Particle Model

Paper 1

3.1.1 Density of Materials

Think
Pair
Share

What is the equation that you would use to calculate density?

Kilograms
kg

Density = Mass / Volume

ρ = m /v

Kilograms Per Metres Cubed
kg/m^3

Metres Cubed
m^3

Be careful. You may need to convert units!

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

Exam Practice

L3

18.45mm = 0.01845

The width of the cube was 18.45 mm. The density of the cube was 8.0×10^3 kg/m^3

Calculate the mass of the cube.

Volume = 0.01845 x 0.01845 x 0.01845 = 6.28×10^{-6}

$\rho = m / v$

$8 \times 10^3 = m / 6.28 \times 10^{-6}$

$m = 8 \times 10^3 \times 6.28 \times 10^{-6}$

Mass = 0.0502 kg

(5)

AQA GCSE Physics Paper 1

3.1.1 Density of Materials

Determining the density of a regularly shaped cube.

1

Measure the mass of the object using a balance.

2

Measure the length width and height of the object.

3

Multiply length width and height to find volume.

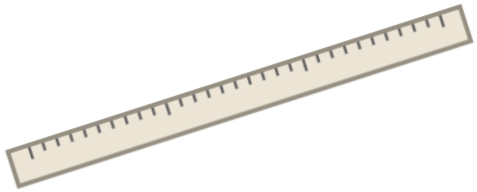
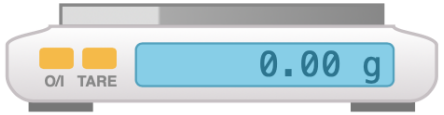
4

Use the values for mass and volume in the equation **Density = Mass / Volume** to find density.

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

3.1.1 Density of Materials

Suggested writing frame for your own method to determine the density of a regular shaped object.

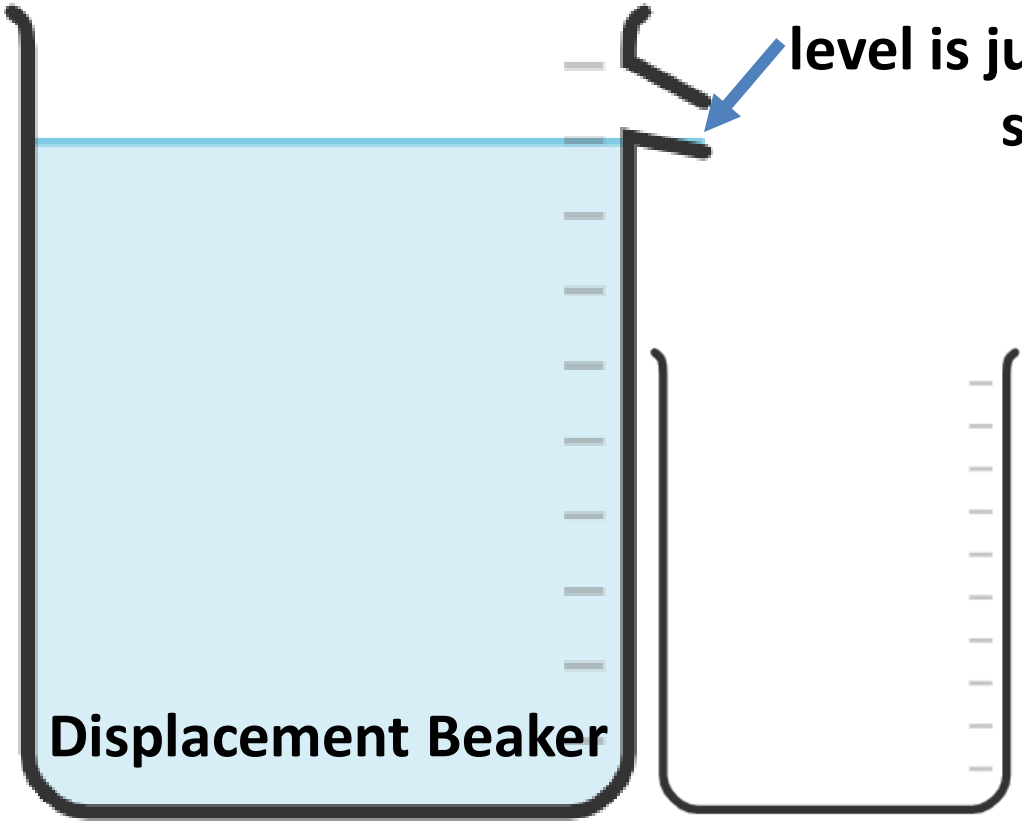
Finding Volume		
Finding Mass		
Determining Density		**Density = Mass / Volume**

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

3.1.1 Density of Materials

Think
Pair
Share

How could you determine the volume of an irregular shaped object?



