

AQA GCSE PHYSICS (HIGHER) • 8463

PHYSICS



EXAM QUESTION PACK

4.2.3 DOMESTIC USES AND SAFETY (PACK 3)

SCORE

/115

PERCENTAGE

%

STEMUP

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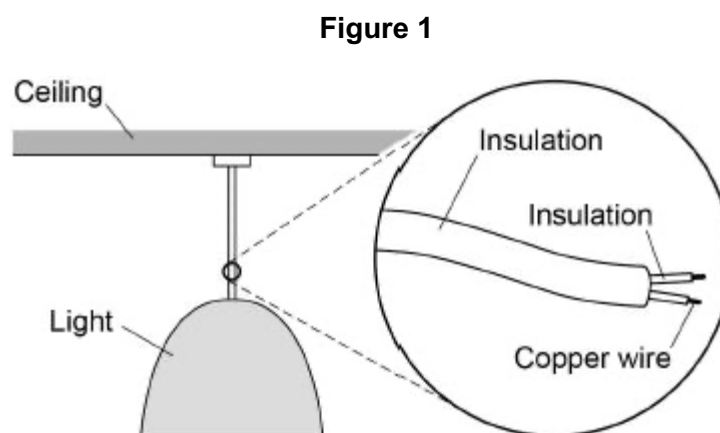
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Q1.

Some ceiling lights in the home are connected to the mains by a two-core cable.

Figure 1 shows a ceiling light.



- (a) Suggest why some ceiling lights do **not** have an earth wire.

(2)

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

(1)

- (c) There is a current of 2.95 A in one of the copper wires for 60 seconds.

Calculate the charge flow through the wire.

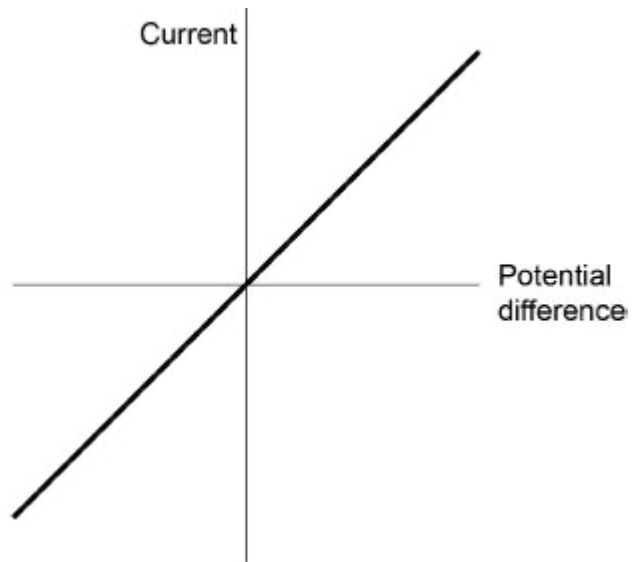
Use your equation from part (b)

Charge flow = _____ C

(2)

- (d) **Figure 2** shows a current potential difference graph for a piece of copper wire.

Figure 2



Draw another line on **Figure 2** for a wire with a different resistance.

(2)

Some fuses have a thin piece of copper that melts if the current is too large.

(e) Draw the circuit symbol for a fuse.

(1)

(f) Describe how the movement of the copper particles in the wire changes when copper melts.

(2)

(g) Old copper wires are melted when they are recycled.

Calculate the energy needed to melt 500 kg of copper at its melting point.

Specific latent heat of fusion of copper = 200 kJ/kg

Use the Physics Equations Sheet.

Energy = _____ J

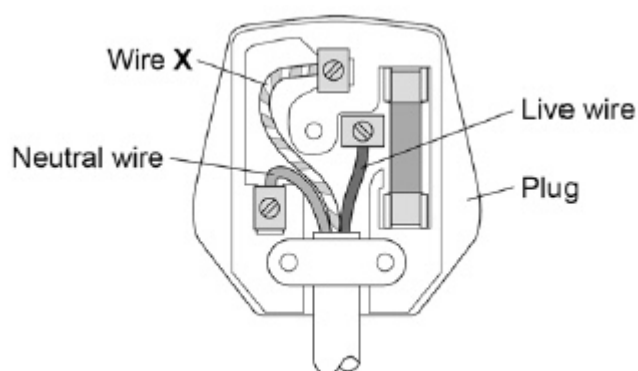
(3)

(Total 13 marks)

Q2.

Figure 1 shows a three pin plug connected to the cable of a metal toaster.

Figure 1



- (a) Name wire **X**.

(1)

- (b) What does wire **X** do?

Tick **one** box.

It provides extra energy to the toaster when needed.

☐

It completes the circuit in the toaster.

☐

It can prevent an electric shock from the toaster.

☐

It supplies the current to the toaster.

☐

(1)

(c) The toaster is plugged in to the mains electricity supply.

What is the potential difference between the live and neutral wires?

Tick **one** box.

