Chestnut Grove Academy

Physics

3. Particle Model of Matter

Revisiting Booklet

Name:

Particle model of matter

Topics:

1. Density of materials
2. Density required practical
3. Changes of state
4. Internal energy
5. Specific heat capacity
6. Specific latent heat
7. Particle motion in gasses
8. TRIPLE ONLY: Pressure in gasses
9. TRIPLE HT ONLY: Increasing the pressure of a gas

Density of Materials

Density is the amount of __________ per unit volume.
What do we measure density in?

If the object is less dense than a substance it will ________ when placed in the substance.
If the object is more dense that a substance it will ________.

1. In each of the following questions find the **density**. State the units of your answer.

a Mass 45g, volume 5cm^3

b Volume 7cm^3, mass 56g

c Volume 0.4m^3, mass 688kg

d Mass 18.9g, volume 9cm^3

e Mass 4340kg, volume 7m^3

f Volume 12.8cm^3, mass 8601.6cm^3

2. In each of the following questions find the **mass**. State the units of your answer.

a Density 5g/cm^3. volume 4cm^3

b Volume 19cm^3, density 8g/cm^3

c Volume 3cm^3, density 1.4g/cm^3

d Density 190kg/m^3, volume 3m^3

e Volume 4m^3, density 5450kg/m^3

f Density 960kg/m^3, Volume 0.25m^3

3. In each of the following questions find the **volume**. State the units of your answer.

a Density 1.4g/cm^3. mass 5.6g

b Mass 4.2g, density 0.7g/cm^3

c Mass 16.32g, density 2.4g/cm^3

d Density 800kg/m^3, mass 4800kg

e Mass 420kg, density 140kg/m^3

f Density 6904kg/m^3, Mass 28306.4kg

4. Lead has a density of 11.5g/cm^3. A rectangular block of lead measures 7cm ×5cm×2cm.

a) Find the volume of the block of lead.
b) Find the mass of the block of lead

5. A plywood plank measures 1cm ×8cm×90cm and weighs 396g.

a) Find the volume of the plywood plank.
b) Find the density of the plywood.

6. The petrol in a petrol can weighs 2000g. The density of petrol is 0.8g/cm^3. What is the volume of the petrol in the can in

a) cm^3

b)litres (1000cm^3=1 litre)

7. A marble slab is 1 metre long and has a rectangular cross section of area 15cm^2.

a) What is the volume of the marble slab?

b) The density of marble is 2.7g/cm^3, what is the mass of the marble slab?

8. Olympics medals have a diameter of 60mm and a thickness of 3mm . Gold has a density of 19g/cm^3. Work out

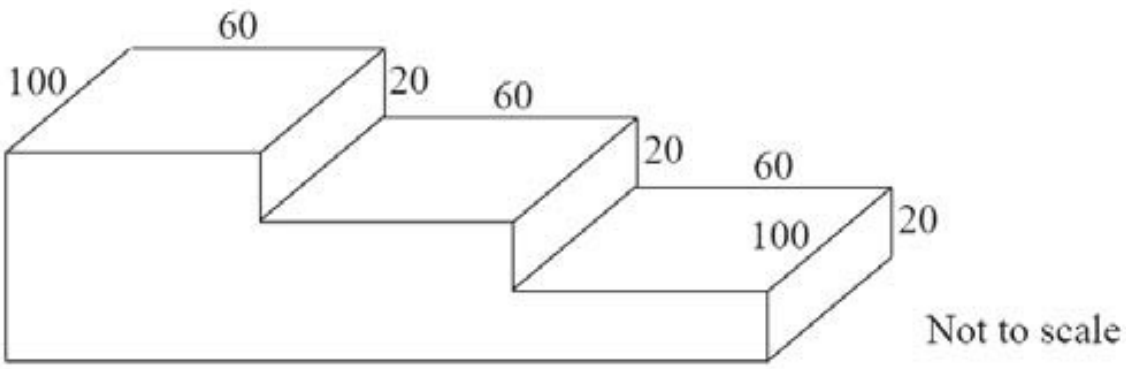
a) the volume of a gold medal
b) the mass of a gold medal.
Hint – think of the gold medal as a cylinder

9. Jack makes some concrete steps. The diagrams show their dimensions in centimetres.

a) Calculate, in cm^3, the volume of concrete needed.

b) There are 1000000cm^3 in 1m^3. Change your answer from a) into m^3

c) The density of concrete is 2400kg/m^3. How much will the steps weigh?