1.
Fill so that the water level is just below the spout

2.
Place an empty beaker below the spout

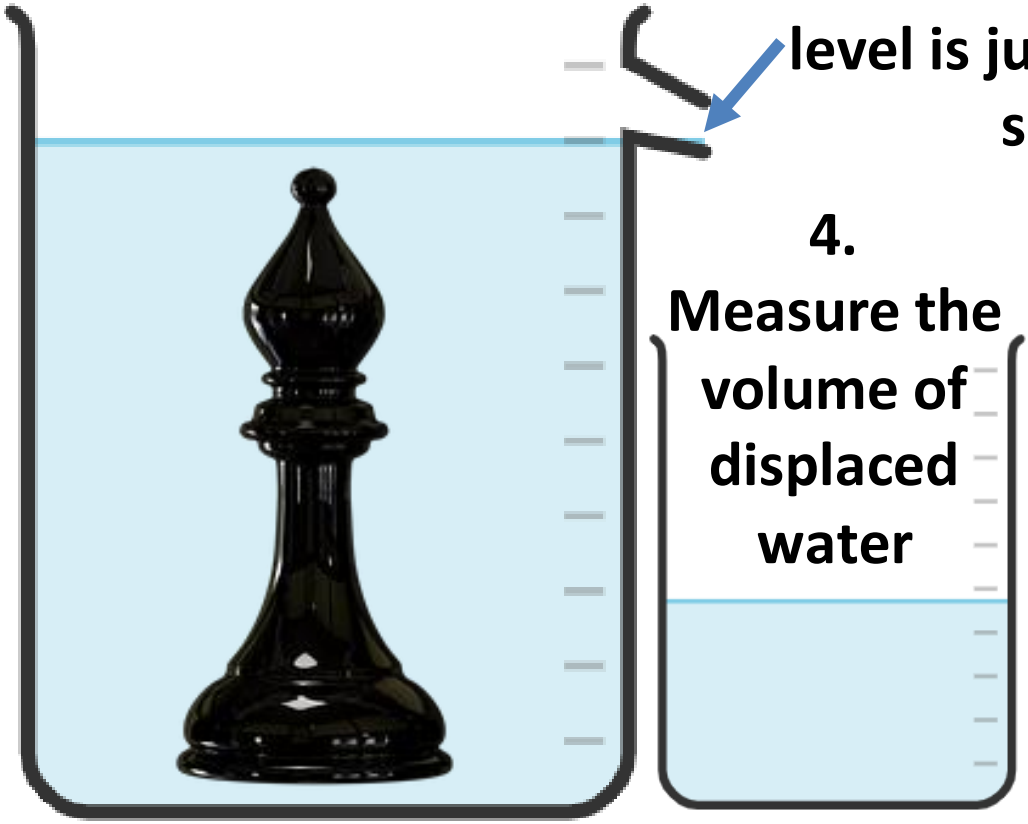
CS/F CS/H SS/F SS/H

3.1.1 Density of Materials

Think
Pair
Share

How could you determine the volume of an irregular shaped object?

1.
Fill so that the water level is just below the spout



2.
Place an empty beaker below the spout

3.
Add the item to the beaker. It should be submerged below the water

4.
Measure the volume of displaced water

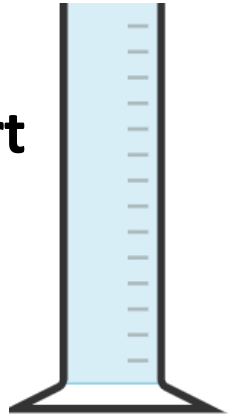
CS/F CS/H SS/F SS/H

3.1.1 Density of Materials

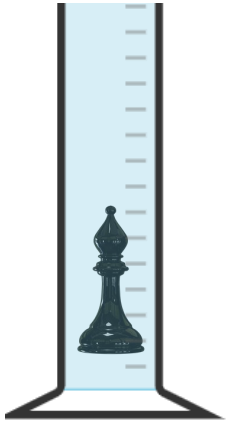
Think Pair Share

How could you determine the volume of an irregular shaped object?

1.
Half fill a measuring cylinder wit water and record the start volume



2.
Add object



3.
Record the new volume

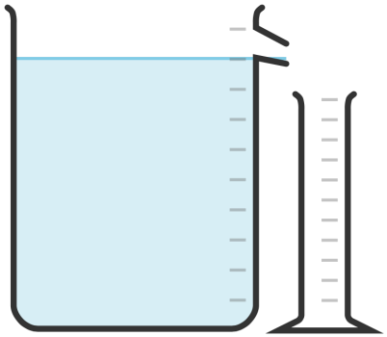
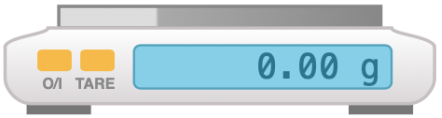
4.
Calculate the change in volume. This gives you the volume of your object.

Once you know the mass and volume you can calculate the density

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

3.1.1 Density of Materials

Suggested writing frame for your own method to determine the density of an irregularly shaped object.

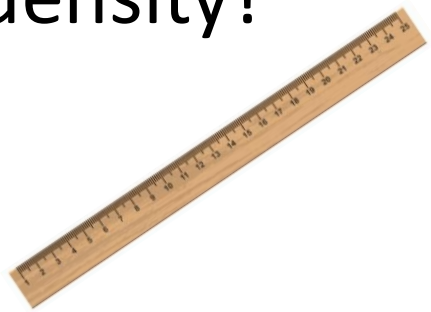
Finding Volume		
Finding Mass		
Determining Density		**Density = Mass / Volume**

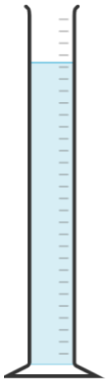
CS/F CS/H SS/F SS/H

3.1.1 Density of Materials

Think
Pair
Share

What are the possible sources of error when finding density?





