AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



EXAM QUESTION PACK

4.1.2.2 EFFICIENCY (PACK 1)

SCORE	PERCENTAGE
/75	%

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Q1.

Astronauts have landed on the Moon on six separate occasions.

(a) The Moon is in a circular orbit around the Earth. The speed of the Moon is constant.

Explain why the Moon is accelerating.

_____

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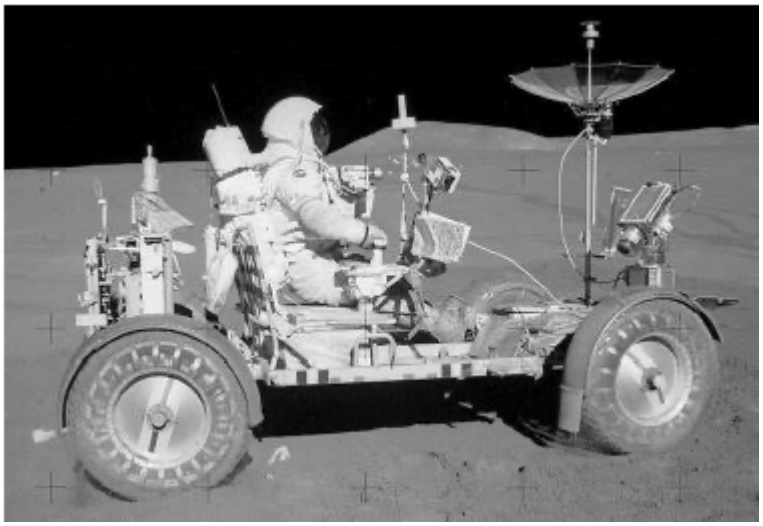
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(3)

The astronauts moved around the surface of the Moon in a lunar rover.

The photograph below shows a lunar rover.



(b) At one point, the lunar rover accelerated from 1.4 m/s to 2.6 m/s

The acceleration of the lunar rover was 0.31 m/s^2

Which calculation could be used to calculate the distance travelled s during this acceleration?

Tick **one** box.

$s = \sqrt{2.6^2 - 1.4^2 - 2 \times 0.31}$ ☐

$s = \dfrac{1.4^2 - 2.6^2}{2 \times 0.31}$ ☐

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$$s = \frac{2.6^2 - 1.4^2}{2 \times 0.31}$$ ☐

$$s = \frac{2 \times (2.6^2 - 1.4^2)}{0.31}$$ ☐

(1)

(c) The lunar rover used four electric motors connected in parallel to a 36 V battery.

The maximum output power of one motor was 190 W

The efficiency of each motor was 72%

Calculate the current drawn from the battery when all four motors were operating at maximum power.

Current = _____ A

(6)

(d) Scientists once thought that the Moon formed elsewhere in the solar system and later came to orbit the Earth.

Studies of Moon rocks brought back by the astronauts showed that the rocks were extremely similar to those found on Earth.

This led to a new theory about how the Moon formed called the 'Giant Impact Hypothesis'.

According to the Giant Impact Hypothesis, a small planet collided with the Earth. Molten rock thrown up by the collision then formed the Moon.

Suggest why a new theory was developed.

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_____

_____

_____

(2)

(Total 12 marks)

Q2.

Figure 1 shows a student making potato soup.

Figure 1



(a) The student places 0.5 kg of potato into a pan of water.

During cooking, the temperature of the potato increases from 20 °C to 100 °C

The specific heat capacity of the potato is 3400 J/kg °C

Calculate the change in thermal energy of the potato.

Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

_____

_____

_____

_____

_____

_____

Change in thermal energy = _____ J

(3)

(b) Why is the energy supplied by the cooker greater than that calculated in part (a)?

_____

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(1)

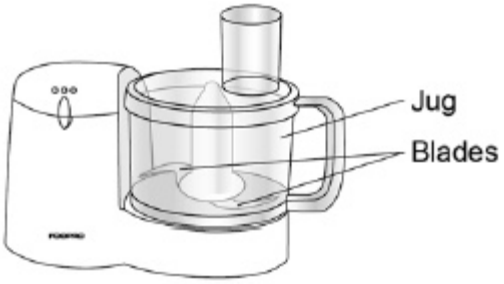
(c) Suggest **one** way that the student could reduce the time to heat the potato to 100 °C

_____

(1)

Figure 2 shows a food processor.

