Energy

Paper 1

1.1.1 Energy Stores and Systems

Think

Pair

Share

What is a system?

When a system changes the way energy is stored also changes.

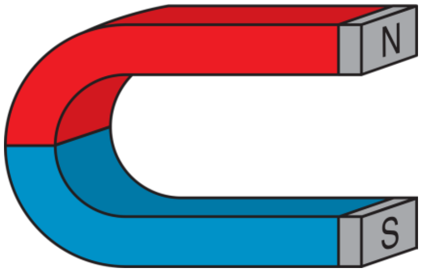
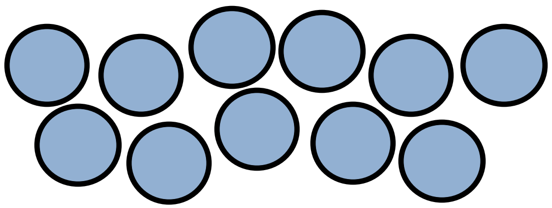
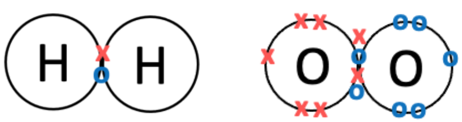
You need to be prepared to describe some energy changes.

Key Term	Definition
System	

CS/F CS/H SS/F SS/H

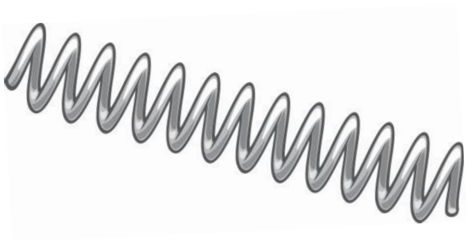
AQA GCSE Physics Paper 1

1.1.1 Energy Stores and Systems

Energy Store	Description	Image
Magnetic		
Internal		
Chemical		

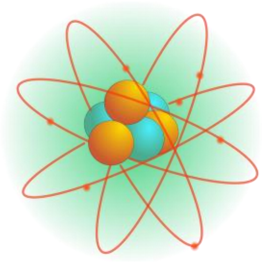
CS/F CS/H SS/F SS/H

1.1.1 Energy Stores and Systems

Energy Store	Description	Image
Kinetic		
Gravitatio-nal Potential		
Elastic Potential		

CS/F CS/H SS/F SS/H

1.1.1 Energy Stores and Systems

Energy Store	Description	Image
Nuclear		
Electrostatic		

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CS/F CS/H SS/F SS/H

1.1.1 Energy Stores and Systems

Scenario:

An object projected upwards.

Energy Changes

Kinetic Energy

↓

Gravitational Potential Energy

CS/F CS/H SS/F SS/H

1.1.1 Energy Stores and Systems

Scenario:

A moving object hitting an obstacle

Energy Changes

Kinetic Energy

↓

Sound Waves

and

Thermal Energy

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CS/F CS/H SS/F SS/H

1.1.1 Energy Stores and Systems

Scenario:

This depends on the context!

An object accelerated by a constant force.

Energy Changes

Chemical Energy

↓

Kinetic Energy

CS/F CS/H SS/F SS/H

1.1.1 Energy Stores and Systems

Scenario:

This depends on the context!

An object accelerated by a constant force.

Energy Changes

Gravitational Potential Energy

↓

Kinetic Energy

CS/F CS/H SS/F SS/H

1.1.1 Energy Stores and Systems

Scenario:

A vehicle slowing down.

Energy Changes

Kinetic Energy

↓

Thermal Energy

CS/F CS/H SS/F SS/H

1.1.1 Energy Stores and Systems

Scenario:

Bringing water to a boil in an electric kettle.

Energy Changes

Electric Current

↓

Thermal Energy

CS/F CS/H SS/F SS/H

1.1.2 Changes in Energy

Think
Pair
Share

What is the equation that you would use to calculate kinetic energy?

You may need to convert units!

Kinetic Energy = 0.5 x Mass x Speed²

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

Joules J

Kilograms kg

Metres per second m/s

Key Term	Definition
Kinetic Energy	

CS/F CS/H SS/F SS/H

1.1.2 Changes in Energy

A 750g book is thrown and has an initial speed of 12m/s. Calculate its kinetic energy. (4)

Convert Units	
Write down the formula.	
Substitute Values	
Do the Maths	
Round and add units.	

Usually 1 mark for this.

Substitute before you do any rearranging. 1 mark for doing this.

Show each step that you do.

Answer to 2 s.f which is the same as the values in the qu.

CS/F CS/H SS/F SS/H

1.1.2 Changes in Energy

A 1300kg car has 1.2kJ of kinetic energy. Calculate it speed (5)

Convert Units	
Write down the formula.	
Substitute Values	
Do the Maths	
Round and add units.	

Usually 1 mark for this.

Substitute before you do any rearranging. 1 mark for doing this.

Show each step that you do.

Answer to 2 s.f which is the same as the values in the qu.

CS/F CS/H SS/F SS/H

1.1.2 Changes in Energy

Think Pair Share

What is the equation that you would use to calculate elastic potential energy?

You may need to convert units!

Newtons per metre N/m

Elastic Potential Energy = 0.5 x Spring Constant x Extension^2

$$E_e = \frac{1}{2} \times k \times e^2$$

Joules J

Metres m

Key Term	Definition
Elastic Potential Energy	

CS/F CS/H SS/F SS/H

1.1.2 Changes in Energy

A spring that has a spring constant of 1.2N/m is stretched 22cm. Calculate its elastic potential energy.

Convert Units	
Write down the formula.	
Substitute Values	
Do the Maths	
Round and add units.	

Usually 1 mark for this.

Substitute before you do any rearranging. 1 mark for doing this.

Show each step that you do.

Answer to 2 s.f which is the same as the values in the qu.

CS/F CS/H SS/F SS/H

1.1.2 Changes in Energy

A spring has 120J of energy and and has a spring constant of 9.2N/m. Calculate its extension. (4)

Convert Units	
Write down the formula.	
Substitute Values	
Do the Maths	
Round and add units.	

Substitute before you do any rearranging. 1 mark for doing this.

Show each step that you do. Do as much as the calculation that you can before rearranging.

Answer to 2 s.f which is the same as the values in the qu.

CS/F CS/H SS/F SS/H

1.1.2 Changes in Energy

Think
Pair
Share

What is the equation that you would use to calculate gravitational potential energy?

You may need to convert units!

Gravitational Potential Energy = Mass x Gravitational Field Strength x Height

$$E_p = m \times g \times h$$

Joules J

Kilograms kg

Newtons per kilogram N/kg

Metres m

Key Term	Definition
Gravitational Potential Energy	

CS/F CS/H SS/F SS/H

1.1.2 Changes in Energy

Think
Pair
Share

What is the equation that you would use to calculate gravitational potential energy?

Weight = Mass x Gravitational Field Strength

You could be given weight in N. To find GPE multiply this by height.

Key Term	Definition
Gravitational Potential Energy	The energy stored in an object at a height.

CS/F CS/H SS/F SS/H

1.1.2 Changes in Energy

A 350g book is lifted 2.8m when gravitational field strength is 9.8N/kg. Calculate the GPE.

Convert Units	
Write down the formula.	
Substitute Values	
Do the Maths	
Round and add units.	

Usually 1 mark for this.

Substitute before you do any rearranging. 1 mark for doing this.

Show each step that you do.

Answer to 2 s.f which is the same as the values in the qu.

CS/F CS/H SS/F SS/H

1.1.2 Changes in Energy

Calculate mass when a block is raised 7.21m and have 1.10kJ of GPE. Gravitational field strength is 9.8N/kg(5)

Convert Units	
Write down the formula.	
Substitute Values	
Do the Maths	
Round and add units.	

Usually 1 mark for this.

Substitute before you do any rearranging. 1 mark for doing this.

Show each step that you do.

