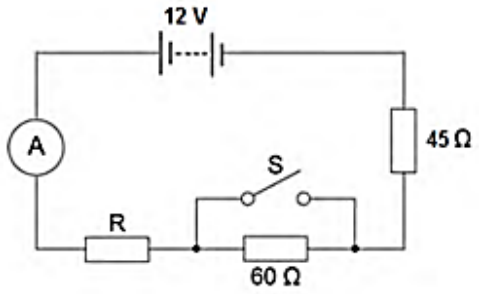
Electricity GCSE AQA Higher Physics Past Papers Questions

01.

A student set up the electrical circuit shown in **Figure 9**.

Figure 9



1 The ammeter displays a reading of 0.10 A.

Calculate the potential difference across the 45 Ω resistor.

[2 marks]

Potential difference = _____ V

2 Calculate the resistance of the resistor labelled **R**.

[3 marks]

Resistance = _____ Ω

. **3** State what happens to the total resistance of the circuit and the current through the circuit when switch **S** is closed.

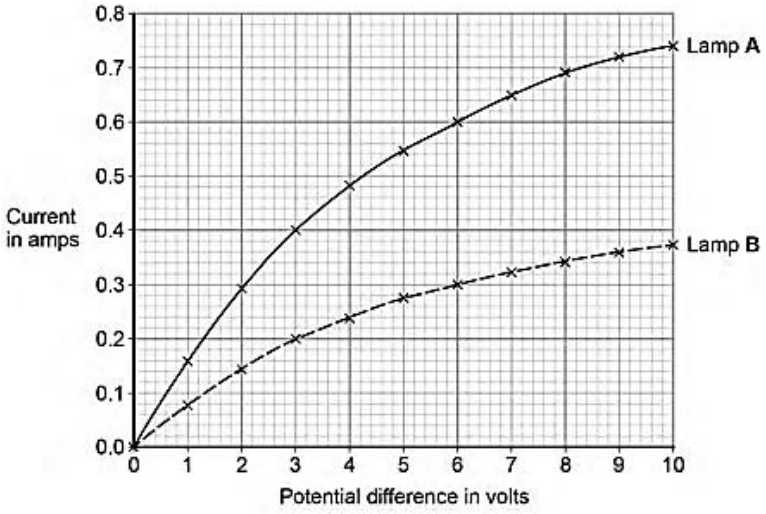
[2 marks]

02.

A student investigated how current varies with potential difference for two different lamps.

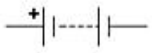
Her results are shown in **Figure 10**.

Figure 10



1 Complete the circuit diagram for the circuit that the student could have used to obtain the results shown in **Figure 10**.

[3 marks]



2 Which lamp will be brighter at any potential difference?

Explain your answer.

Use **Figure 10** to aid your explanation

[2 marks]

3 Lamp **B** has the higher resistance at any potential difference.

Explain how **Figure 10** shows this.

[2 marks]

4 Both lamps behave like ohmic conductors through a range of values of potential difference.

Use **Figure 10** to determine the range for these lamps.

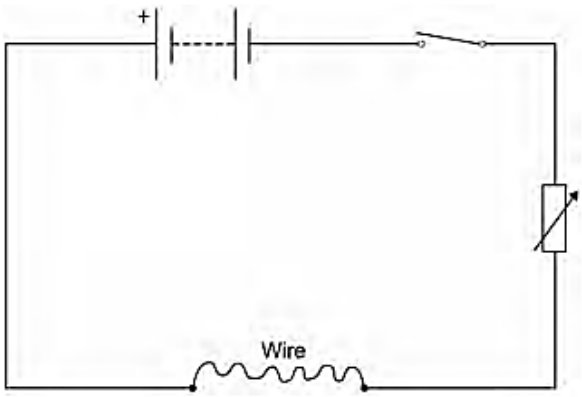
Explain your answer.

[3 marks]

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

Figure 3 shows part of the circuit that the student used.

Figure 3



1 Complete **Figure 3** by adding an ammeter and a voltmeter.

Use the correct circuit symbols.

[3 marks]

. 2 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.

[6 marks]

. 3 Why would switching off the circuit between readings have improved the accuracy of the student's investigation?

Tick **one** box.

[1 mark]

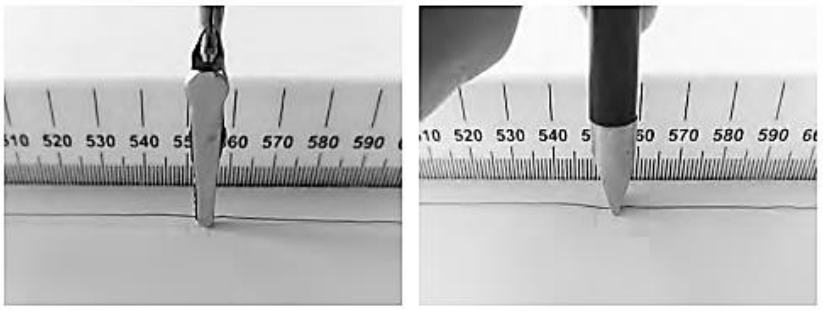
- The charge flow through the wire would not change. ☐
- The potential difference of the battery would not increase. ☐
- The power output of the battery would not increase. ☐
- The temperature of the wire would not change. ☐

4 The student used crocodile clips to make connections to the wire.

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

Figure 4 shows a crocodile clip and a jockey in contact with a wire.

