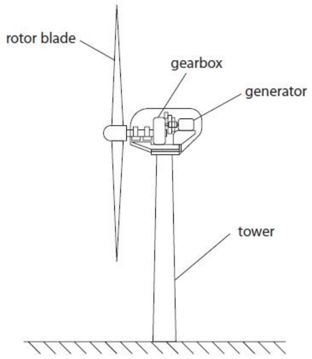
Q1.
Figure 11 shows a wind turbine.



Explain how unwanted energy transfers could be reduced in the gear box.

(2)

Q2.

A cyclist has a mass of 64 kg.

(i) The cyclist rides from a flat road to the top of a hill.
The top of the hill is 24 m above the flat road.
Calculate the gain in gravitational potential energy, ΔGPE, of the cyclist.
Use g = 10 N/kg
Use the equation

$$\Delta GPE = m \times g \times \Delta h$$

(2)

(ii) The cyclist returns to the flat road.
The mass of the cyclist is 64 kg.
Calculate the kinetic energy of the cyclist when the cyclist is travelling at 6.0 m/s.
Use the equation

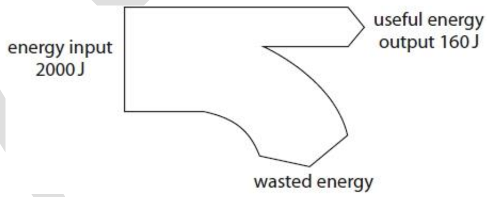
$$KE = \frac{1}{2} \times m \times v^2$$

(3)

(iii) The cyclist then uses the brakes on the bicycle to stop.
Explain what happens to the kinetic energy of the cyclist.

(2)

Q3.
Figure 2 shows an energy transfer diagram for a steam engine.
The diagram shows the amounts of energy transferred each second by the steam engine.



(i) Calculate the amount of wasted energy.

(1)

(ii) Calculate the efficiency of the steam engine.
Use the equation

$$\text{efficiency} = \frac{\text{(useful energy transferred by the steam engine)}}{\text{(total energy supplied to the steam engine)}}$$

(2)

(iii) State what happens to the wasted energy.

(1)

(iv) Coal is a fossil fuel that is burnt in some steam engines.
State **two** ways that the use of coal might be harmful to the environment.

(2)

Q4.
Shot-put is an Olympic event.
The shot is a heavy ball.
An athlete throws the shot as far as possible.
A sports scientist analyses an athlete's throw to help improve performance.
In one throw, the shot continues to rise by another 1.3 m after it leaves the athlete's hand.
The mass of the shot is 7.26 kg.

(i) Calculate the amount of gravitational potential energy gained by the shot.

(2)

(ii) Explain how the total energy stored in the shot changes between leaving the athlete's hand and hitting the ground.

(2)

Q5.
A different cyclist uses a motorised bicycle.
The motorised bicycle is powered by an electric motor.
Figure 3 is an energy diagram for the motor.

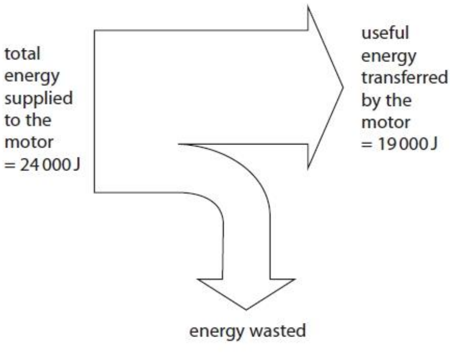


Figure 3

(i) Calculate how much energy is wasted.

(1)

(ii) Calculate the efficiency of the electric motor.
Use the equation:

(2)

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

Q6.
Figure 4 shows a truck lifting a box.