Each piece of equipment that you use to measure something can lead to errors.

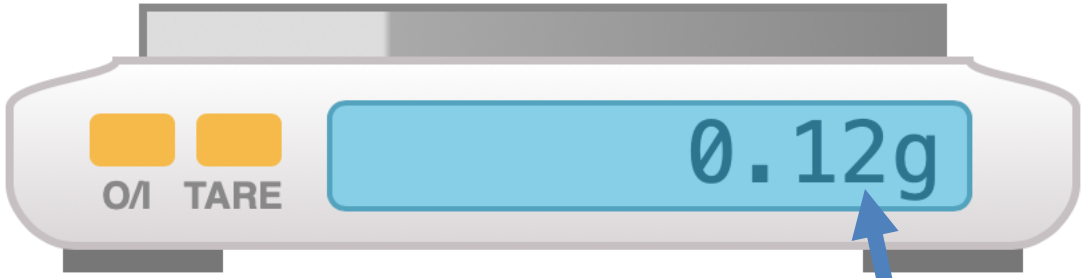
Key Term	Definition
Random Error	
Zero Error	

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

3.1.1 Density of Materials

Think
Pair
Share

How do you correct zero error?



To correct the error you could subtract 0.12g from the mass measured when the object is placed on it.

Zero error of 0.12g

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

3.1.1 Density of Materials

Think
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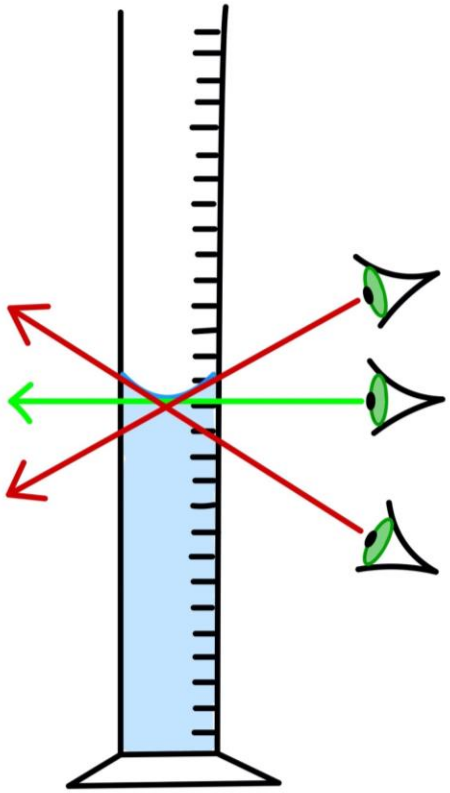
What is parallax error?



When viewing the volume from **below** the volume measured would be **less** than the actual volume.

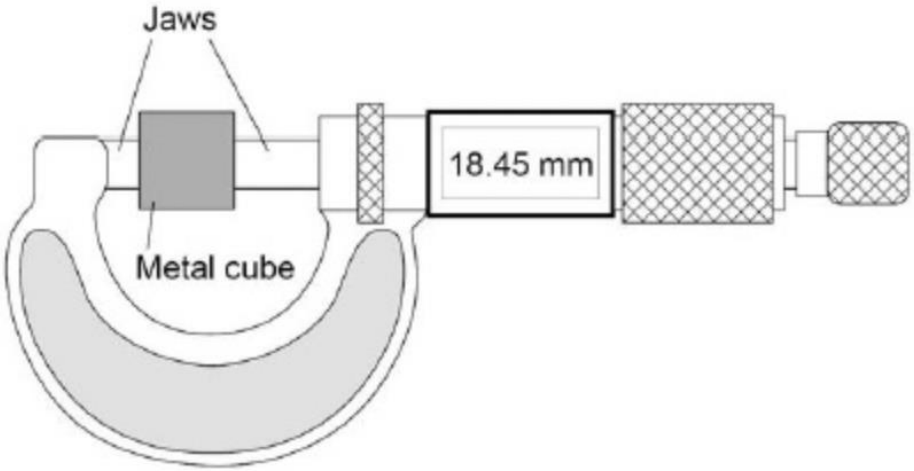
When viewing the volume from **above** the volume measured would be **more** than the actual volume.

Key Term	Definition
Parallax Error	

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

Exam Practice

L3



(a) The resolution of the micrometer is 0.01 mm

The student could have used a metre rule to measure the width of the cube.

Explain how using a metre rule would have affected the accuracy of the student's measurement of width.