Figure 4



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.

[2 marks]

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. ☐

12

04.

. 1 Complete the sentence. Choose answers from the box.

[2 marks]

charge	potential difference	power	temperature	time

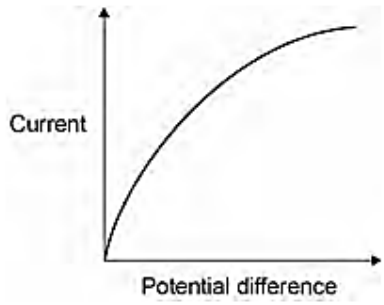
The current through an ohmic conductor is directly proportional to the

_____ across the component, provided

that the _____ remains constant.

. 2 **Figure 7** shows a current – potential difference graph for a filament lamp.

Figure 7



Explain how the resistance of a filament lamp changes as the potential difference across it increases.

[3 marks]

3 Many householders are replacing their filament lamps with LED lamps which are more energy efficient.

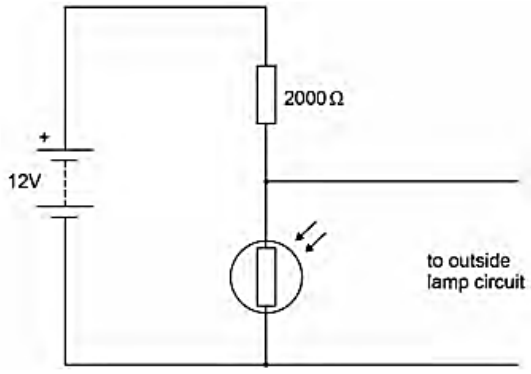
What does more energy efficient mean?

[1 mark]

A Light Dependent Resistor (LDR) is used to turn on an outside lamp when it gets dark.

Part of the circuit is shown in **Figure 8**.

Figure 8



4 The light intensity decreases.

What happens to the potential difference across the LDR and the current in the LDR?

[2 marks]

Potential difference _____

Current _____

5 What is the resistance of the LDR when the potential difference across it is 4 V?

Give a reason for your answer.

[2 marks]

Resistance = _____ Ω

Reason _____

. 6 Calculate the current through the LDR when the resistance of the LDR is 5000 Ω.

Give your answer to 2 significant figures.

[4 marks]

Current = _____ A

14

05.

Figure 15 shows a coffee machine. The coffee machine uses an electric element to heat water.

Figure 15

1 The coffee machine has a metal case.

Why would it be dangerous for the live wire of the electric cable to touch the metal case?

[1 mark]

2 The power output of the coffee machine is 2.53 kW.

The mains potential difference is 230 V.

Calculate the current in the coffee machine.

[3 marks]

Current = _____ A

. 3 The coffee machine heats water from 20 °C to 90 °C.

The power output of the coffee machine is 2.53 kW.

The specific heat capacity of water is 4200 J/kg °C.

Calculate the mass of water that the coffee machine can heat in 14 seconds.

[5 marks]

Mass = _____ kg

9

06.

Light bulbs are labelled with a power input.

1 What does power input mean?

[1 mark]

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. ☐

2 Write down the equation which links current, potential difference and power.

[1 mark]

_____

3 A light bulb has a power input of 40 W

The mains potential difference is 230 V

Calculate the current in the light bulb.

[3 marks]

_____

_____

_____

Current = _____ A

Table 1 shows information about three different light bulbs.

Table 1

Light bulb	Total power input in watts	Useful power output in watts	Efficiency
P	6.0	5.4	0.90
Q	40	2.0	0.05
R	9.0	**X**	0.30

4 Write down the equation which links efficiency, total power input and useful power output.

[1 mark]

5 Calculate the value of **X** in **Table 1**.

[3 marks]

X = _____ W

6 In addition to power input, light bulbs should also be labelled with the rate at which they emit visible light.

Suggest why.

[2 marks]

11

07.

Electric cars have motors that are powered by a battery.

Diesel cars have engines that are powered by diesel fuel.

Table 2 compares one type of electric car with one type of diesel car.

Table 2

Power source	Energy density in MJ / kg	Mass of power source in kg	Total mass of car in kg	Time to recharge battery or refill fuel tank in minutes
Battery	0.95	280	1600	40
Diesel fuel	45	51	1500	3

. 1 The electric car has a range of 400 km with a fully charged battery.