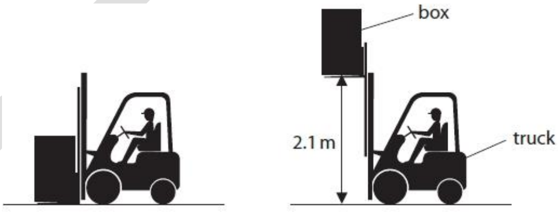


Figure 4

The box has a mass of 57 kg.
The truck lifts the box through a vertical height of 2.1 m.
The gravitational field strength, g = 10 N/kg
Calculate the change in the gravitational potential energy of the box.
Use the equation

$$\Delta GPE = m \times g \times \Delta h$$

(2)

Q7.
Figure 11 is an energy diagram for an electric kettle, used to heat water.

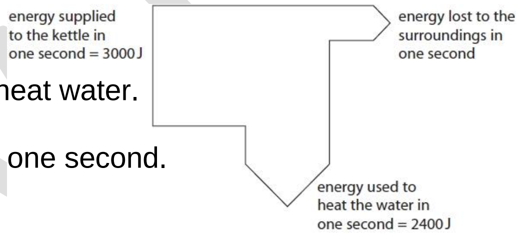


Figure 11

(i) Calculate the amount of energy lost to the surroundings in one second.

(1)

(ii) Calculate the efficiency of the kettle.
Use the equation

$$\text{efficiency} = \frac{\text{useful energy transferred by the kettle in one second}}{\text{total energy supplied to the kettle in one second}}$$

(2)

Q8.
A model train has a mass of 8.0 kg.
It travels at a speed of 1.5 m/s.
Calculate the kinetic energy of the model train.
Use the equation

$$\text{kinetic energy} = \tfrac{1}{2} \times \text{mass} \times (\text{speed})^2$$

(3)

Q9.
A cyclist of mass 70 kg travels at a constant velocity of 8 m/s.
Calculate the kinetic energy of the cyclist.

(3)

Q10.
(i) A car is moving at 90 km/h when the driver has to stop.
Calculate the thinking time of the driver.
Using the equation:
time = distance ÷ average speed

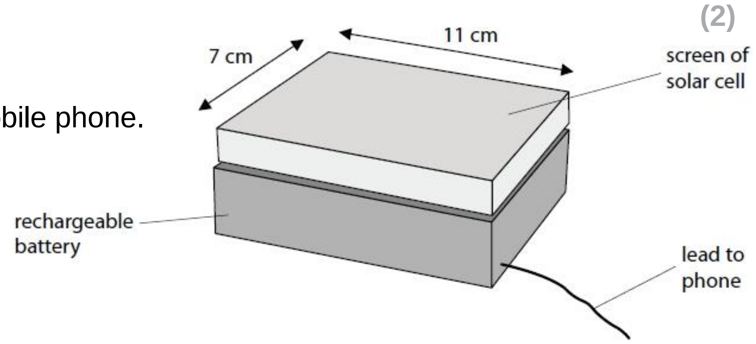
(2)

(ii) A car has a mass of 1300 kg.
Calculate the kinetic energy of the car when it is travelling at 20 m/s.

(2)

Q11.

Figure 1 shows a solar-powered charger for a mobile phone.

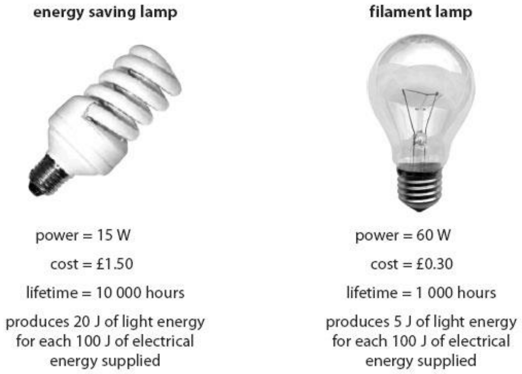


The screen of the solar cell takes in energy from the Sun.
Each second, 0.12 J of energy from the Sun reaches 1 cm^2 of the screen.
Calculate the total amount of energy reaching the whole screen in 1 second.

(3)

Q12.

*Some students found this information about an energy saving lamp and a filament lamp that give out almost the same amount of light.



Describe the advantages and disadvantages of each type of lamp.

(6)

Q13.
A student lifts a toy car from a bench and places the toy car at the top of a slope as shown in Figure 9.