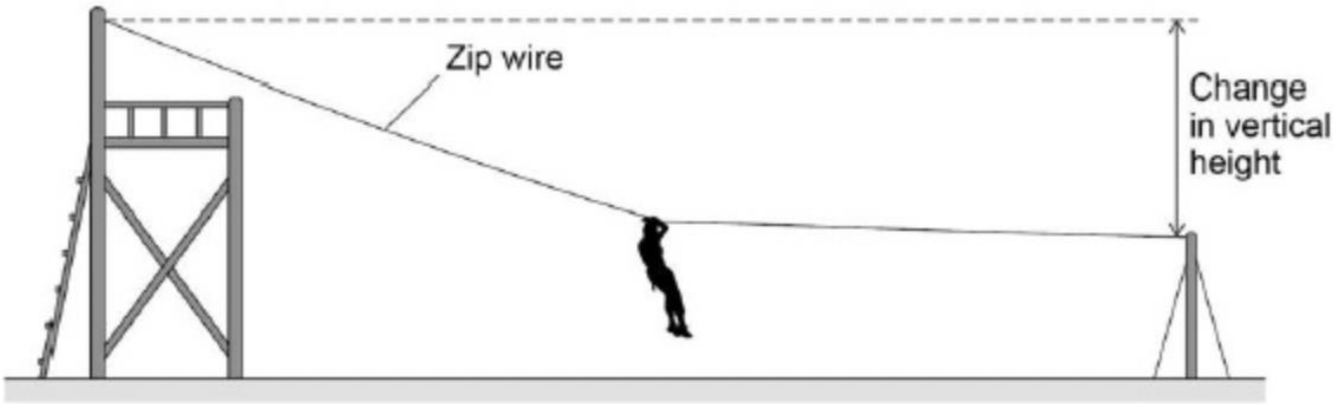
Answer to 3 s.f which is the same as the values in the qu.

CS/F CS/H SS/F SS/H

Exam Practice

Figure 1 shows a person sliding down a zip wire.

Figure 1



(a) As the person slides down the zip wire, the change in the gravitational potential energy of the person is 1.47 kJ → 1470J

The mass of the person is 60 kg

gravitational field strength = 9.8 N/kg

Calculate the change in vertical height of the person.

$E_p = m \times g \times h$

$1470 = 60 \times 9.8 \times h$

$1470 = 588 \times h$

$h = 1470/588$

Change in vertical height = 2.5 m

(3)

Exam Practice

L2

The speed of the rocket just after being launched is 12 m / s.
The mass of the rocket is 0.05 kg.

(i) Calculate the kinetic energy of the rocket just after being launched.

$E_k = ½ \times m \times v^2$

$E_k = ½ \times 0.05 \times 12^2$

Kinetic energy = 3.6 J

(2)

(ii) As the rocket moves upwards, it gains gravitational potential energy.

State the maximum gravitational potential energy gained by the rocket.

Ignore the effect of air resistance.

Maximum gravitational potential energy = 3.6 J

(1)

Exam Practice

(iii) Calculate the maximum height the rocket will reach.

Ignore the effect of air resistance.

Gravitational field strength = 10 N/kg.

$E_p = m \times g \times h$

$3.6 = 0.05 \times 10 \times h$

$h = 3.6 / 0.5$

Maximum height = 7.2 m

(2)

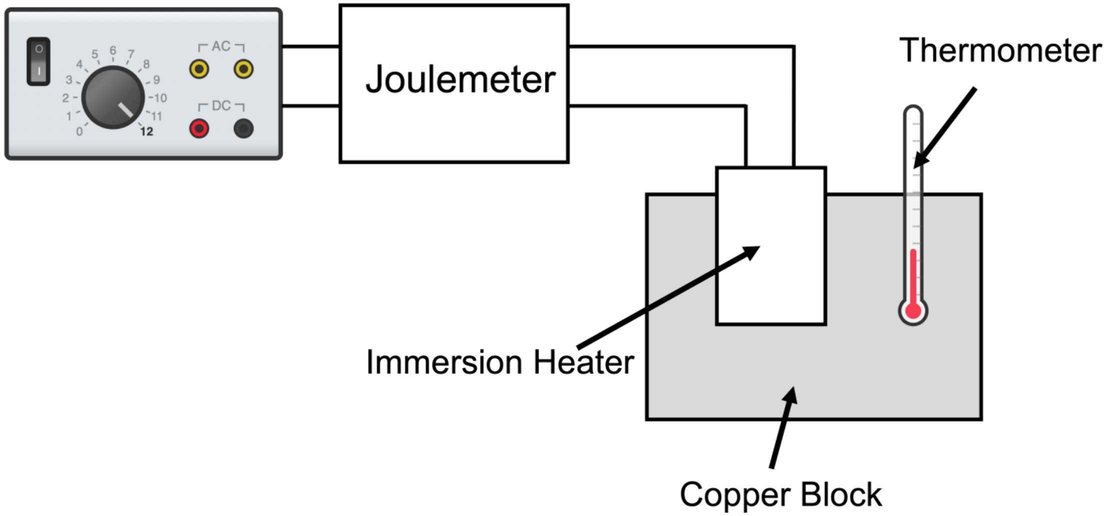
1.1.3 Energy Changes in Systems

Think

Pair

Share

What is specific heat capacity?



Key Term	Definition
Specific Heat Capacity	

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CS/F CS/H SS/F SS/H

1.1.3 Energy Changes in Systems

Think

Pair

Share

What is specific heat capacity?

Joules per kilogram per degree Celsius
J/kg°C

Kilograms
kg

Change in Thermal Energy = Mass x SHC x Temp Change

$$\Delta E = m \times c \times \Delta\theta$$

Joules J

Degrees Celsius °C

Key Term	Definition
Specific Heat Capacity	The amount of energy required to raise the temperature of one kilogram of the substance by one degree Celsius.

CS/F CS/H SS/F SS/H

1.1.3 Energy Changes in Systems

Calculate the energy needed to increase the temperature of a 200g gold block by 10°C. Its SHC is 129J/kg°C. (4)

Convert Units	
Write down the formula.	
Substitute Values	
Do the Maths	
Round and add units.	

Usually 1 mark for this.

Substitute. 1 mark for doing this.

Show each step that you do.

Answer to 3 s.f which is the same as the values in the qu.

CS/F CS/H SS/F SS/H

1.1.3 Energy Changes in Systems

Calculate the specific heat capacity of a 0.85kg block of iron that increases in temperature by 25°C with 9.56kJ

Convert Units	
Write down the formula.	
Substitute Values	
Do the Maths	
Round and add units.	

Usually 1 mark for this.

Substitute before you do any rearranging. 1 mark for doing this.

Show each step that you do.

Answer to 2 s.f which is the same as the values in the qu.

CS/F CS/H SS/F SS/H

Exam Practice

L2

A metalworker quenches a steel rod by heating it to a temperature of 900 °C before placing it in cold water. The mass of the steel rod is 20 kg.

The final temperature of the rod and water is 50 °C.

Calculate the energy transferred from the steel rod to the water.

Specific heat capacity of steel = 420 J/kg °C.

Change in temperature: 850°C

$\Delta E = m \times c \times \Delta\theta$

$\Delta E = 20 \times 420 \times 850$

Energy transferred = 7,140,000 J

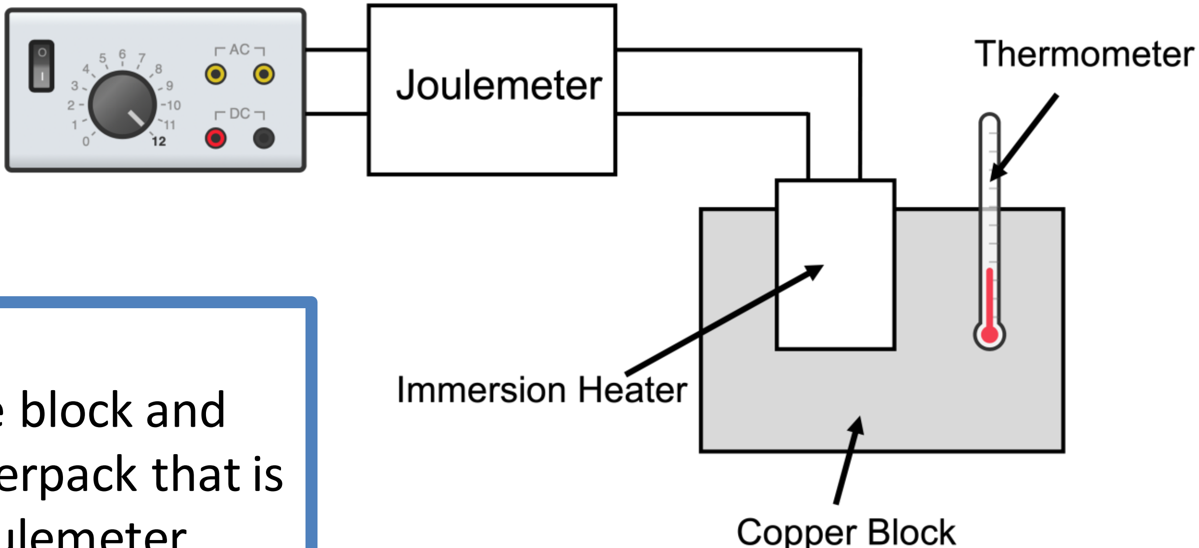
(3)

1.1.3 Energy Changes in Systems

Think Pair Share

How can you use apparatus to determine the specific heat capacity of a material?