Figure 2



(d) The student places the cooked potato into the jug of the food processor.

The food processor contains a motor that spins blades to chop the potato.

The total power input to the motor is 500 W

The useful power output from the motor is 300 W

Calculate the efficiency of the motor in the food processor.

Use the equation:

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

_____

_____

_____

Efficiency = _____

(2)

(e) The jug is made of plastic with a low thermal conductivity.

Explain why this is an advantage.

_____

_____

_____

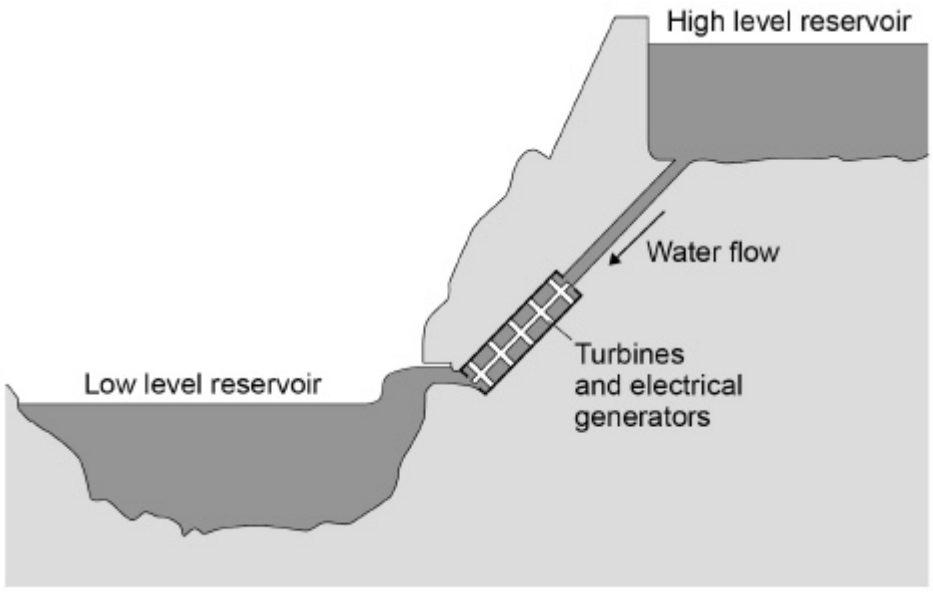
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(2)
(Total 9 marks)

Q3.

The diagram shows the flow of water through a hydroelectric power station.



The falling water turns the turbines.

The movement of the turbines causes the electrical generators to generate electricity.

(a) Write the equation which links kinetic energy, mass and speed.

_____

(1)

(b) In 1 minute, a mass of 9 000 kg of water flows through the turbines.

The speed of the water is 30 m/s

Calculate the total kinetic energy of the water passing through the turbines in 1 minute.

Give your answer in kilojoules (kJ).

_____

_____

_____

_____

Kinetic energy = _____ kJ

(3)

(c) Write the equation which links efficiency, total input energy transfer and useful output energy transfer.

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(1)

(d) The efficiency of the turbines and generators is 80%

Calculate the useful output energy transfer from the hydroelectric power station in 1 minute.

Use your answer to part (b).

Useful output energy transfer = _____ kJ

(3)

(e) A small group of people live in an area in the mountains.

The people plan to buy an electricity generating system that uses either the wind or the flowing water in a nearby river.

- The wind turbine costs £50 000 to buy and install.
- The hydroelectric generator costs £20 000 to buy and install.
- The average power output from the wind turbine is 10 kW
- The hydroelectric generator will produce a constant power output of 8 kW

Compare the advantages and disadvantages of the two methods of generating electricity.

Use your knowledge of energy resources and information given.

