Energy Transfer

Question Paper

Level	GCSE
Subject	Physics
Exam Board	Edexcel IGCSE
Module	Double Award (Paper 1P)
Topic	Energy Resources & Energy Transfer
Sub-Topic	Energy Transfer
Booklet	Question Paper

Time Allowed: **127 minutes**

Score: **/106**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	75%	70%	60%	55%	50%	<50%

1. A shopping centre has escalators to move people between floors.

(a) A man of mass 78 kg steps on to an escalator.

The escalator lifts him a height of 5.0 m.

(i) State the equation linking gravitational potential energy, mass, *g* and height.

(1)

(ii) Show that the gravitational potential energy gained by the man is about 4000 J.

(2)

(iii) State the work done on the man and give the unit.

(2)

Work done = ... Unit .....

(b) The escalator is powered by a 7.5 kW electric motor.

(i) State the equation linking efficiency, useful energy output and total energy input.

(1)

(ii) The escalator lifts 30 people each minute.

Each person has a mass of 78 kg.

Calculate the efficiency of the escalator.

(3)

Efficiency = ...

(c) Another escalator has an efficiency of 20%.

Its input power is 15 kW.

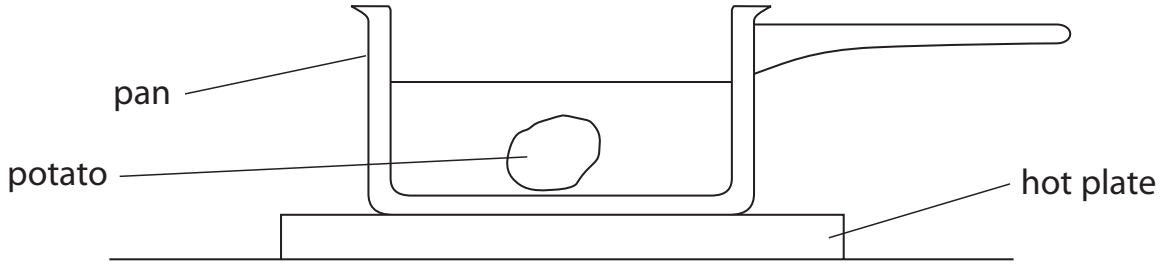
Draw a Sankey diagram for this escalator.

(3)

(Total for Question 1 = 12 marks)

2. This question is about three different methods used to cook potatoes.

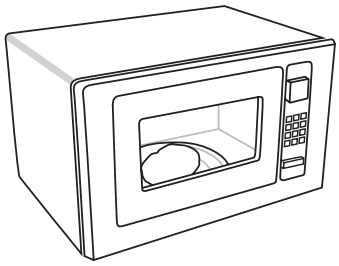
(a) On a traditional cooker, a potato is placed in water in a pan on top of a hot plate.



Describe how energy is transferred from the hot plate to heat up all of the potato.

(4)

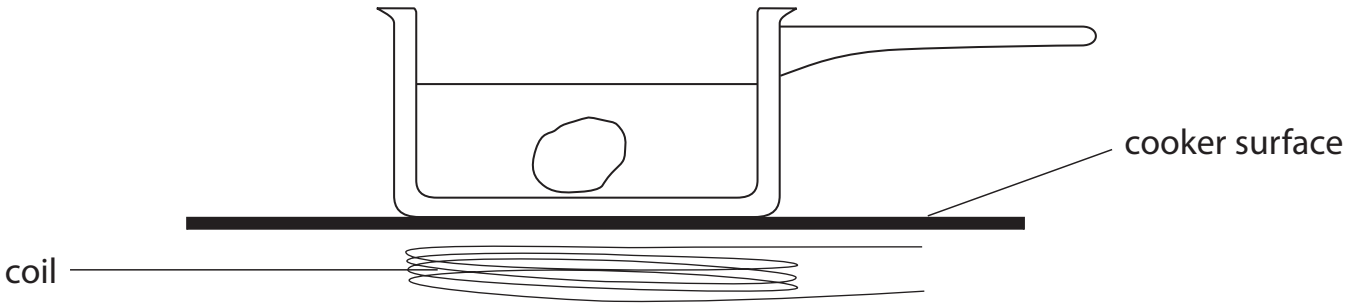
(b) A microwave cooker is often said to *'cook the food from the inside'*.



