THE UNIVERSITY of York

EPSE Project 1: Sample Diagnostic Questions - Set 8

Particle model of matter
These questions probe pupils' ability to apply the particle model of matter (and its elaboration into the atomic/molecular model of matter) to examples of the behaviour of matter, including physical and chemical change.

Q1 tests pupils' ability to recognise the standard representations of solids, liquids and gases, as well as their recall of the terms of changes of state.

Qs2-4 probe pupils ability to link statements about particles to observed behaviours of solids, liquids and gases.

Q5 suggests a way of probing pupils' ability to make sense of (and to read meaning into) common textbook representations of particle models). You could apply this idea to other textbook images if you wish.

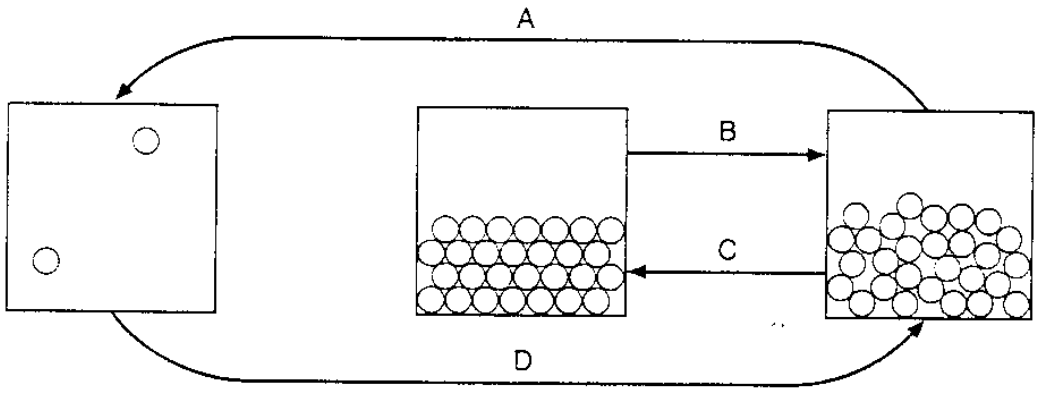
Q6 is a version of a question used by many researchers to probe understanding of the particle model of a gas.

Qs7-10 are about the atomic/molecular model of matter and of chemical change. These ideas provide pupils with a means of explaining the difference between a physical and a chemical change.

These questions are taken from a larger bank of diagnostic questions and tasks developed by the *Evidence-based Practice in Science Education (EPSE) Research Network*. The EPSE network was funded between 1999 and 2003 by the UK Economic and Social Research Council (ESRC) as part of the *Teaching and Learning Research Programme (TLRP).*

1

The diagram below shows particles in a gas, a solid and a liquid. Each arrow, A, B, C and D, represents a change of state.



Choose from the following words to complete the sentences below:

melting	**boiling**	**dissolving**	**evaporating**
softening	**solidifying**	**condensing**	**separating**

(a) Change of state A is called _____

(b) Change of state B is called _____

(c) Change of state C is called _____

(d) Change of state D is called _____

2

The box below contains some statements about the particle model of a solid.

All the statements are correct.

In a solid:	
A	The particles are very closely packed together.
B	The particles are tightly bound to their neighbours.
C	The particles vibrate in their positions but cannot move around.
D	The particles are arranged in a regular pattern.
E	If you heat a solid, the average speed with which the particles vibrate gets bigger.

Which of the statements above help to explain each of the following?
Write a letter (or letters) on the line to show your answer.

(a) Solids do not flow or pour. _____

(b) Solids cannot easily be compressed. _____

(c) Above a certain temperature, many solids melt and turn into liquid. _____

(d) Some solids form crystals. _____

3

The box below contains some statements about the particle model of a liquid.

All the statements are correct.

In a liquid:	
A	The particles are very closely packed together.
B	The particles are not rigidly bound to their neighbours.
C	The particles are not arranged in a regular pattern.
D	The particles vibrate and jostle around.
E	If you heat a liquid, the average speed with which the particles vibrate gets bigger.

Which of the statements above help to explain each of the following?
Write a letter (or letters) on the line to show your answer.