The diesel car has a range of 1120 km with a full tank of diesel.

Explain the difference in the time needed to complete a 500 km journey using the electric car compared with the diesel car.

Assume both cars travel at the same speed.

[2 marks]

2 Energy density is the amount of energy stored per kilogram of the energy source.

Show why the diesel car has a greater range than the electric car.

Use data from **Table 2**.

Assume the efficiency of the two cars is the same.

Include calculations in your answer.

[3 marks]

Engineers have developed a way of charging electric cars while they are driving along the road.

Coils of wire buried under the road transfer energy to the car's battery as the car is passing over the coils.

Figure 6 shows a charging lane on a motorway.

Figure 6

3 Suggest **two** advantages of using this method to charge electric cars compared with plugging them into the mains electricity supply.

[2 marks]

1

2

4 When electric cars are not being driven, energy stored in their batteries could be used to meet sudden peaks in electricity demand.

Suggest how.

[2 marks]

9

08. **Figure 7** shows a person using an electric lawn mower.

Figure 7

1 The lawn mower is connected to the mains electricity supply.

What is the frequency of the mains electricity supply in the UK?

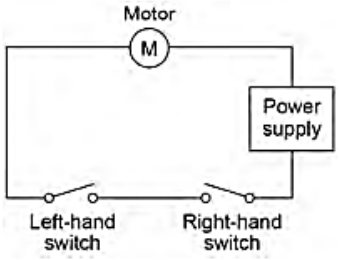
[2 marks]

Frequency = _____ Unit _____

The lawn mower has a switch on each side of the handle.

Figure 8 shows the circuit diagram for the lawn mower.

Figure 8



2 The motor in the lawn mower can only be turned on when the person using it holds the handle of the lawn mower with both hands.

Explain why.

[2 marks]

3 The power input to the motor is 1.8 kW

The resistance of the motor is 32 Ω

Calculate the current in the motor.

[3 marks]

Current = _____ A

. 4 The useful power output from the motor is 1.5 kW

Calculate the time it takes for the motor to transfer 450 000 J of useful energy.

[3 marks]

Time = _____ seconds

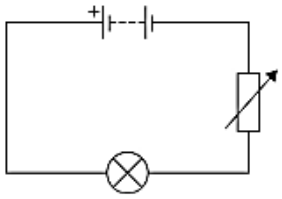
10

09.

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

Figure 1 shows part of the circuit used.

Figure 1



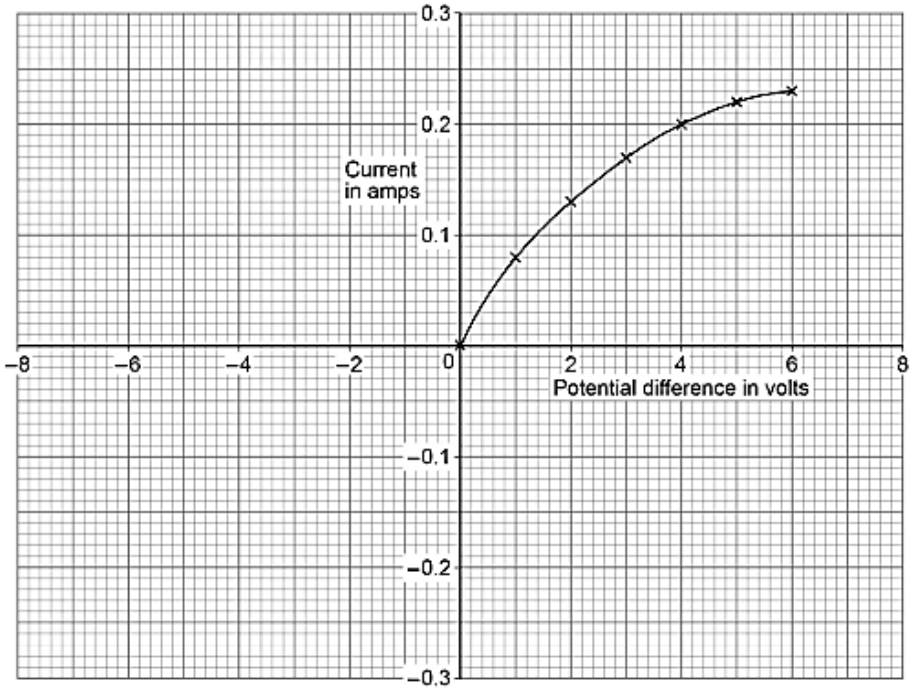
. 1 Complete **Figure 1** by adding an ammeter and a voltmeter.

Use the correct circuit symbols.

[3 marks]

Figure 2 shows some of the results.

Figure 2



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

Draw a line on **Figure 2** to show the relationship between the negative values of current and potential difference.