Meter ruler has a lower resolution

So is less accurate

(2)

3.1.2 Changes of State

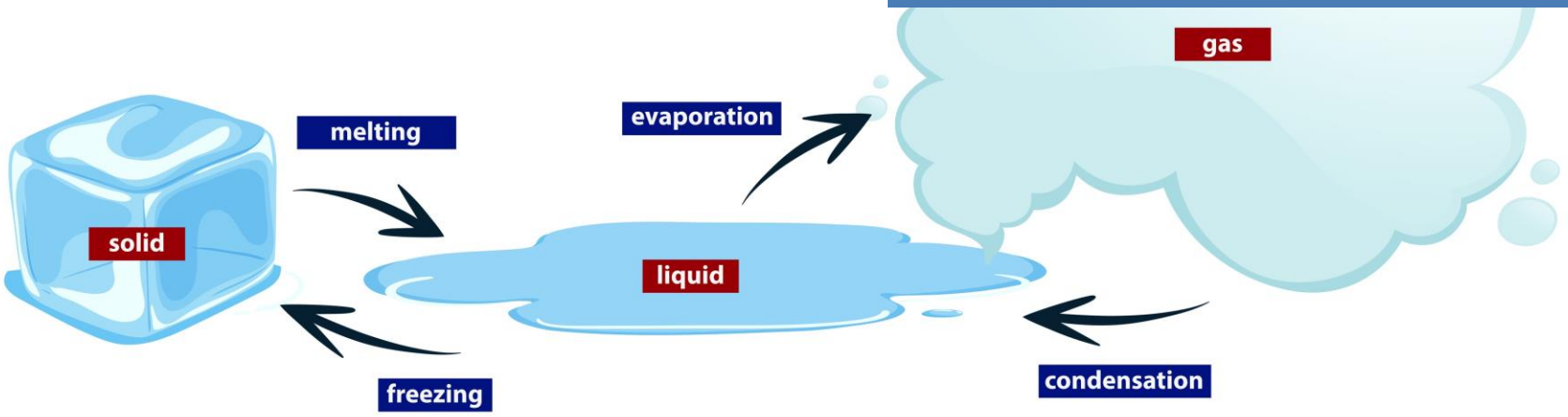
Think
Pair
Share

What happens to mass when substances change state?

When a substance changes state mass is conserved.

Changes of state are physical changes.

They differ from chemical changes because the material recovers its original properties if the change is reversed.

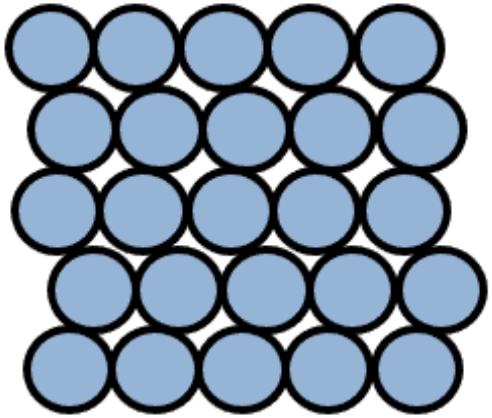


CS/F CS/H SS/F SS/H

3.2.1 Internal Energy

Think
Pair
Share

What is internal energy?



It is the total kinetic energy and potential energy of all the particles in the system.

Key Term	Definition
Internal Energy	

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

3.2.1 Internal Energy

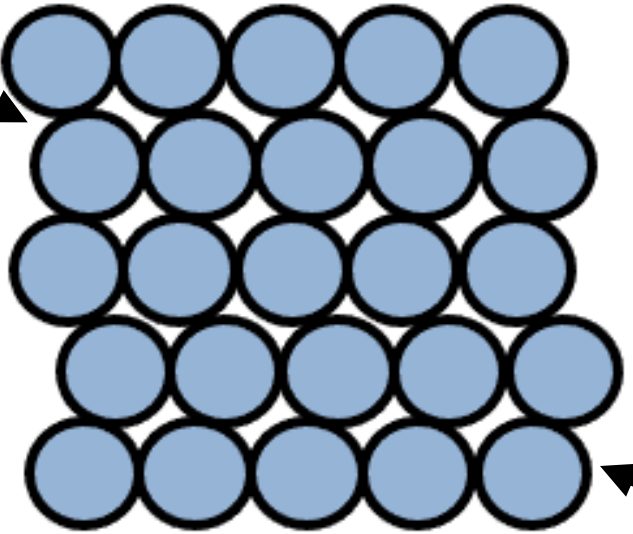
Think Pair Share

What would happen if this solid were heated?

Its temperature could increase

The particles would have more kinetic energy.

Internal energy would increase



Particles within a solid.

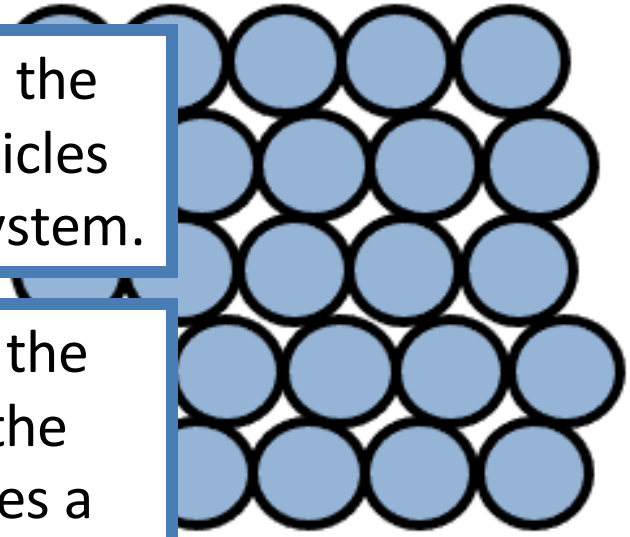
It could change state

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

3.2.1 Internal Energy

Think
Pair
Share

What would happen if this solid were heated?



