Using solar energy

1 A student uses a solar powered battery charger to charge some batteries.

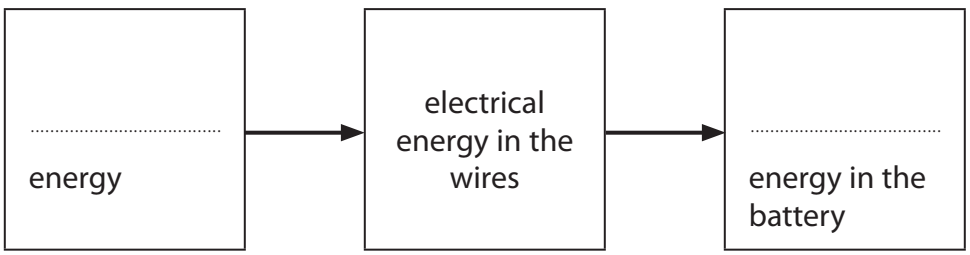
(a) The diagram is an energy transfer diagram for a battery being charged.

Use words from the box to complete the energy transfer diagram.

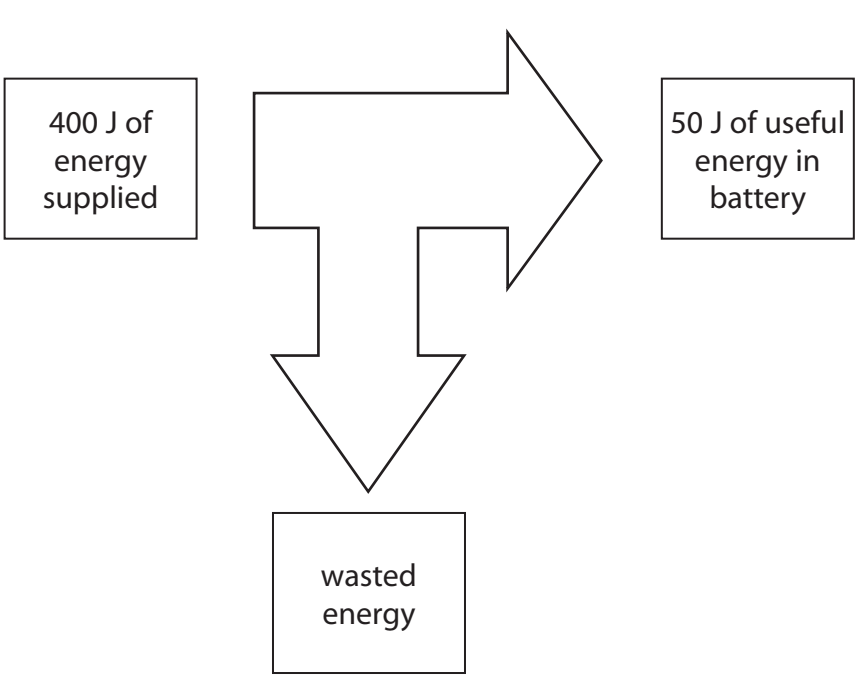
(2)

light	kinetic	sound
electrical	chemical	

Energy transfer diagram



(b) The diagram shows how much energy is usefully transferred by the battery charger.



(i) Calculate the amount of wasted energy.

(1)

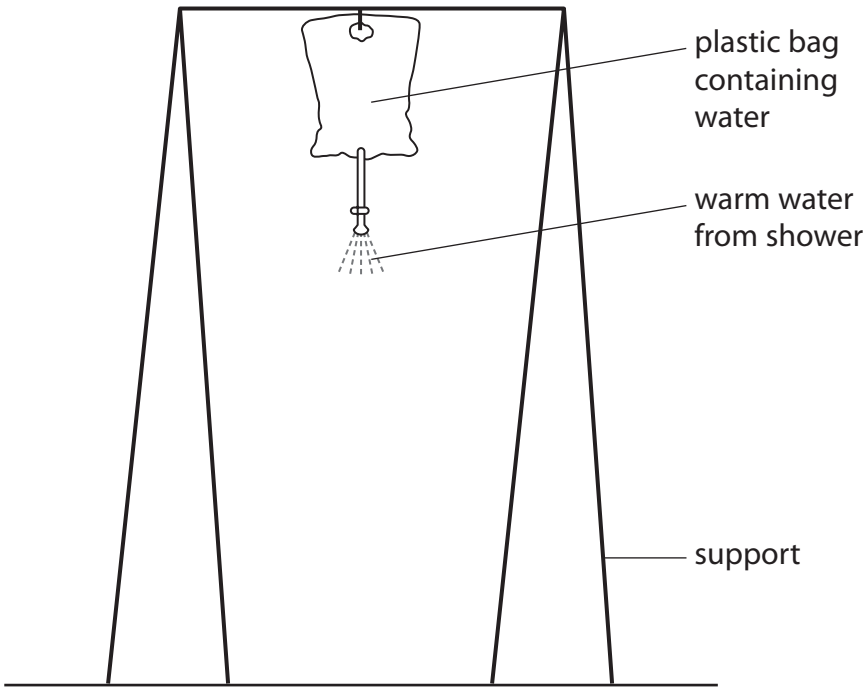
wasted energy = ... J

(ii) Calculate the efficiency of the battery charger.