1
Measure the mass of the material by using a balance.



2
Add a heater to the block and connect this to a powerpack that is connected to a joulemeter.

3
Add a thermometer and record the start temperature.

4
Turn the powerpack on.

CS/F CS/H SS/F SS/H

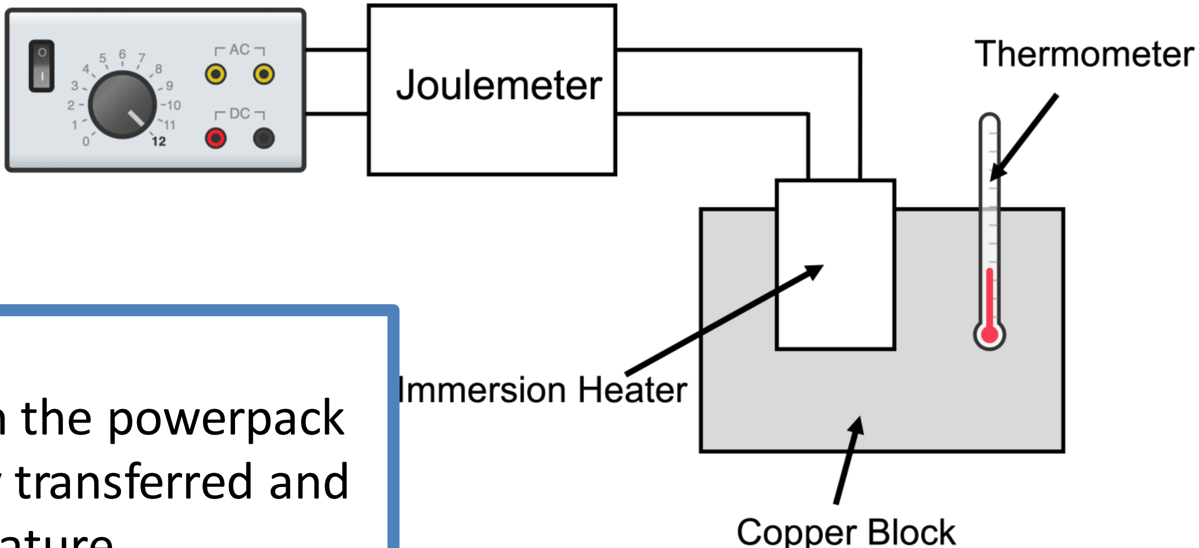
1.1.3 Energy Changes in Systems

Think

Pair

Share

How can you use apparatus to determine the specific heat capacity of a material?



5

After 10 minutes turn the powerpack off, record the energy transferred and the temperature.

6

Use the equation: $\Delta E = m \times c \times \Delta\theta$ to calculate specific heat capacity.

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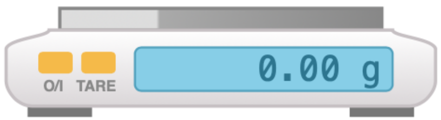
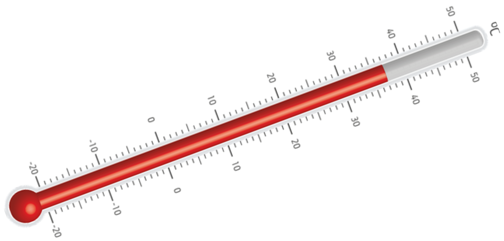
1.1.3 Energy Changes in Systems

To construct your own method to determine the specific heat capacity of a material use the following structure.

Finding Mass		
Finding Temperature Change		
Finding Energy Supplied		
Finding Specific Heat Capacity		**$\Delta E = m \times c \times \Delta\theta$**

CS/F CS/H SS/F SS/H

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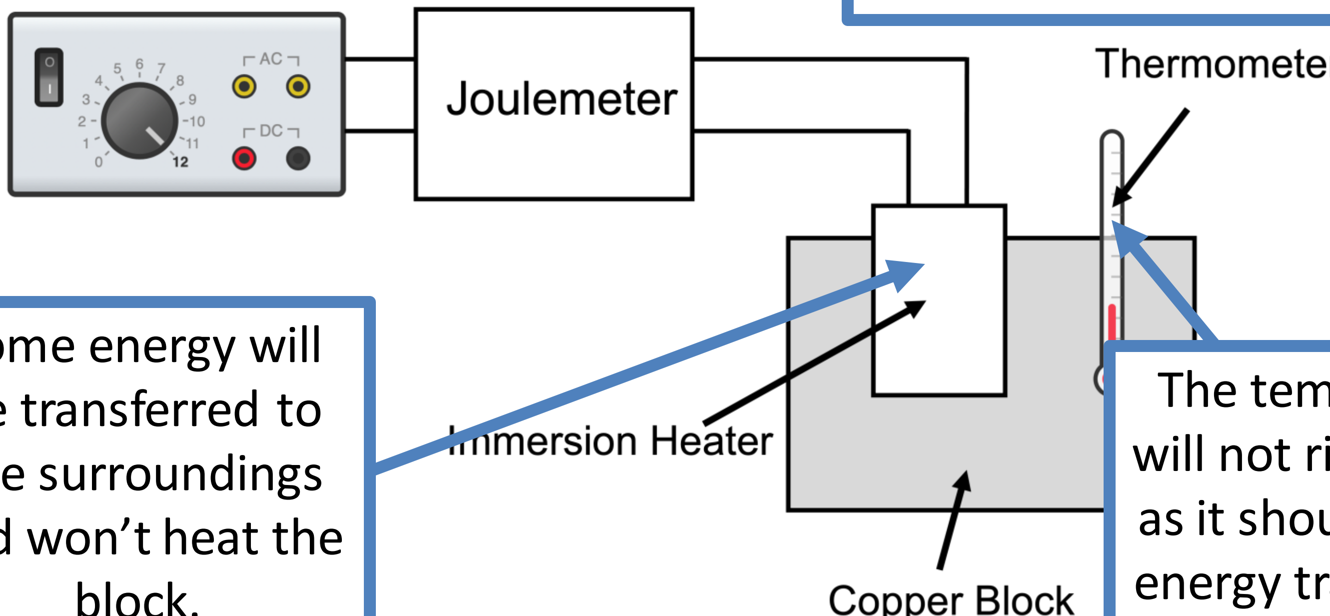
1.1.3 Energy Changes in Systems

Think
Pair
Share

Why may you not find the exact specific heat capacity of a material using this equipment?

This will mean the specific heat capacity calculated will be higher than it should.

To reduce the heat loss the block should be wrapped in insulation.



Some energy will be transferred to the surroundings and won't heat the block.

The temperature will not rise as high as it should for the energy transferred.