Explain whether this statement is true by describing how energy is transferred to heat up all of the potato.

(3)

(c) In an induction cooker, there is a coil under the surface of the cooker.



A potato is placed in water in a metal pan.

An alternating current is switched on in the coil under the pan.

The coil does not heat the surface of the cooker.

Describe how energy is transferred to heat up all of the potato.

(5)

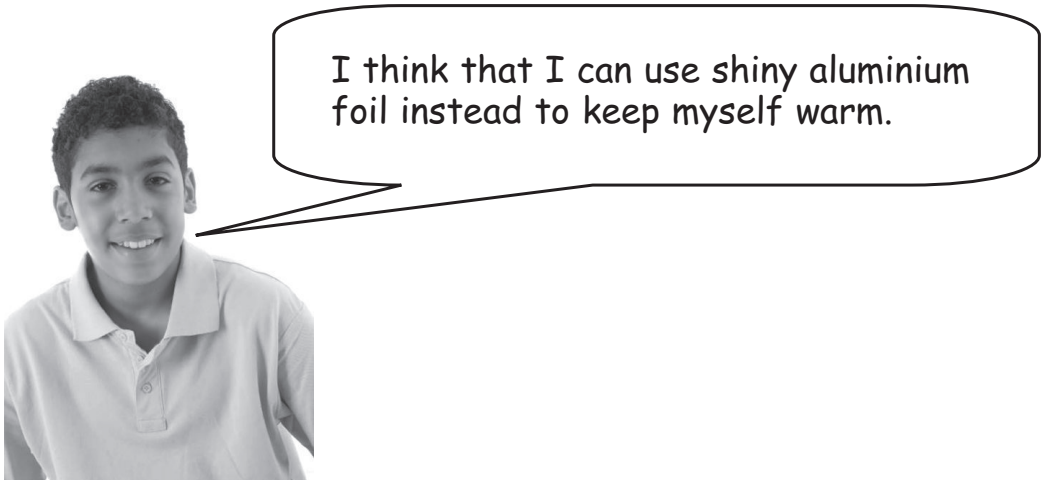
(Total for Question 2 = 12 marks)

3. A student feels cold at night and decides to sleep under a thick woollen blanket.

(a) Explain how the woollen blanket helps to keep the student warm.

(4)