[2 marks]

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

[1 mark]

. 4 Determine the resistance of the filament lamp when the potential difference across it is 1.0 V.

Use data from **Figure 2**.

[4 marks]

Resistance = _____ Ω

. 5 A second student did the same investigation. The ammeter used had a zero error.

What is meant by a zero error?

[1 mark]

10.

Figure 3 shows an LED torch.

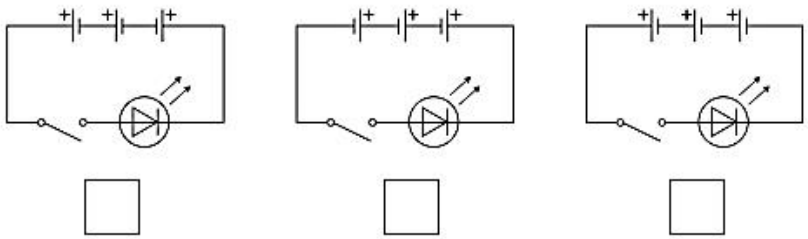
Figure 3

1 The torch contains one LED, one switch and three cells.

Which diagram shows the correct circuit for the torch?

[1 mark]

Tick (✓) **one** box.



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

[1 mark]

. 3 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.

[3 marks]

Total charge flow = _____ C

. 4 When replaced, the cells were put into the torch the wrong way around.

Explain why the torch did not work.

[2 marks]

. 5 Write down the equation which links efficiency, total power input and useful power output.

[1 mark]

. 6 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.

[3 marks]

Useful power output = _____ W

11

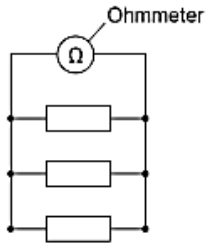
11.

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

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

Figure 11 shows the student's circuit with 3 resistors.

Figure 11



The student repeated each reading of resistance three times.

Table 1 shows some of the results for 3 resistors in parallel.

Table 1

Number of resistors	Total resistance in ohms			
	Reading 1	Reading 2	Reading 3	Mean
3	15.8	15.3	**X**	15.7

1 Calculate value **X** in **Table 1**.

[2 marks]

X = _____ Ω

. 2 The student thought that taking a fourth reading would improve the precision of the results.

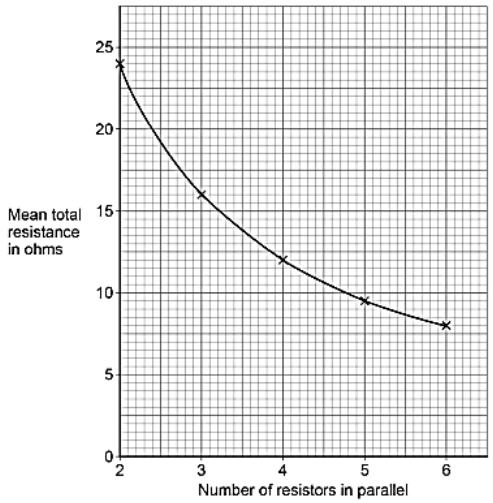
The fourth reading was 16.2 Ω.

Explain why the student was wrong.

[2 marks]

Figure 12 shows the results from the investigation.

Figure 12



. 3 The student concluded that the number of resistors in parallel was inversely proportional to the mean total resistance.

Explain why the student was correct.

Use data from **Figure 12** in your answer.

[3 marks]

. 4 Explain why adding resistors in parallel decreases the total resistance.

[2 marks]

_____

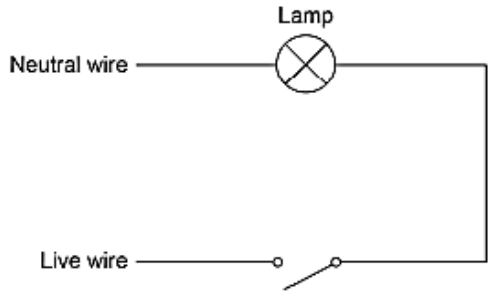
_____

_____

9

12. **Figure 13** shows part of a mains electricity lighting circuit in a house.

Figure 13



1 A fault in the switch caused a householder to receive a mild electric shock before a safety device switched the circuit off.

The mean power transfer to the person was 5.75 W.

The potential difference across the person was 230 V.

Calculate the resistance of the person.

[5 marks]

Resistance = _____ Ω

. 2 An electrician replaced the switch.

The electrician would have received an electric shock unless the circuit was disconnected from the mains supply.