(a) Liquids flow easily and can be poured. _____

(b) Liquids are difficult to compress. _____

(c) Above a certain temperature, a liquid boils and turns into a gas. _____

4

The box below contains some statements about the particle model of a gas.

All the statements are correct.

In a gas:
A The particles are far from each other.
B The particles move around rapidly in all directions.
C The particles collide with the walls of the container they are in.
D The particles are too far apart to exert any force on each other.
E If you heat a gas, the average speed of the particles gets bigger.

Which of the statements above help to explain each of the following?
Write a letter (or letters) on the line to show your answer.

(a) Gases are fairly easy to compress. _____

(b) Gases spread out to fill the whole space they are in. _____

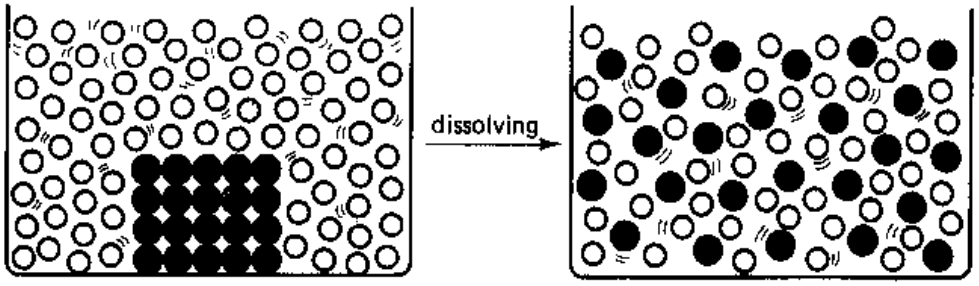
(c) Gases don't settle to the bottom of a container, but fill the whole space. _____

(d) Gases are less dense than solids and liquids _____

5

It is impossible to represent the particles in solids, liquids and gases accurately in a diagram. So all drawings show some aspects of the particle model well, and others not so well.

This diagram from a textbook illustrates the particle model of a solid dissolving in a liquid:



State three ways in which you think the diagram **is a good representation** of a solid dissolving in a liquid:

1 _____

2 _____

3 _____

State three ways in which you think the diagram is **not an accurate representation** of a solid dissolving in a liquid:

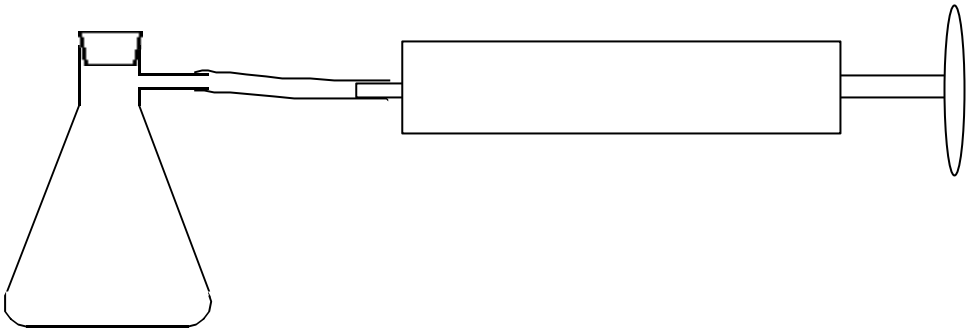
1 _____

2 _____

3 _____

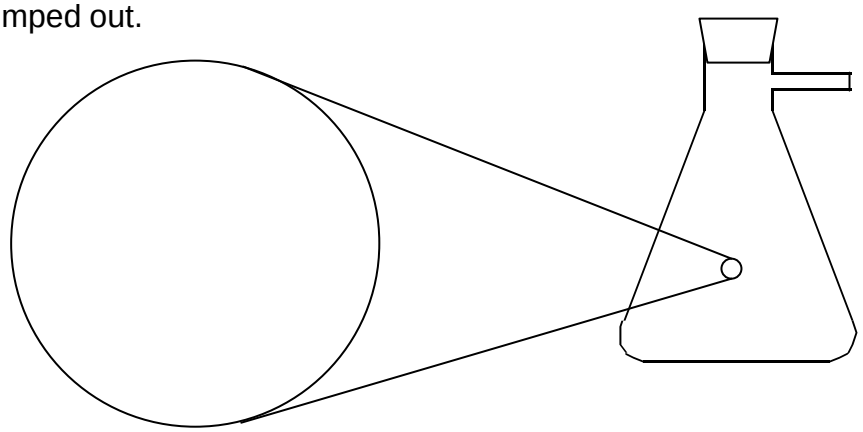
6

In this experiment, a pump is connected to flask. It will be used to pump some air out of the flask.



