$

Current = 0.25 A

0 1 . 5 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:

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

[2 marks]

$R = \frac{6}{0.12} = 50\,\Omega$

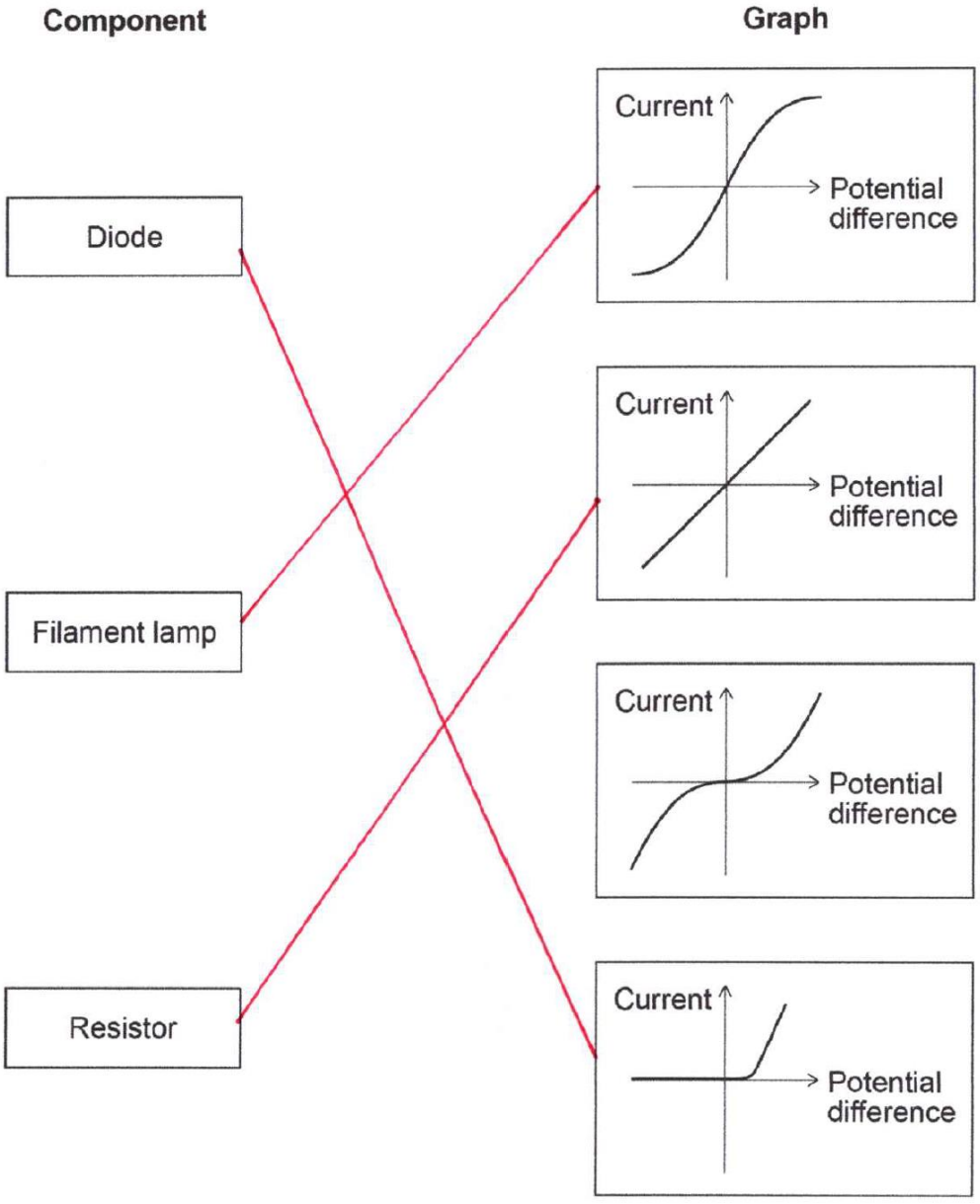
Resistance = 50 Ω

0 1 . 6 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.

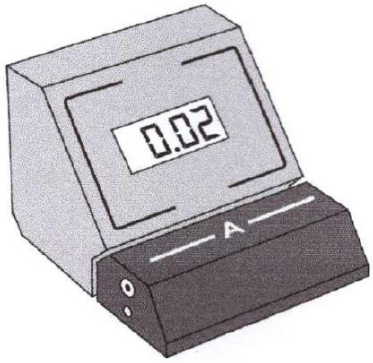
[2 marks]



0 1 . 7 **Figure 2** shows an ammeter.