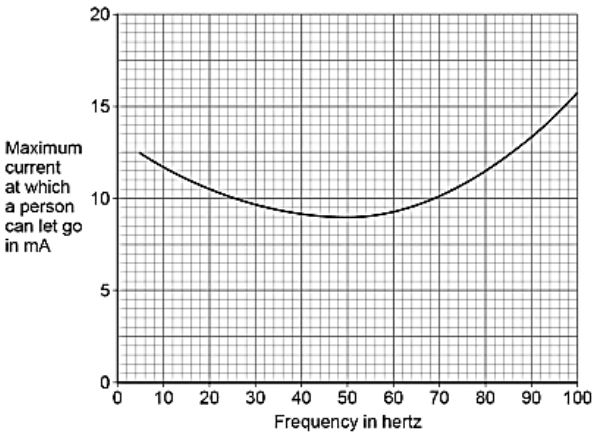
Explain why.

[3 marks]

. 3 The current from an electric shock causes a person's muscles to contract. The person cannot let go of the electrical circuit if the current is too high.

Figure 14 shows how the maximum current at which a person can let go depends on the frequency of the electricity supply.

Figure 14



The UK mains frequency is 50 Hz.

Explain why it would be safer if the UK mains frequency was **not** 50 Hz.

[2 marks]

13.

Figure 1 shows an electric car being recharged.

Figure 1

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

What does 'direct potential difference' mean?

[1 mark]

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

[1 mark]

Tick (✓) **one** box.

- energy transferred = $\frac{\text{power}}{\text{time}}$ ☐
- energy transferred = $\frac{\text{time}}{\text{power}}$ ☐
- energy transferred = power × time ☐
- energy transferred = power^2 × time ☐

3 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.

[3 marks]

Time taken = _____ s

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

[1 mark]

Tick (✓) **one** box.

$I = V \times R$ ☐

$I = V^2 \times R$ ☐

$R = I \times V$ ☐

$V = I \times R$ ☐

5 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.

[3 marks]

Resistance = _____ Ω

6 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**?

[1 mark]

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** ☐

10

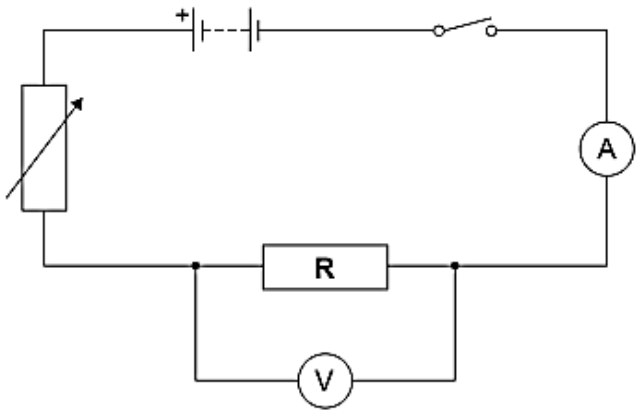
14.

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 2 shows the circuit Student **A** used.

Figure 2



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

[6 marks]

. 2 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.

[2 marks]

_____

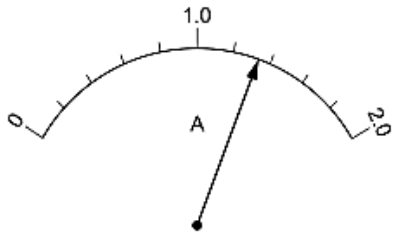
_____

_____

_____

Figure 3 shows the scale on a moving coil ammeter at one time in the investigation.

Figure 3



3 What is the resolution of the moving coil ammeter?

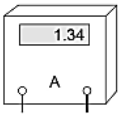
[1 mark]

Resolution = _____ A

. 4 Student **B** replaced the moving coil ammeter with a digital ammeter.

Figure 4 shows the reading on the digital ammeter.

Figure 4



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.

[1 mark]

15. During one year, 1.25×10^{18} J of energy was transferred from the National Grid.

number of seconds in 1 year = 3.16×10^{7}

Calculate the mean energy transferred from the National Grid each second.

Give your answer to 3 significant figures.

[2 marks]

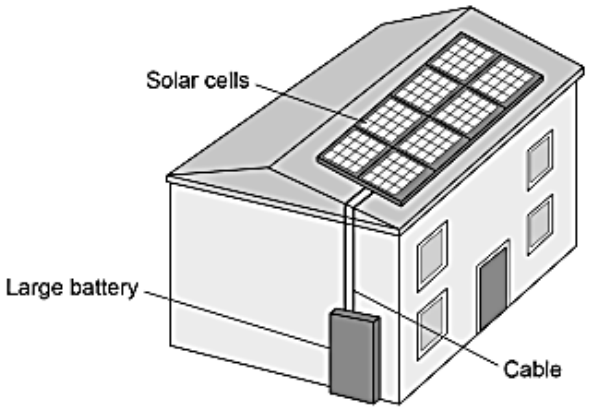
Energy each second (3 significant figures) = _____ J

Figure 5 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.

Figure 5



2 The charge flow through the cable between the solar cells and the battery in 24 hours was 27 000 coulombs.

Calculate the mean current in the cable.

[4 marks]

Mean current = _____ A

3 At one time, the total power input to the solar cells was 7.8 kW.

The efficiency of the solar cells was 0.15

Calculate the useful power output of the solar cells.

