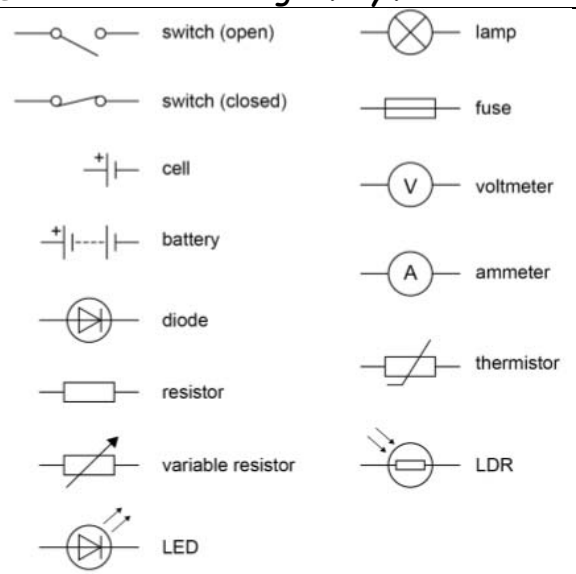
Revision Pack Topic P2- Electricity

	R/A/G
Current, potential difference and resistance	
Standard circuit diagram symbols	
	
Electrical charge and current	
For electrical charge to flow through a closed circuit the circuit must include a source of potential difference.	
Electric current is a flow of electrical charge. The size of the electric current is the rate of flow of electrical charge. Charge flow, current and time are linked by the equation: charge flow = current ×time **Q = I t** charge flow, Q, in coulombs, C current, I, in amperes, A, time, t, in seconds, s A current has the same value at any point in a single closed loop.	
Current, resistance and potential difference	
The current (I) through a component depends on both the resistance (R) of the component and the potential difference (V) across the component. The greater the resistance of the component the smaller the current for a given potential difference (pd) across the component.	
Current, potential difference or resistance can be calculated using the equation: potential difference = current ×resistance V = I R potential difference, V, in volts, V current, I, in amperes, A, resistance, R, in ohms, Ω	
Use circuit diagrams to set up and check appropriate circuits to investigate the factors affecting the resistance of electrical circuits. This should include: • the length of a wire at constant temperature • combinations of resistors in series and parallel.	
Resistors	

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For some resistors, the value of R remains constant but that in others it can change as the current changes. The current through an ohmic conductor (at a constant temperature) is directly proportional to the potential difference across the resistor. This means that the resistance remains constant as the current changes. The resistance of components such as lamps, diodes, thermistors and LDRs is not constant; it changes with the current through the component. The resistance of a filament lamp increases as the temperature of the filament increases. The current through a diode flows in one direction only. The diode has a very high resistance in the reverse direction.	
The resistance of a thermistor decreases as the temperature increases. The resistance of an LDR decreases as light intensity increases.	
Required practical activity 16: use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements, including a filament lamp, a diode and a resistor at constant temperature.	
Series and parallel circuits	
There are two ways of joining electrical components, in series and in parallel. Some circuits include both series and parallel parts. For components connected in series: • there is the same current through each component • the total potential difference of the power supply is shared between the components • the total resistance of two components is the sum of the resistance of each component.	
R_{total} = R1 + R2 resistance, R, in ohms, Ω For components connected in parallel: • the potential difference across each component is the same • the total current through the whole circuit is the sum of the currents through the separate components • the total resistance of two resistors is less than the resistance of the smallest individual resistor.	
Domestic uses and safety	
Direct and alternating potential difference	
Mains electricity is an ac supply. In the United Kingdom the domestic electricity supply has a frequency of 50 Hz and is about 230 V.	
Most electrical appliances are connected to the mains using threec ore cable. The insulation covering each wire is colour coded for easy identification: live wire – brown neutral wire – blue earth wire – green and yellow stripes. T he live wire carries the alternating potential difference from the supply. The neutral wire completes the circuit. The earth wire is a safety wire to stop the appliance becoming live. The potential difference between the live wire and earth (0 V) is about	