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

Figure 2



What type of error does the ammeter display?

[1 mark]

Tick (✓) **one** box.

A positive error ☐

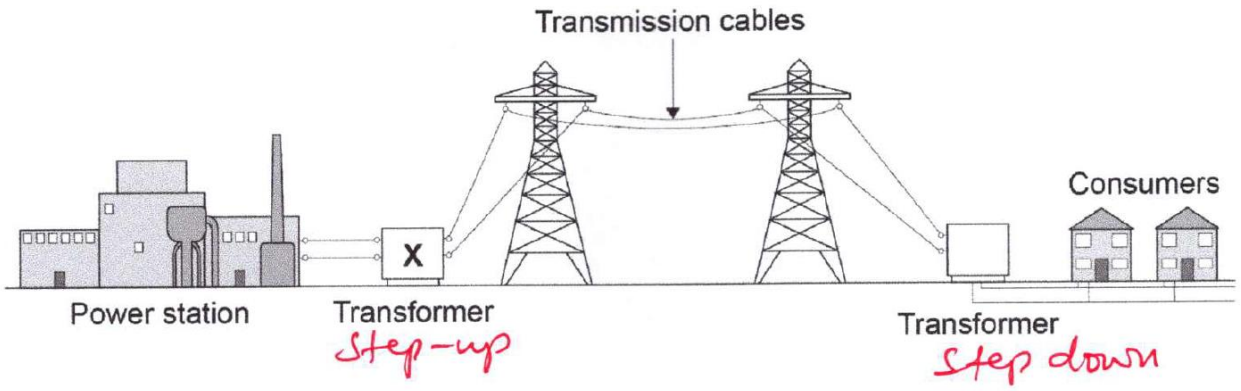
A random error ☐

A zero error ☑ ← Displaying a reading when no mass is added to it

2. No.8

0 8 **Figure 11** shows how the National Grid connects a power station to consumers.

Figure 11



0 8 . 1 Complete the sentences.

[2 marks]

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

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

Use the Physics Equations Sheet to answer questions **08.2** and **08.3**.

0 8 . 2 Which equation links current (I), power (P) and resistance (R)?

[1 mark]

Tick (✓) **one** box.

$P = \frac{I}{R}$ ☐

$P = \frac{I}{R^2}$ ☐

$P = I^2 R$ ✓

$P = IR$ ☐

0 8 . 3 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.

[3 marks]

$P = I^2 R$

$R = \frac{P}{I^2}$

$R = \frac{1.6 \times 10^9 \text{ W}}{2000^2}$

$R = 400\ \Omega$

Resistance = 400 Ω

Use the Physics Equations Sheet to answer questions **08.4** and **08.5**.

0 8 . 4 Write down the equation which links efficiency, total energy input and useful energy output.

[1 mark]

$\text{Efficiency} = \frac{\text{useful energy output}}{\text{Total energy input}} \times 100$

0 8 . 5 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.

[3 marks]

$E = \frac{\text{useful energy}}{\text{Total energy}}$

Useful energy = Eff × Total energy

$= 0.992 \times 34.2 \text{ GJ}$

$= 33.9 \text{ GJ}$

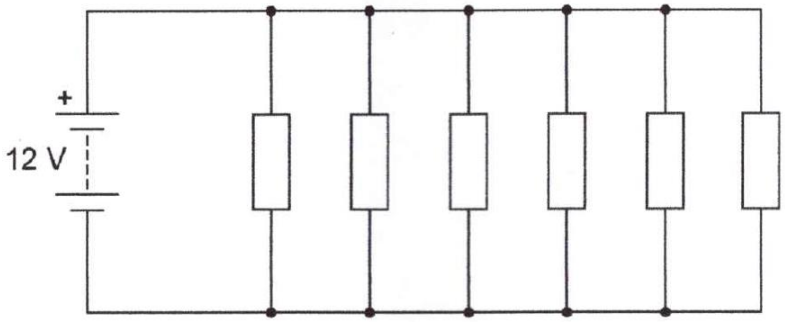
Useful energy output = 33.9 GJ

3. No.10

1 0 **Figure 14** shows an electrical circuit used to heat the windscreen of a car.