Heating increases the energy of the particles that make up the system.

This either raises the temperature of the system or produces a change of state.

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

3.2.2 Temperature Changes

Think
Pair
Share

What does the temperature increase in a system depend on?

The mass substance heated	The type of material.	The energy input to the system.

This means we can use the equation for specific heat capacity!

Key Term	Definition
Specific Heat Capacity	

3.2.2 Temperature Changes

Think
Pair
Share

How do we calculate specific heat capacity?

Kilograms
kg

Joules per kilogram per degree Celsius
J/kg°C

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

3.2.2 Temperature Changes

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

3.2.2 Temperature Changes

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

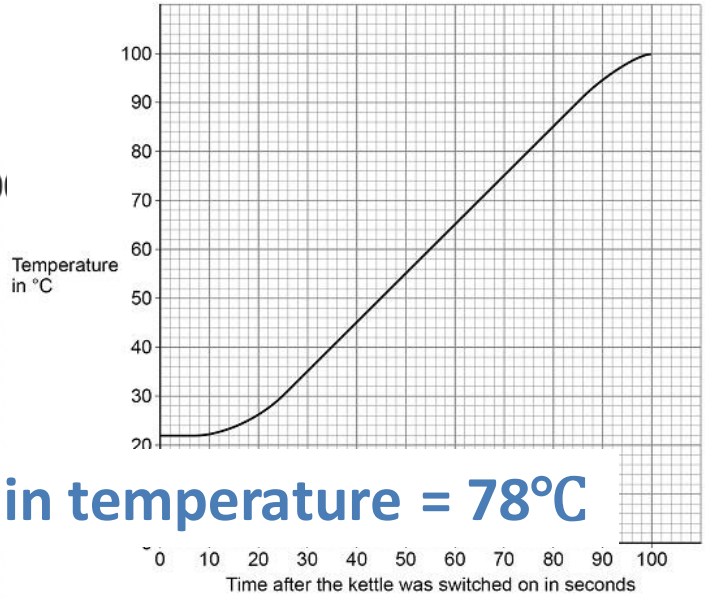
The energy transferred to the water in 100 seconds was 155 00

specific heat capacity of water = 4200 J/kg °C

Determine the mass of water in the kettle.

Use the graph above.

Give your answer to 2 significant figures.



Change in temperature = 78°C

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

$155{,}000 = m \times 4200 \times 78$

$m = 155{,}000 / (4200 \times 78)$

$m = 0.4731$

Mass of water (2 significant figures) = 0.47 kg

(5)

3.2.3 Specific Latent Heat

Think
Pair
Share

What is latent heat?

Key Term	Definition
Latent Heat	
Specific Latent Heat	

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

3.2.3 Specific Latent Heat

Think
Pair
Share

What is latent heat?

Key Term	Definition
Specific Latent Heat of Fusion	
Specific Latent Heat of Vaporisation	

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

3.2.3 Specific Latent Heat

Think
Pair
Share

How can we calculate latent heat?

Kilograms
kg

Energy For a Change in State = Mass x Specific Latent Heat

$$E = m \times L$$

Joules

Joules per kilogram
J/kg

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

3.2.3 Specific Latent Heat

Calculate the energy needed to melt 500g of water which has a latent heat of fusion of 334,000J/kg

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

Usually 1 mark for this.

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

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

3.2.3 Specific Latent Heat

Calculate the mass of water when it takes 125kJ to change it from a solid to liquid. Latent Heat of Fusion 334,000J/kg

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.