[3 marks]

Useful power output = _____ W

4 It is unlikely that **all** of the electricity that the UK needs can be generated by solar power systems.

Explain why.

[2 marks]

11

16.

A student investigated how the current in a series circuit varied with the resistance of a variable resistor.

Figure 8 shows the circuit used.

Figure 8

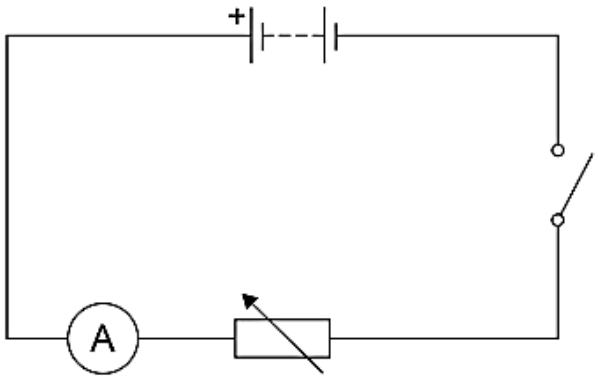
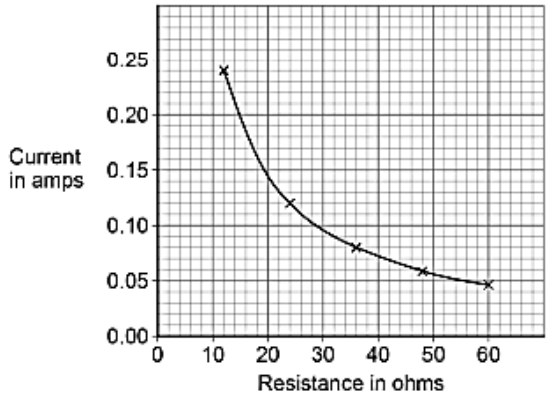


Figure 9 shows the results.

Figure 9



. 1 The battery had a power output of 230 mW when the resistance of the variable resistor was 36 Ω.

Determine the potential difference across the battery.

[4 marks]

Potential difference = _____ V

. 2 The student concluded:

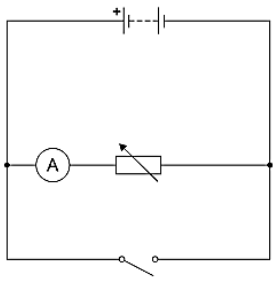
'the current in the circuit was inversely proportional to the resistance of the variable resistor.'

Explain how **Figure 9** shows that the student is correct.

[2 marks]

. 3 **Figure 10** shows a circuit with a switch connected incorrectly.

Figure 10



Explain how closing the switch would affect the current in the variable resistor.

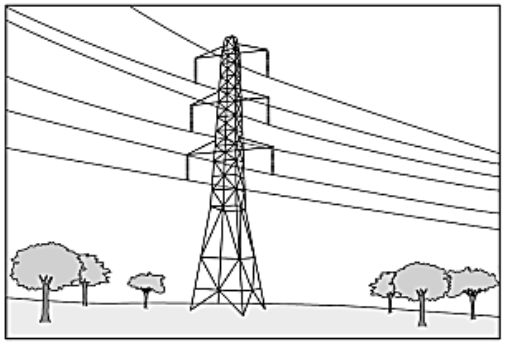
[2 marks]

8

17.

Figure 13 shows some overhead power cables in the National Grid.

Figure 13



. 1 Explain the advantage of transmitting electricity at a very high potential difference.

[3 marks]

. 2 It is dangerous for a person to fly a kite near an overhead power cable.

Figure 14 shows a person flying a kite.

Figure 14

The person could receive a fatal electric shock if the kite was very close to, but not touching the power cable.

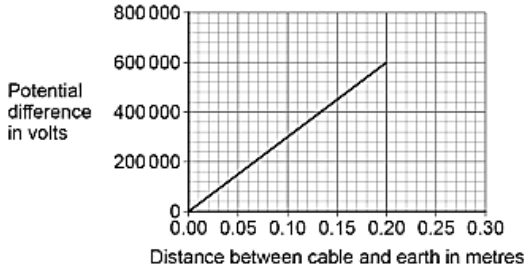
Explain why.

[3 marks]

A scientist investigated how the potential difference needed for air to conduct charge varies with the distance between a cable and earth.

Figure 15 shows the results.

Figure 15



3 The data in **Figure 15** gives the relationship between potential difference and distance when the air is dry.

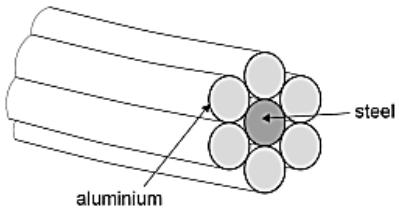
When the humidity of air increases the air becomes a better conductor of electricity.

