



New Document 1

Name: _____

Class: _____

Date: _____

Time: **87 minutes**

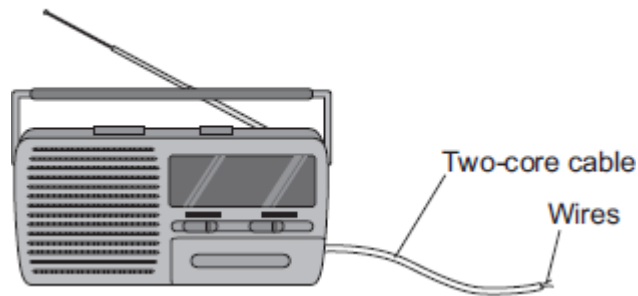
Marks: **87 marks**

Comments:

Q1.

Figure 1 shows a radio. The radio can be powered by connecting the two-core cable to the mains electricity supply.

Figure 1



- (a) (i) What must be fitted to the cable before it can be connected to the mains electricity supply?

(1)

- (ii) There are only two wires inside the cable.
What are the names of the two wires inside the cable?

Tick (✓) **one** box.

- Earth and live
- Earth and neutral
- Live and neutral

(1)

- (iii) Use the correct answer from the box to complete the sentence.

double	extra	fully
---------------	--------------	--------------

It is safe to connect the radio to the mains electricity supply using a two-core cable

because the radio is _____ insulated.

(1)

- (b) The radio can also be powered by a battery.

What type of current does a battery supply?

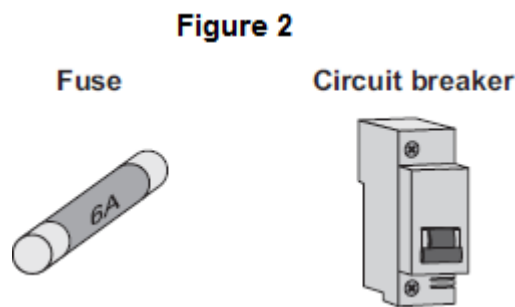
Tick (✓) **one** box.

- Alternating current (a.c.) only
- Direct current (d.c.) only
- Both a.c. and d.c.

(1)

(c) **Figure 2** shows a fuse and a circuit breaker.

Fuses and circuit breakers are able to disconnect and switch off circuits.



(i) Use the correct answer from the box to complete the sentence.

earth live neutral

A fuse or a circuit breaker is connected to the _____ wire in a circuit.

(1)

(ii) What happens to cause a fuse or circuit breaker to disconnect a circuit?

(1)

(iii) Suggest **two** advantages of using a circuit breaker to disconnect a circuit compared with using a fuse.

1. _____

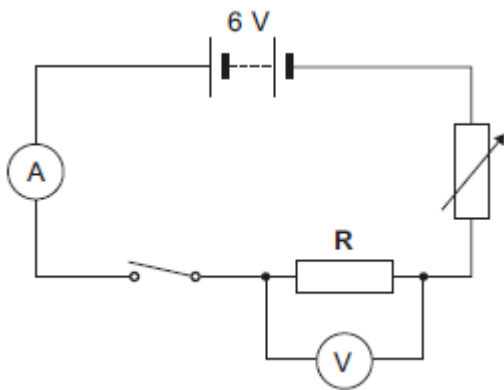
2. _____

(2)

(Total 8 marks)

Q2.

The diagram shows an electrical circuit.



- (a) The 6 V battery shown in the diagram is made up of a number of identical 1.5 V cells.

Calculate the minimum number of cells needed to make the battery.

Number of cells = _____

(1)

- (b) The switch in the diagram is shown in the open position. Closing the switch completes the circuit.

Charge flows through the completed circuit and a reading is shown on both the ammeter and the voltmeter.

- (i) In 10 seconds, 20 coulombs of charge flows through the circuit.

Calculate the current reading shown on the ammeter.

Current = _____ A

(2)

- (ii) For 20 coulombs of charge to flow through the resistor R, 100 joules of work must be done.

Calculate the potential difference reading given by the voltmeter.