CS/F CS/H SS/F SS/H

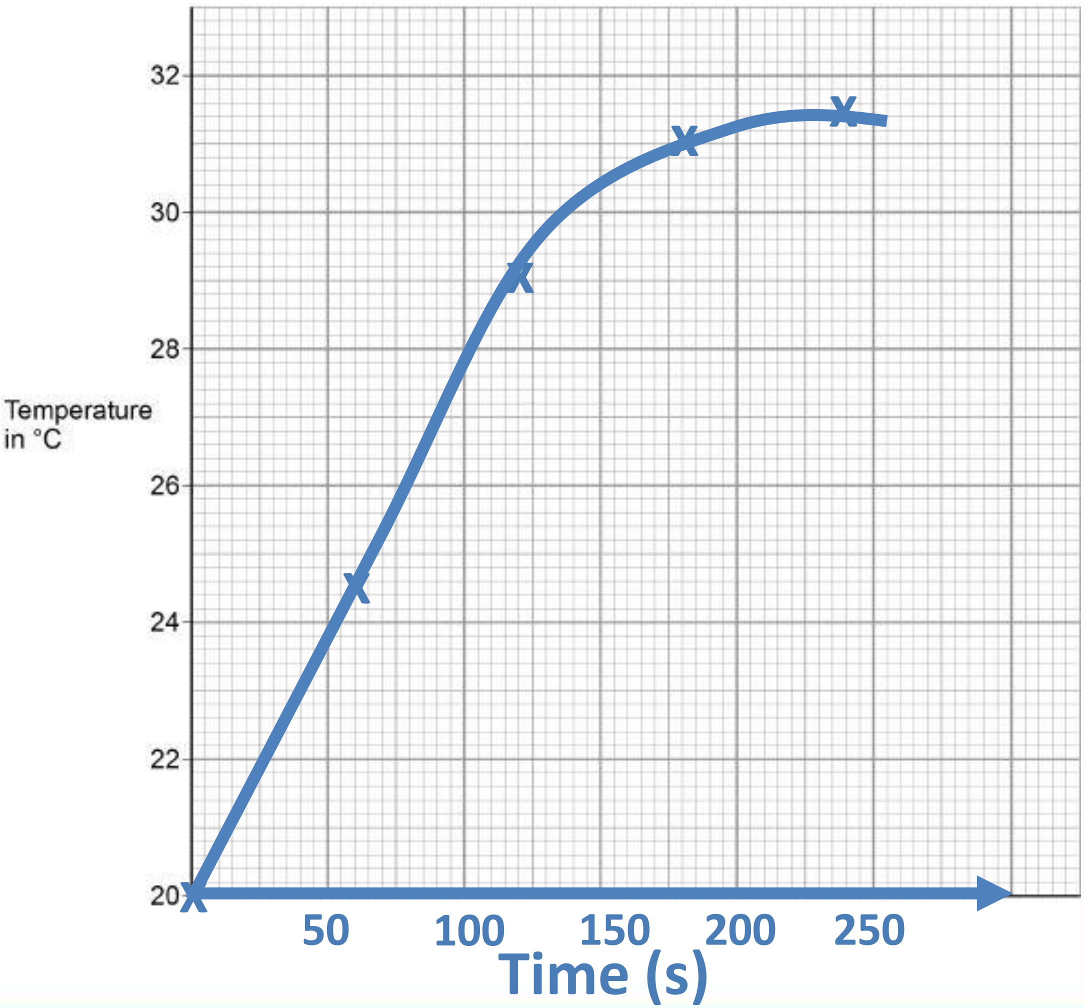
Exam Practice

L3

Complete the graph of the data from the table above on the graph below.

- Choose a suitable scale for the x-axis.
- Label the x-axis.
- Plot the student's results.
- Draw a line of best fit.

Time in s	Temperature in °C
0	20.0
60	24.5
120	29.0
180	31.0
240	31.5



1.1.4 Power

Think

Pair

Share

What is power?

Joules

J

Seconds

s

Power = Energy Transferred / Time

$$P = E / t$$

Watts

W

Key Term	Definition
Power	

CS/F CS/H SS/F SS/H

1.1.4 Power

Think
Pair
Share

What is power?

Energy Transferred = Work Done

So…

Key Term	Definition
Power	The rate at which energy is transferred or the rate at which work is done.

CS/F CS/H SS/F SS/H

1.1.4 Power

Think

Pair

Share

What is power?

Joules
J

Seconds
s

Power = Work Done / Time

$$P = W / t$$

Watts
W

Key Term	Definition
Power	The rate at which energy is transferred or the rate at which work is done.

CS/F CS/H SS/F SS/H

1.1.4 Power

Think
Pair
Share

What is power?

Power = Work Done / Time

Power = Energy Transferred / Time

An energy transfer of 1 joule per second is equal to a power of 1 watt!

Key Term	Definition
Power	The rate at which energy is transferred or the rate at which work is done.

CS/F CS/H SS/F SS/H

1.1.4 Power

The electrical generators can provide 1.5 x 10^9W of power for a maximum of 5 hours. Calculate the energy transferred. (3)

Convert Units	
Write down the formula.	
Substitute Values	
Do the Maths	
Round and add units.	

Usually 1 mark for this.

Substitute before you do any rearranging. 1 mark for doing this.

Show each step that you do.

Answer to 2 s.f which is the same as the values in the qu.

CS/F CS/H SS/F SS/H

1.2.1 Energy Transfers in a System

Think
Pair
Share

What is the law of the conservation of energy?

This means that when ever there are energy transfers in a closed system, that there is no net change to the total energy.

Energy In = Energy Out

Key Term	Definition
Law of the Conservation of Energy	

CS/F CS/H SS/F SS/H

1.2.1 Energy Transfers in a System

Think

Pair

Share

What is the law of the conservation of energy?

However..

In all system changes energy is dissipated.

The energy is stored in less useful ways.

For example in this TV energy is wasted as thermal energy.

CS/F CS/H SS/F SS/H

1.2.1 Energy Transfers in a System

Think
Pair
Share

How can we reduce unwanted energy transfers?

CS/F CS/H SS/F SS/H

1.2.1 Energy Transfers in a System

Think

Pair

Share

How can we reduce unwanted energy transfers?

We can use lubricants

This reduces friction between surfaces.

Surfaces will now slide over each other more smoothly.

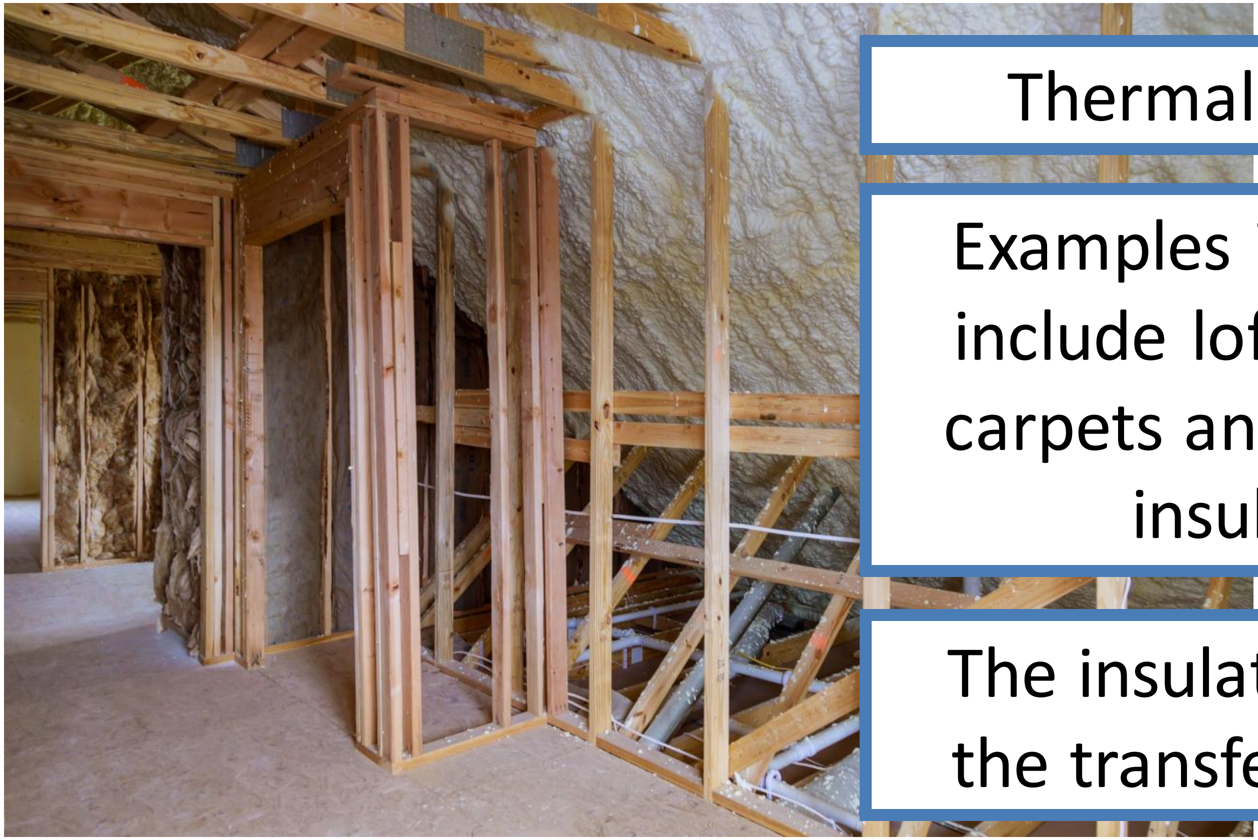
Less energy will be wasted as heat.

CS/F CS/H SS/F SS/H

1.2.1 Energy Transfers in a System

Think
Pair
Share

How can we reduce unwanted energy transfers?