Draw a line on **Figure 15** to show how the potential difference changes with distance if the humidity of the air increases.

[2 marks]

4 **Figure 16** shows a cross-section through a power cable.

Figure 16



A 1 metre length of a single aluminium wire is a better conductor than a 1 metre length of the steel wire.

The individual wires behave as if they are resistors connected in parallel.

Explain why the current in the steel wire is different to the current in a single aluminium wire.

[2 marks]

_____

_____

_____

_____

_____

_____

10

18.

Figure 2 shows a rock found by a student on a beach.

To help identify the type of rock, the student took measurements to determine its density.

Figure 2

1 Describe a method the student could use to determine the density of the rock.

[6 marks]

The student determined the density of the rock to be 2.55 ± 0.10 g/cm^3.

2 What are the maximum and minimum values for the density of the rock?

[1 mark]

Maximum density = _____ g/cm^3

Minimum density = _____ g/cm^3

3 **Table 1** gives the density of five different types of rock.

Table 1

Type of rock	Density in g/cm^3
Basalt	2.90 ± 0.10
Chalk	2.35 ± 0.15
Flint	2.60 ± 0.10
Sandstone	2.20 ± 0.20
Slate	2.90 ± 0.20

Which two types of rock in **Table 1** could be the type of rock the student had?

[1 mark]

Tick (✓) **one** box.

Basalt or chalk ☐

Chalk or flint ☐

Flint or sandstone ☐

Sandstone or slate ☐

. 4 The student only took one set of measurements to determine the density of the rock.

Explain why taking the measurements more than once may improve the accuracy of the density value.

[2 marks]

10

19. An engineering company has invented pavement tiles that generate electricity as people walk on them.

Figure 3 shows someone walking on the pavement tiles.

Figure 3

Use the Physics Equations Sheet to answer questions **03.1** and **03.2**.

. 1 What equation links current (I), potential difference (V) and power (P)?

[1 mark]

Tick (✓) **one** box.

$P = \frac{V}{I}$ ☐

$P = V \times I$ ☐

$I = P \times V$ ☐

$V = I^2 \times P$ ☐

. 2 When a person walks on a tile, a potential difference of 40 V is induced across the tile.

The power output of the tile is 4.4 W.

Calculate the current in the tile.

[3 marks]

Current = _____ A

. 3 What equation links efficiency, total power input and useful power output?

[1 mark]

Tick (✓) **one** box.

Efficiency = $\frac{\text{useful power output}}{\text{total power input}}$ ☐

Efficiency = $\frac{\text{total power input}}{\text{useful power output}}$ ☐

Efficiency = useful power output × total power input ☐

. 4 The tiles are used to power LED lights in the pavement.

An LED light has a total power input of 4.0 W.

The efficiency of the LED light is 0.85

Calculate the useful power output of the LED light.

[3 marks]

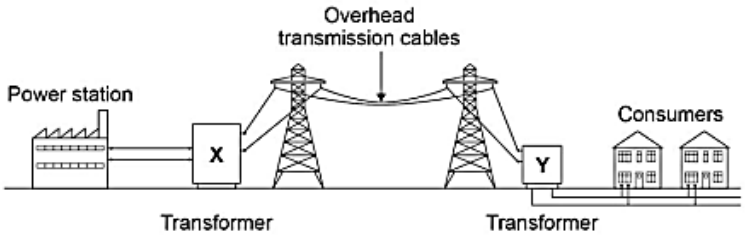
Useful power output = _____ W

—
8

20.

Figure 8 shows how electricity is supplied to consumers by the National Grid.

Figure 8



. 1 Explain why transformer **X** is used in the National Grid.

[4 marks]

. 2 Explain why transformer **Y** is used in the National Grid.

[2 marks]

3 The town of Hornsdale in Australia has electricity supplied by a huge battery.

On one day the battery transferred 3.24×10^{11} J of energy to the town.

The potential difference of the town's electricity supply is 230 V.

Calculate the charge flow to the town on this day.

Use the Physics Equations Sheet.

Give your answer to **3** significant figures.

[4 marks]

Charge flow (3 significant figures) = _____ C

21.

Figure 12 shows some hair straighteners.

Hair straighteners contain heating elements.

Figure 12

1 When the hair straighteners reach normal operating temperature, an LED turns on.

Draw the circuit symbol for an LED in the box.

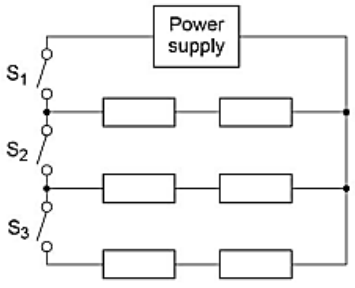
[1 mark]

Figure 13 shows the circuit diagram for the hair straighteners.

Each resistor represents a heating element.