Potential difference = _____ V

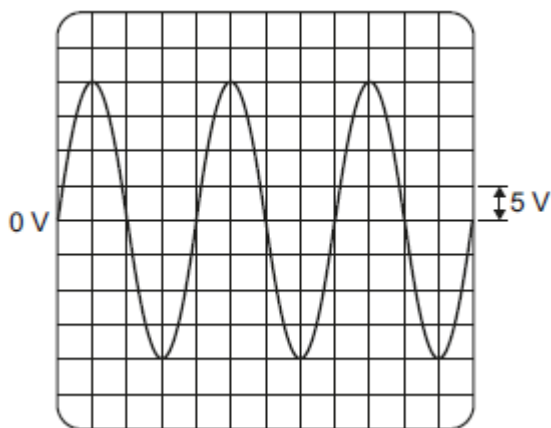
(2)

(Total 5 marks)

Q3.

- (a) **Figure 1** shows the oscilloscope trace an alternating current (a.c.) electricity supply produces.

Figure 1



One vertical division on the oscilloscope screen represents 5 volts.

Calculate the peak potential difference of the electricity supply.

Peak potential difference = _____ V

(1)

- (b) Use the correct answer from the box to complete the sentence.

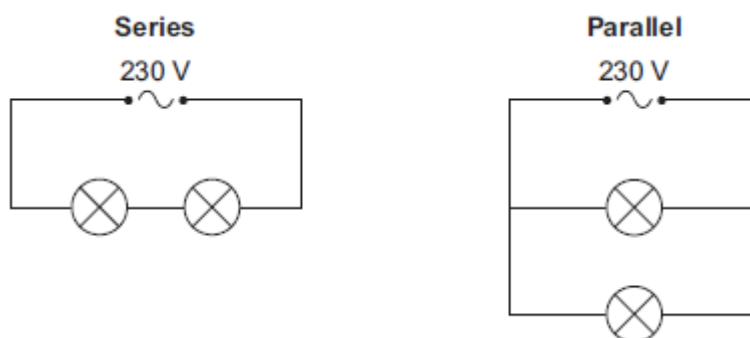
40	50	60
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In the UK, the frequency of the a.c. mains electricity supply is _____ hertz.

(1)

- (c) **Figure 2** shows how two lamps may be connected in series or in parallel to the 230 volt mains electricity supply.

Figure 2



- (i) Calculate the potential difference across each lamp when the lamps are connected in **series**.

The lamps are identical.

Potential difference when in series = _____ V

(1)

- (ii) What is the potential difference across each lamp when the lamps are

connected in **parallel**?

Tick (✓) **one** box.

115 V 230 V 460 V

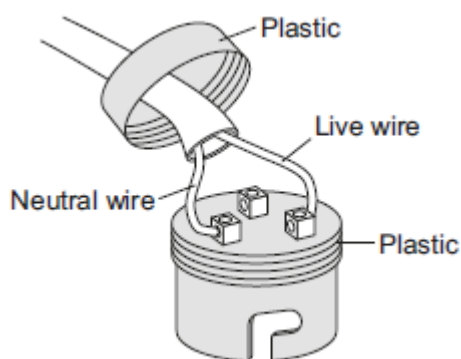
(1)

(iii) Give **one** advantage of connecting the lamps in parallel instead of in series.

(1)

(d) **Figure 3** shows the light fitting used to connect a filament light bulb to the mains electricity supply.

Figure 3



The light fitting does **not** have an earth wire connected.

Explain why the light fitting is safe to use.

(2)

(e) A fuse can be used to protect an electrical circuit.

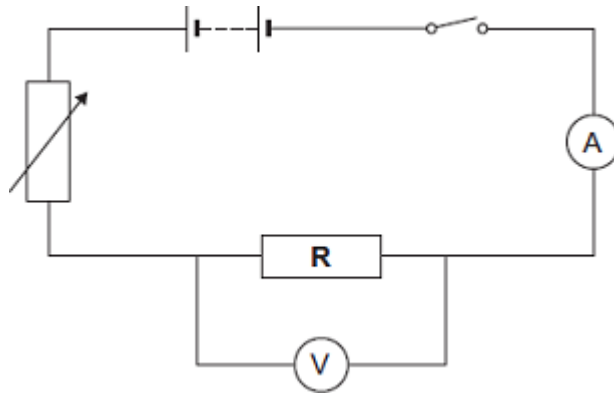
Name a different device that can also be used to protect an electrical circuit.