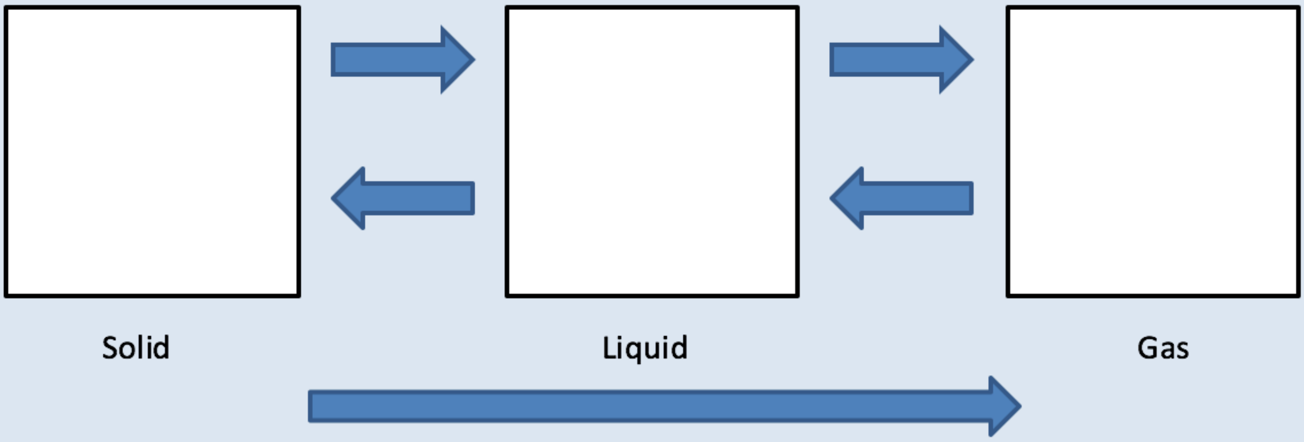
Density Required Practical

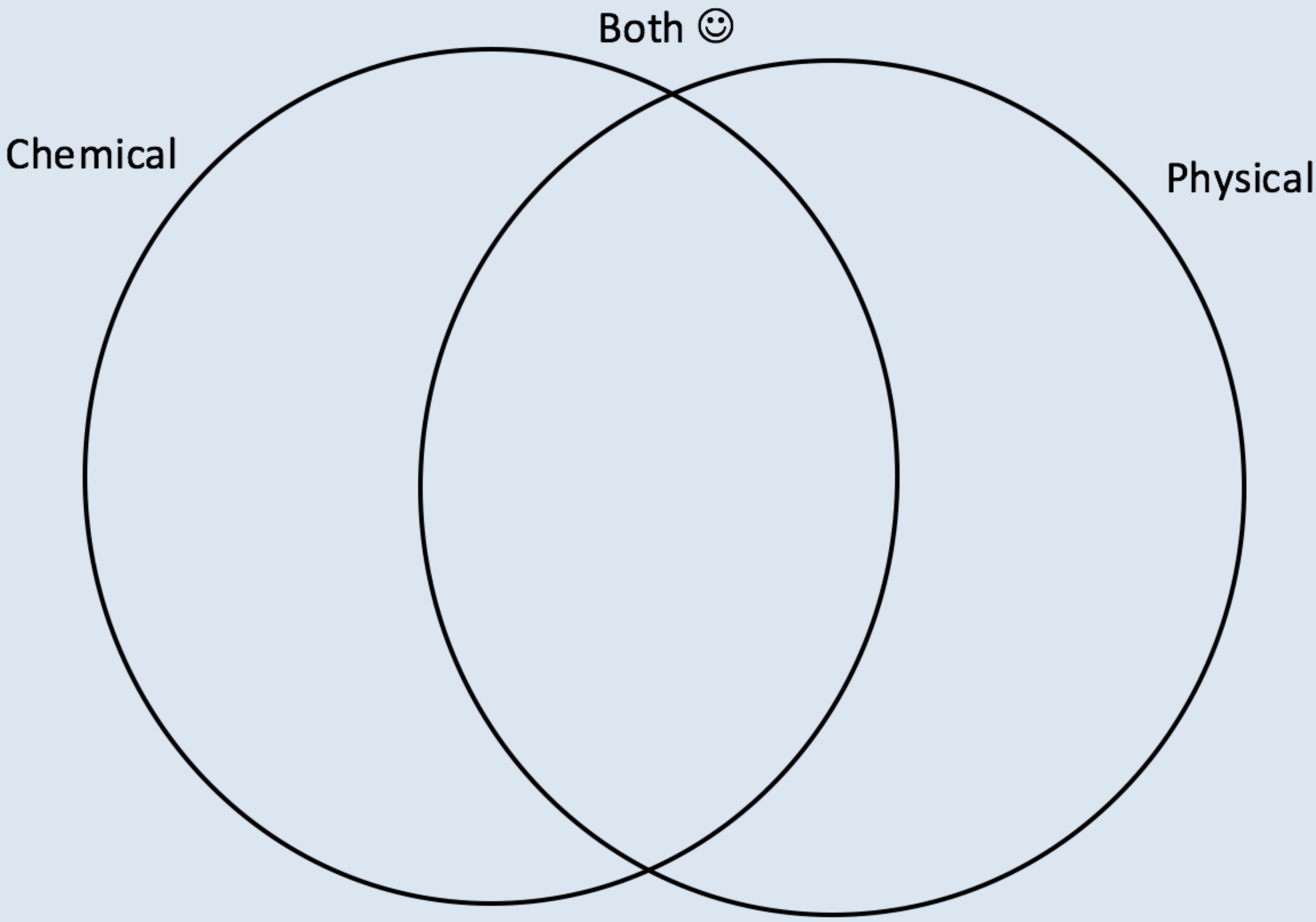
<u>Method for regular objects (activity 1)</u> Write a *detailed* set of instructions for how to carry out this practical. 1. 2. 3. 4. 5. 6. 7.
<u>Method for irregular objects (activity 2)</u> Write a *detailed* set of instructions for how to carry out this practical. 1. 2. 3. 4. 5. 6. 7.
<u>Method for liquids objects (activity 3)</u> Write a *detailed* set of instructions for how to carry out this practical. 1. 2. 3. 4. 5. 6. 7.

Changes of State

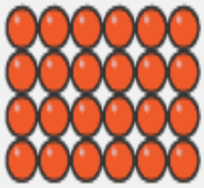