Each resistor in the circuit represents a heating element.

Figure 14



1 0 . 1 The 12 V battery supplies direct potential difference.

What is meant by 'direct potential difference'?

[1 mark]

the voltage is to only one direction

Use the Physics Equations Sheet to answer questions **10.2** and **10.3**.

1 0 . 2 Which equation links charge flow (Q), energy (E) and potential difference (V)?

[1 mark]

Tick (✓) **one** box.

$E = \frac{V}{Q}$ ☐

$E = QV$ ☑

$E = \frac{Q}{V}$ ☐

$E = \frac{V^2}{Q}$ ☐

10.3 Calculate the charge flow through the 12 V battery when the battery transfers 5010 J of energy.

[3 marks]

$E = 5010$
$V = 12$

$E = Q V$

$Q = \frac{E}{V}$

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

$Q = 417.5\ C$

Charge flow = 417.5 C

10.4 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.

[3 marks]

$m = 0.015$
$E = 5010$

$E = m L_f$

$L_f = \frac{E}{m}$

$L_f = \frac{5010}{0.015}$

$L_f = 334{,}000\ J/kg$

Specific latent heat of fusion of water = 334,000 J/kg

1 0 . 5 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 marks]

At 0°C

- The particles in a solid are in regular pattern and vibrating at a fixed position
- As the ice melts, the temperature remains constant, so KE does not increase, but the potential energy increases. The ice melts.

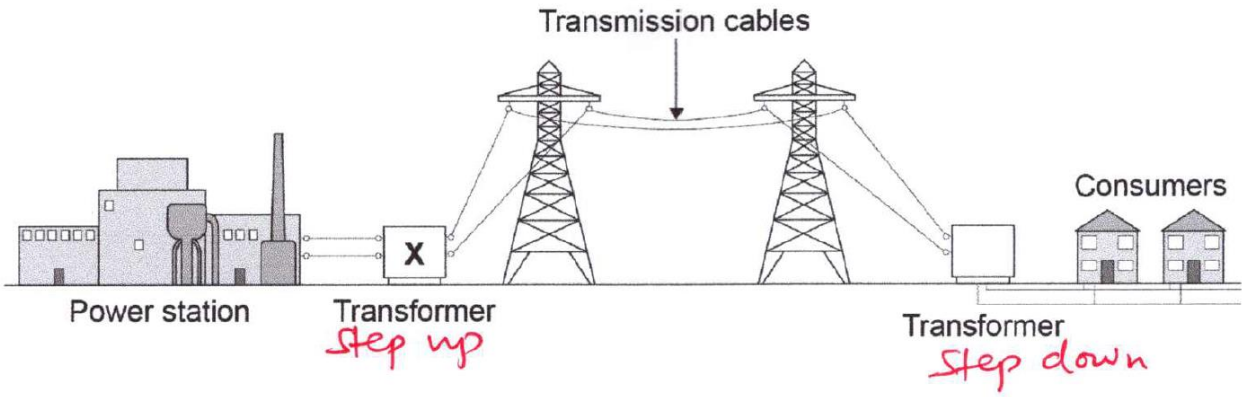
0°C - 5°C

The liquid is gaining kinetic energy. So the particles vibrate faster, in a random motion and moving freely.

4. No.1

0 1 **Figure 1** shows how the National Grid connects a power station to consumers.

Figure 1



0 1 . 1 Complete the sentences.

[2 marks]

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

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

Use the Physics Equations Sheet to answer questions **01.2** and **01.3**.

0 1 . 2 Which equation links current (I), power (P) and resistance (R)?

[1 mark]

Tick (✓) **one** box.

$P = \frac{I}{R}$ ☐

$P = \frac{I}{R^2}$ ☐

$P = I^2 R$ ✓

$P = IR$ ☐

0 1 . 3 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.

[3 marks]

$P = I^2R$

$R = \frac{P}{I^2}$

$R = \frac{1.6 \times 10^9}{2000^2}$

$R = 400\,\Omega$

Resistance = 400 Ω

Use the Physics Equations Sheet to answer questions **01.4** and **01.5**.

0 1 . 4 Write down the equation which links efficiency, total energy input and useful energy output.

[1 mark]

$E = \frac{\text{useful energy output}}{\text{Total energy input}}$

0 1 . 5 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.