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_____

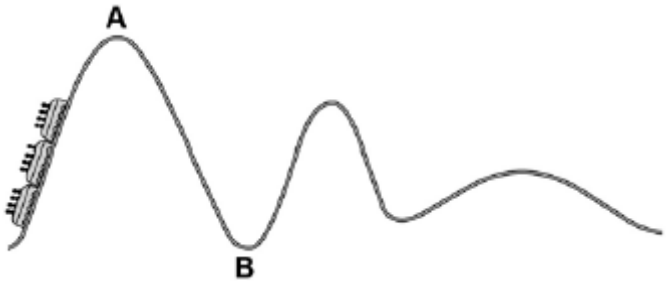
_____

(4)

(Total 12 marks)

Q4.

The figure below shows a rollercoaster.



The rollercoaster car is raised a vertical distance of 35 m to point **A** by a motor in 45 seconds.

The mass of the rollercoaster is 600 kg.

The motor has a power rating of 8 000 W.

(a) Calculate the percentage efficiency of the motor.

Gravitational field strength = 9.8 N / kg.

_____

_____

_____

_____

_____

_____

_____

Efficiency = _____ %

(5)

(b) The rollercoaster rolls from point **A** to point **B**, a drop of 35 m.

Calculate the speed of the roller coaster at point **B**.

Assume that the decrease in potential energy store is equal to the increase in kinetic energy store.

_____

_____

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Speed at point **B** = _____ m / s

(6)

(Total 11 marks)

Q19.

Laptop computers can get very hot when they are left on for a long time. This decreases the energy efficiency of a laptop computer.

(a) Which statement best describes what **decreased efficiency** means?

Tick (✓) **one** box.

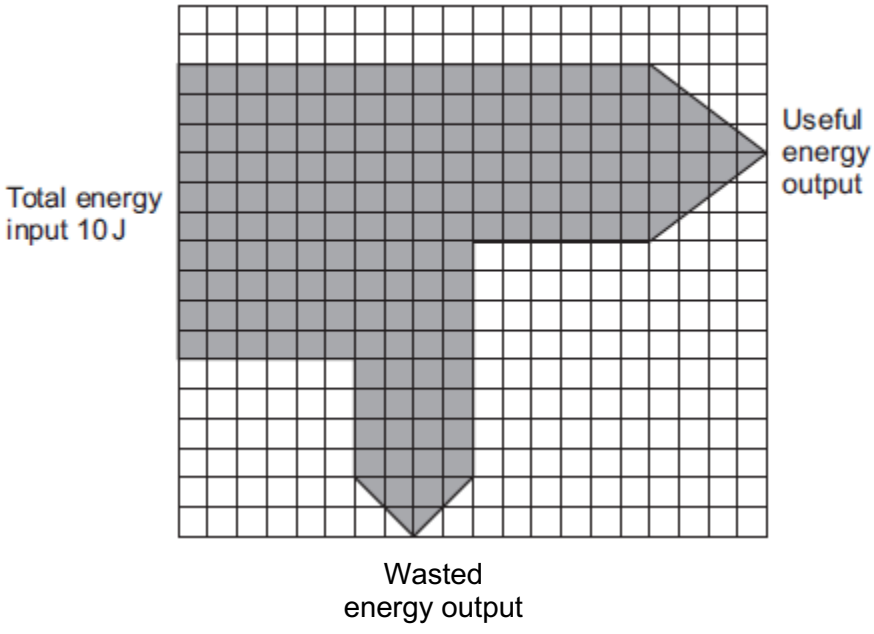
Statement	**Tick (✓)**
The energy output is increased.	
A greater proportion of the energy is wasted.	
The energy input is decreased.	

(1)

(b) The total energy input to a laptop computer is 10 J each second.

Figure 2 shows the energy transfers in a laptop computer each second.

Figure 2



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(i) Use **Figure 2** to calculate the useful energy output each second for the laptop computer.

Useful energy output each second = _____ J

(1)

(ii) Calculate the efficiency of the laptop computer.

Use the correct equation from the Physics Equations Sheet.

_____

_____

_____

Efficiency = _____

(2)

(iii) What effect does the wasted energy have on the surroundings?

_____

(1)

(Total 5 marks)

Q20.

Laptop computers can get very hot when they are left on for a long time. This decreases the energy efficiency of a laptop computer.