(1)

(Total 8 marks)

Q4.

(a) A resistor is a component that is used in an electric circuit.



- (i) Describe how a student would use the circuit to take the readings necessary to determine the resistance of resistor **R**.

(6)

- (ii) Explain why the student should open the switch after each reading.

(2)

- (iii) In an experiment using this circuit, an ammeter reading was 0.75 A. The calculated value of the resistance of resistor **R** was 16 Ω .

What is the voltmeter reading?

Voltmeter reading = _____ V

(2)

(iv) The student told his teacher that the resistance of resistor **R** was 16 Ω .

The teacher explained that the resistors used could only have one of the following values of resistance.

10 Ω 12 Ω 15 Ω 18 Ω 22 Ω

Suggest which of these resistors the student had used in his experiment.

Give a reason for your answer.

(2)

(b) The diagram shows a fuse.



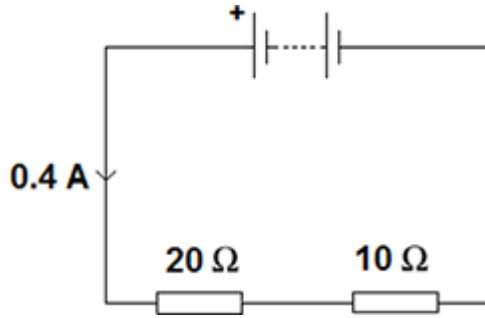
Describe the action of the fuse in a circuit.

(3)

(Total 15 marks)

Q5.

An electrical circuit is shown in the figure below.



- (a) The current in the circuit is direct current.

What is meant by direct current?

Tick **one** box.

Current that continuously changes direction.

Current that travels directly to the component.

Current that is always in the same direction.

(1)

- (b) The equation which links current, potential difference and resistance is:

potential difference = current \times resistance

Calculate the potential difference across the battery in the circuit in the figure above.

Potential difference = _____ V

(3)

- (c) The equation which links current, potential difference and power is:

power = current \times potential difference

Calculate the power output of the battery in the figure above.

Give your answer to one significant figure.

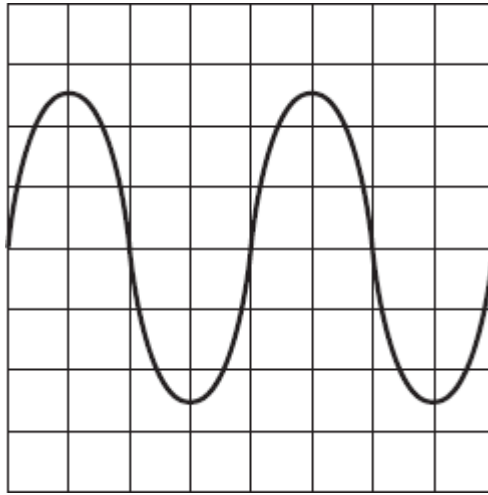
Power = _____ W

(2)

(Total 6 marks)

Q6.

An oscilloscope is connected to an alternating current (a.c.) supply. The diagram shows the trace produced on the oscilloscope screen.



Each horizontal division on the oscilloscope screen represents 0.002 s.

- (a) Calculate the frequency of the alternating current supply.

Show clearly how you work out your answer and give the unit.

Frequency = _____

(3)

- (b) What is the frequency of the a.c. mains electricity supply in the UK?

(1)

(Total 4 marks)

Q7.

The image shows a man using a leaf blower to move some leaves.



The leaf blower is powered by an electric motor connected to a battery.

- (a) Energy transfers take place when the leaf blower is being used.

Use the correct answer from the box to complete each sentence.

chemical	electrical	kinetic	nuclear	sound
----------	------------	---------	---------	-------

The battery stores _____ energy which is transferred into electrical energy.