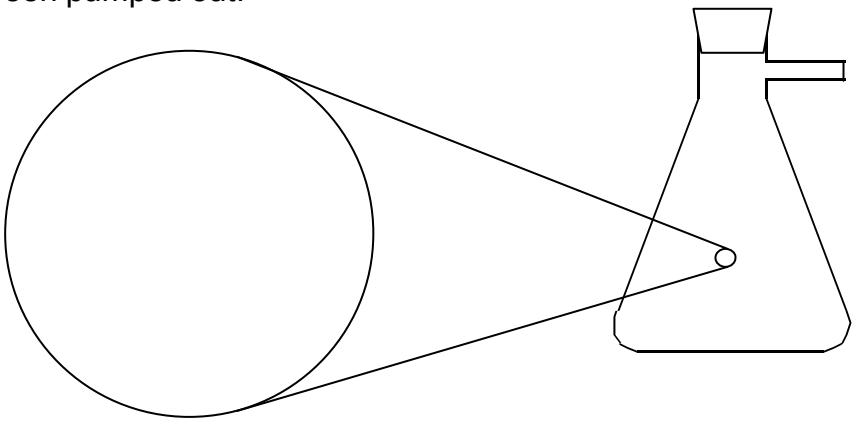
Before any air is pumped out

In the circle below, draw what you think the air inside the flask will look like, before any air is pumped out.



After half of the air has been pumped out

In the circle below, draw what you think the air inside the flask will look like, after half of it has been pumped out.

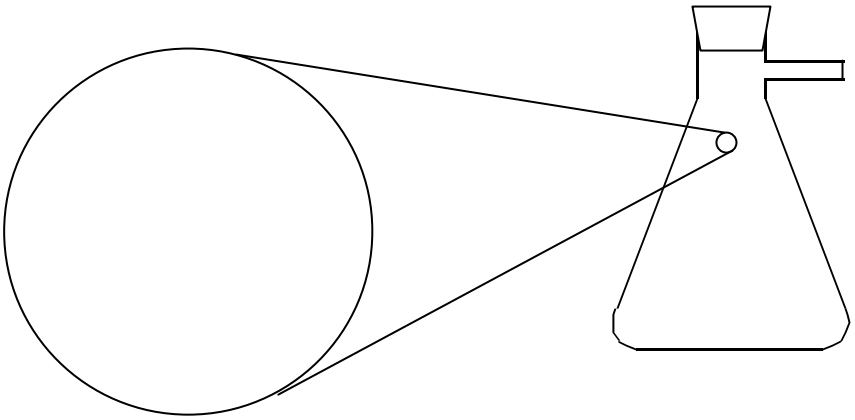


Would either of your drawings have been different if you were looking at the air at a different point in the flask?

Before any air is pumped out

Tick ONE box (✓) ❑ yes ❑ no

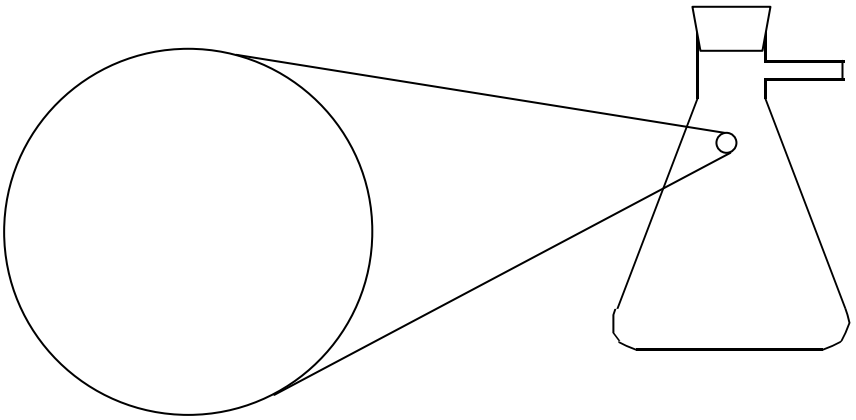
If you have answered 'yes', draw what you think the air will look like at this point in the flask, before any air has been pumped out.



