AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



EXAM QUESTION PACK

4.1.1.2 CHANGES IN ENERGY (PACK 1)

SCORE	PERCENTAGE
/92	%

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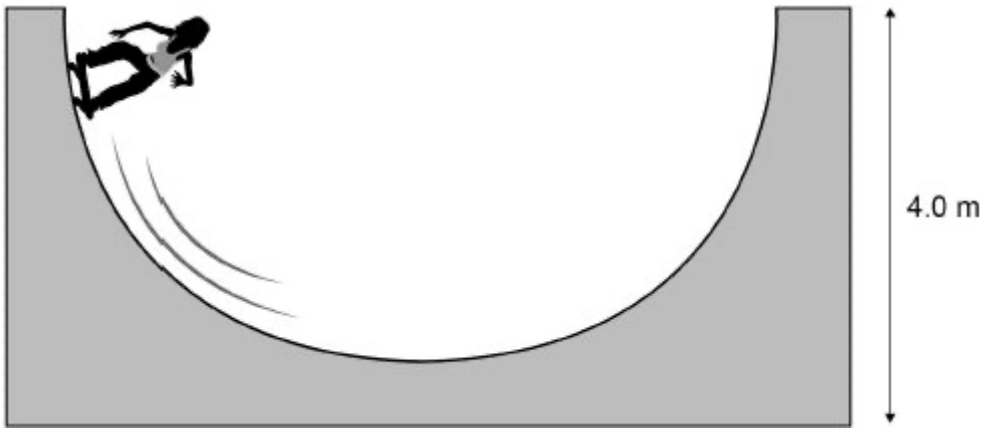
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Q1.

The diagram below shows a girl skateboarding on a semi-circular ramp.



The girl has a mass of 50 kg

(a) Calculate the gravitational potential energy (g.p.e.) of the girl at the top of the ramp.

Use the equation:

g.p.e. = mass × gravitational field strength × height

gravitational field strength = 9.8 N/kg

_____

_____

g.p.e. = _____ J

(2)

(b) The girl has a speed of 7 m/s at the bottom of the ramp.

Calculate the kinetic energy of the girl at the bottom of the ramp.

Use the equation:

kinetic energy = 0.5 × mass × $(\text{speed})^2$

_____

_____

Kinetic energy = _____ J

(2)

(c) Not all of the g.p.e. has been transferred to kinetic energy.

Which **two** statements explain why?

Tick **two** boxes.

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Some energy is wasted. ☐

The mass of the girl is too low. ☐

The ramp is not high enough. ☐

The g.p.e. of the girl is not zero. ☐

The speed of the girl is too great. ☐

(2)

(d) Explain how lubricating the wheels of the skateboard can increase the speed of the girl.

Use ideas about energy in your explanation.

_____

_____

_____

_____

_____

_____

(3)

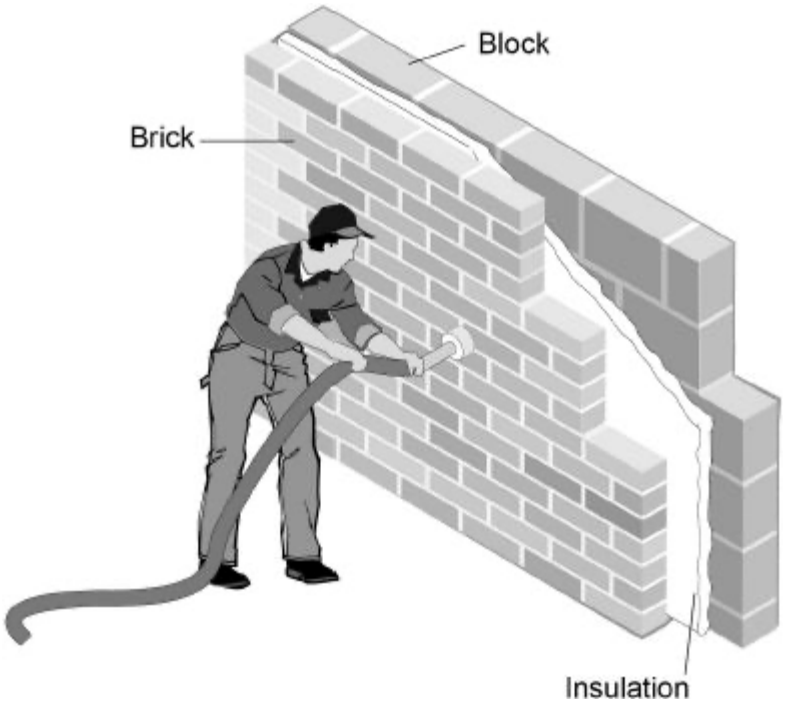
(Total 9 marks)

Q2.