The electric motor transfers electrical energy usefully into _____ energy.

The motor wastes energy as _____ energy and as energy that heats the surroundings.

(3)

- (b) The total power input to the leaf blower is 750 W.
The useful power output of the leaf blower is 360 W.

Calculate the efficiency of the leaf blower.

Efficiency = _____

(2)

(Total 5 marks)

Q8.

The diagram shows the label from a new freezer.

Model Energy A	SALE See inside for details
More efficient Less efficient	
Energy consumption per year	225 kWh

- (a) An old freezer has an energy consumption per year of 350 kWh.

Use the equation in the box to calculate the extra cost of using the old freezer for one year compared with using a new 'A' rated freezer.

total cost = number of kilowatt-hours × cost per kilowatt-hour
--

Assume 1 kilowatt-hour (kWh) of energy costs 12 p.

Show clearly how you work out your answer.

Extra cost per year = £ _____

(2)

- (b) The price of the new freezer was reduced in a sale.

Reducing the price reduces the payback time for replacing the old freezer from 12 years to 9 years.

Calculate, in pounds, how much the new freezer was reduced in the sale.

Show clearly how you work out your answer.

Price reduced by = £ _____

(2)

- (c) An advertisement in a shop claims that:

‘Replacing an old freezer with a new ‘A’ rated freezer will benefit the environment.’

Do you agree that replacing the freezer will benefit the environment?

Answer yes or no. _____

Explain the reasons for your answer.

(2)

(Total 6 marks)

Q9.

A homeowner had a new gas boiler installed.

- (a) The following information is an extract from the information booklet supplied with the boiler.

Fuel	Natural Gas
Water temperature	60 °C
Energy supplied to gas boiler	8.0 kJ/s (8.0 kW)

Efficiency	0.95
-------------------	------

- (i) Calculate the energy transferred each second by the gas boiler to the water inside the boiler.

Show clearly how you work out your answer.

Energy transferred by the gas boiler each second = _____ kJ

(2)

- (ii) The energy value of the gas used in a home is measured in kilowatt-hours (kWh).

The homeowner has a pre-payment meter and pays £30 into his account. With a pre-payment meter, gas costs 15p per kilowatt-hour.

Calculate the total number of hours that the gas boiler would operate for £30.

Show clearly how you work out your answer.

Number of hours = _____

(2)

- (b) Although the gas boiler is very efficient, some energy is wasted.

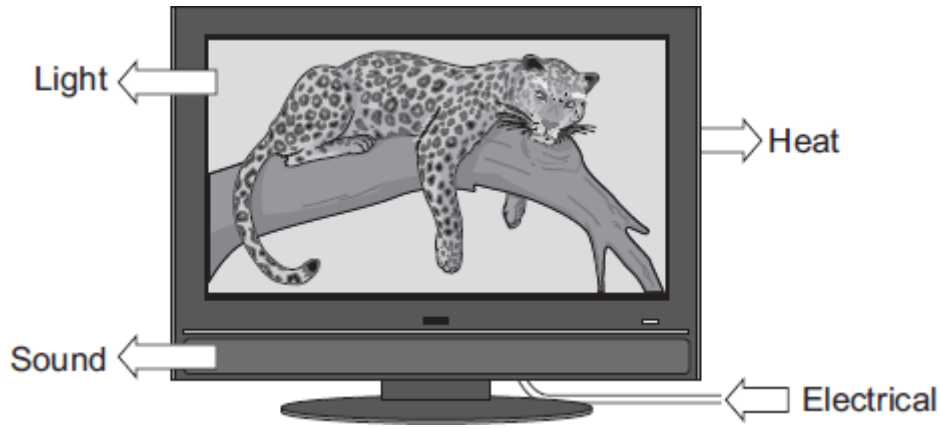
Explain what happens to the waste energy.

(2)

(Total 6 marks)

Q10.

- (a) The diagram shows the energy transformations produced by a television.



When the television is working, 1200 joules of energy are supplied to the television every second. The useful energy transferred by the television is 720 joules every second.