(b) The student says



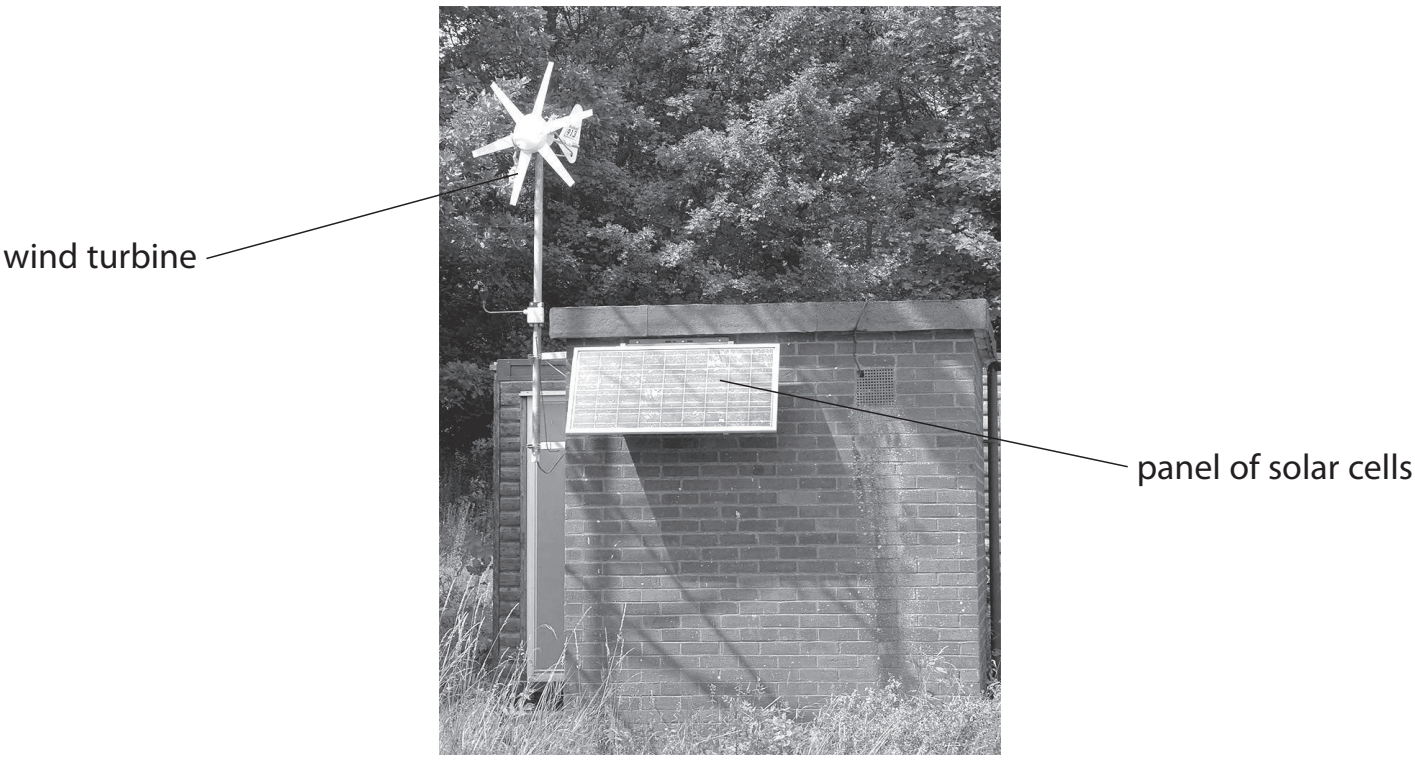
Do you agree with the student?

Explain why.

(1)

(Total for Question 3 = 5 marks)

4. The photograph shows equipment used for generating electricity from renewable sources.



(a) Complete the sentences using words from the box.

chemical	**heat**	**kinetic**	**light**	**sound**

(i) The panel of solar cells transforms ..... energy into electrical energy.

(1)

(ii) The wind turbine transforms ..... energy into electrical energy.

(1)

(b) On a windy day, the wind turbine transfers 78 W of power.

(i) State the equation linking power, energy transferred and time.

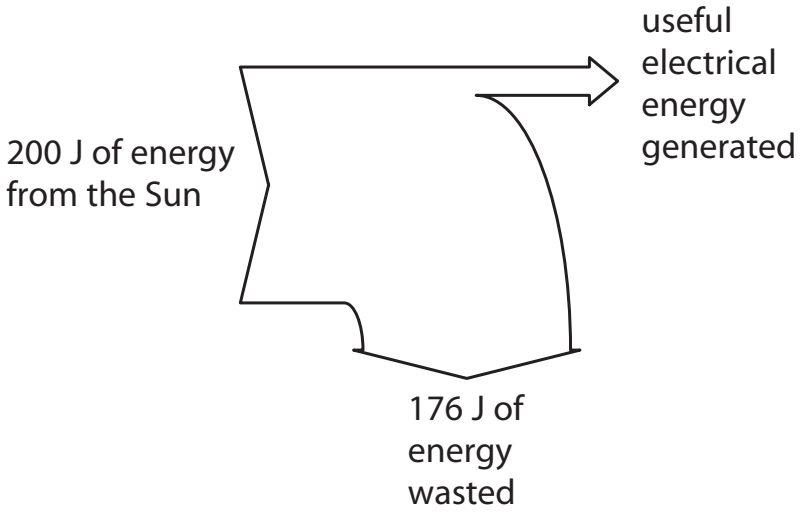
(1)

(ii) Calculate the amount of energy the turbine transfers in 10 s.