Label the arrows: **melt, freeze, boil, evaporate, condense or sublimate**

Ext: Describe how a solid could turn into a gas.





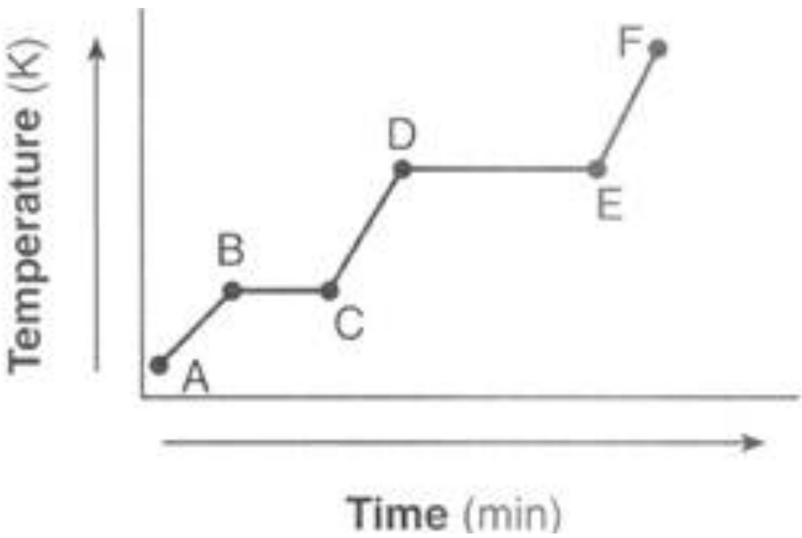
Complete the Table!

	Solid	Liquid	Gas
Arrangement of particles	**Keywords**: pattern, together	**Keywords**: pattern, random	Far apart Random arrangement
Movement of particles		Move around each other	
Diagram			

Internal Energy

1.Define internal energy (use a diagram to illustrate your answer)

2.Label the heating curve with the states, changes of states



3. Explain the shape of the graph (hint: do this in stages)

Specific Heat Capacity

Match the symbol to what they mean and the unit!