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230 V. The neutral wire is at, or close to, earth potential (0 V). The earth wire is at 0 V, it only carries a current if there is a fault.	
Energy transfers	
Power	
Students should be able to explain how the power transfer in any circuit device is related to the potential difference across it and the current through it, and to the energy changes over time: ower = potential difference ×current P =V I power = current 2 ×resistance P = I2 R power, P, in watts, W potential difference, V, in volts, V current, I, in amperes, A, resistance, R, in ohms, Ω	
Energy transfers in everyday appliances	
Everyday electrical appliances are designed to bring about energy transfers. The amount of energy an appliance transfers depends on how long the appliance is switched on for and the power of the appliance. Work is done when charge flows in a circuit. The amount of energy transferred by electrical work can be calculated using the equation: energy transferred = power ×time E = P t energy transferred = charge flow × potential difference E =Q V energy transferred, E, in joules, J power, P, in watts, W time, t, in seconds, s charge flow, Q, in coulombs, C potential difference, V, in volts, V	
The National Grid	
The National Grid is a system of cables and transformers linking power stations to consumers.	
Electrical power is transferred from power stations to consumers using the National Grid. Step-up transformers are used to increase the potential difference from the power station to the transmission cables then step-down transformers are used to decrease, to a much lower value, the potential difference for domestic use.	

Current and circuit symbols

Define the term current and give the unit.

Define the term voltage and give the unit.

Define the term resistance and give the unit.

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Give the equation used to calculate charge:

Match the terms below:

Current	Placed in parallel; measures the potential difference across a component
Potential difference	Flow of electric charge
Resistance	Component; resistance decreases as temperature increases
Voltmeter	Charge/ current moves in one direction around the circuit
Ammeter	Voltage; energy transferred per unit of charge
Direct current	Charge/ current changes direction
Alternating current	Placed in series; measures the current
Thermistor	Component; resistance decreases as intensity of light increases
LDR	Calculated using the equation V ÷ I

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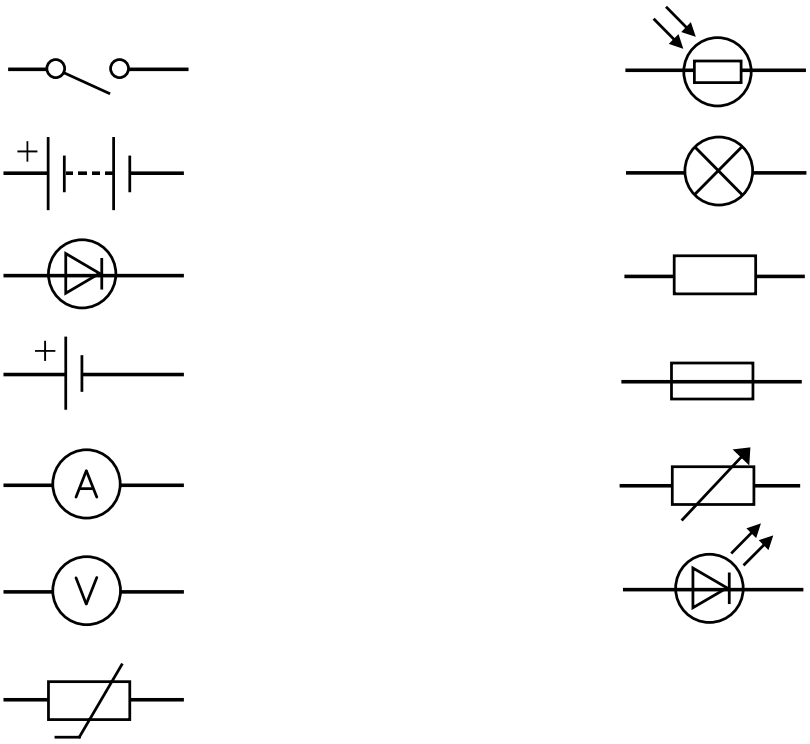
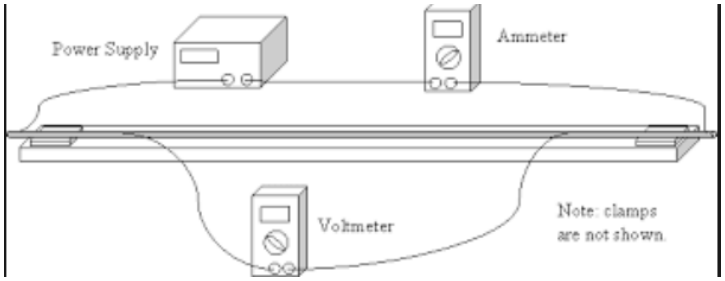
Label the circuit symbols with the correct word:



Resistance and Ohm's Law

Give the equation for Ohm's law and show the rearrangements.