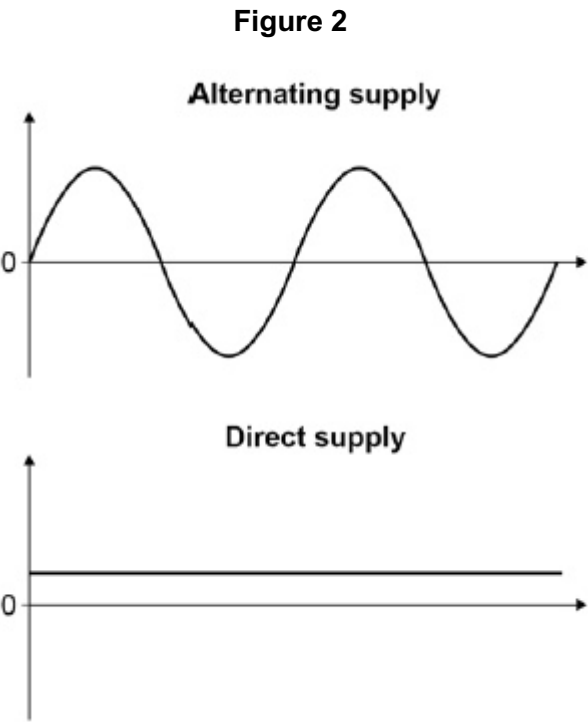
0 V	☐	120 V	☐	230 V	☐	460 V	☐
-----	--------------------------	-------	--------------------------	-------	--------------------------	-------	--------------------------

(1)

(d) Mains electricity is an alternating supply.

A battery is a direct supply.

Figure 2 shows an alternating supply and a direct supply.



Give **two** differences between the alternating supply and the direct supply.

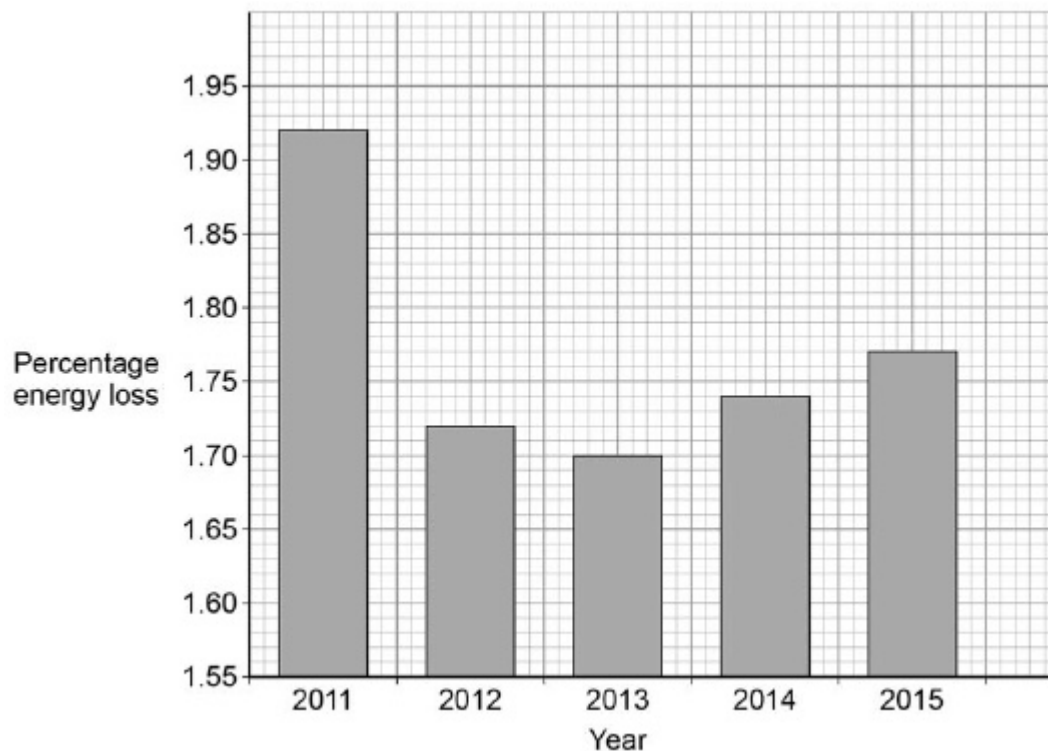
1. _____
2. _____

(2)

Energy is transferred to homes by the National Grid.

Figure 3 shows the percentage energy losses over the National Grid for different years.

Figure 3



- (e) Describe the changes in percentage energy loss.

(2)

- (f) Calculate the mean percentage energy loss per year in **Figure 3**.

Mean energy loss per year = _____ %

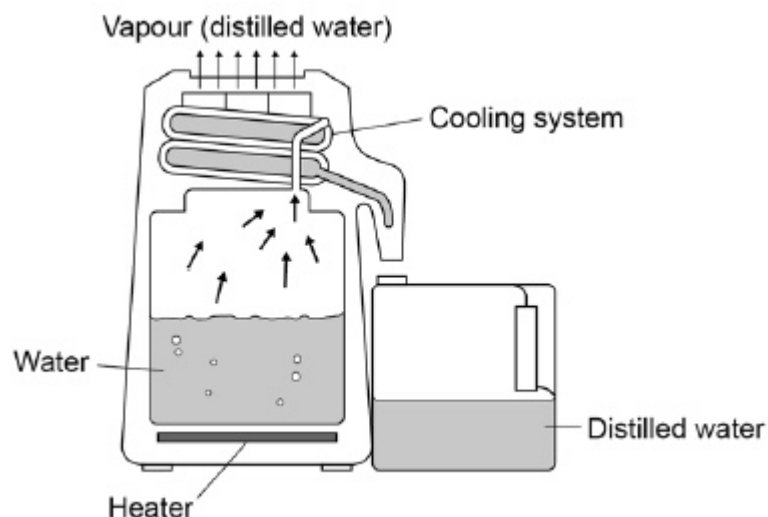
(3)

(Total 10 marks)

Q3.