Thermal insulation

Examples in the home include loft insulation, carpets and cavity wall insulation.

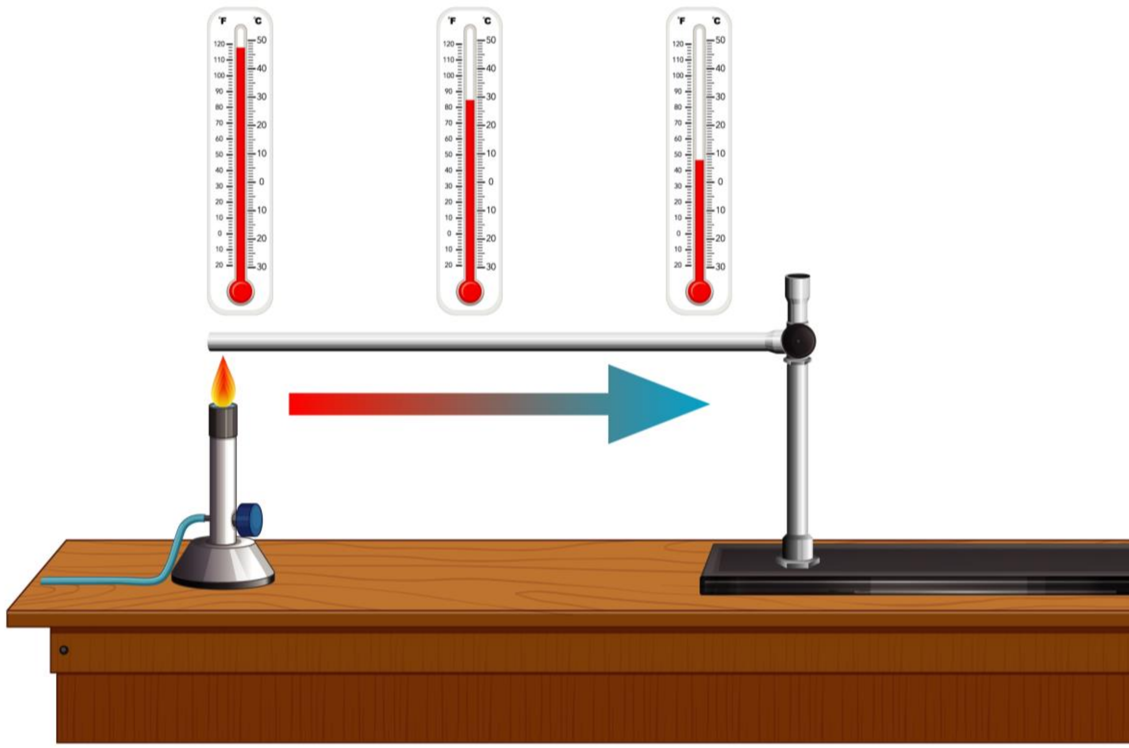
The insulation reduces the transfer of energy.

CS/F CS/H SS/F SS/H

1.2.1 Energy Transfers in a System

Some materials are good conductors of heat.

They have a high thermal conductivity.



The higher a materials thermal conductivity, the higher the rate of energy transfer by conduction.

CS/F CS/H SS/F SS/H

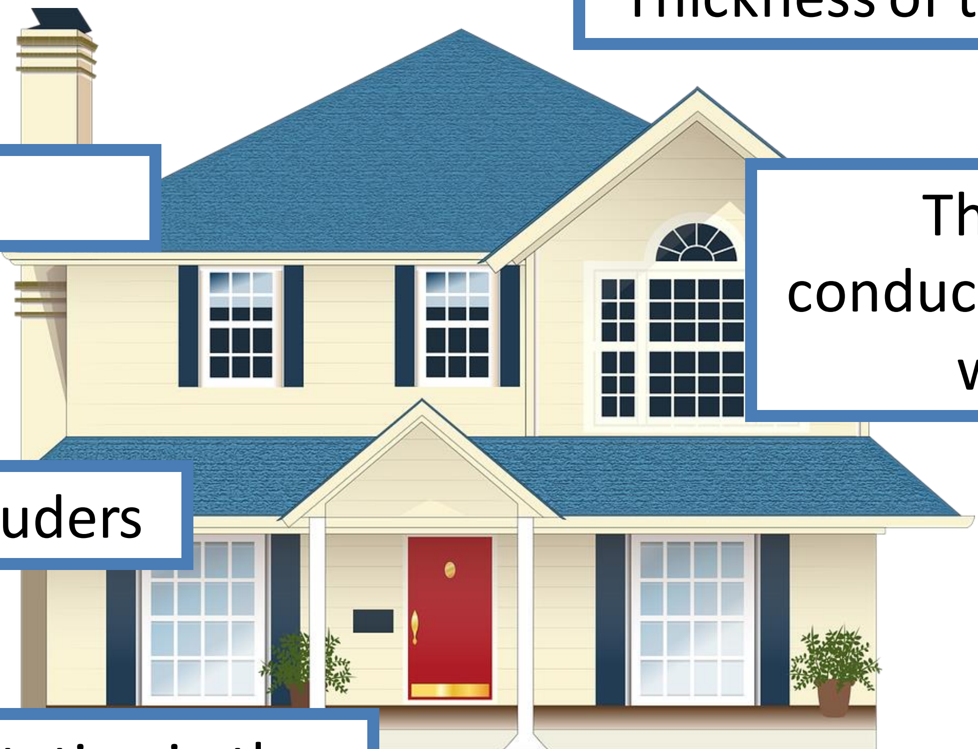
1.2.1 Energy Transfers in a System

Think

Pair

Share

What affects the rate of cooling of a building?



Thickness of the walls.

Glazing

Thermal conductivity of the walls.

Draught excluders

Insultation in the building.

CS/F CS/H SS/F SS/H

1.2.1 Energy Transfers in a System

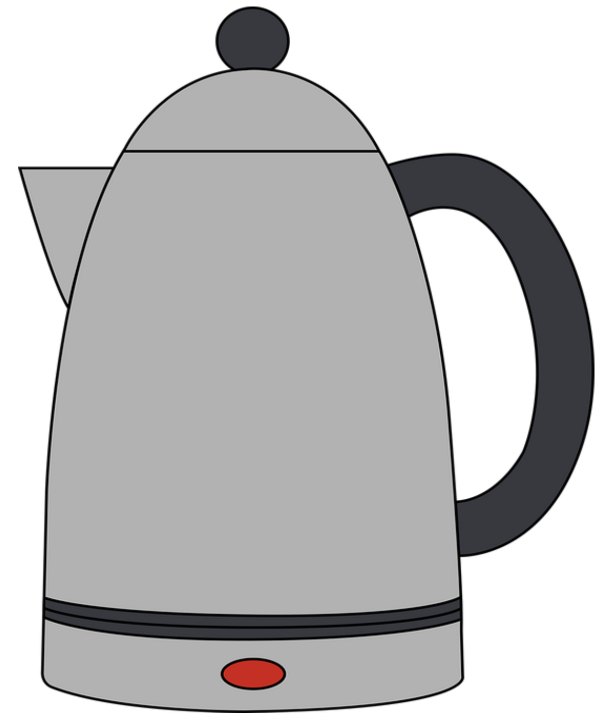
Think
Pair
Share

How can we test the effectiveness of materials as insulators?

1

Boil water in a kettle and add 80cm^3 of this water to a 100cm^3 beaker.

Control Variable



CS/F CS/H SS/F SS/H

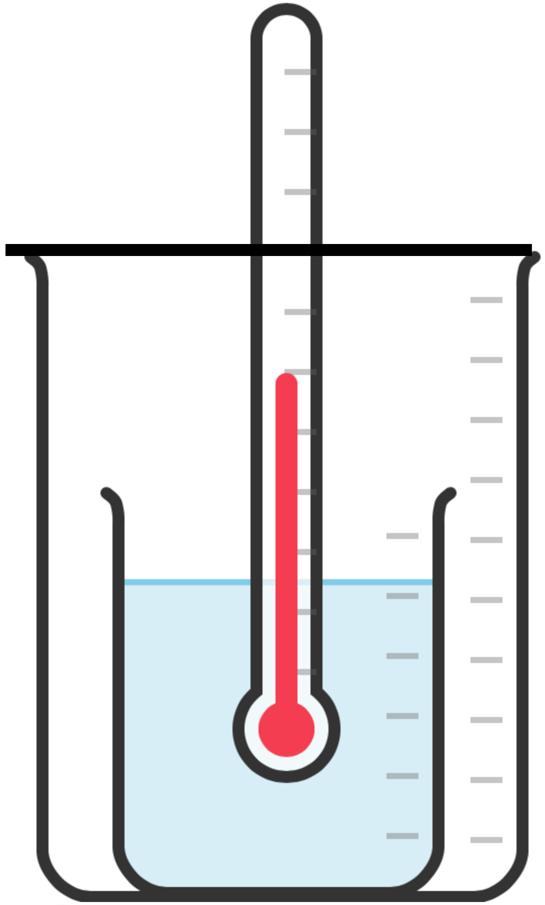
1.2.1 Energy Transfers in a System

Think

Pair

Share

How can we test the effectiveness of materials as insulators?