ΔE	Specific heat capacity	Kg (kilograms)
m	*Change in thermal energy*	*J (Joules)*
c	Mass	°C (degrees celcius)
$\Delta \vartheta$	Change in temperature	J/kg °C (Joules per kilogram per degree Celsius)

Ext: How much energy is supplied If a **2kg** ice cube is heated by **10°C** and has a specific heat capacity is **4200J/kg °C ?**

$$\Delta E = \boldsymbol{m\, c\, \Delta \vartheta}$$

1. A 1 kg block of Compound A (Specific Heat Capacity of 1000 J / kg °C) is heated, increasing its temperature by 1 °C. How much energy has been added to the block?

   m=

   c=

   $\Delta \vartheta$ *(temperature change) =*

   Now use the equation

   $\Delta E =$

   $\Delta E =$

Specific Heat Capacity values	
Water	4,180 J / kg °C

Copper	390 J / kg °C
Glass	840 J / kg °C

1. Which substance requires the least amount of energy to raise its temperature?

2. How much energy is needed to increase the temperature of 1kg of water by 10°C?

3. How much energy is needed to increase the temperature of 1kg of copper by 10°C?

4. A 2 kg block of copper is put in 1 kg of water. How much energy is needed to increase the temperature by 10°C? (Hint: You are heating up BOTH the copper AND the water so do them separately)

$$\boldsymbol{\Delta \vartheta} = \Delta E \div mc$$

5. A 1 kg block of Compound A (specific heat capacity = 1000J/kg °C) is heated, increasing its energy by 3000 Joules. How much warmer does it get?

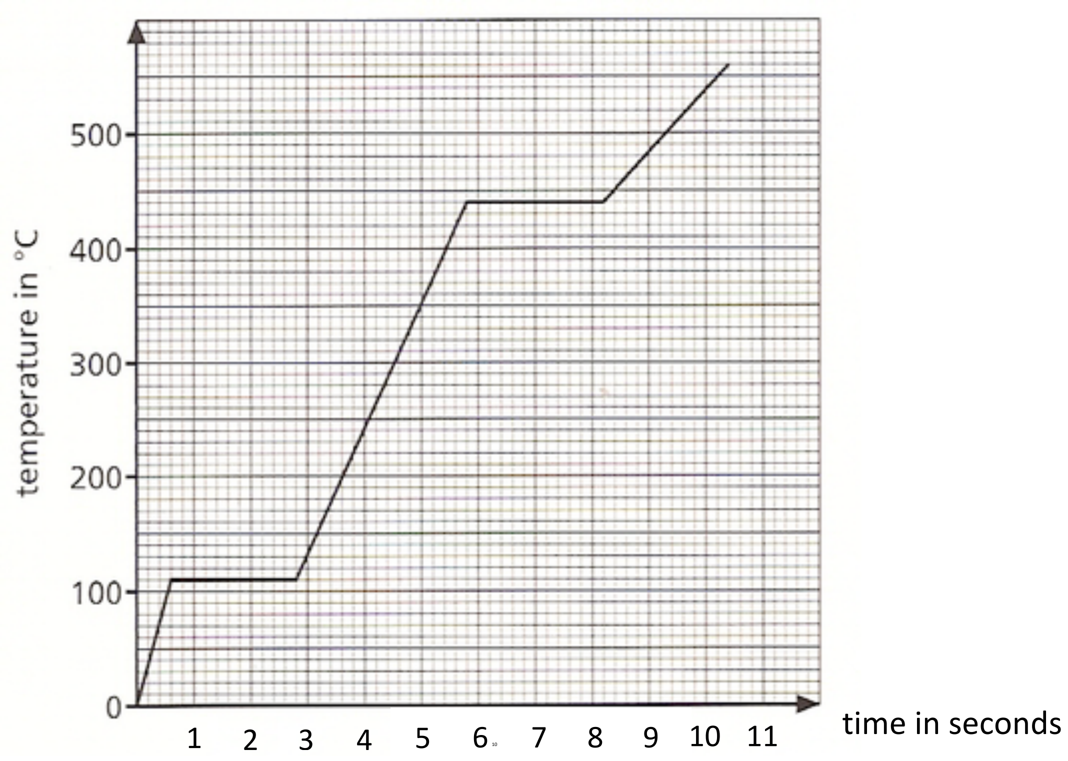
Specific Latent Heat

1. (a) The melting point and boiling point of lead are 327 and 1774 degrees Celsius and -219 and -183 for Oxygen.