Figure 1 shows cavity wall insulation being installed in the wall of a house.

Figure 1

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(a) Explain how the wall reduces unwanted energy transfers.

(3)

(b) The cavity insulation was tested.

- The heating inside the house was switched off.
- The temperature inside the house was measured every 20 minutes for 2 hours.

The table below shows the results.

Time in minutes	Temperature in °C
0	25.0
20	20.8
40	17.4
60	14.5
80	12.1

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100	10.0
120	8.4

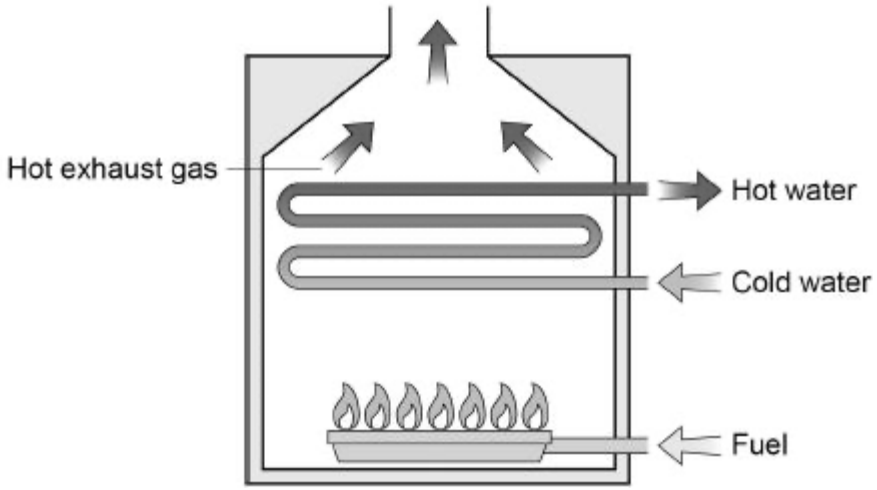
Determine the temperature inside the house after 30 minutes.

Temperature = _____ °C

(2)

(c) **Figure 2** shows the gas boiler used to heat the house.

Figure 2



Describe how different energy stores are changed by the boiler.

(3)

(d) To heat the house, the boiler transfers 15 MJ of energy in 10 minutes.

Calculate the power of the boiler.

Write any equation that you use.

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Power = _____ W

(4)

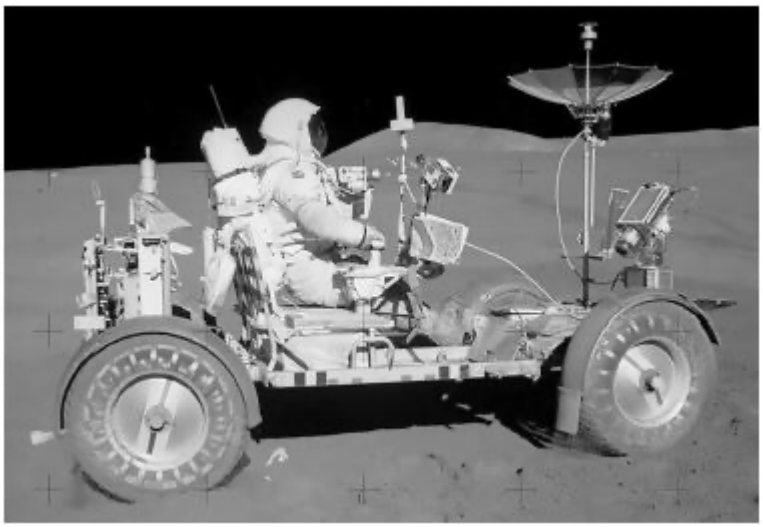
(Total 12 marks)

Q3.