2

Place this beaker into a larger beaker with a lid

Place a thermometer through the lid.

CS/F CS/H SS/F SS/H

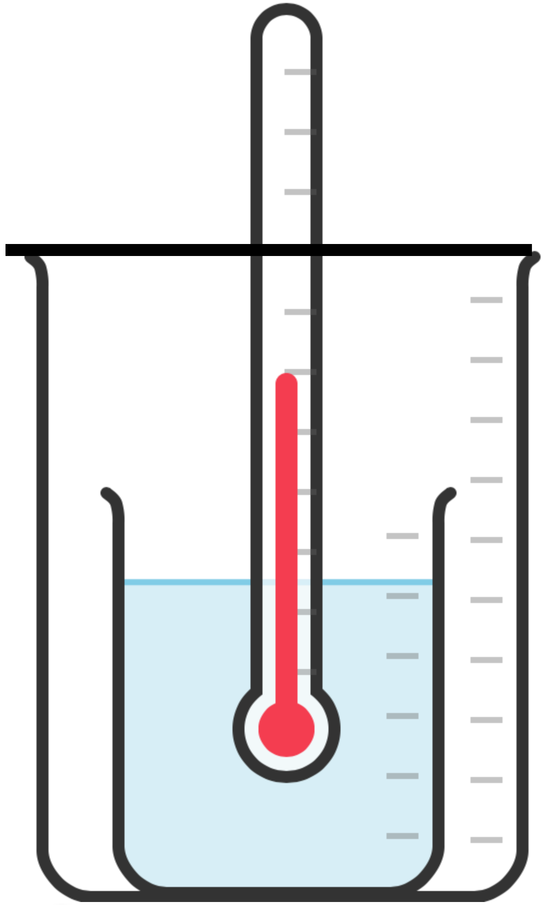
1.2.1 Energy Transfers in a System

Think

Pair

Share

How can we test the effectiveness of materials as insulators?



3

Record the start temperature.

4

Start the timer and record the temperature at 5, 10, 15 and 20 minutes.

CS/F CS/H SS/F SS/H

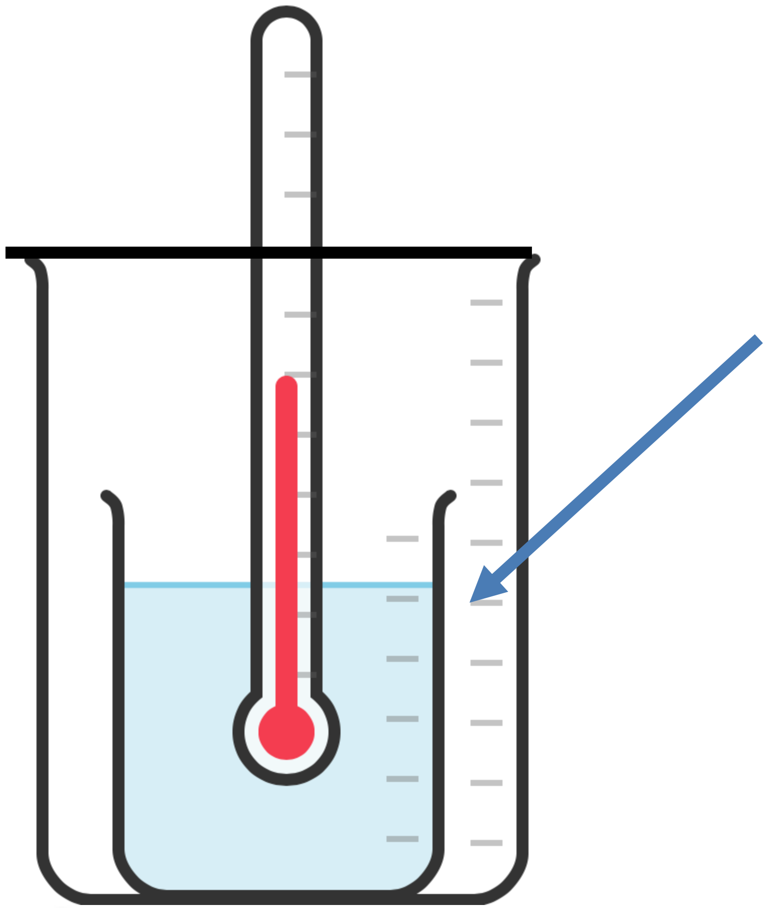
1.2.1 Energy Transfers in a System

Think

Pair

Share

How can we test the effectiveness of materials as insulators?



5

Repeat steps **1-4** with different materials placed in the gap between the smaller and larger beaker.

CS/F CS/H SS/F SS/H

1.2.1 Energy Transfers in a System

Think

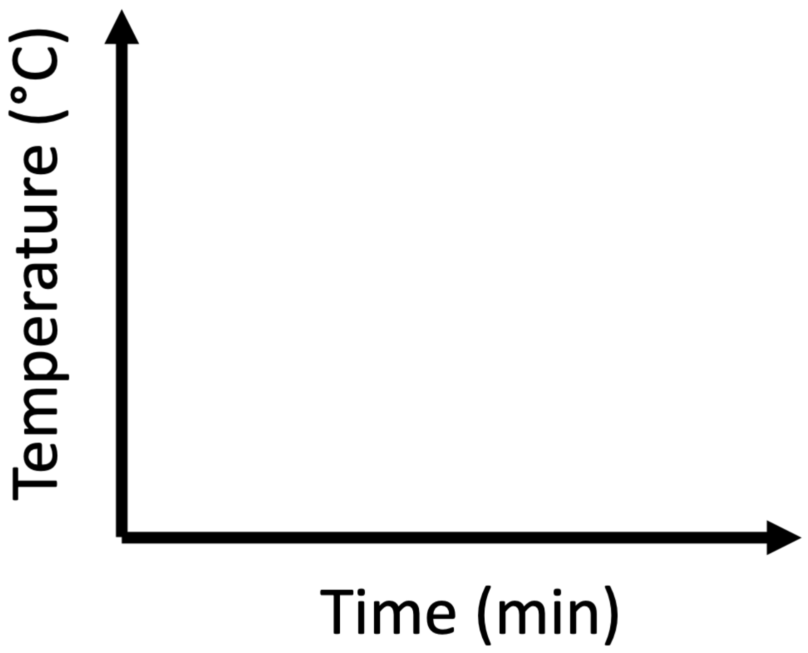
Pair

Share

How can we test the effectiveness of materials as insulators?

6

Plot a cooling curve of temperature against time.



CS/F CS/H SS/F SS/H

1.2.1 Energy Transfers in a System

Think

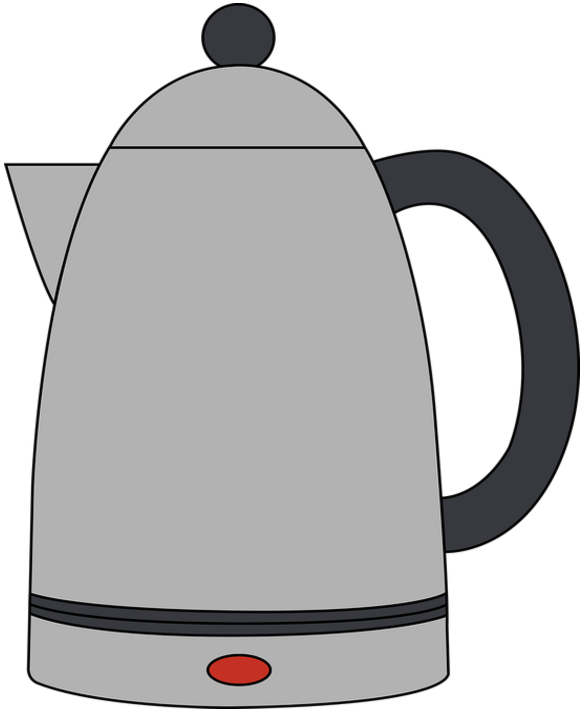
Pair

Share

How can we investigate factors that affect the insulation properties of materials?