(2)

efficiency of the battery charger = ... %

(c) The following arrangement is used as a solar powered shower.



The bag is left out in the sunlight during the day.

(i) Explain what colour the bag should be to heat the water to the highest temperature.

(2)

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(ii) On a sunny day the bag is filled with cold water.
Explain why the temperature of the water increases and then stays constant.

(3)

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(Total for Question 4 = 10 marks)

Investigating electric motors

2 Some students investigate the efficiency of electric motors.

(a) (i) The students find that one electric motor has an efficiency of 60%.

Explain in terms of energy what is meant by an efficiency of 60%.

(2)

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(ii) The students use some motors to lift weights.

The students measure the input power and output power of two motors.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The power of a motor is the rate at which it transfers

(1)

☒ **A** current

☒ **B** energy

☒ **C** voltage

☒ **D** charge

(iii) The first motor has a power rating of 20 W.

The motor is used for 15 s.

Calculate the energy supplied to the motor.

(2)

energy supplied to the motor = ... J

(iv) In the second motor, the useful output power was 18 W when the input power was 24 W.
Calculate the efficiency of this motor.

(2)

efficiency = ... %

(b) One of the students states that all of the energy supplied to a motor is transferred into other forms.

Complete the following sentence by putting a cross (☒) in the box next to your answer.
This statement is one example of the idea of

(1)

☒ **A** renewable energy

☒ **B** conservation of energy

☒ **C** non-renewable energy

☒ **D** sustainable energy

(Total for Question 2 = 8 marks)

The power of television

3 Modern televisions use small amounts of power.

(a) Which of these describes power?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** distance travelled per second

☒ **B** energy transferred

☒ **C** energy transferred per second

☒ **D** work done

(b) A television is connected to the 230 V mains.
When it is switched on, the current in the television is 0.25 A.

(i) Calculate the power consumption of the television when it is switched on.

(2)

power consumption = ... W

(ii) Describe what is meant by **current**.

(2)

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(c) When the television is switched to standby, the power consumption falls to 0.5 W.

(i) State how this changes the current in the television.

(1)

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(ii) The cost of electricity is 26p per kW h.

Show that the cost of leaving the television on standby for 48 hours is less than 1p.

(3)

(iii) It is cheaper to switch the television off instead of leaving it on standby.

Suggest another reason why it is better not to leave the television on standby.

(1)

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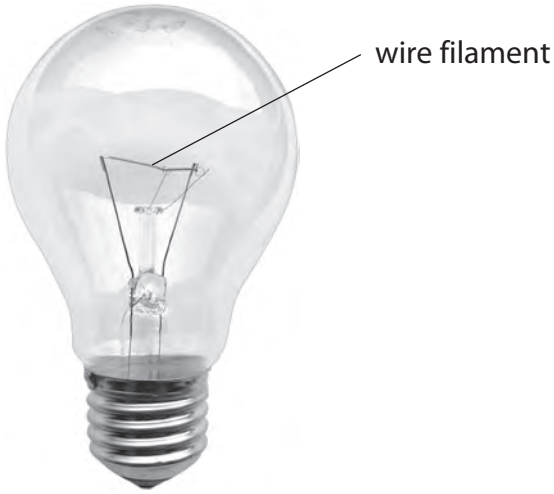
(Total for Question 4 = 10 marks)

Lamps

4 This lamp has a wire filament that glows white hot when it is in use.



(a) A 100 W filament lamp is 15% efficient.

(i) Explain the meaning of the term **15% efficient**.

(2)

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(ii) Draw a labelled energy flow diagram to show what happens to 100 J of electrical energy supplied to the lamp.

(2)

(b) Many people choose to buy expensive low-energy lamps instead of cheaper filament lamps.

Give **two** reasons for this.

(2)

(c) When a filament lamp is in use, the temperature of the wire filament remains at 2500 °C.

Explain why this temperature remains constant.

(3)

(Total for Question 2 = 9 marks)

5 A pilot begins to land an aircraft.

(a) The height of the aircraft decreases from 200 m above the ground to 100 m.

(i) What happens to the gravitational potential energy of the aircraft?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** it becomes zero

☒ **B** it decreases

☒ **C** it does not change

☒ **D** it increases

(ii) The velocity of the aircraft remains constant.

What happens to the kinetic energy of the aircraft?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** it becomes zero

☒ **B** it decreases

☒ **C** it does not change

☒ **D** it increases

(b) The aircraft lands with its wheels on the runway as shown.

The aircraft is moving forwards.

(i) Draw an arrow on the diagram to show the direction of the momentum of the aircraft.

(1)

(ii) The velocity of the aircraft when it lands is 75 m/s.

The mass of the aircraft is 130 000 kg.

Calculate the momentum of the aircraft.

(2)

momentum = ... kg m/s

(iii) The aircraft comes to a stop.

State the momentum change of the aircraft from when it lands to when it stops.

(1)

change in momentum = ... kg m/s

(c) When the aircraft lands, the momentum of each passenger also changes.

(i) Explain why it is more comfortable for a passenger if the aircraft takes a longer time to slow down.

(2)

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(ii) Suggest why some aircraft need a very long runway to land safely.

(2)

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(Total for Question 4 = 10 marks)