Use the diagram to explain how to investigate the factors affecting resistance:



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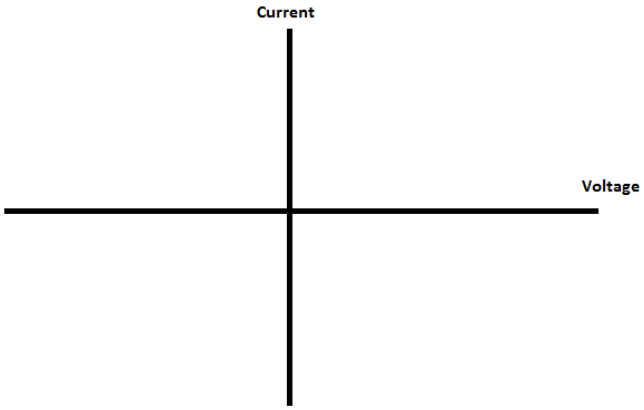
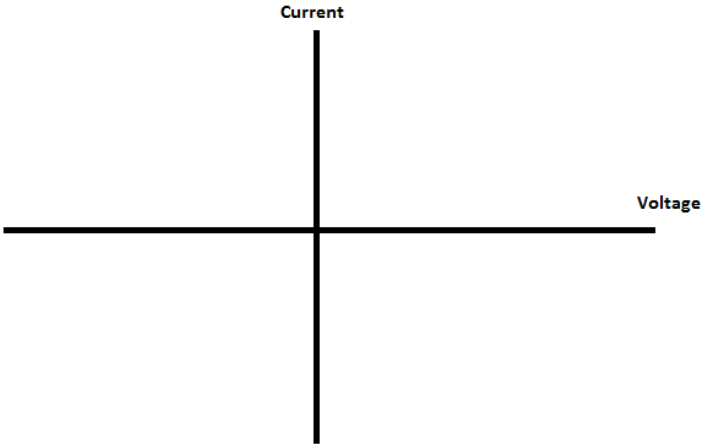
Draw graphs showing voltage against current for each of the following components and explain what it shows.

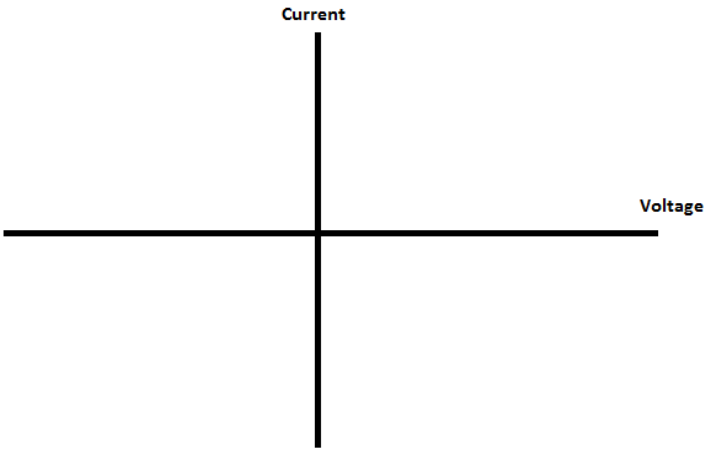
Diode



Filament Lamp



Fixed Resistor



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Changing Resistance of LDRS and Thermistors

Thermistor

_____
_____
_____
_____

Light Dependent Resistor

_____
_____
_____
_____

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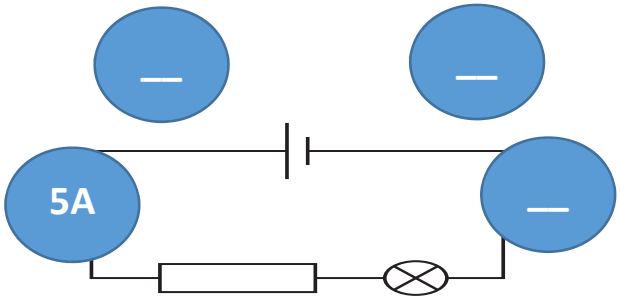
Series Circuits

Series – Means that all the components are connected in one loop.