(3)

Energy transferred = ... J

(c) The Sankey diagram shows the energy transferred by the panel of solar cells.



Show that the efficiency of the panel of solar cells is 12%.

(2)

(Total for Question 4 = 8 marks)

5. The photograph shows a small aeroplane, of mass 600 kg.

This aeroplane has an electric motor powered by fuel cells.

Fuel cells use hydrogen gas and provide an electric current.

(a) When the aeroplane is working, the energy changes are

(1)

☒ **A** chemical → electrical → kinetic

☒ **B** electrical → chemical → kinetic

☒ **C** electrical → kinetic → chemical

☒ **D** kinetic → chemical → electrical

(b) The velocity of the aeroplane is 28 m/s.

(i) State the equation linking kinetic energy, mass and velocity.

(1)

(ii) Calculate the kinetic energy of the aeroplane.

(2)

Kinetic energy = ... J

(c) The aeroplane takes off and climbs to a height of 1000 m.

(i) State the equation linking gravitational potential energy (GPE), mass, *g* and height.

(1)

(ii) Calculate the gravitational potential energy gained by the aeroplane.

(2)

GPE of the aeroplane = ... J

(iii) The fuel cells provide a maximum total power of 24 kW. The aeroplane also carries a large rechargeable battery.

Show, by calculation, that the aeroplane needs this extra source of power to climb to 1000 m in 3 minutes.

(2)

(iv) The aeroplane uses fuel cells connected together in series in a 'stack'.

The voltage of each fuel cell is 0.6 V. The maximum current in each fuel cell is 30 A.

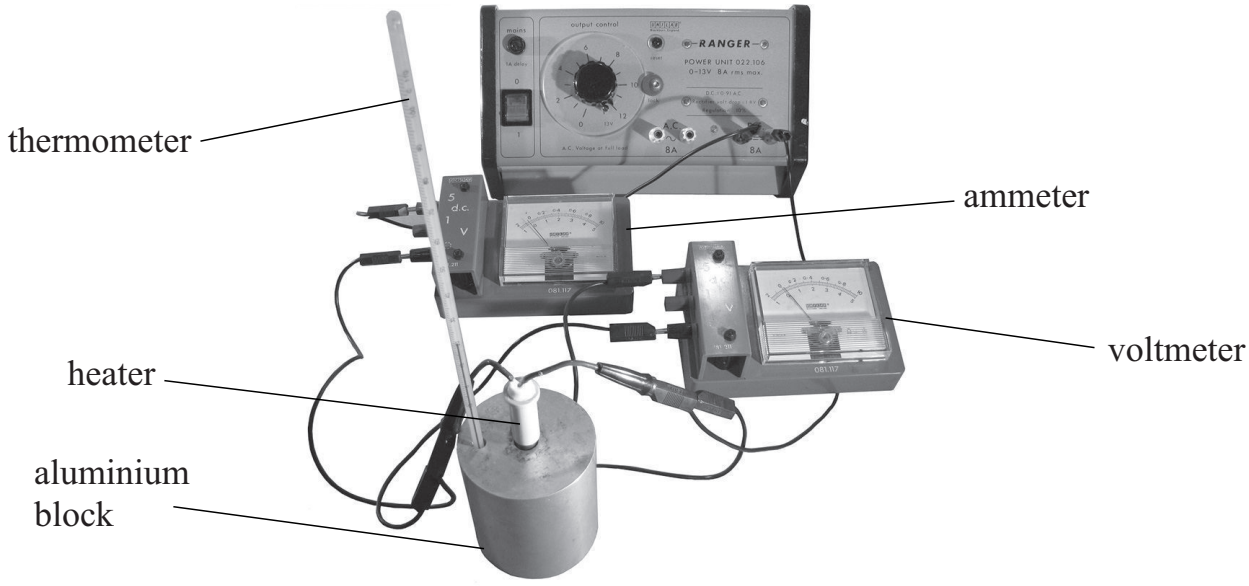
Show that there must be more than 1300 fuel cells in the stack.