Astronauts have been to the Moon.

(a) Astronauts moved around the surface of the Moon in a lunar rover.

The photograph below shows a lunar rover.



The batteries on the lunar rover provided a potential difference of 36 V

The total charge stored in the batteries was 870 000 C

Calculate the maximum energy that could have been transferred from the batteries.

Use the equation:

energy transferred = charge flow × potential difference

Maximum energy transferred = _____ J

(2)

(b) Not all of the energy from the batteries was usefully transferred to the kinetic energy of the lunar rover.

Explain why.

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_____

_____

_____

(2)

The astronauts collected rock samples from the Moon.

Scientists analysed the percentages of elements in Moon rock and Earth rock.

The table below shows the results.

Element	**Percentage in Moon rock**	**Percentage in Earth rock**
Aluminium	8	8
Iron	13	5
Oxygen	42	47
Silicon	**X**	28
Other elements	10	12

(c) Calculate value **X** in the table above.

X = _____ %

(1)

(d) Give **one** similarity and **one** difference between Moon rock and Earth rock.

Use the table above.

Similarity _____

_____

Difference _____

_____

(2)

(e) Scientists used to think the Earth and Moon formed separately.

Scientists now believe that the Moon formed after a collision between the Earth and a small planet.

This new idea came from the study of Moon rocks.

Why do scientific theories sometimes change?

Tick **one** box.

Scientists agree that the existing theory is old-fashioned ☐

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Scientists change their theories to make the theories more popular ☐

Scientists decide that the new theory is more exciting ☐

Scientists discover new evidence which the existing theory cannot explain ☐

(1)

(f) Write down the equation which links gravitational field strength, gravitational potential energy, height and mass.

_____

_____

(1)

(g) When the astronauts left the Moon, they used a spacecraft with a mass of 2150 kg

Calculate the height reached by the spacecraft at the point where it had a gravitational potential energy of 86 000 000 J

The gravitational field strength of the Moon is 1.6 N/kg

_____

_____

_____

_____

_____

_____

Height = _____ m

(3)

(Total 12 marks)

Q4.

The image shows a girl riding a self-balancing scooter.

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(a) The scooter has an electric motor powered by a battery.

During the ride the battery transfers 15 000 C of charge.

The potential difference across the battery is 36 V

Calculate the energy transferred by the battery.

Use the equation:

energy transferred = charge flow × potential difference

Give your answer in kJ

Energy transferred = _____ kJ

(3)

The table gives data for two scooters with different motors.

Both motors have the same efficiency.

	Power of motor in W	**Mass in kg**
Scooter A	500	10.5
Scooter B	700	14.0

(b) Explain why scooter **B** has a higher maximum speed.

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_____

_____

_____

_____

(2)

(c) Both scooters can be ridden for 20 minutes before the battery needs recharging.

Compare the amount of chemical energy stored in the batteries of each scooter.

_____

_____

(1)

(d) Write the equation that links energy transferred, power and time.

_____

(1)

(e) Calculate the energy transferred by the motor in scooter **B** in 20 minutes.

_____

_____

_____

_____

_____

_____

Energy transferred = _____ J

(3)

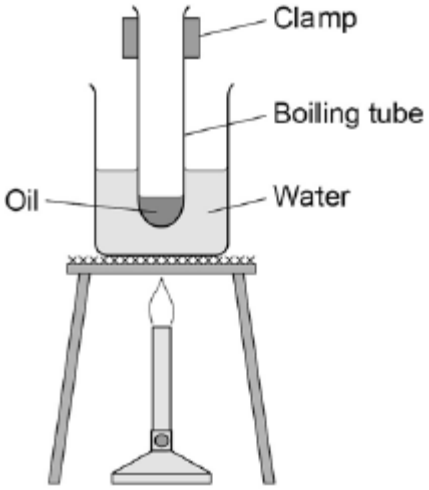
(Total 10 marks)

Q5.

A student investigated the change in temperature when oils of different specific heat capacities were heated.

She set up the apparatus shown in the figure below.

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This is the method used.