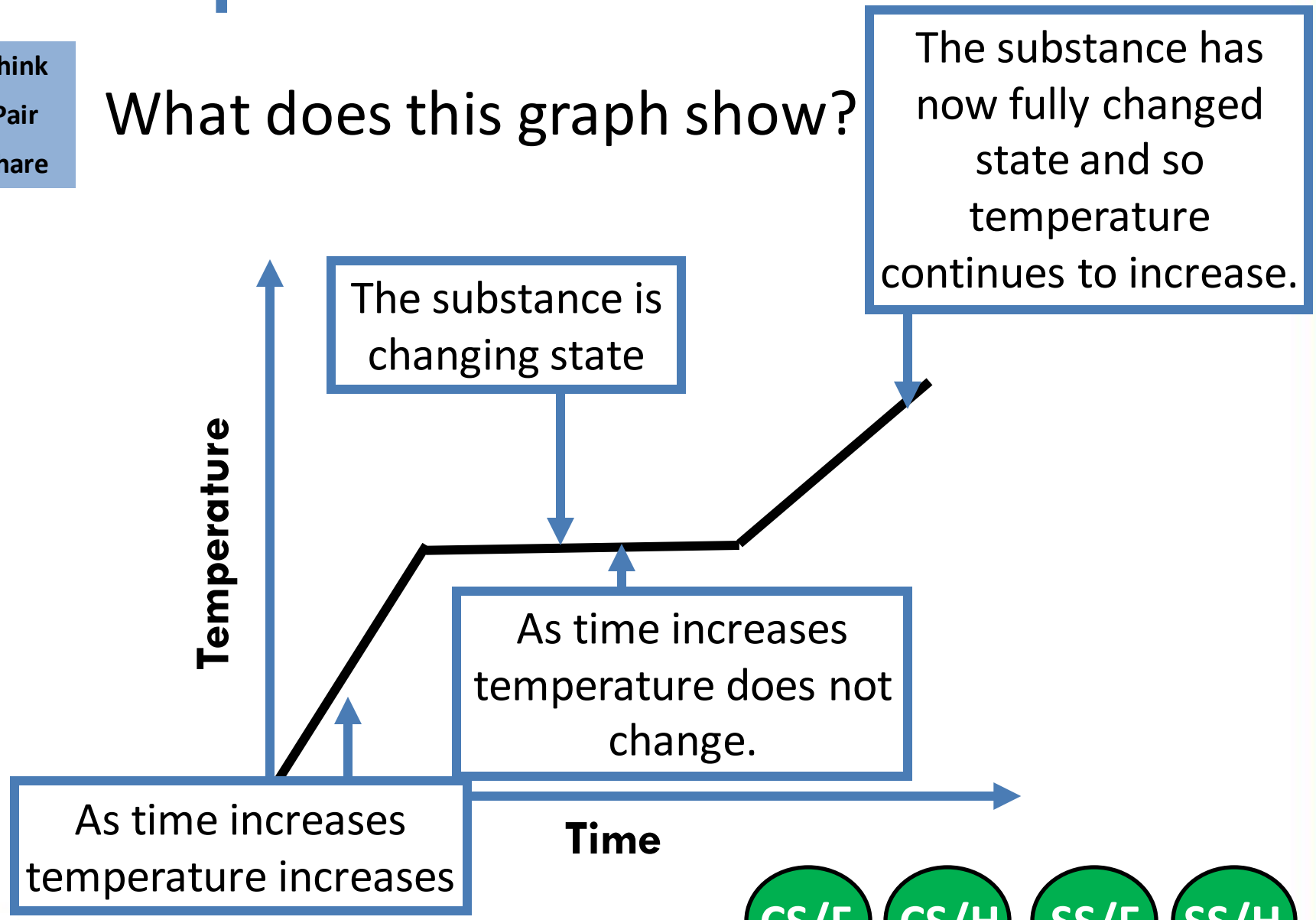
Answer to 3 s.f which is the same as the values in the qu.

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

3.2.3 Specific Latent Heat

Think
Pair
Share

What does this graph show?



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

3.2.3 Specific Latent Heat

Think
Pair
Share

What is the difference between specific heat capacity and specific latent heat?

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

While

Specific Latent Heat	The amount of energy need to **change the state** of one kilogram of the substance with no change in temperature.

Be prepared for calculations in which you need to use both formulas together!

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

Exam Practice

L3

(d) An ice cube has a temperature of −15.0 °C

The total thermal energy needed to raise the temperature of this ice cube to 0.0 °C and completely melt the ice cube is 5848 J

specific heat capacity of ice = 2100 J/kg °C
specific latent heat of fusion of ice = 334 000 J/kg

Calculate the mass of the ice cube.

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

$\Delta E = m \times 2100 \times 15$

$E = 31{,}500m$

$5848 = 31{,}500m + 334{,}000m$

$E = m \times L$ $\quad 5848 = 365{,}500m$

$E = m \times 334{,}000$ $\quad m = 5848 / 365{,}500$

$E = 334{,}000m$ $\quad m = 0.016$

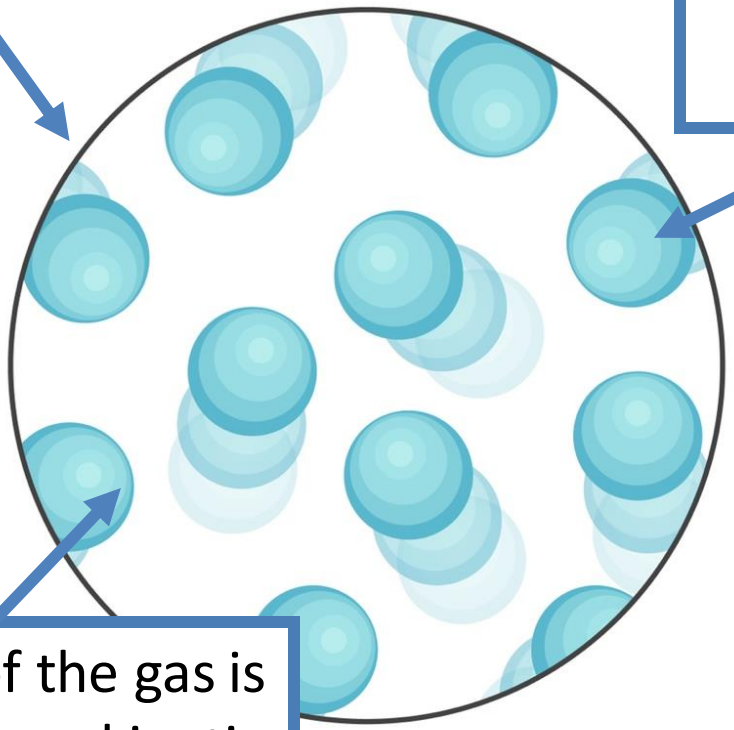
Mass of ice cube = 0.016 kg

(5)

3.3.1 Particle Motion in Gases

The molecules of a gas are in constant random motion.