Figure 1 shows a water distiller which is used to purify water.

Figure 1



The distiller boils water and then condenses most of the water vapour back to water.

- (a) The water distiller is filled with 5.0 kg of water at 20 °C

The specific heat capacity of water = 4 200 J/Kg °C

Calculate the energy needed to raise the temperature of the water to 100 °C

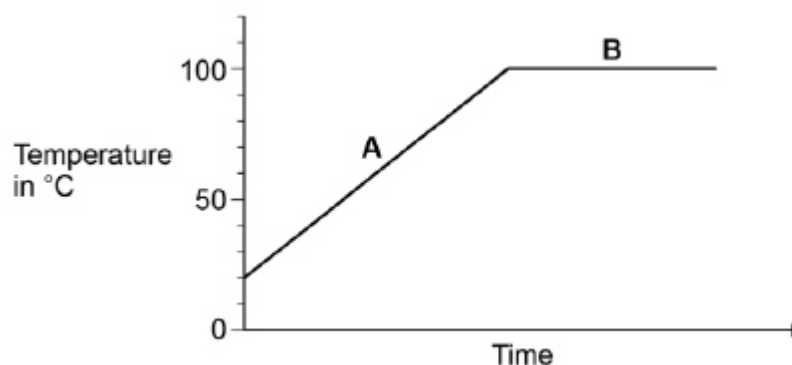
Use the Physics Equations sheet.

Energy = _____ J

(3)

Figure 2 shows how the temperature of the water in the distiller changes with time.

Figure 2



- (b) Energy is transferred to the water at a constant rate.

Explain why the graph is a different shape in parts **A** and **B**.

(3)

- (c) When the water drops to a low level, the heater automatically switches off.

Explain what problem would be caused if the heater did **not** automatically switch off.

(3)

- (d) The distiller is connected to the mains by a three-core cable.

The wires are covered by different coloured insulation.

What colour is the insulation covering each of the wires?

Live wire _____

Neutral wire _____

Earth wire _____

(2)

- (e) Which statement gives the purpose of the earth wire?

Tick **one** box.

It carries an alternating potential difference.

☐

It melts if the current in the circuit is too high.

☐

It provides a connection to complete the circuit.

☐

It stops the casing of the appliance becoming live.

☐

(1)

- (f) The heating element has a power of 2.5 kW

The resistance of the heating element is $17\ \Omega$

Calculate the current in the heating element.

Give your answer to 2 significant figures.

Write any equations that you use.

Current = _____ A

(5)

(Total 17 marks)

Q4.

Figure 1 shows the information label from a hairdryer.

Figure 1

50 Hz	230 V	2100 W
-------	-------	--------

- (a) What is the power of the hairdryer?

Tick **one** box.

50 Hz

☐

230 V

☐

2100 W

☐

(1)

- (b) What is the equation which links current, potential difference and power?

Tick **one** box.

power = potential difference $\times$ current

☐

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

☐

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

☐

(1)

- (c) The mains electricity supply in the UK is an alternating current (ac).

What is the frequency of the UK ac supply?

(1)

- (d) Some electrical appliances use batteries.

What type of current does a battery supply?

Tick **one** box.

Alternating current (ac) only

☐

Direct current (dc) only

☐

Both ac and dc

☐

Not ac or dc

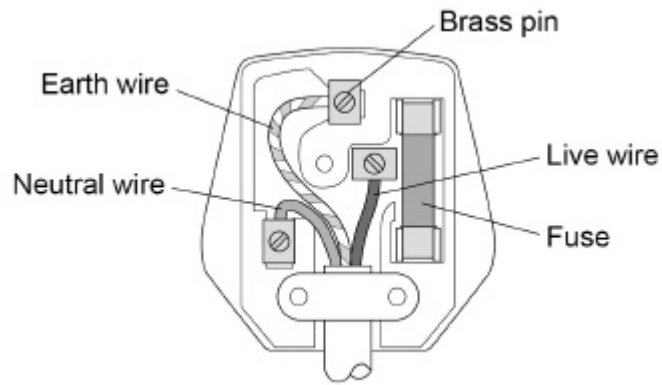
☐

(1)

The hairdryer is connected to the mains electricity supply by a plug.

Figure 2 shows the inside of a plug.

Figure 2



- (e) Draw **one** line from each wire to the colour of insulation around the wire.

Wire	Colour of insulation around wire
	Blue
Live	Brown
	Green
Neutral	White
	Yellow

(2)

- (f) The insulation around the Earth wire has two colours.

What are the **two** colours?

_____ and _____

(1)

- (g) Brass is an alloy of copper and zinc.

Give **two** properties of brass that make it suitable to use in the plug.