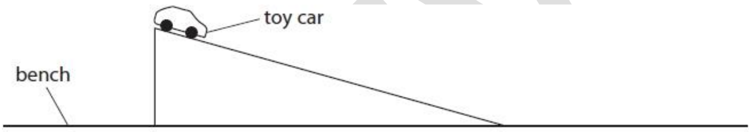


Figure 9

Describe an energy transfer that occurs when the student lifts the toy car from the bench and places the toy car at the top of the slope.

(2)

Q14.
Expanded polystyrene, used to insulate buildings, has different densities.
Figure 10 shows how the thermal conductivity of expanded polystyrene changes with the density of expanded polystyrene.

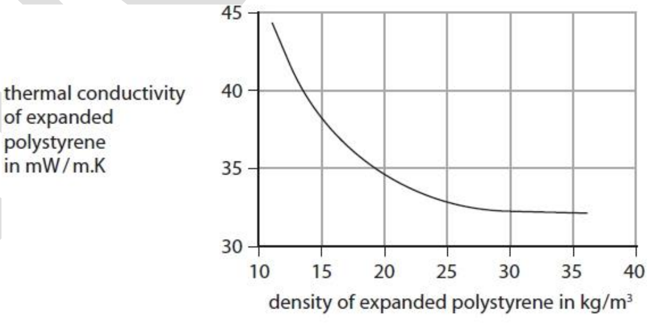


Figure 10

Using the graph in Figure 10, describe how the thermal conductivity of expanded polystyrene changes with the density of expanded polystyrene.

(2)

Q15.
A house has a boiler to provide hot water.
One type of boiler burns natural gas.
Natural gas is a non-renewable source of energy.
* A company has developed a new material which they think could be used instead of foam around the cylinder.

Devise an investigation they could carry out to make a fair comparison of the insulating properties of their new material with those of the foam.

(6)

Q16.

Some students investigate the efficiency of electric motors.

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

Q17.

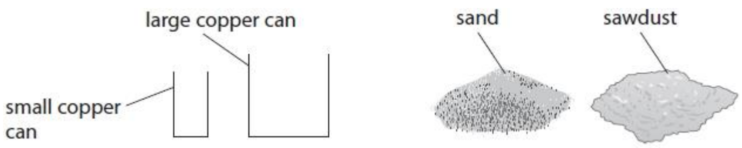


Figure 9

A student uses the apparatus in Figure 9 to find out which of two materials, sand or sawdust, is the better insulator.

The student also has a kettle to boil water, a thermometer and a stop clock.

(i) Draw a labelled diagram to show how the student should set up the equipment to investigate which material is the better insulator.

(3)

(ii) Give **three** factors that the student must control in this investigation.

(3)

Q18.

* A student stands on the ground with an egg in his hand.
He throws the egg vertically upwards.
The egg rises to a height of 10 m.
Then the egg falls and lands on the ground.
Describe the energy changes of the egg during this sequence of events.

(6)

Q19.

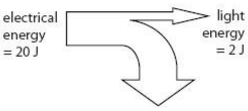
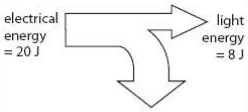
Andrew skis down a hill.

Andrew starts from the top of the hill and his speed increases as he goes downhill.
He controls his speed and direction by using his skis.
He brings himself to a stop at the bottom of the hill.
Describe the energy changes that happen between starting and stopping.

(3)

Q20.

Many appliances are sold with an energy efficiency rating.
A-rated appliances are the most energy efficient.
Here is some information about two types of electric lamp.

	halogen lamp	compact fluorescent lamp (CFL)
energy efficiency rating	B	A
energy transfer diagrams (not drawn to scale)	energy transfer in one second 	energy transfer in one second 

(i) Calculate how much energy is wasted in one second by the compact fluorescent lamp (CFL).

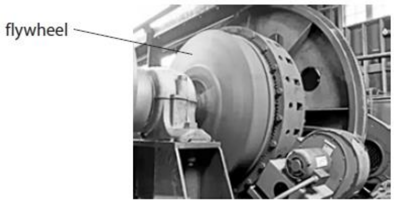
(1)

(ii) Use the energy transfer diagrams to explain why the CFL lamp has a better efficiency rating than the halogen lamp. `

(2)

Q21.