The power output of the hair straighteners can be changed by closing different switches.

Figure 13



. 2 Why do the hair straighteners **not** turn on when only switch S_2 is closed?

[1 mark]

. 3 The hair straighteners have a maximum power output of 120 W.

The energy transferred to the hair straighteners to reach normal operating temperature is 3.6 kJ.

Calculate the time taken for the hair straighteners to reach normal operating temperature when operating at maximum power.

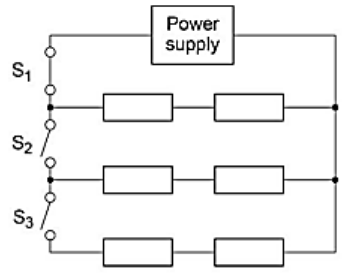
Use the Physics Equations Sheet.

[4 marks]

Time = _____ seconds

. 4 **Figure 14** shows the hair straighteners circuit with switch S_1 closed.

Figure 14



Switch S_2 and switch S_3 are then closed at the same time.

Explain what happens to the power output of the power supply.

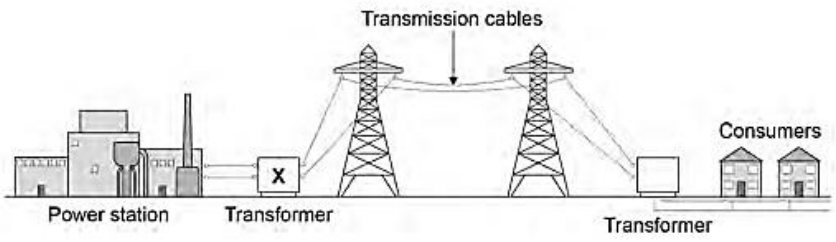
[3 marks]

9

22.

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

Figure 1



. 1 Complete the sentences.

[2 marks]

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

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

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

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

[1 mark]

Tick (✓) **one** box.

$P = \frac{I}{R}$ ☐

$P = \frac{I}{R^2}$ ☐

$P = I^2 R$ ☐

$P = IR$ ☐

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]

Resistance = _____ Ω

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

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

[1 mark]

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]

Useful energy output = _____ GJ

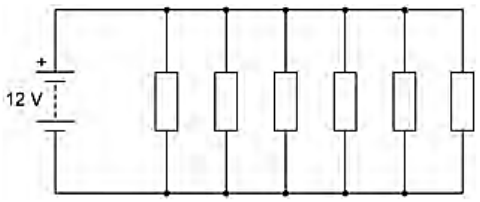
10

23.

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



1 The 12 V battery supplies direct potential difference.

What is meant by 'direct potential difference'?

[1 mark]

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

[1 mark]

Tick (✓) **one** box.

$E = \frac{V}{Q}$ ☐

$E = QV$ ☐

$E = \frac{Q}{V}$ ☐

$E = \frac{V^2}{Q}$ ☐

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

[3 marks]

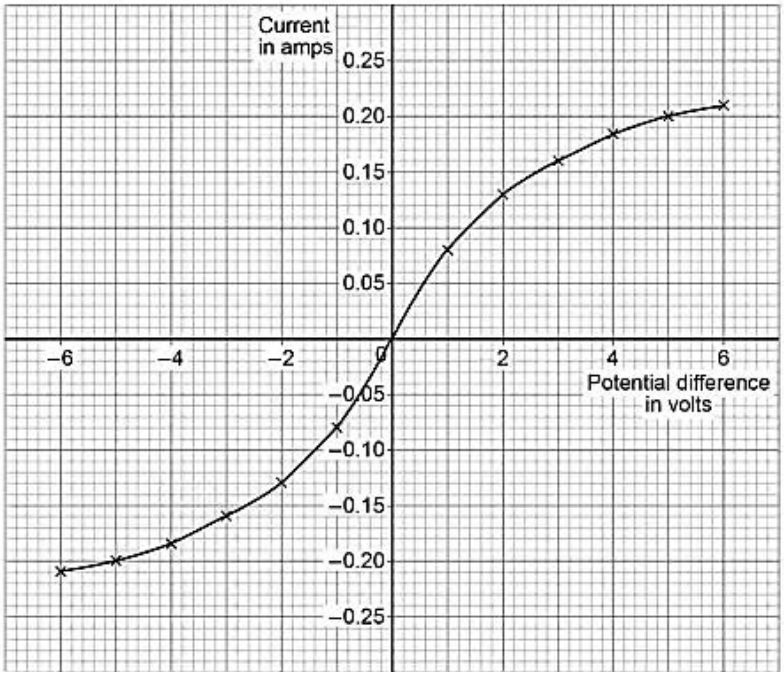
Charge flow = _____ C

24.

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



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

You should include a circuit diagram.

[6 mark

. 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]

Resistance = _____ Ω

. 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]

Energy transferred = _____ J

. 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]