(a) What does **decreased efficiency** mean?

Tick (✓) **one** box.

Statement	**Tick (✓)**
The energy output is increased.	
A greater proportion of the energy is wasted.	
The energy input is decreased.	
A greater proportion of the energy is usefully transferred.	

(1)

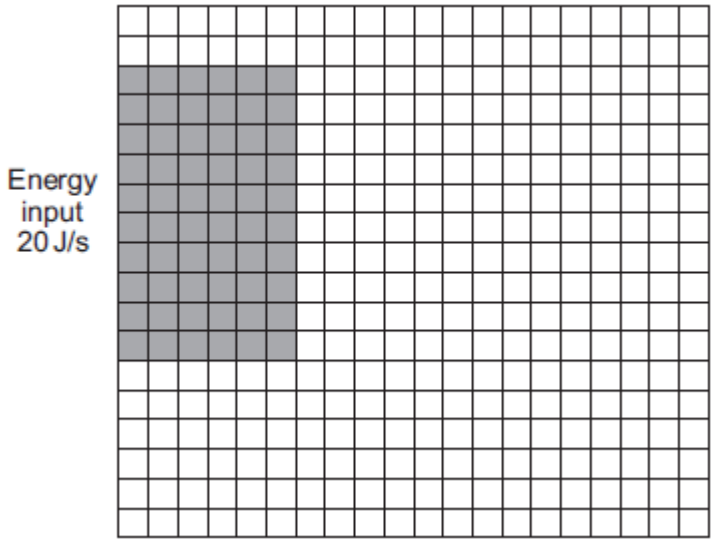
(b) The input energy to a laptop computer is 20 J each second. When the laptop is being used, 12 J of energy is transferred usefully each second and 8 J of energy is wasted each second.

Use the grid in **Figure 2** to complete the Sankey diagram for the laptop computer when it is being used.

Label your diagram.

Figure 2

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(2)
(Total 3 marks)

Q21.

The cost of electricity is increasing. People want to use devices that are more energy efficient.

(a) What does *energy efficient* mean?

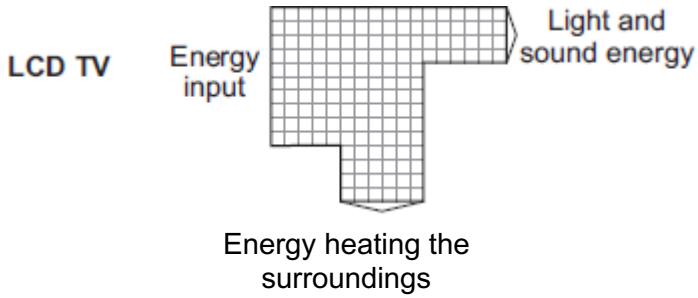
Tick (✓) **one** box.

Statements	Tick (✓)
Energy efficient means a low energy input.	
Energy efficient means a small proportion of wasted energy.	
Energy efficient means a small proportion of useful energy.	

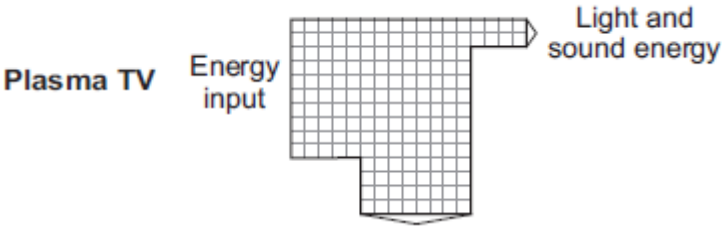
(1)

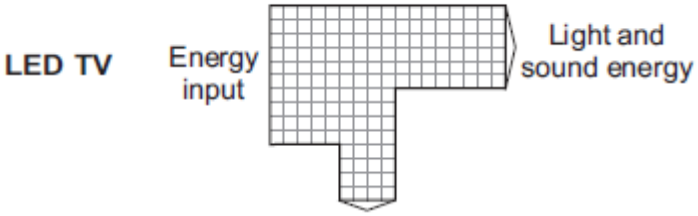
(b) A householder is trying to decide which TV to buy. The choice is between an LCD TV, a Plasma TV and an LED TV. The TVs had the same sized screens.