Figure 6 shows a spinning flywheel.



© coasterphotos.com

(i) State how energy is stored in a spinning flywheel.

(1)

(ii) State **one** way to increase the amount of energy stored in the flywheel.

(1)

Q22.

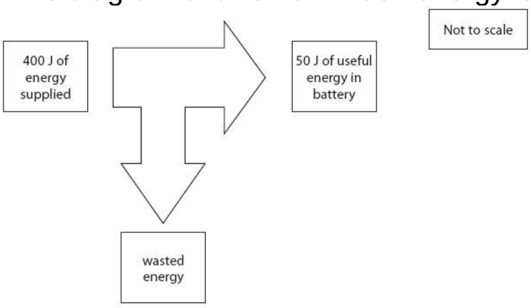
The photograph shows a man dropping an egg inside a padded box from a height.
He is investigating to see if the padding stops the egg from breaking.
State the type of energy which the egg gains as it falls.

(1)

Q23.

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

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



(i) Calculate the amount of wasted energy.

(1)

(ii) Calculate the efficiency of the battery charger.

(2)

Q24.

The photographs show two ways of supplying thermal energy.
Use words from the box to complete the sentence under each photograph.

chemical	electrical	kinetic	light	sound

(i) The photograph shows a kettle.
The kettle transfers .... energy to thermal energy.

(1)

(ii) The photograph shows a barbecue.
The barbecue transfers .... energy to thermal energy.

(1)

Q25.

This photograph shows a fan.

The blades of the fan are turned by an electric motor.
In one second, the motor gets 200 J of electrical energy from the mains supply.
Only 180 J of this energy is used to turn the blades of the fan.
The rest of the energy is wasted.

(i) Calculate how much of the 200 J of energy is wasted.

(1)

wasted energy = ... J

(ii) State what happens to the wasted energy.

(1)

(iii) Calculate the efficiency of the motor.

(2)

Q26.
A house has a boiler to provide hot water.
One type of boiler burns natural gas.
Natural gas is a non-renewable source of energy.
Figure 9 shows a foam jacket around a copper cylinder.

The hot water is stored in the copper cylinder until it is needed.
The foam jacket helps to keep the water hot.
Explain how the foam helps to keep the water hot.

(2)

Q27.
A student lifts a toy car from a bench and places the toy car at the top of a slope as shown in Figure 9.

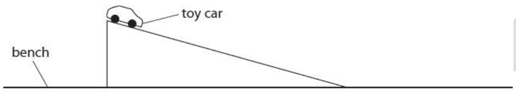


Figure 9

Explain **one** way the student could reduce the amount of thermal energy transferred to the surroundings as the toy car rolls down the slope.

(2)

Q28.
Here are some forms of energy:

chemical | elastic potential | electrical | heat (thermal) | kinetic | light | nuclear | sound

(i) Use words from the box to complete the table.
Each word may be used once, more than once, or not at all.
The first one has been done for you.

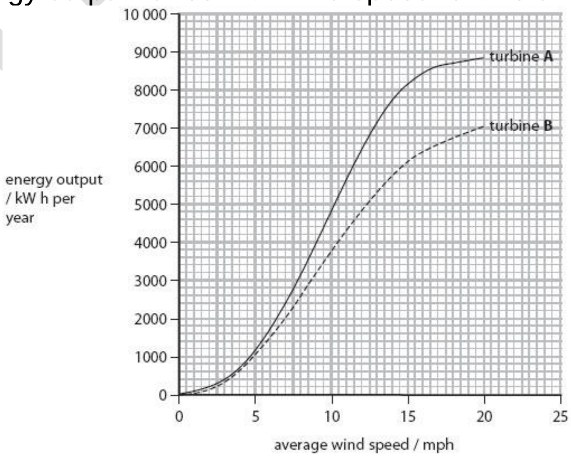
(3)

device	energy transferred from...	energy is mostly transferred into...
electric motor	electrical	kinetic
bow and arrow	elastic potential	
electric kettle	electrical	
microphone		electrical

(ii) In the electric motor only some of the electrical energy is transferred into kinetic energy.
State what happens to the remaining electrical energy.