1

Boil water in a kettle and add 200cm^3 of this water to a 250cm^3 beaker.

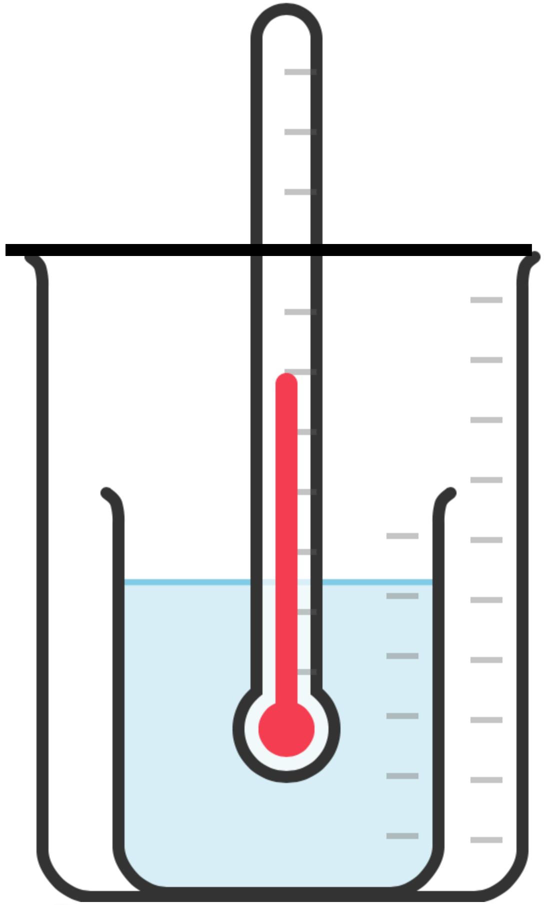


CS/F CS/H SS/F SS/H

1.2.1 Energy Transfers in a System

Think
Pair
Share

How can we investigate factors that affect the insulation properties of materials?



2

Place a thermometer through a cardboard lid.

3

Record the start temperature.

CS/F CS/H SS/F SS/H

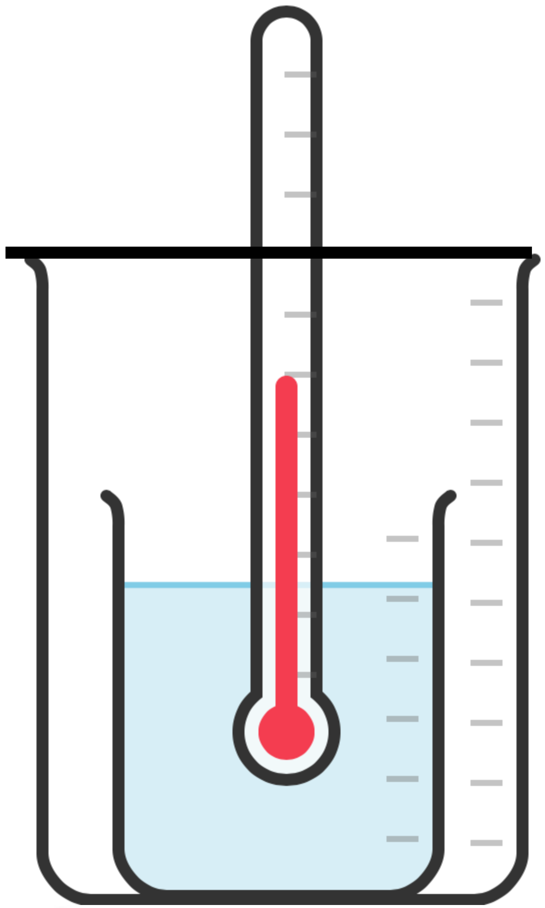
1.2.1 Energy Transfers in a System

Think

Pair

Share

How can we investigate factors that affect the insulation properties of materials?



4

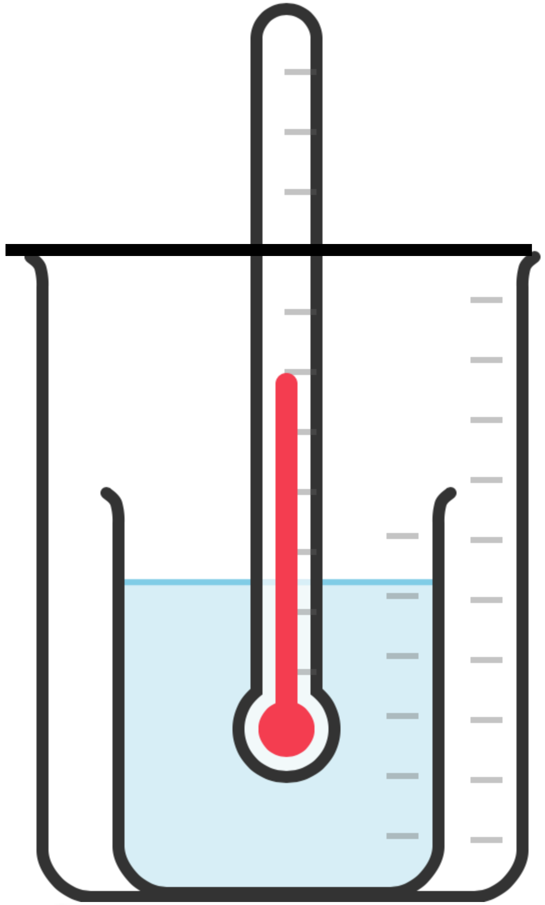
Start the timer and record the temperature at 5, 10 , 15 and 20 minutes.

CS/F CS/H SS/F SS/H

1.2.1 Energy Transfers in a System

Think
Pair
Share

How can we investigate factors that affect the insulation properties of materials?



5

Repeat steps **1-4** with different number of layers of insulation held in place with elastic bands.

CS/F CS/H SS/F SS/H

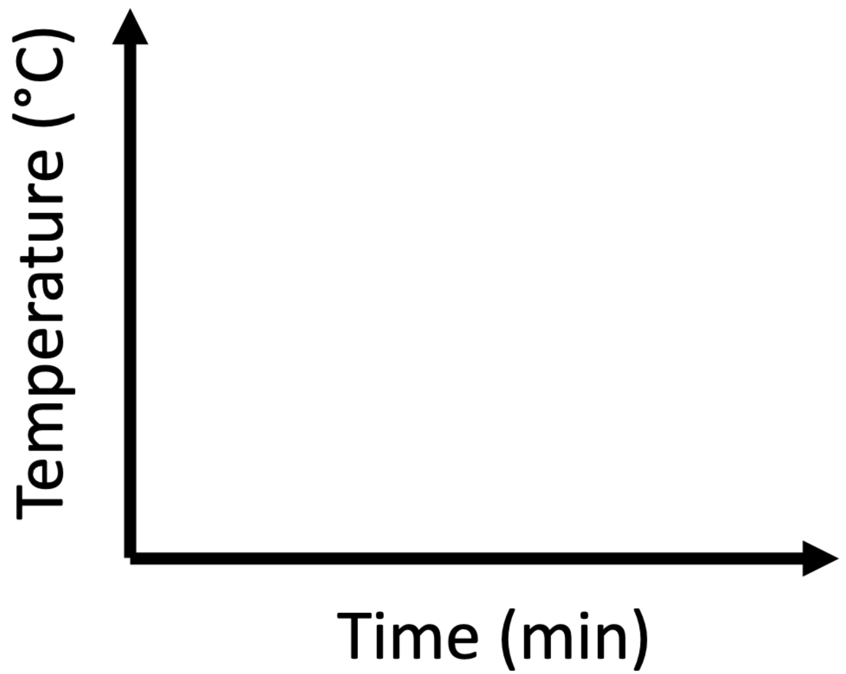
1.2.1 Energy Transfers in a System

Think
Pair
Share

How can we investigate factors that affect the insulation properties of materials?

6

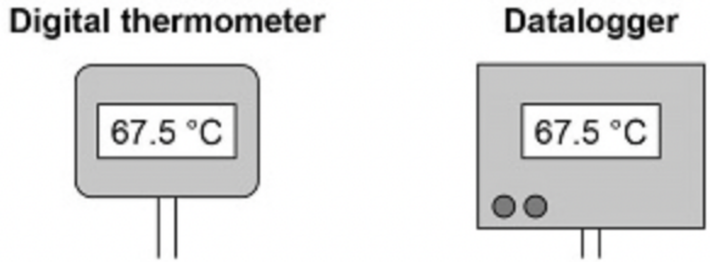
Plot a cooling curve of temperature against time.