The Sankey diagrams show the proportion of the input energy that is transferred to different energy forms by the three TVs.



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Which TV wastes the largest proportion of the input energy?

_____

(1)

(c) The power rating of a TV when in use is 0.3 kW.

Calculate the energy used by the TV when in use for 6 hours.

Use the correct equation from the Physics Equations Sheet.

Draw a ring around the correct unit.

_____

_____

_____

_____

Energy used = _____

kW
kWh
W

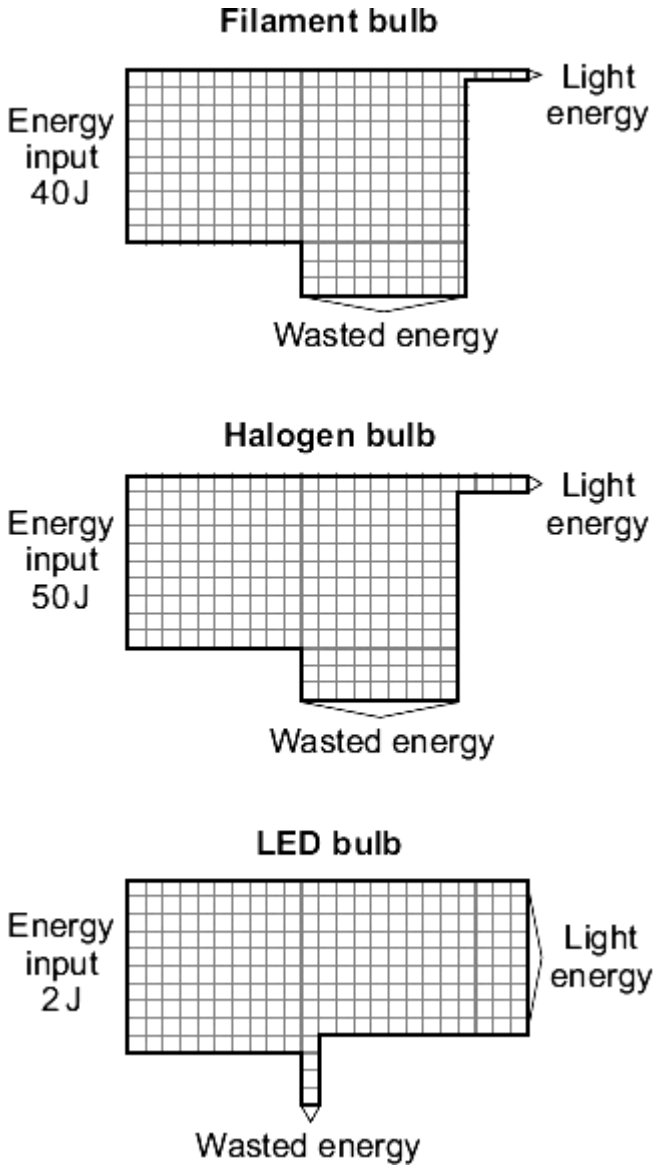
(3)

(Total 5 marks)

Q22.

The Sankey diagrams show the energy transferred to the surroundings each second by three different bulbs.

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(a) The filament bulb is the least efficient of the three bulbs.

Explain what *least efficient* means.

_____

_____

_____

_____

(2)

(b) Calculate the percentage efficiency of the halogen bulb.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

_____

_____

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_____

_____

Efficiency = _____%

(2)

(c) What effect does the wasted energy from a bulb have on the surroundings?

_____

_____

(1)

(d) Use the Sankey diagrams to give a reason why the overall cost of using an LED bulb is the lowest of the three bulbs.

_____

_____

(1)

(e) The table gives further information about each type of bulb.

Bulb	Cost to buy in £	Average lifespan in hours
Filament	0.50	1000
Halogen	2.00	2500
LED	15.00	25000

Use **only** the information in the table to answer the following questions.

(i) Which type of bulb is the most cost-effective?

Give a reason for your answer.

Bulb _____

Reason _____

_____

(2)

(ii) Sales of LED bulbs are increasing.