- (i) Use the equation in the box to calculate the efficiency of the television.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

$$\text{Efficiency} = \underline{\hspace{10em}}$$

(2)

- (ii) Use **one** word from the diagram to complete the following sentence.

The electrical energy that is **not** usefully transformed by the television is wasted as _____.

(1)

- (b) A homeowner is sent an electricity bill every 3 months. The total amount of electrical energy used during one 3-month period was 800 kilowatt-hours. Electrical energy costs 15p per kilowatt-hour.

Use the equation in the box to calculate the cost of the energy transferred from the mains electricity supply.

$$\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}$$

Show clearly how you work out your answer and give the unit.

$$\text{Cost} = \underline{\hspace{10em}}$$

(2)

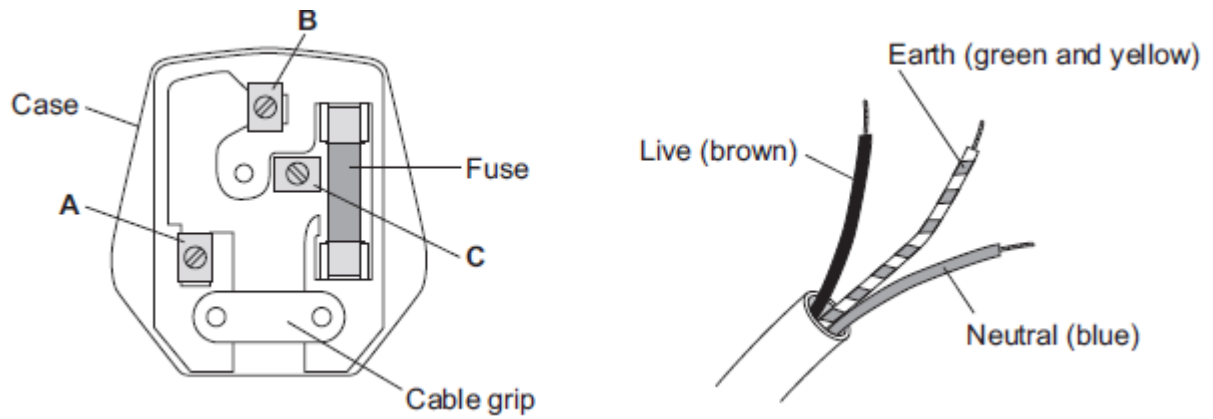
(Total 5 marks)

Q11.

(a) **Figure 1** shows the inside of a three-pin plug and a length of three-core cable.

The cable is to be connected to the plug.

Figure 1



(i) Complete **Table 1** to show which plug terminal, **A**, **B** or **C**, connects to each of the wires inside the cable.

Table 1

Wire	Plug terminal
Live	
Neutral	
Earth	

(2)

(ii) Name a material that could be used to make the case of the plug.

(1)

(b) **Figure 2** shows an electric drill and an extension lead. The drill is used with the extension lead.

Figure 2



Electric drill

Extension lead

(i) The drill is used for 50 seconds.

In this time, 30 000 joules of energy are transferred from the mains electricity

supply to the drill.

Calculate the power of the drill.

Power = _____ W

(2)

- (ii) A second drill is used with the extension lead. The power of this drill is 1200 W.

The instructions for using the extension lead include the following information.

When in use the lead may get hot:

DO NOT go over the maximum power

- lead wound inside the case: 820 watts
- lead fully unwound outside the case: 3100 watts

It would **not** be safe to use this drill with the extension lead if the lead was left wound inside the plastic case.

Explain why.

(3)

- (c) **Table 2** gives information about three different electric drills.

Table 2

Drill	Power input in watts	Power output in watts
X	640	500
Y	710	500
Z	800	500

A person is going to buy **one** of the drills, **X**, **Y** or **Z**. The drills cost the same to buy.

Use only the information in the table to decide which **one** of the drills, **X**, **Y** or **Z**, the person should buy.

Write your answer in the box.

Give a reason for your answer.

(1)

(Total 9 marks)

Q12.

A student finds some information about energy-saving light bulbs.