Current



Label the diagram with the current at each point

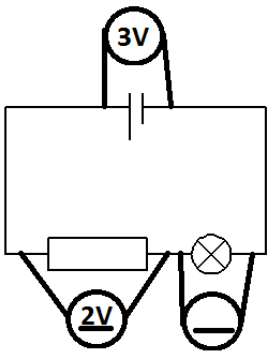
Series Circuit Current Rule:

Current is _____

Because _____

_____.

Voltage



Label the diagram with the voltage at each point

Series Circuit Voltage Rule:

Voltage is _____

Because _____

_____

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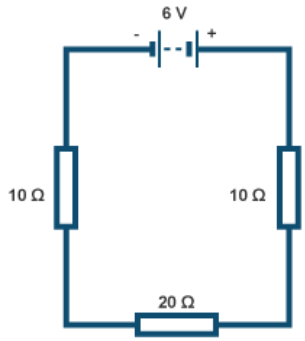
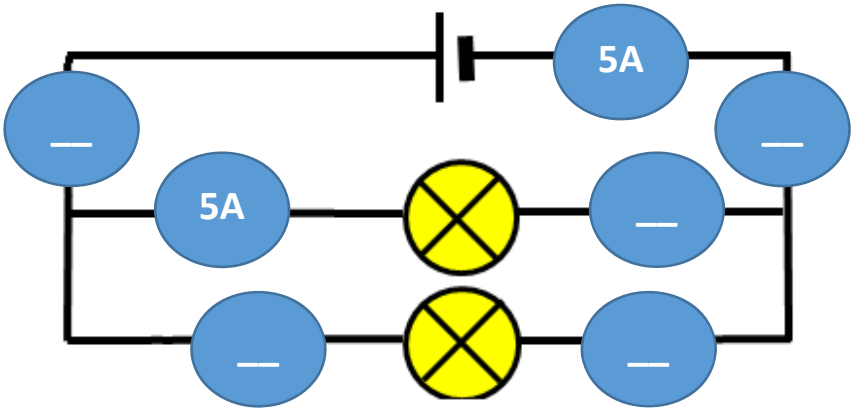
Calculating total resistance in a series circuit:



Parallel Circuits

Parallel – Means that the components are connected in multiple loops.

Current



Label the diagram with the current at each point

Parallel Circuit Current Rule:

Current is _____

Because _____

_____.

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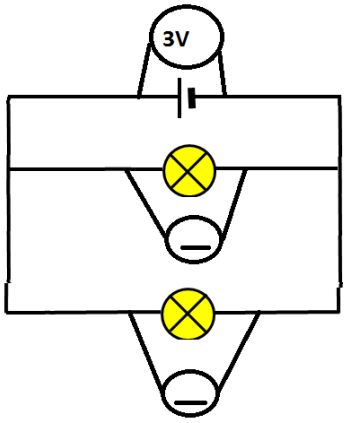
Voltage



Label the diagram with the voltage at each point

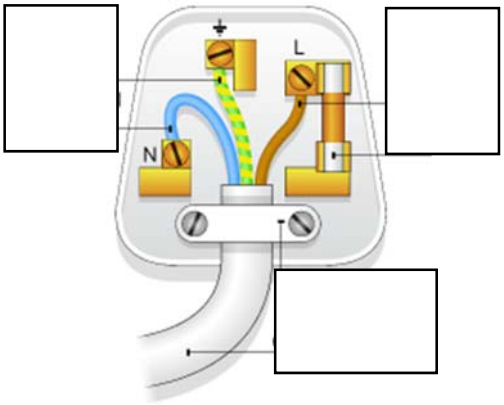
Parallel Circuit Voltage Rule:

Voltage is _____

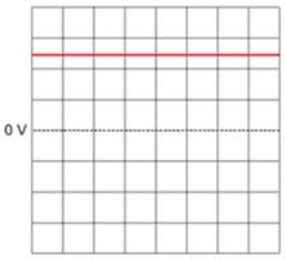
Because _____

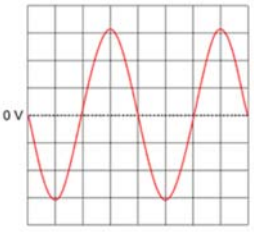
Circuits in the home

Explain the features of a common plug:



Label the graphs to show the difference between A.C. and A.C.