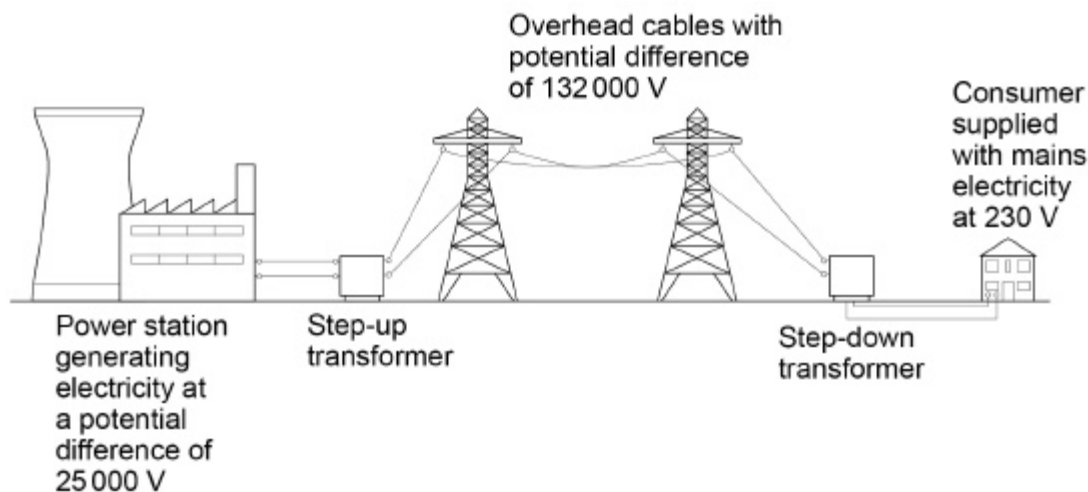
1. _____

2. _____

(2)

- (h) **Figure 3** shows how the National Grid links power stations to consumers.

Figure 3



Describe how electrical power is transferred from power stations to consumers by the National Grid.

(4)

(Total 13 marks)

Q5.

Some electrical appliances use electricity from the mains supply and some use electricity from a battery.

- (a) Explain the differences between the current supplied by the mains supply and the current supplied by a battery.

(2)

- (b) Which set of units correctly links current, potential difference and power?

Tick **one** box.

one watt = one volt × one amp

☐

one watt = $\frac{\text{one amp}}{\text{one volt}}$

☐

one watt = $\frac{\text{one volt}}{\text{one amp}}$

☐

(1)

Electrical appliances can be connected to the mains supply using three-core cables.

The cables contain the mains wires.

(c) What are the colours of the insulation around the wires?

Tick **one** box.

Earth	Live	Neutral	Tick one box
Blue	Brown	Green and yellow	☐
Blue	Green and yellow	Brown	☐
Brown	Blue	Green and yellow	☐
Brown	Green and yellow	Blue	☐
Green and yellow	Blue	Brown	☐
Green and yellow	Brown	Blue	☐

(1)

(d) Touching the live wire of an appliance is dangerous when the appliance is connected to the mains electricity supply.

Explain why.

(4)

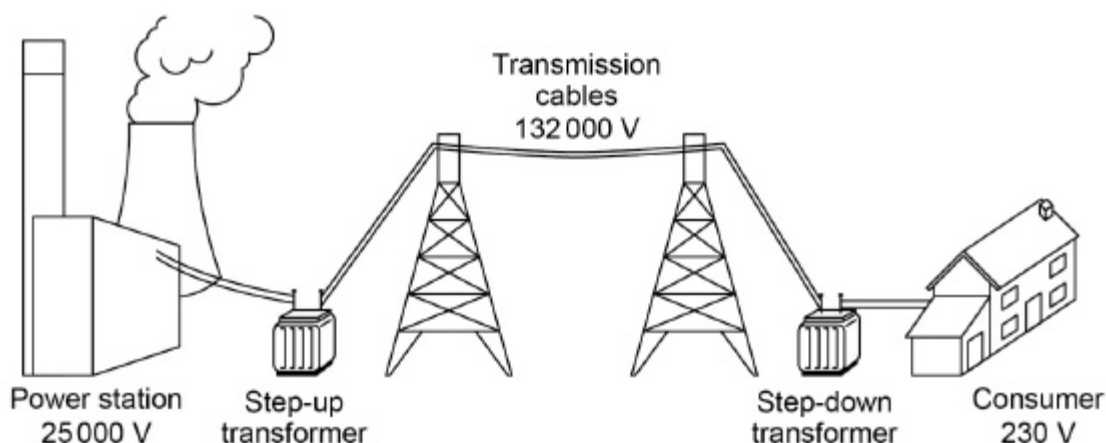
(Total 8 marks)

Q6.

The National Grid is used to transfer electrical power around the country.

Figure 1 shows a simplified diagram of the National Grid.

Figure 1



- (a) The gas-fired power station shown in **Figure 1** uses a non-renewable energy resource.

Some power stations use renewable energy resources.

What is the difference between renewable and non-renewable energy resources?

(2)

- (b) Explain how transformers are used in the National Grid.

(3)

- (c) The current in the transmission cables is 8 700 A

The current causes energy to be transferred to the surroundings by heating.

The power is 9.135 MW for a 1 km length of cable.

Calculate the resistance of 1 km of cable.