(a) A 30W light bulb uses 600J of electrical energy in a certain period of time. In that time, it produces 450 J of light energy. The rest of the energy is wasted.

(i) Calculate the energy wasted by the light bulb in this period of time.

Wasted energy = _____ J

(1)

(ii) What happens to the energy wasted by the light bulb?

(1)

(iii) Calculate the efficiency of this light bulb.

Efficiency = _____

(2)

(iv) Calculate the period of time, in seconds, during which the 600 J is provided to the 30 W light bulb.

Time = _____ s

(2)

(b) A company that makes light bulbs provides information about some of their products.

The table shows some of this information.

	Power in watts	Lifetime in hours	Cost of bulb in £
Filament bulb	60	1250	2.00
LED bulb	12	50 000	16.00

- (i) Suggest why it is important to confirm this information independently.

(1)

- (ii) A homeowner is thinking about replacing his filament bulbs with LED bulbs.

A 12 W LED bulb gives the same light output as a 60 W filament bulb.

Suggest reasons why the homeowner is likely to choose LED bulbs.

Use the information given in the table.

(2)

- (iii) State **one** factor, other than efficiency, that is important when considering the choice of a bulb for lighting in the home.

(1)

(Total 10 marks)

Mark schemes

Q1.

- (a) (i) (3-pin) plug
*do **not** accept plug socket* 1
- (ii) live and neutral 1
- (iii) double 1
- (b) direct current (d.c.) only 1
- (c) (i) live 1
- (ii) too great a current flows
accept a surge of current
accept too great a power
accept an electrical fault
*do **not** accept voltage / energy / electricity too high* 1
- (iii) can be reset
accept does not need replacing 1
- (disconnects circuit) faster
cheaper is insufficient
does not melt is insufficient
quicker to fix / replace is insufficient 1

[8]

Q2.

- (a) 4 1
- (b) (i) 2
allow 1 mark for correct substitution ie
$$I = \frac{100}{20}$$

provided no subsequent step 2
- (ii) 5
allow 1 mark for correct substitution ie
$$V = \frac{100}{20}$$

provided no subsequent step 2

[5]

Q3.

- (a) 20 1
- (b) 50 1
- (c) (i) 115 1
- (ii) 230 1
- (iii) if one goes out the other still works
or
 brighter
accept power (output) is greater
can be switched on/off independently is insufficient 1
- (d) the outside/casing is plastic
there is plastic around the wires is insufficient
it is plastic is insufficient 1
- and plastic is an insulator
an answer the light fitting is double insulated gains both marks 1
- (e) (residual current) circuit breaker
accept RCCB
accept RCBO
accept RCCD
accept RCB
accept miniature circuit breaker / MCB
trip switch is insufficient
breaker is insufficient
do not accept earth wire 1

[8]**Q4.**

- (a) (i) any **six** from:
- switch on
 - read both ammeter and voltmeter
allow read the meters
 - adjust variable resistor to change the current
 - take further readings
 - draw graph
 - (of) V against I
allow take mean
 - $R = V / I$
allow take the gradient of the graph

- (ii) resistor would get hot if current left on 1
so its resistance would increase 1
- (iii) 12 (V)
0.75 × 16 gains 1 mark 2
- (iv) 15 (Ω) 1
16 is nearer to that value than any other 1
- (b) if current is above 5 A / value of fuse 1
fuse melts
allow blows / breaks
*do **not** accept exploded* 1
breaks circuit 1
- [15]**

Q5.

- (a) current that is always in the same direction 1
- (b) total resistance = 30 (Ω) 1
 $V = 0.4 \times 30$ 1
12 (V) 1
allow 12 (V) with no working shown for 3 marks
an answer of 8 (V) or 4 (V) gains 2 marks only
- (c) $P = 0.4 \times 12 = 4.8$ 1
5 (W) 1
allow 5 (W) with no working shown for 2 marks
allow 4.8 (W) with no working shown for 1 mark
- [6]**

Q6.

- (a) 125
allow 1 mark for obtaining time period = 0.008 (s)
or
frequency = 1 / time period (or their calculated time period)

hertz
or
Hz

do **not** accept hz

1

(b) 50 (hertz)

1

[4]

Q7.