CS/F CS/H SS/F SS/H

Exam Practice

L2



The datalogger records 10 readings every second.

The student considered using a temperature probe and datalogger.

Explain why it was **not** necessary to use a temperature probe and datalogger for this investigation.

Thermometer and datalogger have the same resolution

Only need to measure start and end temperature

(2)

1.2.2 Efficiency

Think

Pair

Share

What is efficiency?

This could either be in watts or joules.

Efficiency = Useful Output / Total Input

Key Term	Definition
Efficiency	

CS/F CS/H SS/F SS/H

1.2.2 Efficiency

The total power input to the solar cell is 2.4 W when the efficiency is 0.20. Calculate the useful power output of the solar cell. (3)

Convert Units	
Write down the formula.	
Substitute Values	
Do the Maths	
Round and add units.	

Substitute before you do any rearranging. 1 mark for doing this.

Answer to 2 s.f which is the same as the values in the qu.

CS/F CS/H SS/F SS/H

1.3 Energy Resources

Think Pair Share

What are the different non renewable energy resources on Earth?

Coal

Oil

Coal, oil and natural gas are all fossil fuels that have formed over millions of years from the remains of dead organisms.

Natural Gas

Nuclear

CS/F CS/H SS/F SS/H

1.3 Energy Resources

Think

Pair

Share

What are the advantages and disadvantages of these non renewable energy resources?

Energy Resource	Advantages	Disadvantages
Fossil Fuels		

CS/F CS/H SS/F SS/H

1.3 Energy Resources

Think

Pair

Share

What are the advantages and disadvantages of these non renewable energy resources?

Energy Resource	Advantages	Disadvantages
Nuclear Fuel		

CS/F CS/H SS/F SS/H

1.3 Energy Resources

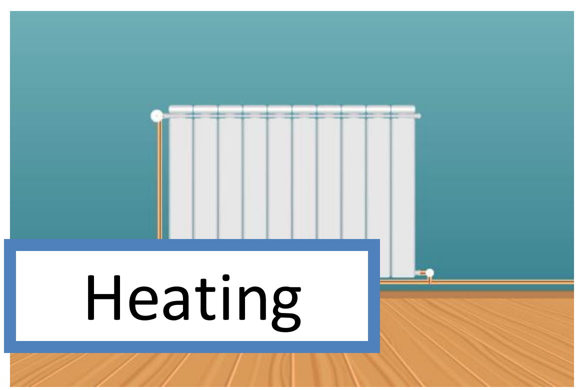
Think Pair Share

What are renewable energy resources?

Key Term	Definition
Renewable Energy Resource	

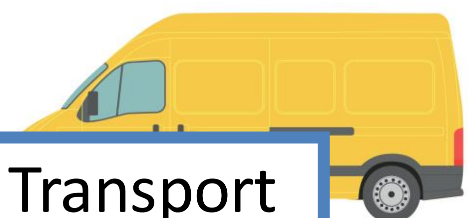
Think Pair Share

What uses to we have for energy resources?



Heating

Electricity



Transport

CS/F CS/H SS/F SS/H

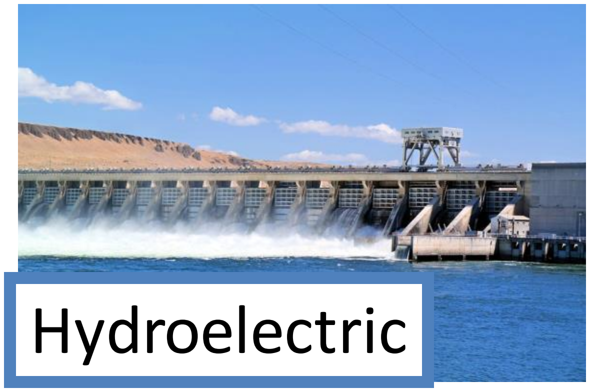
1.3 Energy Resources

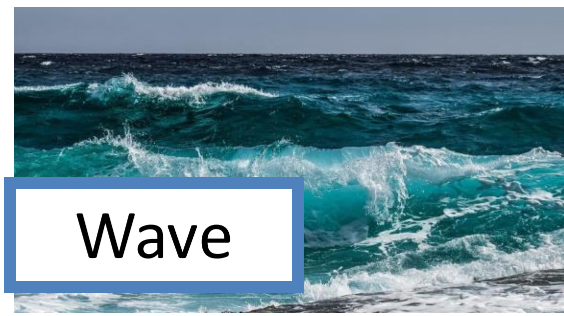
Think

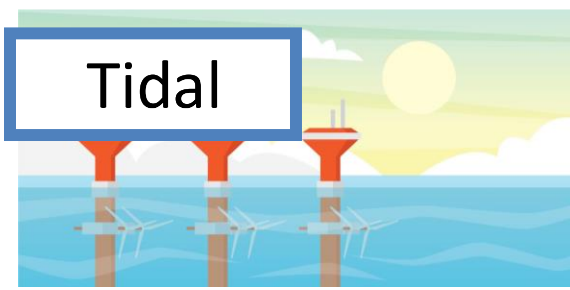
Pair

Share

What are the different renewable energy resources on Earth?







CS/F CS/H SS/F SS/H

1.3 Energy Resources

Think
Pair
Share

What are the advantages and disadvantages of these **renewable energy** resources?

Energy Resource	Advantages	Disadvantages
Biofuel		

We typically use this for:

Electricity Generation

Heating

Transport

CS/F CS/H SS/F SS/H

AQA GCSE Physics Paper 1

1.3 Energy Resources

Think
Pair
Share

What are the advantages and disadvantages of these **renewable energy** resources?

Energy Resource	Advantages	Disadvantages
Wind		

We typically use this for:

Electricity Generation

CS/F CS/H SS/F SS/H

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1.3 Energy Resources

Think Pair Share

What are the advantages and disadvantages of these **renewable energy** resources?

Energy Resource	Advantages	Disadvantages
Hydro-electricity		

We typically use this for:

Electricity Generation

CS/F CS/H SS/F SS/H

AQA GCSE Physics Paper 1

1.3 Energy Resources

Think

Pair

Share

What are the advantages and disadvantages of these **renewable energy** resources?

Energy Resource	Advantages	Disadvantages
Geothermal		

We typically use this for:

Electricity Generation

Heating

CS/F CS/H SS/F SS/H

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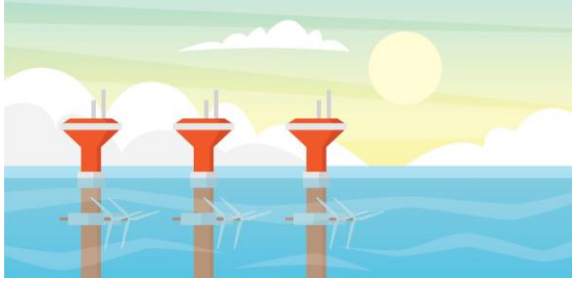
1.3 Energy Resources

Think
Pair
Share

What are the advantages and disadvantages of these **renewable energy** resources?

Energy Resource	Advantages	Disadvantages
Tidal		



We typically use this for:

Electricity Generation

CS/F CS/H SS/F SS/H

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1.3 Energy Resources

Think

Pair

Share

What are the advantages and disadvantages of these **renewable energy** resources?

Energy Resource	Advantages	Disadvantages
Solar		

We typically use this for:

Electricity Generation

Heating

CS/F CS/H SS/F SS/H

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1.3 Energy Resources

Think
Pair
Share

What are the advantages and disadvantages of these **renewable energy** resources?

Energy Resource	Advantages	Disadvantages
Water Waves		

We typically use this for:

Electricity Generation

CS/F CS/H SS/F SS/H

1.3 Energy Resources

Think Pair Share

Why are some energy resources more reliable than others?

Reliable

Unreliable

Solar and wind are unpredictable and so are less reliable than other energy resources.

CS/F CS/H SS/F SS/H

1.3 Energy Resources

Think Pair Share

Why are some energy resources more reliable than others?

Reliable

These resources are always available to be used. This makes them very reliable.

Unreliable

Solar and wind are unpredictable and so are less reliable than other energy resources.

CS/F CS/H SS/F SS/H