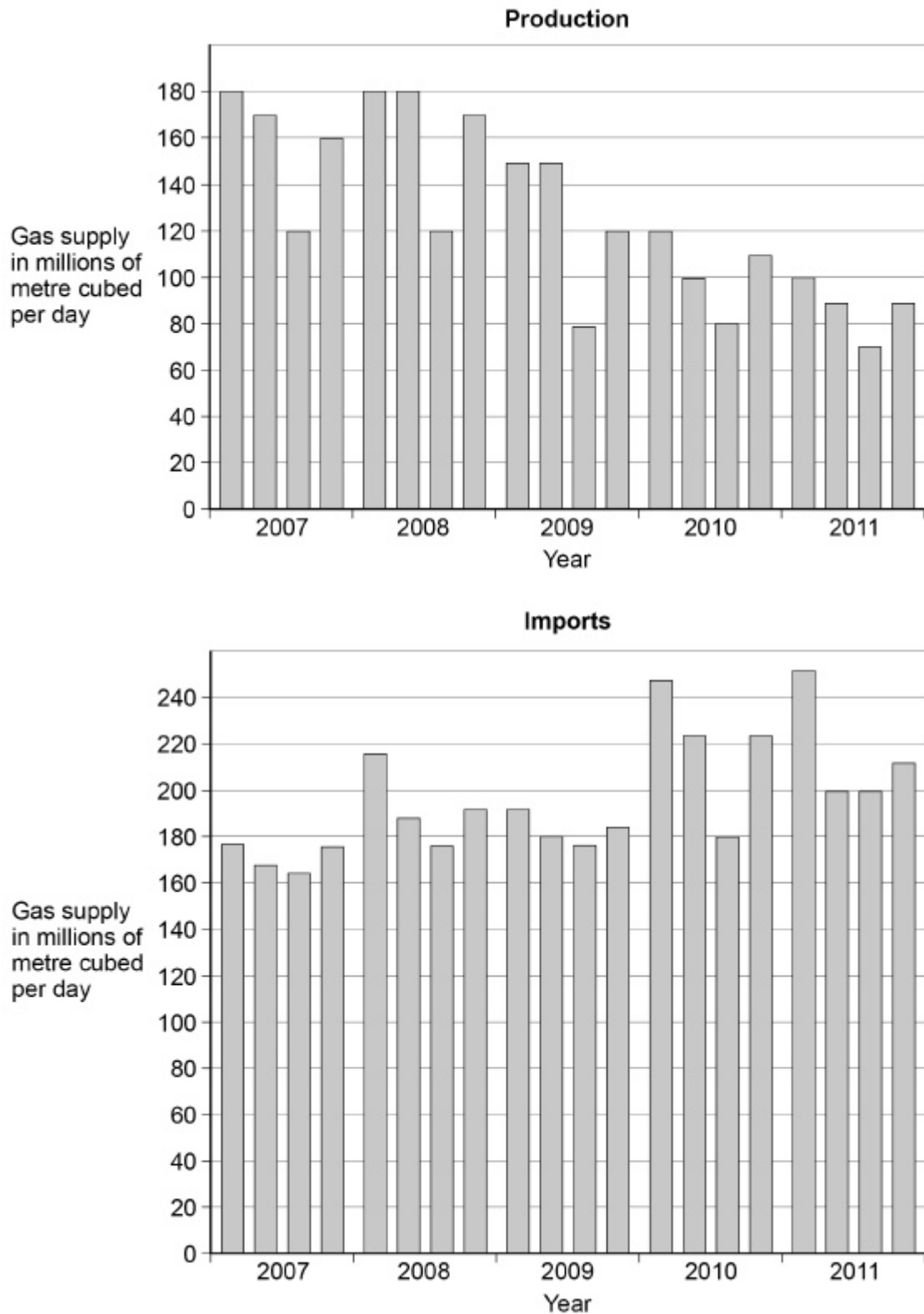
Resistance = _____ Ω

(3)

- (d) The UK produces natural gas. The UK also imports natural gas from other countries.

Figure 2 shows how the supply of natural gas varied over a 5-year period.

Figure 2



Give **three** conclusions you can make from **Figure 2**.

1. _____

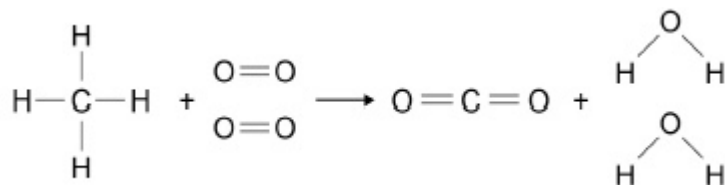
2. _____

3. _____

(3)

- (e) Natural gas contains methane.

The displayed equation for the combustion of methane is:



The table shows bond energies.

Bond	Bond energy in kJ/mol
C-H	413
O=O	498
C=O	805
O-H	464

The energy input to the power station in one second from the combustion reaction is 2.29×10^6 kJ

Calculate:

- the overall energy change in kJ/mol for the reaction
- the number of moles of methane used in the power station in one second.

Use the displayed equation and the table.

Overall energy change = _____ kJ/mol

Number of moles of methane = _____ mol

(5)

(Total 16 marks)

Q7.

Most electrical appliances are connected to the mains electricity using three-core cables.

- (a) What is the approximate value of the potential difference of the UK mains electricity supply?

Tick **one** box.

23 V

☐

230 V

☐

300 V

☐

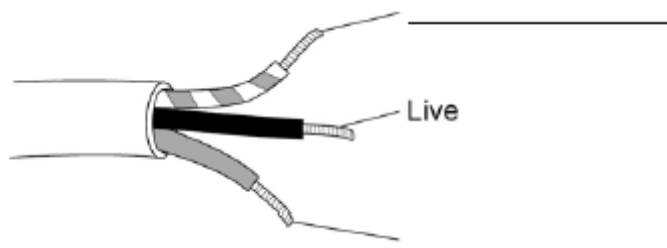
350 V

☐

(1)

- (b) **Figure 1** shows a three-core cable.