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Describe the energy transfers that take place when a kettle boils:

Describe the energy transfers that take place when a fan spins:

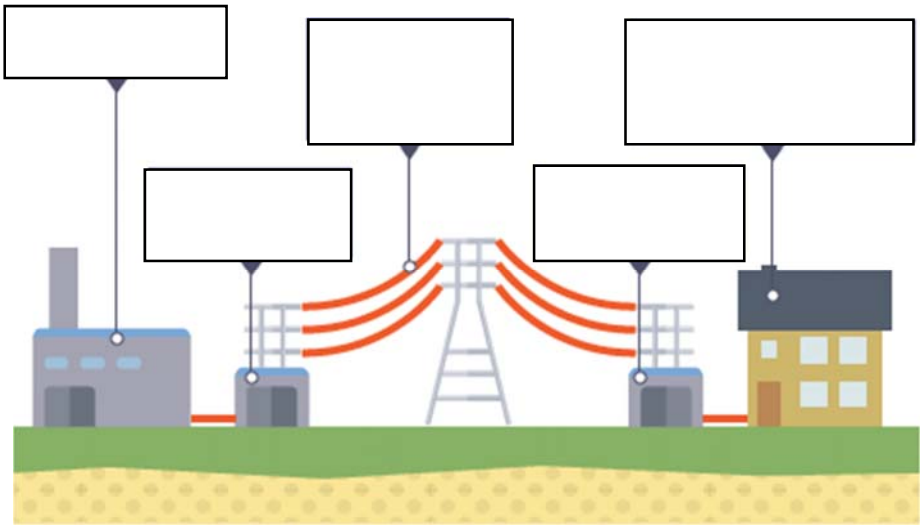
Give the two equations for calculating energy transferred:

Give the two equations for calculating power:

The National Grid

What is the National Grid?

Use the diagram below to explain how the National Grid transports electricity to our homes.
You should include information to explain the role of step up and step down transformers.



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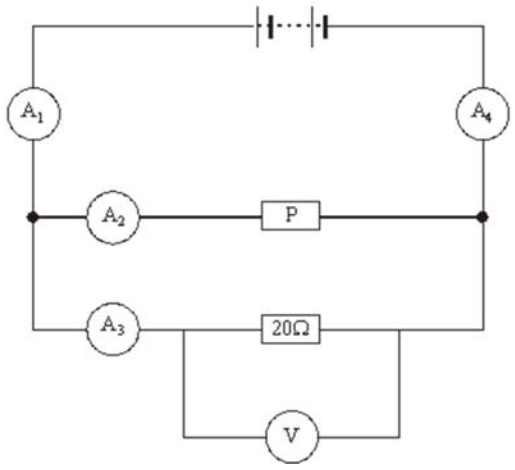
Practice Exam Questions

Q1. The circuit shown has four identical ammeters.



(a) The table gives the current through two of the ammeters.

(i) Complete the table to show the current through the other two ammeters.

Ammeter	Reading on ammeter in amps
A_1	
A_2	0.2
A_3	0.3
A_4	

(2)

(ii) Which **one** of the following statements is correct. Tick (✓) the box next to your choice.

The resistance of **P** is more than 20 Ω. ☐

The resistance of **P** is equal to 20 Ω. ☐

The resistance of **P** is less than 20 Ω. ☐

Give a reason for your choice.

.....

..... **(2)**

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(b) (i) Write down the equation that links current, potential difference and resistance.

.....

(1)

(ii) Calculate the reading on the voltmeter. Show clearly how you work out your answer.

.....

.....

Voltmeter reading = ... volts.