1. Put 25 g of oil into a boiling tube.
2. Pour 100 ml of water into a beaker and heat it with a Bunsen burner.
3. When the water is boiling, put the boiling tube into the beaker.
4. When the temperature of the oil reaches 30 °C, heat for a further 30 seconds and record the rise in temperature.
5. Repeat with different oils.
6. Repeat the whole investigation.

(a) Name **two** pieces of apparatus the student used that are **not** shown in the figure above.

1. _____

2. _____

(2)

(b) What are the independent and dependent variables in the student's investigation?

Independent _____

_____

Dependent _____

_____

(2)

(c) Give **two** safety precautions the student should have taken.

1. _____

_____

2. _____

_____

(2)

(d) Suggest **one** improvement to the student's method.

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_____

_____

_____

_____

(2)

(e) The table below shows the student's results.

	Temperature rise in °C			
Type of oil	**1**	**2**	**3**	**Mean**
Castor oil	20	19	21	20
Linseed oil	19	18	19	19
Mineral oil	21	21	21	21
Olive oil	17	17	18	
Sesame oil	23	23	20	22

Calculate the mean temperature rise for olive oil.

Give your answer to two significant figures.

_____

_____

_____

_____

Mean temperature rise = _____ °C

(2)

(f) The mean change in temperature of the castor oil is 20 °C

The specific heat capacity of castor oil is 1 800 J / kg °C

The mass of oil used is 0.025 kg

Calculate the change in thermal energy of the castor oil the student used.

Use the correct equation from the Physics Equations Sheet.

Select the correct unit from the box.

joule	**newton**	**volt**

_____

_____

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Change in thermal energy = _____

Unit = _____

(3)

(Total 13 marks)

Q6.

Figure 1 shows a battery operated remote control car.

Figure 1



© Brandon Bolin/iStock/Thinkstock

(a) The car's battery contains a store of energy.

As the car moves, energy from one store is transferred to another store.

Describe how different stores of energy change as the car moves.

(2)

(b) The car has a top speed of 12 m / s and a mass of 800 g.

Write down the equation that links kinetic energy, mass and speed.

Equation _____

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(1)

(c) Calculate the maximum kinetic energy of the car.

Maximum kinetic energy = _____ J

(2)

(d) Explain why having a more efficient motor increases the top speed of the car.

(2)

(e) **Figure 2** shows an electric car being charged.

Figure 2



By Alan Trotter Electric Car Charging [CC-BY-2.0]via Flickr

A driver wishes to buy a new car.

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The table below gives some data about an electric car and one with a petrol engine.

	Electric car	Petrol engine car
Cost (£)	27 000	15 000
Running cost per year (£)	250	2 000
Average lifetime (years)	12	12

Which car would be the most economic over its 12 year lifetime?

Use data from the table above to support your answer.

You should include the difference in cost in your answer.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 11 marks)

Q15.

(a) A washing machine washes dirty clothes and then spins the clothes to remove some of the water.

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

chemical	**electrical**	**kinetic**	**sound**

When the washing machine spins the clothes, _____

energy is transferred into useful _____ energy.

(2)

(ii) Name **one** type of energy the washing machine wastes when spinning the clothes.

_____

(1)

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(iii) What eventually happens to all the wasted energy?

Tick **one** box.

The wasted energy is transferred to the clothes. ☐

The wasted energy is transferred to the surroundings. ☐

The wasted energy is trapped and is re-used. ☐

(1)

(b) The table shows information about two different washing machines, **A** and **B**.

	Washing machine A	**Washing machine B**
Cost to buy	£269	£249
Maximum wash load	8 kg	7 kg
Energy transferred in one wash cycle	0.7 kWh	1.2 kWh
Water used in one wash cycle	48 litres	50 litres

Use the information in the table to give **one** advantage and **one** disadvantage of washing machine **A** compared with washing machine **B**.