Figure 1



Use answers from the box to label the wires and complete **Figure 1**.

Earth	Negative	Neutral
-------	----------	---------

(2)

- (c) In the UK the three wires in a three-core cable are always the same colours.

Why are the wires always the same colours?

Tick **one** box.

Each wire is made by a different company.

☐

It is easy to identify each wire. ☐

They are cheaper to manufacture. ☐

(1)

- (d) Touching the live wire is dangerous.

Use answers from the box to complete the sentences.

current	resistance	shock	force	voltage
----------------	-------------------	--------------	--------------	----------------

Touching the live wire causes a large potential difference to exist across the body.

This causes a _____ through the body, which results in an electric _____

(2)

- (e) What is the approximate frequency of the UK mains electricity supply?

Tick **one** answer.

50 Hz ☐

75 Hz ☐

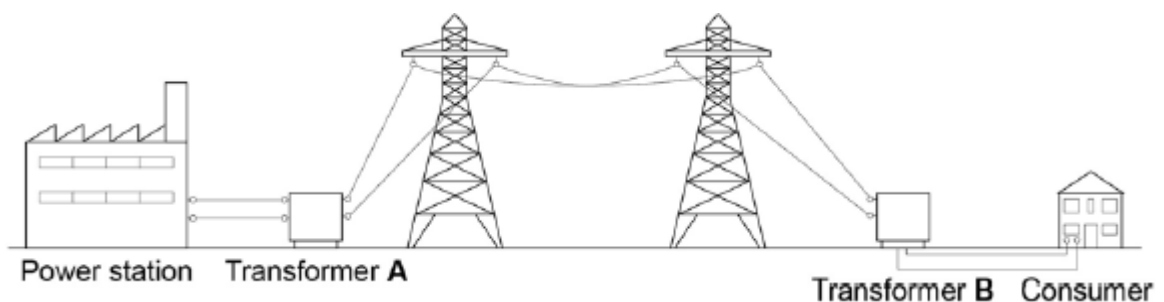
100 Hz ☐

150 Hz ☐

(1)

- (f) **Figure 2** shows how power stations transfer electrical power to consumers using the National Grid.

Figure 2



The power station generates electricity at a voltage of 25 kV.

Transformer **A** increases the voltage by a factor of 16.

What is the voltage output of transformer **A**?

Output voltage = _____ kV

(2)

(g) Why is the voltage increased by transformer **A**?

Tick **one** box.

To reduce the energy lost due to heating ☐

To increase the power ☐

To increase the current ☐

(1)

(h) Why is it important that the voltage is decreased by transformer **B**?

Tick **one** box.

Less energy is used by consumers ☐

It is safer for consumers ☐

It reduces consumers' electricity bills ☐

(1)

(Total 11 marks)

Q8.

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

(a) Complete the sentence.

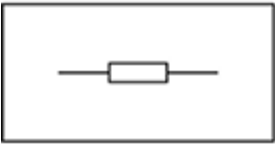
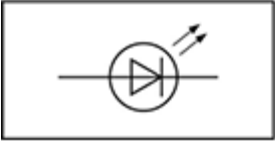
Use a word from the box.

atoms	electrons	ions	molecules
-------	-----------	------	-----------

Metals are good conductors of electricity because electrical charge is transferred

(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)

(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

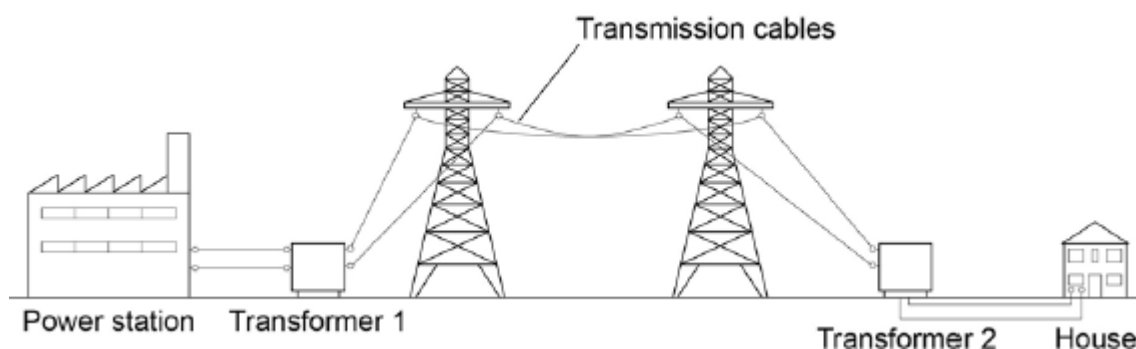
- use the equation

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

to calculate the total current needed.

(4)

- (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)

Q9.

We use mains electricity in our homes.

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

Tick **one** box.

23 Hz

☐

50 Hz

☐

230 Hz

☐

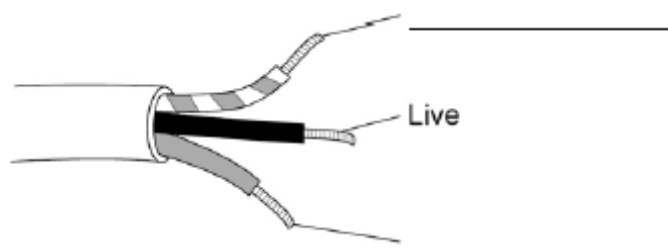
500 Hz

☐

(1)

- (b) Many appliances in the home use three-core electrical cable.