[3 marks]

$E = \frac{\text{useful energy}}{\text{Total energy}}$

useful energy = Eff × total energy

$= 0.992 \times 34.2$ GJ

$= 33.9$ GJ

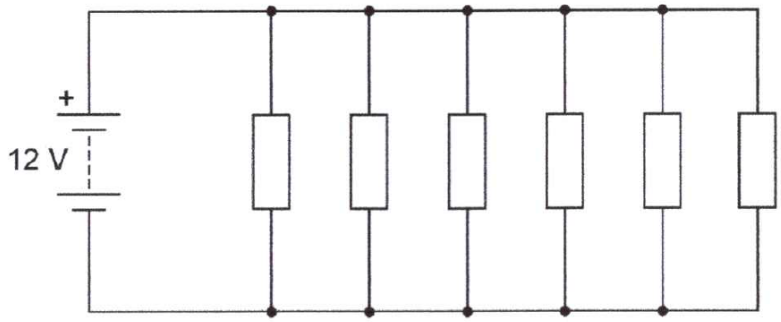
Useful energy output = 33.9 GJ

5. No.3

0 3 **Figure 4** shows an electrical circuit used to heat the windscreen of a car.

Each resistor in the circuit represents a heating element.

Figure 4



0 3 . 1 The 12 V battery supplies direct potential difference.

What is meant by 'direct potential difference'?

[1 mark]

the voltage is to only one direction

Use the Physics Equations Sheet to answer questions **03.2** and **03.3**.

0 3 . 2 Which equation links charge flow (Q), energy (E) and potential difference (V)?

[1 mark]

Tick (✓) **one** box.

$E = \frac{V}{Q}$ ☐

$E = QV$ ☑

$E = \frac{Q}{V}$ ☐

$E = \frac{V^2}{Q}$ ☐

0 3 . 3 Calculate the charge flow through the 12 V battery when the battery transfers 5010 J of energy.

[3 marks]

$Q = \frac{E}{V}$

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

$Q = 417.5\ C$

Charge flow = 417.5 C

0 3 . 4 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.

[3 marks]

$E = mL_f$

$L_f = \frac{E}{m}$

$L_f = \frac{5010}{0.015}$

$L_f = 334,000\ J/kg$

Specific latent heat of fusion of water = 334,000 J/kg

0 3 . 5 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 marks]

At 0°C

- The particles in the solid ice are in a regular pattern and vibrating at a fixed position.
- As the ice melts, the temperature remains constant, so KE does not increase, but the potential energy increases. The ice melts

0°c – 5°c

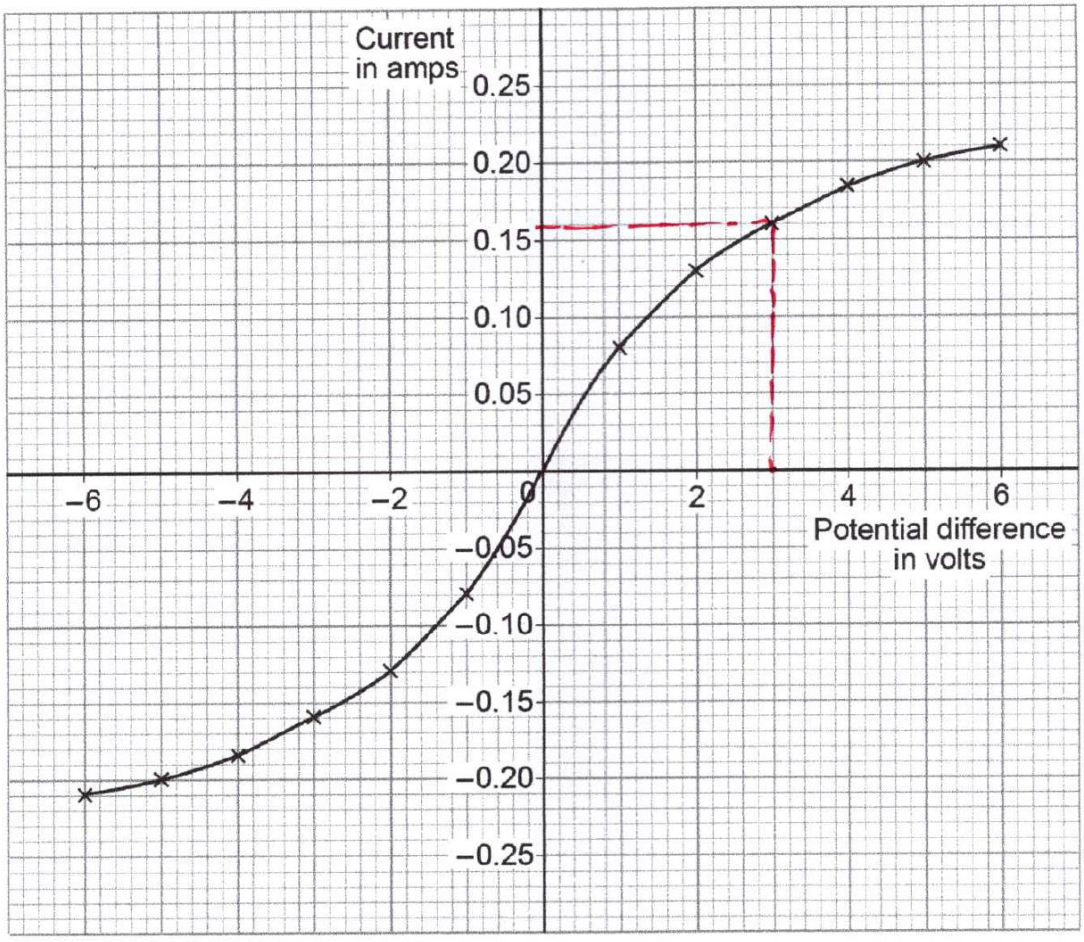
The liquid is gaining kinetic energy. So the particles vibrate faster, in a random motion and moving freely.