(1)

Q29.
(a) Eric owns a small farm where chicks are hatched from eggs.
He is considering generating his own electricity to heat and light a barn rather than using electricity from the National Grid.
This graph shows how the energy output varies with wind speed for two different wind turbines, **A** and **B**.



The average wind speed at Eric's farm is 13 mph.
The total heating and lighting in the barn requires 6000 kW h of electrical energy each year.
(i) Use the data in the graph to recommend the best turbine for Eric's barn. (1)

(ii) Eric pays 14p per kW h for electrical energy supplied by the National Grid.
Calculate how much he could expect to save each year by using the energy from this wind turbine to heat and light the barn.

(2)

(iii) Eric looks at the cost of installing the turbine.
State how he should work out the payback time.

(1)

(iv) The chicks need to be kept warm at all times.
Eric uses halogen lamps to provide heat and light for most of the day.
Eric thinks about changing his halogen lamps for energy saving lamps.
Suggest why this might not actually be a benefit.

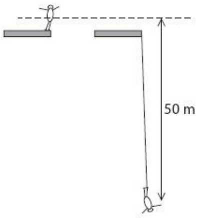
(2)

*(b) There are several large-scale energy resources which are suitable alternatives to fossil fuels in some situations.
Two of these alternatives are hydro-electric power and solar power.
Compare hydro-electric power with solar power as energy resources for the large-scale generation of electricity.

(6)

Q30. Q31.

A 60 kg student weighs 600 N.
He does a bungee jump.



The bungee cord becomes straigh fallen 50 m.
(i) Calculate the change in gravitational potential energy as the student falls 50 m.
Give the unit.

(3)

(ii) State at what point in the bungee jump the student has maximum kinetic energy.

(1)

(iii) Explain why his maximum kinetic energy is likely to be less than your answer to (c)(i).

(2)

Q32. Q33.

(i) Which of these would be a typical speed for a racing cyclist travelling down a steep straight slope?

(1)

☐ **A** 0.2 m/s
☐ **B** 2 m/s
☐ **C** 20 m/s
☐ **D** 200 m/s

(ii) A cyclist travels down a slope.
The top of the slope is 20 m vertically above the bottom of the slope.
The cyclist has a mass of 75 kg.
Calculate the change in gravitational potential energy of the cyclist between the top and the bottom of the slope.
The gravitational field strength, g, is 10 N/kg.

(3)

Q34.

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)

(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)

(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)

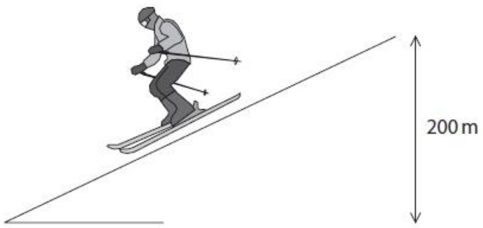
(b) One of the students states that all of the energy supplied to a motor is transferred into other forms.
This statement is one example of the idea of

(1)

☒ **A** renewable energy
☒ **B** conservation of energy
☒ **C** non-renewable energy
☒ **D** sustainable energy

Q35.

Figure 7 shows a skier going down a hill.



She descends through a vertical height of 200 m.
The skier's mass is 65 kg.

(i) Calculate the change in gravitational potential energy.
Use the equation

$$\Delta GPE = m \times g \times \Delta h$$

Take the gravitational field strength, *g*, as 10 N / kg.

(2)

(ii) At the bottom of the slope her speed was 36 m/s.
Calculate her kinetic energy at the bottom of the slope.
Use the equation

$$KE = \frac{1}{2} \times m \times v^2$$

(3)

Q36.

* There are several large-scale energy resources which are suitable alternatives to fossil fuels in some situations.
Two of these alternatives are hydro-electric power and solar power.
Compare hydro-electric power with solar power as energy resources for the large-scale generation of electricity.