(2)

(Total for Question 5 = 11 marks)

6. A student uses an electric heater to investigate efficiency.

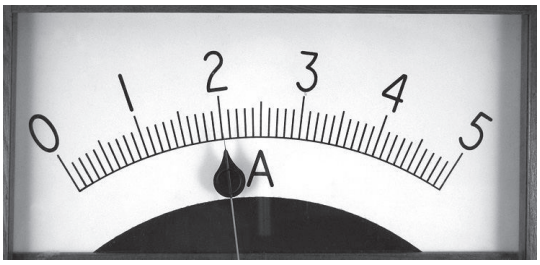
He places the heater in an aluminium block, switches the heater on and measures the temperature of the block each minute for 20 minutes.

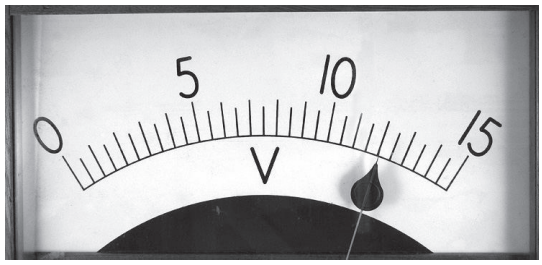


(a) The student wants to calculate the electrical energy supplied to the heater.

(i) Complete the table by recording the readings shown on the meters below.

(2)





Current in amps, A	
Voltage in volts, V	

(ii) Show that the energy supplied to the heater in 20 minutes is about 30 000 J.

(3)

(b) The student is told that only 22 000 J are used to raise the temperature of the aluminium block by 25 °C.

(i) State the equation linking efficiency, useful energy output and total energy input.

(1)

(ii) Calculate the efficiency of heating the aluminium block.

(2)

Efficiency = ...

(iii) The efficiency of the **heater** will be **higher** than this value.

Suggest why.

(1)

.....

.....

.....

(iv) State **one** way in which the student could increase the efficiency of heating the aluminium block.

(1)

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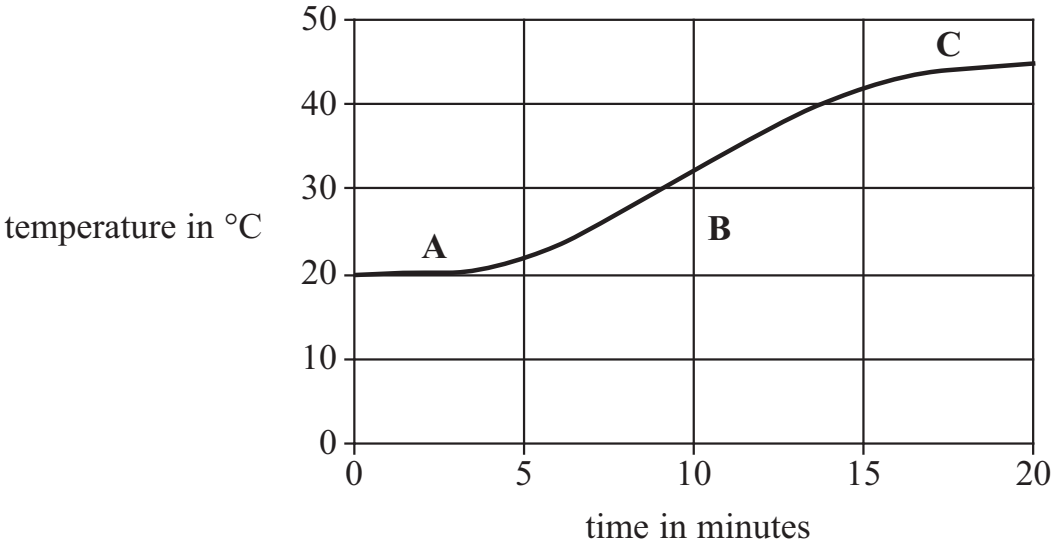
.....