(i) At - 200 °C will the oxygen be a solid, liquid, or gas? ....

(ii) At 450 °C will the lead be a solid, liquid, or gas? ....

(b) The graph shown alongside shows how the temperature of a pure substance changes as it is heated.



(i) At what temperature does the substance melt? ....

(ii) Label the section of the graph with a letter X where the substance is a liquid only and with a letter Y where it exists as both a liquid and solid at the same time.

(iii) If the heater provides 100J of heat energy every second use the graph to calculate the energy required to melt this substance

....

(iv) If 1.5 kg of the substance was used, use your answer to part (ii) to calculate the specific latent heat of fusion for this substance.

....

....

2. Fill the blanks in the following sentences:

(a) A solid must be given .... heat of .... before it can be melted into a liquid.

(b) A liquid must be given .... heat of .... before it can be boiled into a gas.

(c) The energy needed to melt a solid is used to break the .... between the molecules so that they can move .... freely.

(d) The specific latent heat of fusion is the amount of energy (measured in ....) needed to melt .... kg of a solid into a .... without changing its ....

3. Explain why a scald from steam at 100 degrees C is very much worse than a scald from water at 100 degrees C.

4. An electric kettle produces 2000 J of energy each second. It is filled with water, weighed and switched on. After coming to the boil, it is left on for a further 120 seconds and is then switched off. It is found to be 90 g lighter. Calculate the specific latent heat of vaporisation from this data.

Remember: Energy = mass x specific latent heat

Hint: Try rearranging the formula.

Work out how much total energy is used in 120seconds

Particle motion in gasses

Questions

1) Match up the units

Pressure	**Metres**	**Pa**
Force	**Pascals**	**m**
Area	**Newtons**	**N**

2) If a hammer exerts 10N on a nail with an area of $2m^2$ what is the pressure?

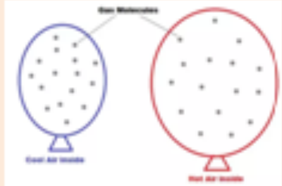
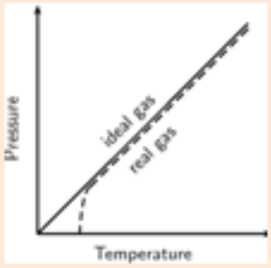
3) In box 1 draw the particles in a gas at a low temperature. In box 2 draw the particles in a gas at a higher temperature

Low Temperature High Temperature

4) What can you say has happened to the pressure of the gas?

Ext: In your books describe in your own words how a wateriet works.

Complete each task in the space below

Describe how the particle arrangement in gases is different to that in solids and liquids.	Which one is under greater pressure? How can you tell? 	State what happened to the air in the balloon when it was cooled in the liquid nitrogen 
Explain, in terms of energy, what happens to the particles in a gas when they are heated up	Explain what happens to the volume of a gas as it is heated up.	Explain what happens to the pressure of a gas when it is heated up.
Create a flow chart to show how volume and pressure changes with increased temperature in gases	What is the difference between volume and pressure?	Describe what this graph shows 

TRIPLE ONLY: Pressure in gasses

$$\text{pressure} \times \text{volume} = \text{constant}$$
$$p\,V = \text{constant}$$

Pressure, p, in pascals, Pa
Volume, V, in metres cubed, m^3
A **constant** is any number.

1. What is the definition of pressure?

2. If the volume is kept constant and the temperature increases what happens to the speed of the particles?

3. What will happen to the pressure of a gas at constant temperature if the volume is decreased?
4. A gas is initially at pressure 5Pa and volume $2m^3$, what will the pressure be if the volume increases to $20m^3$.

5. A gas is initially at pressure 5Pa and volume $2m^3$, what will the volume be if the pressure increases to 10Pa .

Ext: What happens to the temperature of a gas if the particles are pushed back by the wall of a container.