Look at the figure below.



Label the wires in the cable in the figure above.

Use words from the box.

Earth	Negative	Neutral	Positive
-------	----------	---------	----------

(2)

- (c) The sentences explain how touching the live wire in a cable can cause an electric shock.

Complete the sentences.

Use words from the box.

current	force	resistance	potential difference
---------	-------	------------	----------------------

Touching the live wire causes a large _____ to exist across the body.

This causes a _____ through the body, which results in an electric shock.

(2)

- (d) A heater has a power rating of 2500 W.

The heater is turned on for 180 seconds.

Calculate the energy transferred by the heater.

Use the equation:

$$\text{energy transferred} = \text{power} \times \text{time}$$

Give your answer in kilojoules (kJ).

Energy transferred = _____ kJ

(3)

- (e) Write down the equation that links charge flow, energy transferred and potential difference.

(1)

- (f) The mains electricity supply is at 230 V.

A different heater transfers 4200 J of energy.

Calculate the charge flow through the heater.

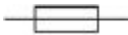
Charge flow = _____ C

(3)

(Total 12 marks)

Mark schemes

Q1.

- (a) (casing is) not made of metal
allow (casing is) made of plastic
allow they are double insulated 1
- little / no chance of electric shock 1
- (b) charge flow = current $\times$ time
allow the equation given in symbols 1
- (c) $Q = 2.95 \times 60$
an answer of 177 scores 2 marks 1
- $Q = 177 \text{ (C)}$
allow 180 (C) 1
- (d) straight line with a different positive gradient
must go through the first and third quadrant 1
- straight line with positive gradient through the origin 1
- (e)  1
- (f) the particles vibrate about a fixed position regular arrangement
allow the particles are in a regular arrangement 1
- (the particles change) to being free to move around
allow correct description of translational kinetic energy 1
- (g) $L = 200\,000 \text{ (J/kg)}$ 1
- $E = 500 \times 200\,000$
allow $1 \times 10^8 \text{ (J)}$ 1
- $E = 100\,000\,000 \text{ (J)}$
allow correct calculation for incorrect conversion
or no conversion of L for 2 marks 1
- an answer of 100 000 000 scores 3 marks*

Q2.

- (a) earth 1
- (b) it can prevent an electric shock from the toaster 1
- (c) 230 V 1
- (d) (the potential difference) for the alternating supply changes direction
allow current 1
- (the potential difference) for the alternating supply changes magnitude
allow current
allow converse
allow potential difference of alternating supply is greater 1
- (e) there is an overall decrease
allow there is an decrease in percentage energy loss until
2013 1
- but there is a (small) increase since 2013 1
- (f) 1.92, 1.72, 1.70, 1.74, 1.77 1
- $(1.92 + 1.72 + 1.70 + 1.74 + 1.77)/5$ 1
- 1.77(%)
an answer of 1.77(%) scores 3 marks 1

[10]

Q3.

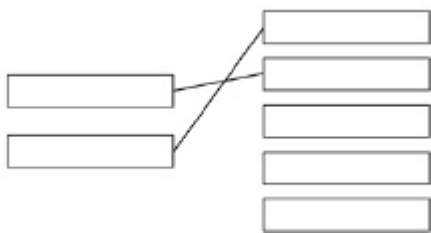
- (a) 80 1
- $E = 5.0 \times 4200 \times 80$ 1
- $E = 1\,700\,000 \text{ (J)}$
an answer of 1 700 000 (J) or
1 680 000 (J) scores 3 marks
allow 1 680 000 1
- (b) in part **A** the increase in internal energy raises the temperature of the water 1

in part B the increase in internal energy changes the state	1
without changing the temperature	1
(c) the heater would continue to transfer energy which would not be transferred to the water	1
so would raise the temperature of the device	1
causing it to be damaged	1
(d) brown	
blue	
green and yellow stripes	
<i>allow 1 mark for 2 correct</i>	2
(e) it stops the casing of the appliance becoming live	1
(f) $P = I^2 R$	
$I = \sqrt{(P/R)}$	1
$P = 2\,500 \text{ (W)}$	1
$I = \sqrt{(2\,500 / 17)}$	1
$I = 12.1267812$	1
$I = 12 \text{ (A)}$	
<i>an answer of 12 (A) scores 5 marks</i>	1
	[17]

Q4.

(a) 2100 W	1
(b) power = potential difference × current	1
(c) 50 (Hz)	1
(d) direct current (dc) only	1

(e)



1
1

(f)

green **and** yellow

both colours required

1

(g)

any **two** from:

- good conductor
- hard
- corrosion resistant

2

(h)

Level 2: Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	3-4
Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1-2
No relevant content	0
Indicative content allow voltage / volts / pd for potential difference • cables transmit electricity at very high potential differences • transformers change the potential difference • step up transformer increases potential difference • overhead cables transfer electricity at a higher potential difference • step down transformer decreases potential difference • the potential difference to the consumers is much lower than the potential difference from the power station • the potential difference to the consumers is much lower than the potential difference in the cables	

Q5.