6. No.6

0 6 A student investigated how the current in a filament lamp varies with the potential difference across the filament lamp.

Figure 6 shows the results.

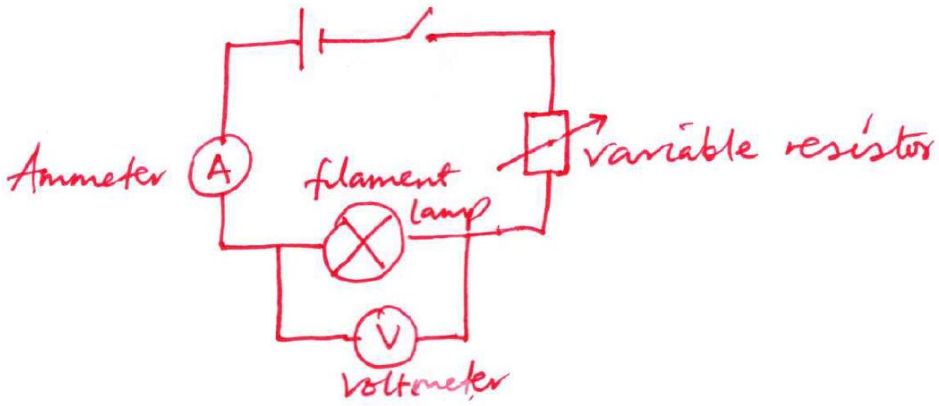
Figure 6



0 6 . 1 Describe a method the student could use to obtain these results.

You should include a circuit diagram.

[6 marks]



- Connect an ammeter in series with the lamp and the voltmeter across the lamp.
- Using a variable resistor, varry the current and p.d across the filament lamp using the ammeter and voltmeter respectively.
- Repeat the experiment 3 times and get the mean
- Reverse the connection to obtain the negative results too.

0 6 . 2 Determine the resistance of the filament lamp when the potential difference across it is +3.0 V.

Use the Physics Equations Sheet.

Use **Figure 6** on page 18.

[3 marks]

$R = \frac{V}{I}$

when $V = 3$, $I = 0.16$ A

So

$R = \frac{3}{0.16}$

$R = 18.75\ \Omega$

Resistance = 18.8 Ω

0 6 . 3 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.

[5 marks]

$E = VIt$ Time must be in seconds.

$E = 0.21 \times 6 \times (30 \times 60)$

$E = 2268$ Joules

Energy transferred = 2268 J

0 6 . 4 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 marks]

-for the Power to quadruple, the current and the p.d has to double. But from the graph, current is not proportional to p.d, current does not double when p.d doubles. So the power does not quadruple. The student is woong.