Increasing the temperature of a gas increases the pressure exerted by the gas.



The temperature of the gas is related to the average kinetic energy of the molecules.

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

3.3.1 Particle Motion in Gases

Think
Pair
Share

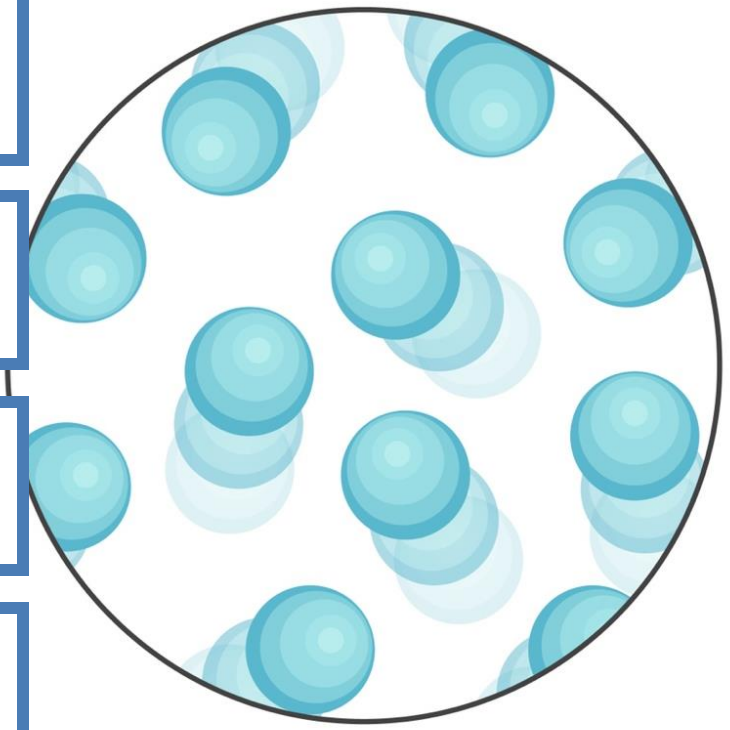
Why does pressure of a gas increase when its temperature is increased?

When the temperature is increased particles have more kinetic energy.

The particles collide more with the sides of the container per second.

Greater forces exerted in the collisions.

So there is a greater force exerted in the area.



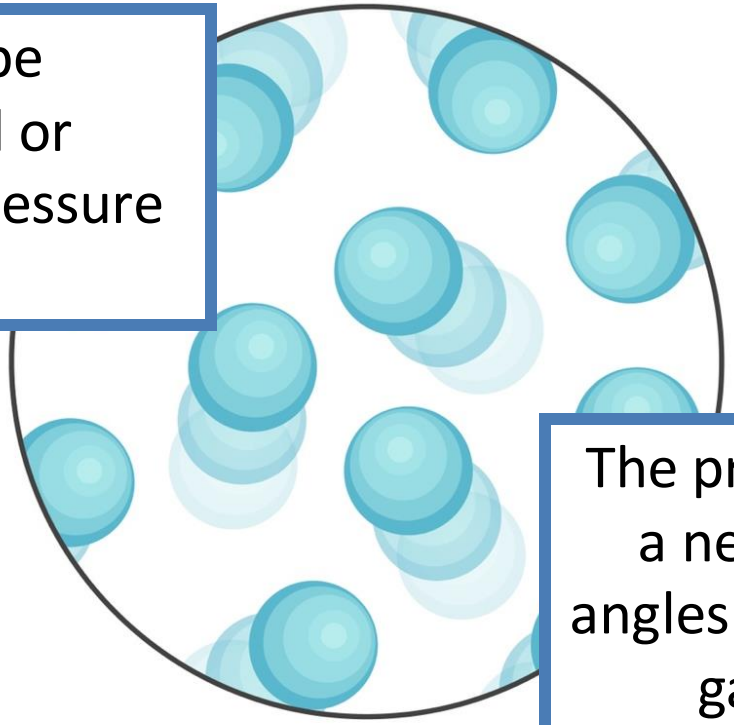
CS/F CS/H SS/F SS/H

3.3.2 Pressure in Gases

Think
Pair
Share

How can a gas be compressed or expanded?

A gas can be compressed or expanded by pressure changes.



The pressure produces a net force at right angles to the wall of the gas container.

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

3.3.2 Pressure in Gases

Think
Pair
Share

How can pressure be calculated?