.....

(c) The graph shows how the temperature of the block increases from 20 °C to 45 °C during the investigation.



Use ideas about heat transfer to help you explain the shape of the graph in

(i) section **A**,

(1)

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.....

.....

(ii) section **B**,

(2)

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(iii) section **C**.

(2)

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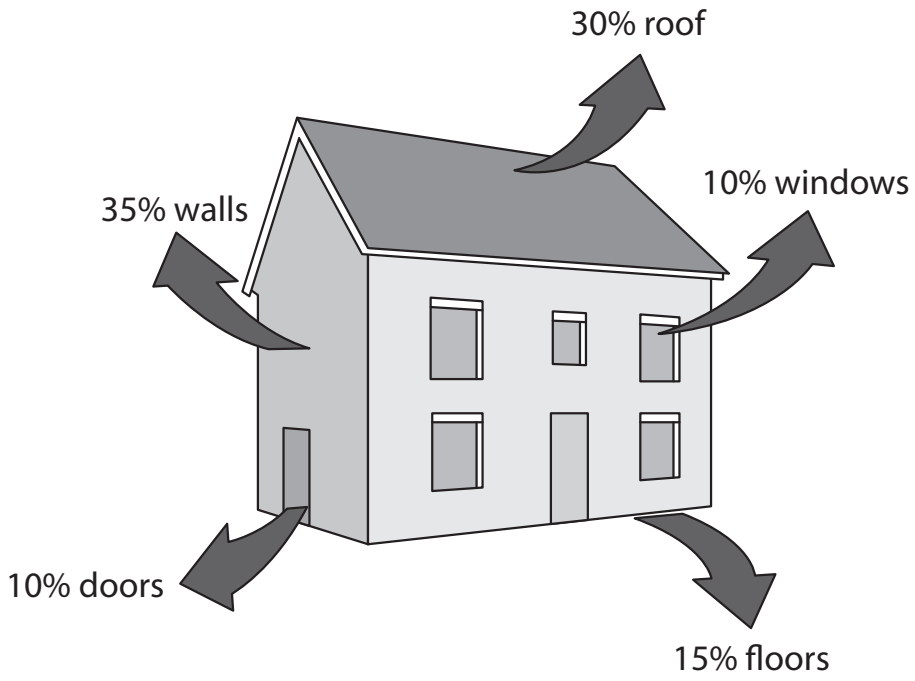
(Total for Question 6 = 15 marks)

7. The diagram shows typical values for the percentage energy losses from a house.



(a) Most energy is lost through

(1)

- ☒ **A** the floors
- ☒ **B** the roof
- ☒ **C** the walls
- ☒ **D** the windows

(b) The total percentage energy loss from the roof and the windows is

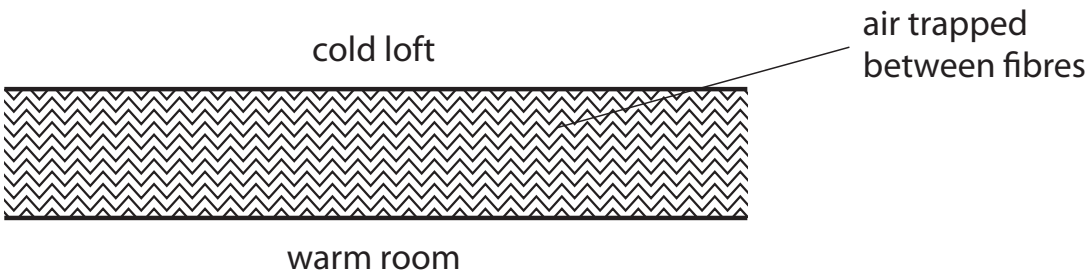
(1)

- ☒ **A** 10%
- ☒ **B** 20%
- ☒ **C** 30%
- ☒ **D** 40%

(c) Insulation is used to reduce energy losses from houses.

