**Chemistry: 1. States of Matter**

***Please remember to photocopy 4 pages onto one sheet by going A3→A4 and using back to back on the photocopier***

**Syllabus**

**OC1** Name three states of matter and know their characteristics

**Matter can exist in three states – solid, liquid and gas**



**Student Notes**

Everything around us is made up of ‘stuff’. The science term for this is ‘matter’.  
Matter can be in one of three states; solid, liquid or gas

**Characteristics of Solids, Liquids and Gases**

|  |  |  |
| --- | --- | --- |
| **Solids** | **Liquids** | **Gases** |
| Definite shape | No definite shape | No definite shape |
| Definite volume | Definite volume | No definite volume |
| Hard to compress | Hard to compress | Easy to compress |
| Do not flow | Flow easily | Diffuse to fill all available space |

**Explanation**

**1. Every ‘thing’ is made up of very small particles (which we call ‘atoms’).**

**2. Atoms jiggle**

**Atoms are really, really small**

These particles are so small that two million of them would fit into the full stop at the end of this sentence!

It’s not surprising that it took thousands of years before people believed that atoms exist.

In fact many scientists, even Albert Einstein, were doubtful that atoms existed at all!

We can now see atoms using special hi-tech microscopes.

Now however we know that not only do these ‘atoms’ exist, but in fact they are always moving (jiggling), no matter how hot or cold the object is, and it is this movement that determines whether the object is a solid, a liquid or a gas.



|  |  |
| --- | --- |
| **Change of State** | **Description** |
| Solid – Liquid | Melting |
| Liquid – Solid | Freezing |
| Liquid – Gas | Evaporation |
| Gas – Liquid | Condensing |

**Now for the interesting bits (that won’t be on the Junior Cert exam)**

In a solid the atoms jiggle around a fixed position but don’t actually move anywhere. Now as you heat the solid the atoms jiggle more quickly and push over and back over a greater area. So although you can’t see the atoms moving, the solid itself actually expands slightly!

If you keep heating the solid then eventually the atoms get so much energy that they are able to leave their fixed position and whole groups of atoms start to move off, sliding over each other while all the time continuing to jiggle.

We say that the solid is turning to a liquid.

If you keep heating the liquid even further then eventually the atoms get so much energy and vibrate so much that they leave the rest of the liquid altogether and end up in the air.

We say that the liquid is turning to a gas.

**Jiggling atoms and temperature**

**Question**

Can you explain why the level of alcohol in the thermometer rises when you dip a thermometer into a beaker of hot water?

**Answer**

The atoms in the hot water are jiggling rapidly and bang off the atoms in the glass part of the thermometer. The glass is solid so the atoms in the glass don’t move anywhere but because they are getting battered by the atoms in the water outside they start to jiggle more rapidly.

Some of these atoms are in contact with the alcohol so now these atoms start to jiggle more rapidly and as a result the alcohol rises a little on top due to all this movement.

So what a thermometer is actually responding to the jiggliness of the atoms – the more the atoms jiggle the higher the thermometer reading!

**Evaporation and Boiling Point**

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Even at room temperature some of the atoms in water get enough energy to leave the liquid and become part of the air.

This happens slowly and we call this evaporation.

However at a certain temperature (100 0C) every atom can leave the liquid and when this starts to happen we say that the water is boiling.

Condensation is the changing of a gas to a liquid e.g. steam meeting cold glass.

**Exam Questions**

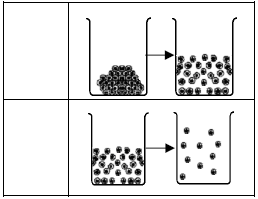
1. [2010 OL]

Water exists in the three states of solid, liquid and gas.

1. What is the solid state of water more commonly known as?
2. What word describes the change of state from a solid to a liquid?
3.  [2009 OL] [2007 OL] [2006 OL]

The diagram shows the arrangement of particles in the three states of matter.

1. Which diagram represents the arrangement of particles in a solid?
2. Which diagram represents the arrangement of particles in a liquid?
3. Which diagram represents the arrangement of particles in a gas?
4. Name the physical change that takes place when A changes into B.



1. [2011 OL

The diagrams show the change in the arrangement of particles in the states of matter as they are heated.

1. Which diagram which shows melting?
2. Which diagram which shows boiling (evaporation)?
3. [2009]

There are three states of matter: solid, liquid and gas.

1. Give one property that liquids and gases have in common.
2. Give one property in which liquids and gases differ.
3. [2012]  
   The diagram shows the evaporation of water.
4. What is evaporation?
5. What do molecules have to gain in order to evaporate from liquid water?
6. [2006]

Study the diagram carefully. It shows the ways that the particles of gases and solids occupy space.

The particles of gas have lots of space and move randomly at high speeds in three dimensions and collide with each other and with their container.

The arrows represent the velocities of the gas particles.

The particles of a solid are packed closely together and cannot move around but they can vibrate.

Give one property of a gas and one property of a solid that you have observed and is consistent with (matches) this micro-view of these states of matter.

**Exam Solutions**

1. Ice
2. Melting
   1. A
   2. B
   3. C
   4. Melting
   5. Top
   6. Bottom
3. They can flow/ allow diffusion/ don’t have definite shape/ take shape of container...
4. Gases are compressible (liquids are incompressible)/ gases have lower density (liquids have higher density)/ gases fill container...
5. Liquid to gas (vapour)
6. Energy/ heat
7. One property of a gas: No fixed shape (volume)/ takes volume of container

One property of a solid: Definite shape (volume)/ incompressible/ does not flow…