Metres Cubed
m^3

Pressure x Volume = Constant

ρ V = Constant

Pascals
Pa

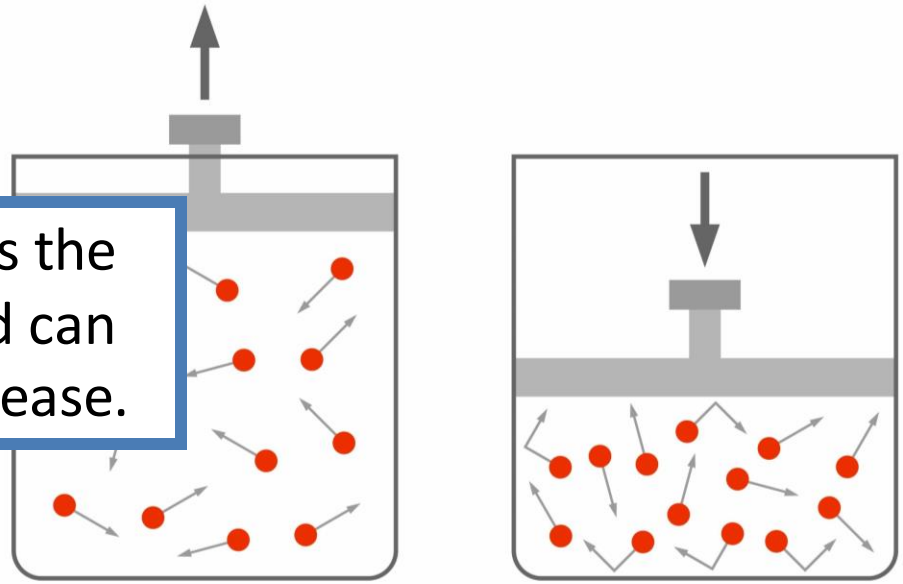
Be careful. You may need to convert units!

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

3.3.3 Increasing Pressure in Gases

Think
Pair
Share

What is work?



Doing work on a gas increases the internal energy of the gas and can cause the temperature to increase.

Key Term	Definition
Work	

3.3.3 Increasing Pressure in Gases

Think
Pair
Share

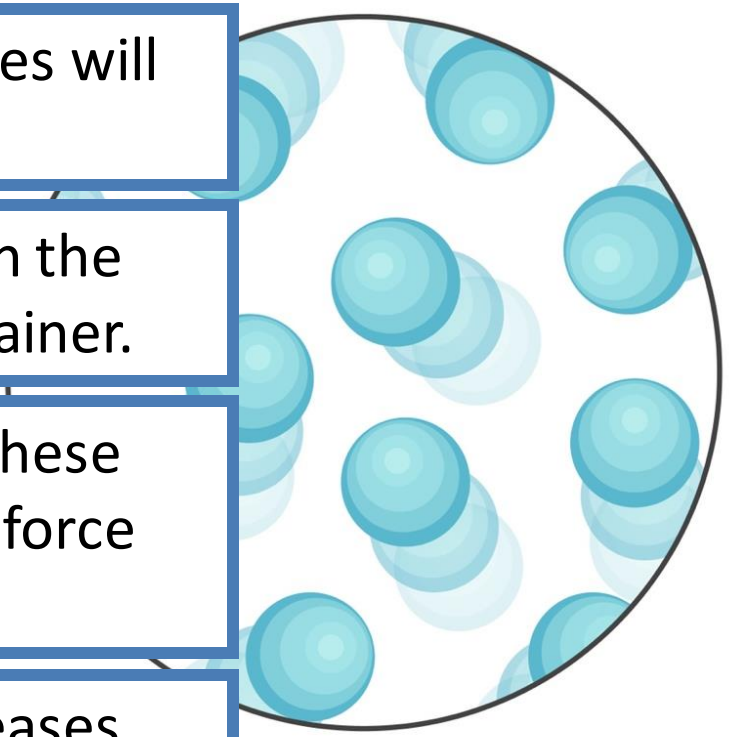
Why does pressure increase when temperature is increased?

When temperature is higher particles will have more kinetic energy.

There are more collisions between the particles and the walls of the container.

A greater force is also exerted in these collisions and so there is a greater force exerted in the same area.

This means that the pressure increases.



3.3.3 Increasing Pressure in Gases

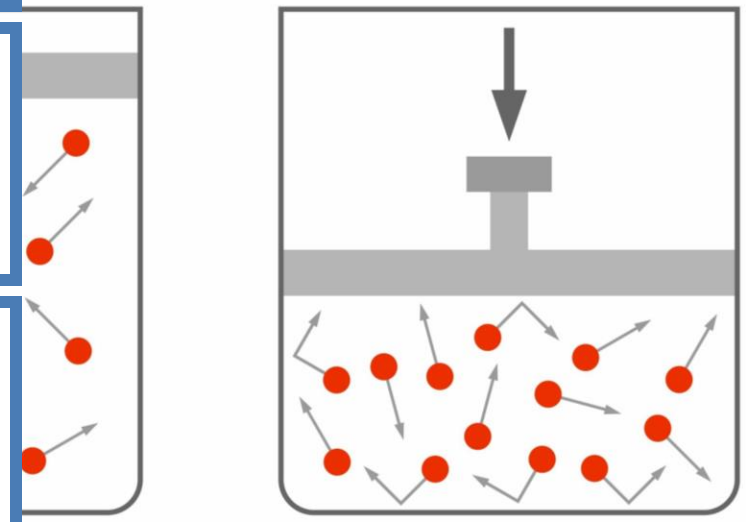
Think
Pair
Share

Why does pressure increase when a gas is compressed?

As the gas is compressed the volume of the gas decreases.

This means that there are more frequent collisions between the particles and the container wall.

Each particle collision with the wall exerts a force and so there is a greater force on the walls.



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