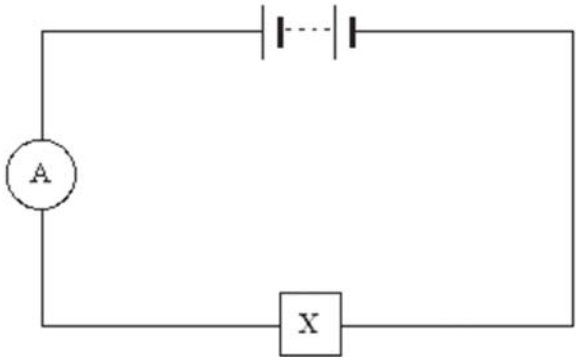
(2)

(iii) State the potential difference of the power supply.

.....

(1)

(c) A second circuit contains an unknown component labelled **X**.



As component **X** is heated, the reading on the ammeter goes up.

What is component **X**?

.....

Give a reason for your answer.

.....

.....

(2)

(Total 10 marks)

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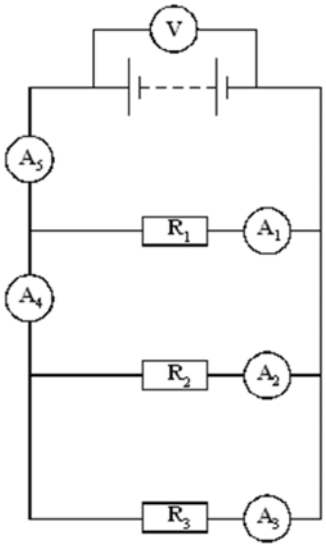
Q2. A circuit was set up as shown in the diagram.



(a) The table gives the current through three of the ammeters. Complete the table to show the current through the other two ammeters.

Ammeter	Reading on ammeter in amps
A_1	0.2
A_2	0.6
A_3	0.3
A_4	
A_5	

(2)

(b) The reading on the voltmeter is 12 V.

What is the resistance of $\mathbf{R_2}$?

Show your working and include the correct unit.

.....

.....

.....

Resistance = ...

(3)

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(c) In the circuit above, the resistor R_2 burned out and current stopped flowing in it. There was no other change to the circuit. Complete the table below to show the readings on the ammeters after this took place.

Ammeter	Reading on ammeter in amps
A_1	0.2
A_2	0.0
A_3	
A_4	
A_5	

(3)

(Total 8 marks)

Q3. An electric current is a flow of electrical charge through a circuit.

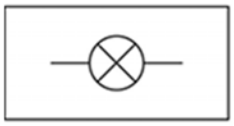
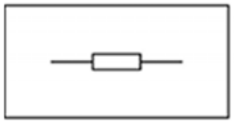
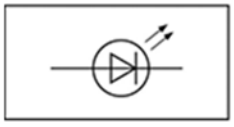
(a) Complete the sentence. Use a word from the box.

atoms	electrons	ions	molecules

Metals are good conductors of electricity because electrical charge is transferred by delocalised .....

(1)

(b) Draw **one** line from each symbol to the name of the component.

Standard symbol	Name of component
	Battery
	Lamp
	LED
	Resistor
	Switch

(3)

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(c) The table below shows information about some electrical appliances.

Electrical appliance	Power in watts
 Hairdryer	1500
 Kettle	2500
 Electric hob	3000
 Television	360

A student plugs all four of the appliances into one multi-way socket.

The mains electricity is 230 V.

The highest safe current in the socket is 30 A.

Explain why it is not safe to use all four appliances at the same time.

In your answer you should:

- calculate the total power needed
- use the equation

  current = power ÷ potential difference

  to calculate the total current needed.

.....

.....

.....