(a) chemical

correct order only

1

kinetic

1

sound

1

(b) 48% or 0.48

an answer of 0.48 with a unit gains 1 mark

an answer of 0.48% gains 1 mark

an answer of 48 with or without a unit gains 1 mark

2

[5]

Q8.

(a) £15

allow 1 mark for use of 125 (kWh)

allow 1 mark for an answer 1500

*allow **both** marks for 1500 pence / p*

allow 1 mark for correct calculation of annual cost for either freezer (£27 and £42)

2

(b) £45

or their (a) $\times 3$

allow 1 mark for correct use of 3

allow 1 mark for $12 - 9 = 3$

2

(c) any two from:

the marks are for the explanation

yes **plus** explanation

- less electricity / energy needed / used
accept less energy wasted
- less (fossil) fuels burned
accept a named fossil fuel
*do **not** accept conserving (fossil) fuels*

- less polluting gases emitted
accept a named polluting gas / greenhouse gases / carbon emissions / reduce global warming
accept an answer in terms of nuclear fuel
eg less nuclear fuel required (1)
less nuclear waste (1)

2

or no plus explanation

- old freezer must be disposed of
- hazardous chemicals inside freezer
accept CFC gases
- (lot of) energy used in producing new freezer

[6]

Q9.

- (a) (i) 7.6

allow 1 mark for correct substitution and / or transformation

$$ie \quad 0.95 = \frac{x}{8}$$

$$95 \times 8.0$$

2

- (ii) 25 (hours)

allow 1 mark for obtaining number of kWh = 200

an answer of 26(.3) gains both marks

2

- (b) any **two** from

- transferred to the surroundings / air / atmosphere
- becomes spread out
- shared between (many) molecules
- (wasted as) heat / sound

2

[6]

Q10.

- (a) (i) 0.6

or
60%

allow 1 mark for correct substitution ie $\frac{720}{1200}$ provided no subsequent step shown

an answer of 0.6 / 60 with a unit gains 1 mark only

an answer of 60 gains 1 mark only

2

- (ii) heat

allow thermal

1

- (b) 12 000 p
or
£120

to score both marks the unit must be consistent with the numerical answer

answers 12 000 and 120 gain 1 mark only

allow 1 mark for correct substitution ie 800×15 or 800×0.15

provided no subsequent step shown

2

[5]

Q11.

- (a) (i)

Wire	Plug terminal
Live	C
Neutral	A
Earth	B

all 3 correct for 2 marks

allow 1 mark for 1 correct

2

- (ii) plastic
or
rubber

accept:

ABS

UF / urea formaldehyde

nylon

PVC

1

- (b) (i) 600

allow 1 mark for correct substitution,

30 000

ie $P = \frac{30000}{50}$

provided no subsequent step

2

- (ii) power is greater than 820 (W)

power is 1200 W is insufficient

1

the lead / cable / wire will overheat / get (too) hot

accept lead / cable will melt

may overheat / get hot is insufficient

1

so there is a risk of fire

accept causing a fire

1

(c) X

any **one** from:

- most / more efficient
- smallest energy input (per second)
- cheapest to operate

mark only scores if X is chosen

mark is for the reason

accept smallest input (power) for same output (power)

accept wastes least energy

smallest (power) input is insufficient

uses least electricity is insufficient

1

[9]

Q12.

(a) (i) 150

1

(ii) transferred to the surroundings by heating
reference to sound negates mark

1

(iii) 0.75

450 / 600 gains 1 mark

accept 75% for 2 marks

maximum of 1 mark awarded if a unit is given

2

(iv) 20 (s)

correct answer with or without working gains 2 marks

correct substitution of 600 / 30 gains 1 mark

2

(b) (i) to avoid bias

1

(ii) use less power and last longer

1

1 LED costs £16, 40 filament bulbs cost £80

or

filament costs (5 times) more in energy consumption

1

(iii) any **one** from:

- availability of bulbs
- colour output
- temperature of bulb surface