Advantage _____

_____

Disadvantage _____

_____

(2)

(Total 6 marks)

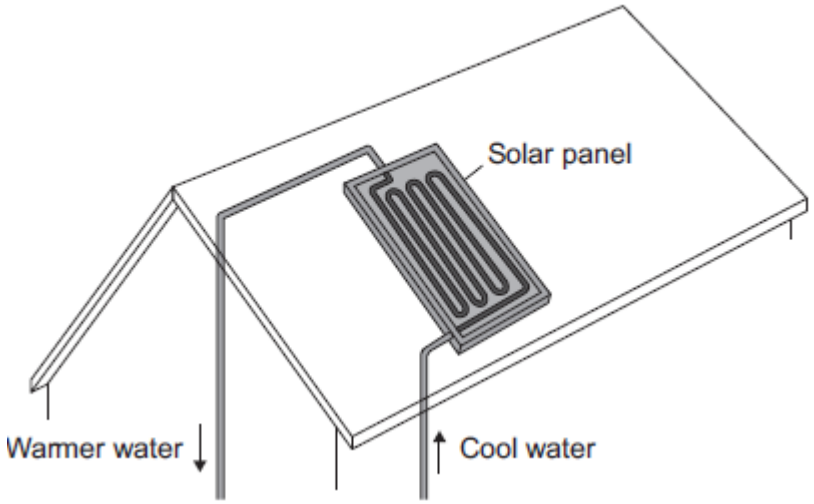
Q16.

Solar panels can heat water for use in a home.

Figure 1 shows a solar panel on the roof of a house.

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Figure 1



(a) The solar panel is designed to transfer as much energy to the water as possible.

(i) Draw a ring around the correct answer to complete the sentence.

The solar panel is black to increase energy transferred to the water by

conduction. **infrared radiation.**

(1)

(ii) Draw a ring around the correct answer to complete the sentence.

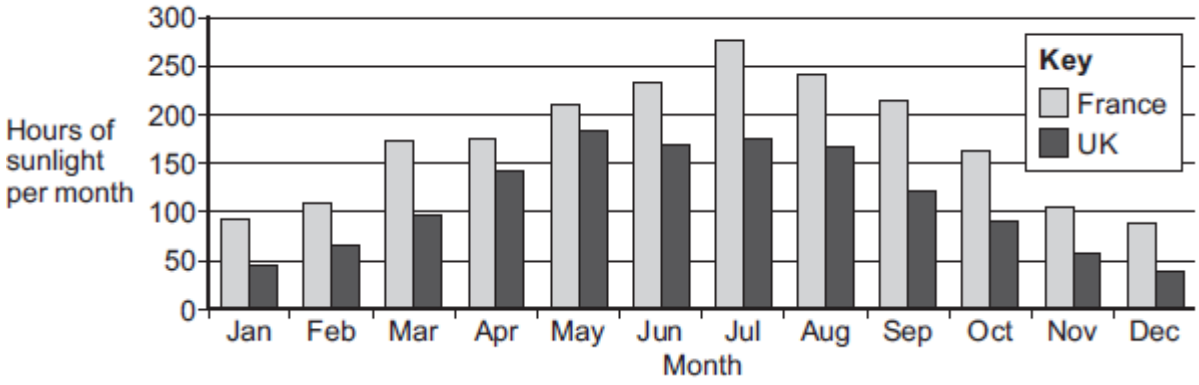
Solar panels usually have a large surface area so that more energy can be

absorbed. **emitted.** **reflected.**

(1)

(b) **Figure 2** shows the hours of sunlight each month for one year in France and in the UK.

Figure 2



Solar panels are used more in France than in the UK.

Use **Figure 2** to explain why.

_____

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_____

_____

_____

(2)

(c) The solar panel heats 200 kg of water each day. On one day it increases the temperature of the water by 50 °C.

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

Calculate the energy needed to increase the temperature of 200 kg of water by 50 °C.

Use the correct equation from the Physics Equations Sheet.

Tick (✓) the correct unit.

_____

_____

_____

_____

Energy = _____

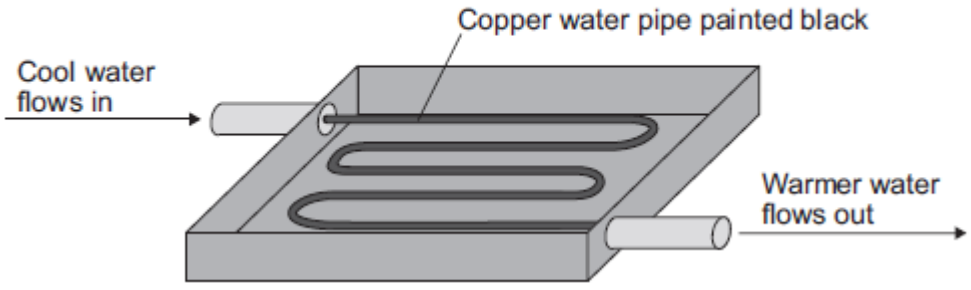
	Tick (✓)
joules	
seconds	
watts	

(3)
(Total 7 marks)

Q17.