..... **(4)**

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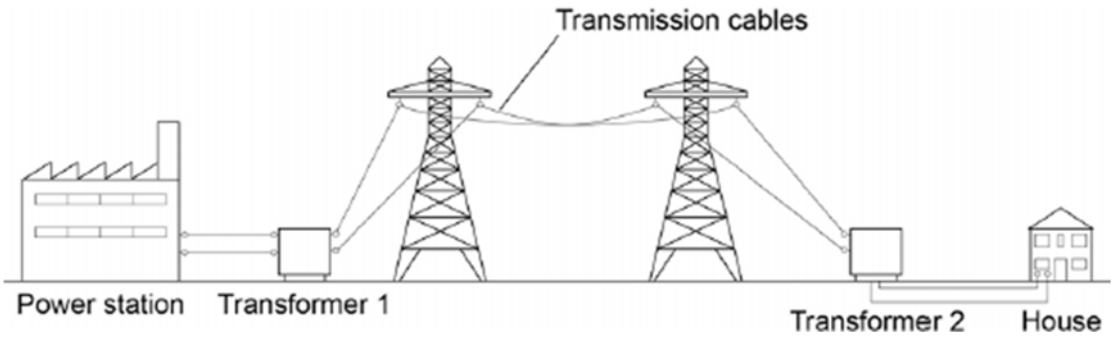
(d) The figure below shows how electrical power is transferred from power stations to consumers using the National Grid.



Transformer 1 is a step-up transformer.

Explain why step-up transformers are used in the National Grid.

.....

.....

.....

.....

(3)

(e) What is the purpose of Transformer 2?

.....

.....

(1)

(f) In a power station 900 MJ of thermal energy were released by burning natural gas.

Write down the equation that links efficiency, useful input energy transfer and useful output energy transfer.

.....

(1)

(g) In a power station 900 MJ of thermal energy were released by burning natural gas.

Only 405 MJ was generated.

Calculate the efficiency of this energy transfer.

.....

.....

.....

Efficiency = ...**(2)(Total 15 marks)**

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Markscheme

M1. (a) (i) $A_1 = 0.5$

ignore any units

1

$A_4 = 0.5$

*allow **1** mark for $A_1 = A_4 \neq 0.5$*

1

(ii) the resistance of **P** is more than 20 Ω

1

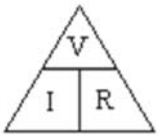
a smaller current goes through P / A_2 (than 20 Ω)

dependent on getting 1st mark correct
accept converse

1

(b) (i) potential difference = current × resistance

accept pd / voltage for potential difference
accept V = I × R, correct symbols and correct case only
accept volts = amps × ohms
accept



provided subsequent method is correct
allow combination of
physical quantities and named units
allow voltage = I × R

1

(ii) 6

*allow **1** mark for correct substitution*

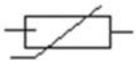
2

(iii) 6

accept their (b)(ii)

1

(c) <u>thermistor</u> or



accept correct circuit symbol
allow phonetic spelling

1

<u>resistance</u> goes down (as temperature of thermistor goes up)

*do **not** accept changes for goes down*
*do **not** accept an answer in terms of current only*

1

[10]

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M2. (a) 0.9

1

1.1

accept the value of A_4 + 0.2

1

(b) V = I R **or** 12 = 0.6 R **or** $\frac{12}{0.6} = ?$

accept V = A R
V = I × ohm's sign
do not credit Ohm's law triangle

2

R = 20

correct numerical answer earns both marks

ohms

1

(c) A_3 = 0.3

A_4 = 0.3

accept the same numeric value as A_3

A_5 = 0.5

accept the value of A_4 + 0.2

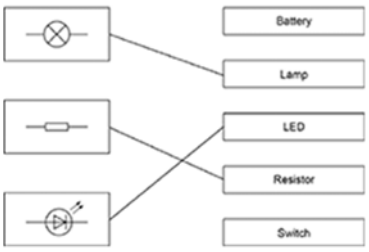
3

[8]

M3.(a) electrons

1

(b)



extra lines from a symbol negate the mark

3

(c) the total power = 7360 watts

1

current = 7360 ÷ 230

1

= 32 A

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*allow 32 with no working shown for **3** marks*

1

so the current is greater than 30 A

1

(d) to increase the voltage (across the cables) or to decrease the current (through the cables)

1

reducing energy losses (in the cables)

*do **not** allow electricity for energy*

*do **not** allow no energy loss*

1

increasing the efficiency of transmission

1

(e) to decrease the potential difference for domestic use

1

(f) $$efficiency = \frac{useful\ output\ energy\ transfer}{total\ input\ energy\ transfer}$$

1

(g) 405 / 900

1

=0.45

accept 45%

1

*allow 0.45 **or** 45% with no working shown for **2** marks*

[15]