Insulating material often consists of fibres with air between them.

The diagram shows a section through some insulating material.



(i) Explain how this type of insulation reduces energy loss by **conduction**.

(2)

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(ii) Explain how this type of insulation reduces energy loss by **convection**.

(2)

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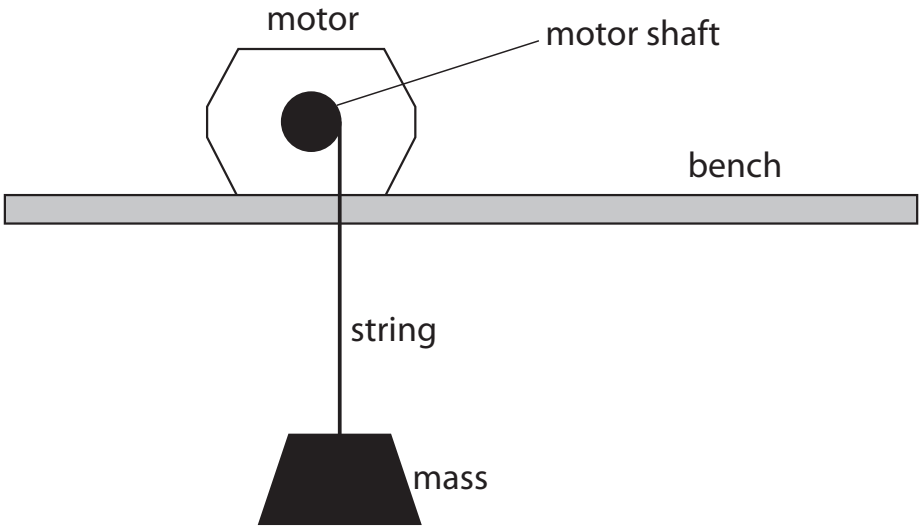
(Total for Question 7 = 6 marks)

8. A student investigates the efficiency of an electric motor.



She uses the motor to lift a mass.

The table shows her measurements.

Current in motor	1.3 A
Voltage across motor	10.3 V
Time taken to lift mass	4.7 s
Force needed to lift mass	20 N
Distance the mass was lifted	0.85 m

(a) Calculate the electrical energy supplied to the motor during this time.

(2)

energy supplied = ... J

(b) (i) State the equation linking work done, force and distance moved.

(1)

(ii) Calculate the work done on the mass.

(2)

work done = ... J

(iii) State the useful energy transferred to the mass.

(1)

.....

(c) (i) State the equation linking efficiency, useful energy output and total energy input.

(1)

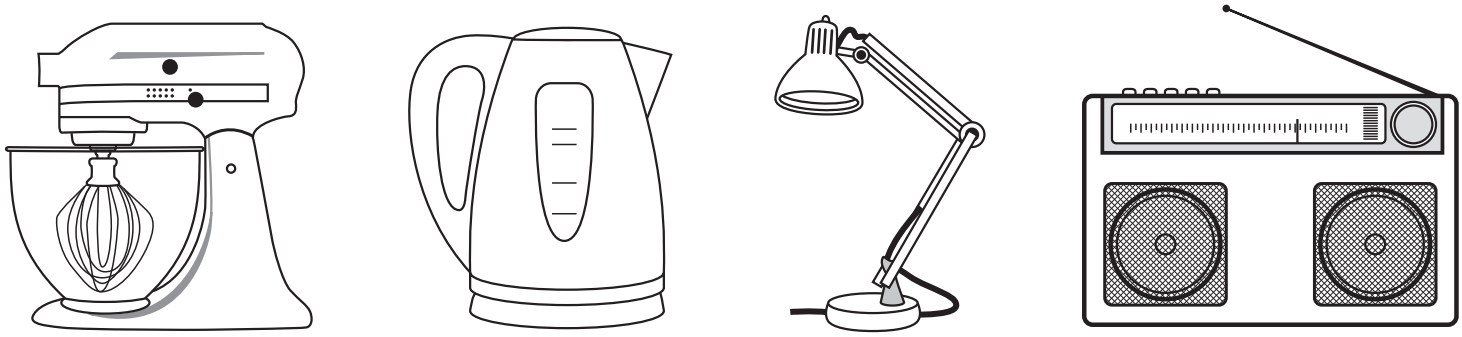
(ii) Calculate the efficiency of the motor.