(6)

Q37.

State **two** non-renewable energy sources.

(2)

Q38.

Figure 10 shows all the energy sources used in Canada in 2014 and a prediction for 2040.

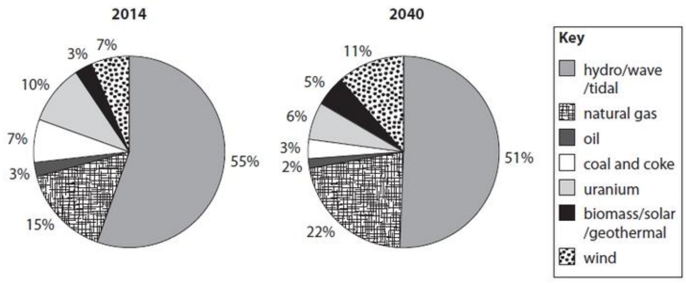


Figure 10

Discuss the effects on the environment of **two** predicted changes between 2014 and 2040. **(4)**

Q39.

Figure 9 shows the renewable energy sources used in the UK in 2015.
Figure 9 is to scale.

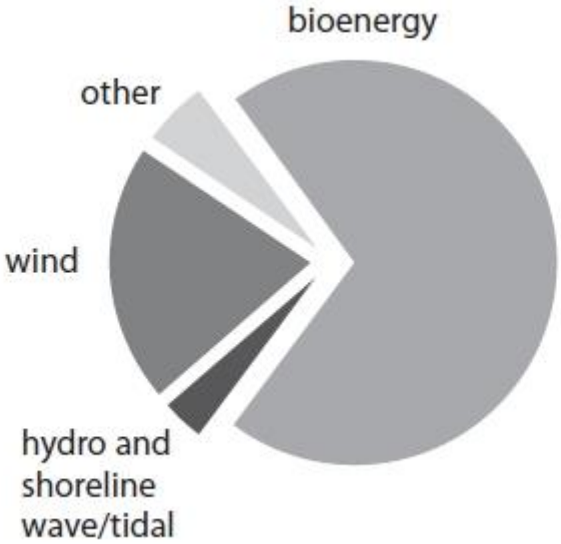


Figure 9

(i) State the energy source that gave the greatest amount of renewable energy for the UK in 2015.

(1)

(ii) Justify your choice of energy source in part (i).

(1)

(iii) State which of these energy sources gave about 20% of the energy from renewable sources for the UK in 2015.

(1)

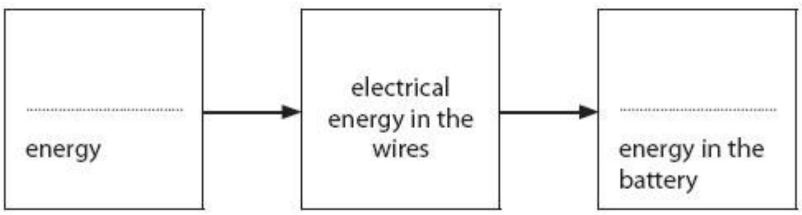
Q40.

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

The diagram is an energy transfer diagram for a battery being charged.
Use words from the box to complete the energy transfer diagram.

light	kinetic	sound
electrical	chemical	

Energy transfer diagram



Q41.

A house has a boiler to provide hot water.
One type of boiler burns natural gas.
Natural gas is a non-renewable source of energy.

(i) State a renewable source of energy that could be used to heat water in a house.

(1)

Figure 8 shows some information in a booklet supplied with a gas boiler.