(a) **Figure 1** shows a solar panel. Solar panels can be fitted to house roofs and used to heat water for domestic hot water systems.

Figure 1



Use **Figure 1** to explain how the design of the water pipe increases the rate of

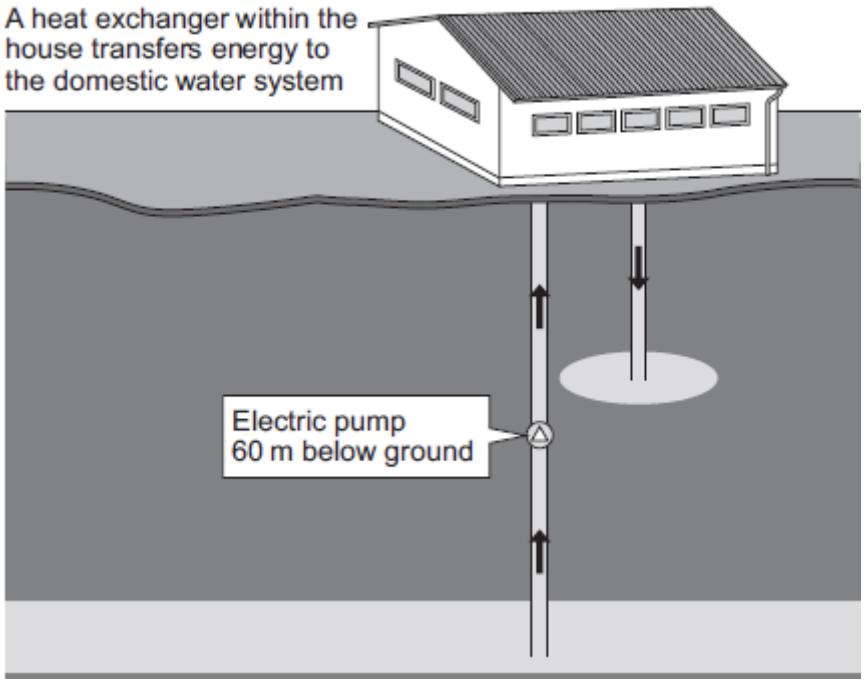
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energy transfer from the Sun to the water.

(3)

(b) **Figure 2** shows a different method of heating water called a ground source heat pump. Two holes are drilled into the ground and fitted with pipes. Warm water is pumped up one pipe and waste water is returned to the ground through the other pipe. In the house, energy is transferred from the warm water by a heat exchanger.

Figure 2



(i) Suggest **one** advantage of using this method of heating water rather than using solar panels.

(1)

(ii) A leaflet about a ground source heat pump states:

'Ground source heat pumps are 300 – 400% efficient. For each joule of mains electrical energy the pumps use, they transfer three to four times more energy from the water'.

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Two students read the leaflet.

Student **A** says, 'It is incorrect to say that a device is 300 – 400% efficient'.

Student **B** says, 'The statement is correct'.

Both conclusions could be considered to be correct.

Explain why.

Student **A**'s conclusion _____

_____

_____

_____

_____

Student **B**'s conclusion _____

_____

_____

_____

_____

_____

(4)

(iii) Domestic water enters the heat exchanger at a temperature of 7.0 °C and leaves the heat exchanger at a temperature of 55 °C.

Each day 19 000 000 joules of energy are supplied to the water passing through the heat exchanger.

Calculate the mass of water that can be heated each day.

Choose the correct equation from the Physics Equations Sheet.

Specific heat capacity of water = 4200 J / kg °C.

Give your answer to 2 significant figures.

_____

_____

_____

_____

_____

_____

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Mass of water = _____ kg

(4)

(Total 12 marks)

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