(2)

efficiency = ...

(Total for Question 8 = 9 marks)

9. The diagram shows some electrical appliances.



A **B** **C** **D**

(a) (i) Which appliance is designed to transfer electrical energy to thermal energy?

(1)

- ☒ **A** food mixer
- ☒ **B** kettle
- ☒ **C** lamp
- ☒ **D** radio

(ii) Which appliance is designed to transfer electrical energy to kinetic energy?

(1)

- ☒ **A** food mixer
- ☒ **B** kettle
- ☒ **C** lamp
- ☒ **D** radio

(b) In all the appliances, energy is conserved.

What is meant by the phrase **energy is conserved**?

(1)

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(c) (i) The lamp has an efficiency of 20%.

Explain what this means.

(2)

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(ii) Draw a labelled Sankey diagram for the lamp.

(3)

(Total for Question 9 = 8 marks)

10. A student investigates how the surface area of water affects how quickly it cools down.

He puts warm water into different shaped containers.

The photograph shows two of the containers.

This is the student's plan.

I will use four different containers and work out the surface area of water in each one.

I will heat some water and pour the same volume into each container.

I will put a thermometer into each container and measure the water temperatures.

After 15 minutes I will measure the temperatures again.

(a) State the independent variable in this investigation.

(1)

.....

(b) (i) State one variable that the student plans to control.

(1)

.....

(ii) Explain why it is important to control this variable.

(2)

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.....

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.....

(c) Suggest a safety precaution for this investigation.

(1)

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.....

(d) The table shows the student's results.

Surface area in cm^2	Starting temperature in °C	Temperature after 15 minutes in °C	Temperature difference in °C
600	85	54	
400	95	55	
300	88	60	
150	85	60	

(i) Complete the table by inserting the missing temperature differences.

(2)

(ii) The student wants to display the data on a graph.

Give suitable labels for the axes of his graph.

(3)

x-axis .....

y-axis .....

(iii) The student realises that it was a mistake to have different starting temperatures.

Suggest how he could change his method to correct this mistake.

(2)

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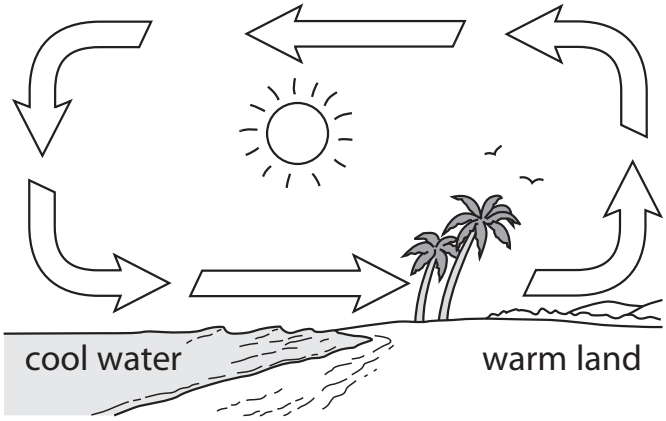
(Total for Question 10 = 12 marks)

11. The diagram shows how air moves near the coast on a warm day.



(a) Explain why air moves as shown on the diagram.

(5)

(b) Explain how Brownian motion provides evidence that air is made of small particles.

(3)

(Total for Question 11 = 8 marks)