Suggest **one** reason why.

_____

_____

(1)

(Total 9 marks)

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Q23.

A battery powered electric fan is used to move air around a room.



Photograph supplied by Comstock/Thinkstock

(a) Use words from the box to complete each sentence.

chemical	light	kinetic	electrical	sound

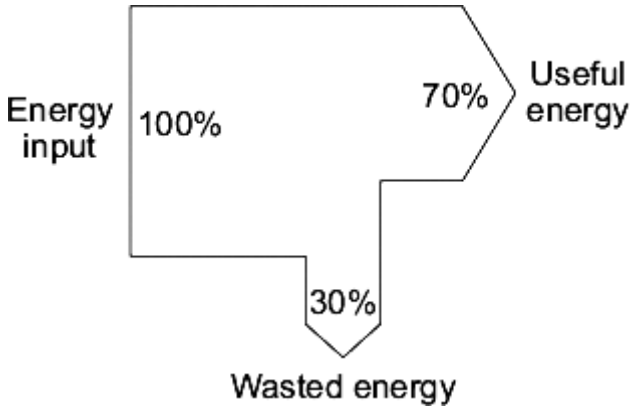
In the batteries, _____ energy is transferred to

_____ energy in the wires.

The fan has _____ energy as it rotates.

(3)

(b) The Sankey diagram shows how much energy is usefully transferred when the fan is being used.



(i) What is the efficiency of the fan?

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(1)

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

All of the energy from the fan is eventually transferred to the surroundings.

This makes the temperature of the surroundings

increase.
decrease.
stay the same.

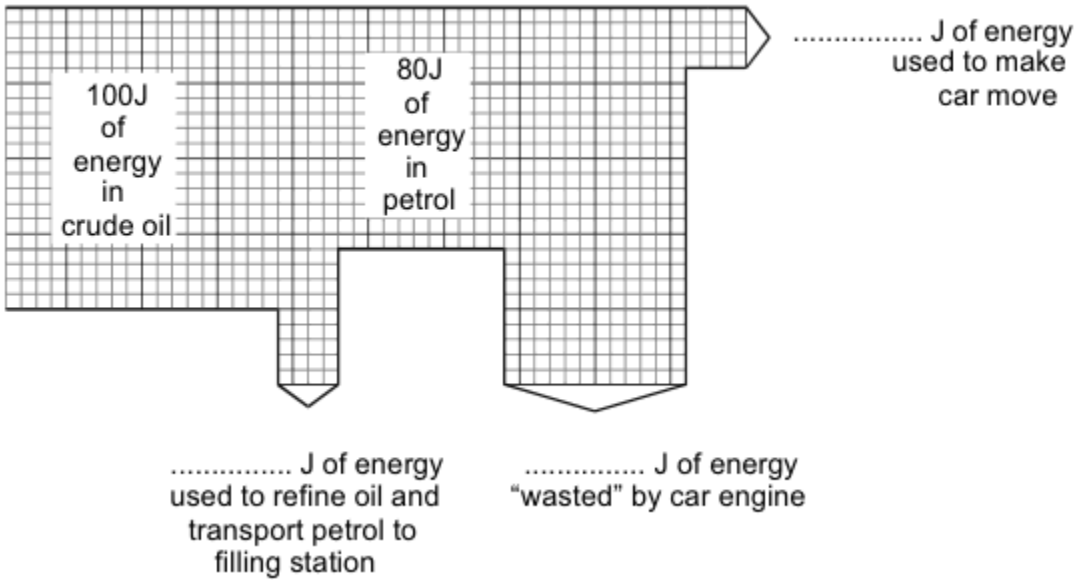
(1)

(Total 5 marks)

Q24.

The diagram shows what happens to each 100 joules of energy from crude oil when it is used as petrol in a car.

The widths of the arrows show exactly how much energy is transferred in each particular way.



(a) Complete the diagram by adding the correct energy value alongside each arrow.

(2)

(b) Calculate how efficient the car engine is at transferring the energy **from petrol** into useful movement.

Show clearly how you work out your answer.

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(2)
(Total 4 marks)

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