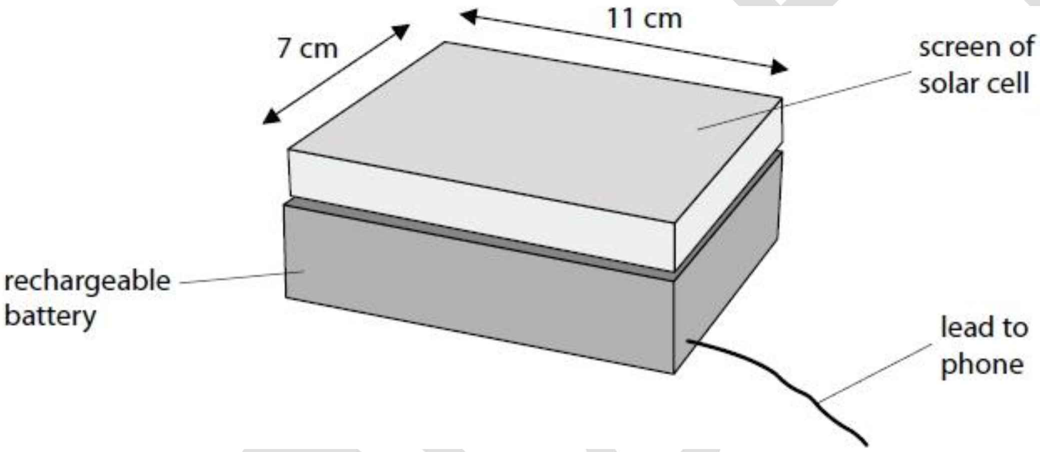
fuel	natural gas
temperature of hot water	65°C
energy supplied to the boiler in one second	7500 J
efficiency of boiler	96%

(ii) Calculate the energy transferred to the water by the boiler in one second.

(2)

Q42.

Figure 1 shows a solar-powered charger for a mobile phone.



The screen of the solar cell takes in energy from the Sun.
State how energy is stored in the charger.

(1)

Q43.

A student lifts a toy car from a bench and places the toy car at the top of a slope as shown in Figure 9.

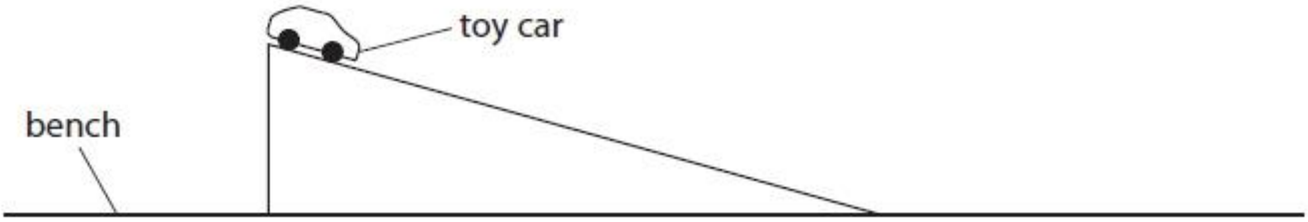


Figure 9

When the toy car rolls down the slope, some energy is transferred to the surroundings as thermal energy.
State how the student could calculate the amount of energy transferred to the surroundings.

(1)

Q44.

A student lifts a toy car from a bench and places the toy car at the top of a slope as shown in Figure 9.