- (a) mains electricity is an alternating current (ac) which is constantly changing direction 1
- a battery supplies a direct current (dc) which flows in one direction only 1
- (b) one watt = one volt × one amp 1
- (c) green and yellow - brown - blue 1
- (d) the potential of the live wire is 230 V 1
- a person's potential is 0 V 1
- (so) there is a large potential difference between live wire and a person 1
- and so the charge / current passes through the person's body
allow would result in an electric shock 1

[8]

Q6.

- (a) renewable resources are replenished
allow the converse 1
- (at least) as fast as they are used up 1
- (b) (step-up) transformer between power station and grid increases p.d. 1
- giving lower current
or
more efficient transmission 1
- (step-down) transformer between grid and domestic users decreases pd 1
- (c) $9.135 \times 10^6 = (8700)^2 \times R$ 1
- $$R = \frac{9.135 \times 10^6}{8700^2}$$
- 1

0.12 (Ω)

an answer 0.12 (Ω) scores 3 marks
allow correct rounding of 0.1206897

1

(d) any **three** from:

- seasonal variation in production/imports – more gas required in winter than summer
- year to year variation – some years total demand is higher than others (due to variation in weather conditions etc)
- (allowing for seasonal variation) overall trend in production across the 5-year period is decreasing
- (allowing for seasonal variation) overall trend in imports across the 5-year period is increasing (with exception of 2009)
- production varies over a wider range than imports.

3

(e) (energy required to break bonds = $[4 \times 413] + [2 \times 498]$) = 2648 (kJ/mol)

1

(energy from forming bonds = $[2 \times 805] + [4 \times 464]$) = 3466 (kJ/mol)

1

(overall energy change = $2648 - 3466$) = (-) 818 (kJ/mol)

allow ecf from step 1 and/or step 2

1

number of moles = $\frac{2.29 \times 10^6}{818}$

allow ecf from step 3

1

= 2800 (mol)

allow 2799.5... (mol)

allow ecf from step 4

1

[16]

Q7.

(a) 230 V

1

(b) Earth

must be in the correct order

1

Neutral

1

(c) It is easy to identify each wire.

1

(d) current

must be in the correct order

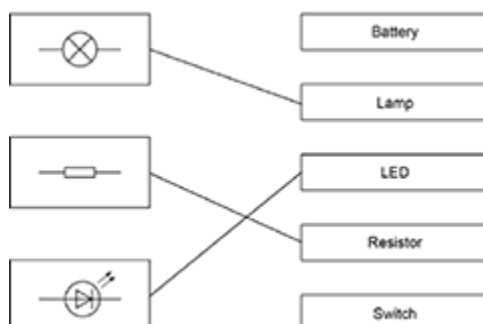
1

- shock 1
- (e) 50 Hz 1
- (f) output = 25×16 1
- 400 (kV) 1
- allow 400 (kV) with no working shown for 2 marks*
- (g) It reduces the energy lost due to heating 1
- (h) It is safer for consumers 1
- [11]

Q8.

- (a) electrons 1

(b)



extra lines from a symbol negate the mark

3

- (c) the total power = 7360 watts 1

current = $7360 \div 230$ 1

= 32 A 1

allow 32 with no working shown for 3 marks

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

1

- (g) 405 / 900

1

=0.45

accept 45%

1

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

[15]

Q9.

- (a) 50 Hz

1

- (b) Top: Earth

1

Bottom: Neutral

1

- (c) potential difference

1

current

1

- (d) energy = 2500 × 180

1

= 450 000

1

= 450 kJ

1

allow 450 with no working shown for **3** marks

- (e) energy transferred = charge flow × potential difference

allow $E = QV$

1

- (f) 4 200 = Q × 230

1

$Q = 4\,200 \div 230$

1

= 18.3 (C)

1

allow 18.3 with no working shown for 3 marks

[12]

Examiner reports

Q1.

- (a) Very few students demonstrated an understanding of the purpose of the earth wire. The most common error was mentioning the insulation on the wires. There was a widespread misconception that earth wires are only found in 13A sockets. Many students commented that the light was on the ceiling and therefore was not near the earth.
- (b) 56% of the students correctly recalled the equation. Some presented a symbol equation using incorrect letters.
- (c) 67% of students obtained both marks for this item, although almost a tenth did not attempt it. The most common mistake was dividing rather than multiplying the quantities.
- (d) The majority of students scored zero on this question. Quite a number of students drew the characteristic graph for a filament bulb or a diode. Another common error was drawing a straight line with a negative gradient through the origin or a line drawn as a mirror reflection. Some drew lines parallel to the one given or drew curves.
- (e) Only 22% of students scored on this question and 11% did not attempt it. Many students put the symbol for a resistor or thermistor instead of the fuse. Some tried to draw a fuse rather than its circuit symbol.
- (f) Less than a fifth of students scored on this question. Many students had the idea of more energy/movement as the copper melted, but not adequate detail of the movement or arrangement before and after. Getting the 'moving freely' mark was more common than getting the 'fixed position/regular arrangement' mark.
- (g) 75% of students scored at least two marks but only 1% scored three marks. In this calculation, students were required to choose the correct equation from the Physics Equations Sheet but a significant minority did not do this. Most students multiplied 200×500 and gained 2 of the 3 marks. Very few students performed the necessary unit conversion of 200 kJ/kg first while some converted incorrectly. Students should be aware that kg is the SI unit so does not need converting but in many other scenarios, any unit preceded by kilo will need converting by multiplying by one thousand. Another common mistake was getting the number of zeros incorrect.