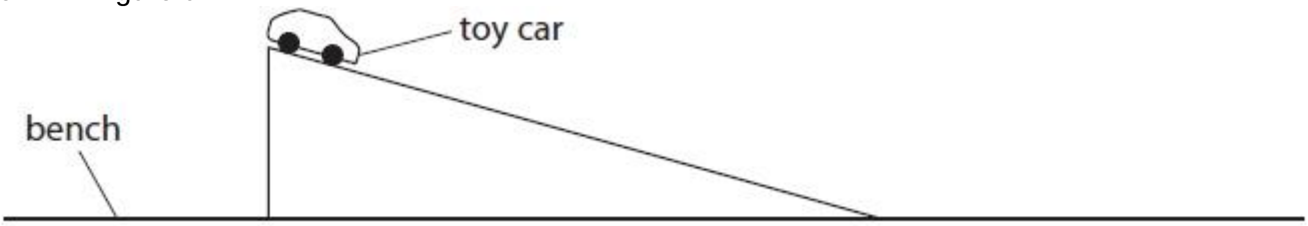


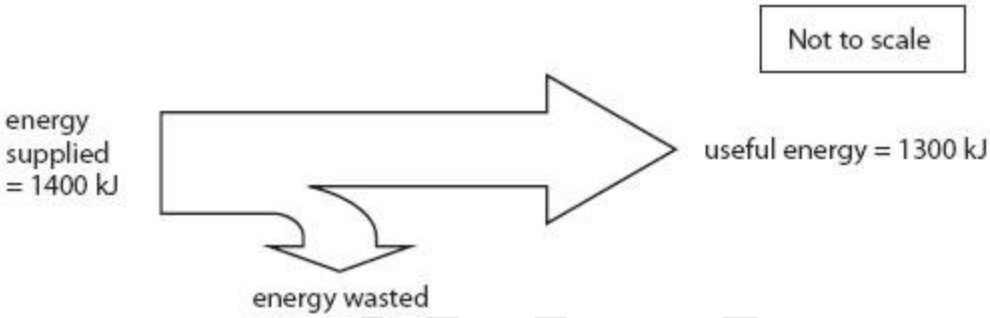
Figure 9

The student needs to develop the experiment to determine the loss in potential energy and the gain in kinetic energy as the toy car is rolling down the slope.
State the other measurements the student must make.

(2)

Q45.

The diagram represents the energy transfer in one second in the generator.



(i) Calculate the amount of energy wasted in one second in the generator.

(1)

(ii) Calculate the efficiency of the generator.

(2)

Q46.

* Figure 12 is a speed-time graph for a car moving on a horizontal road.

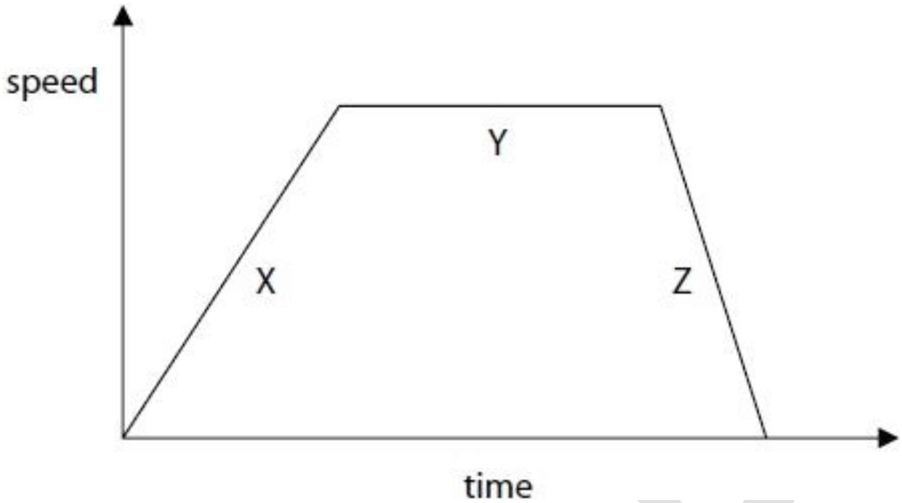


Figure 12

Describe the energy transfers taking place during the movement of the car.
You should refer to energy stores as well as transfers between energy stores for all three sections of the graph.

(6)

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Q47.

(a) Complete the sentence by putting a cross (☒) in the box next to your answer.
An electric current is the rate of flow of

(1)

☐ **A** atoms
☐ **B** charge
☐ **C** voltage
☐ **D** watts

(b) An electric kettle is connected to a mains voltage of 230 V.
The current in the kettle is 12 A.
Calculate the power of the kettle.

(2)

(c) A television has a power of 400 W.
The cost of 1 kW h of electrical energy is 15p.
Calculate the cost of using the television for 10 hours.

(3)

*(d) Some students found this information about an energy saving lamp and a filament lamp that give out almost the same amount of light.

energy saving lamp	filament lamp
	
power = 15 W	power = 60 W
cost = £1.50	cost = £0.30
lifetime = 10 000 hours	lifetime = 1 000 hours
produces 20 J of light energy for each 100 J of electrical energy supplied	produces 5 J of light energy for each 100 J of electrical energy supplied

Describe the advantages and disadvantages of each type of lamp.

(6)

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