After half of the air has been pumped out

Tick ONE box (✓) ❑ yes ❑ no

If you have answered 'yes', draw what you think the air will look like at this point in the flask, after half of the air has been pumped out.



7

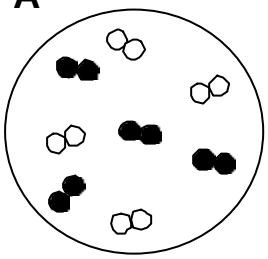
In the diagrams below, the atoms of different elements are represented by the symbols ○ ●.

Each diagram represents one of the following:

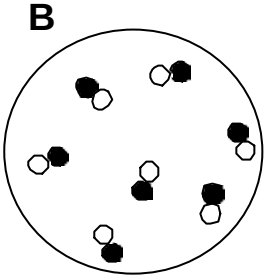
A	a single element
B	a single compound
C	a mixture of two elements
D	a mixture of two compounds

In the box beneath each diagram, write one letter (A, B, C or D) to say what you think it represents.

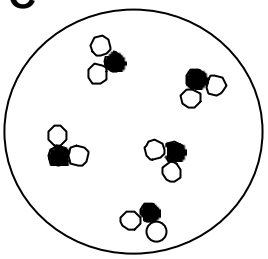
A



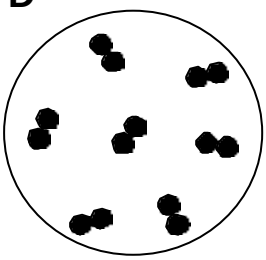
B



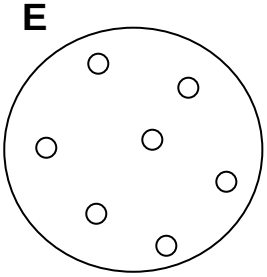
C



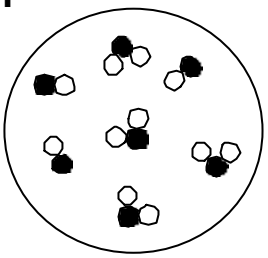
D



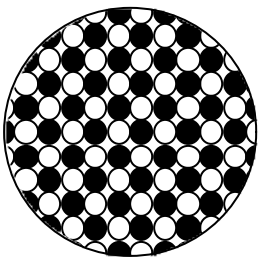
E



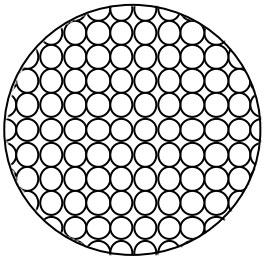
F



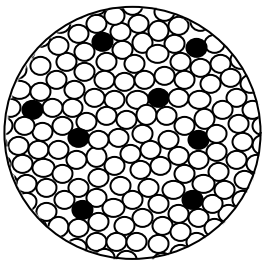
G



H



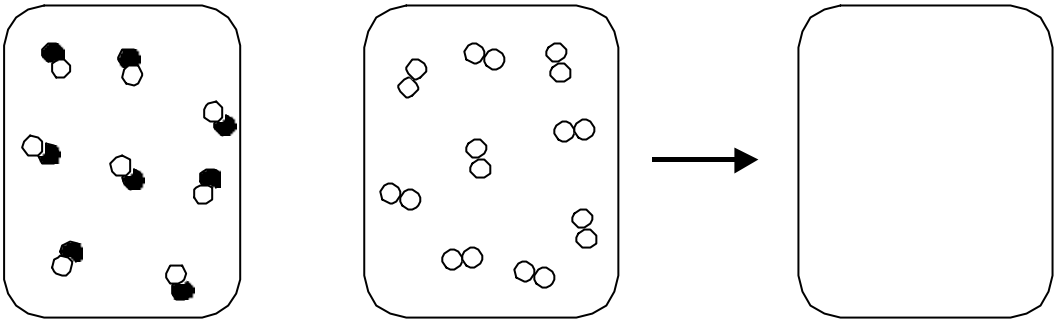
I



8

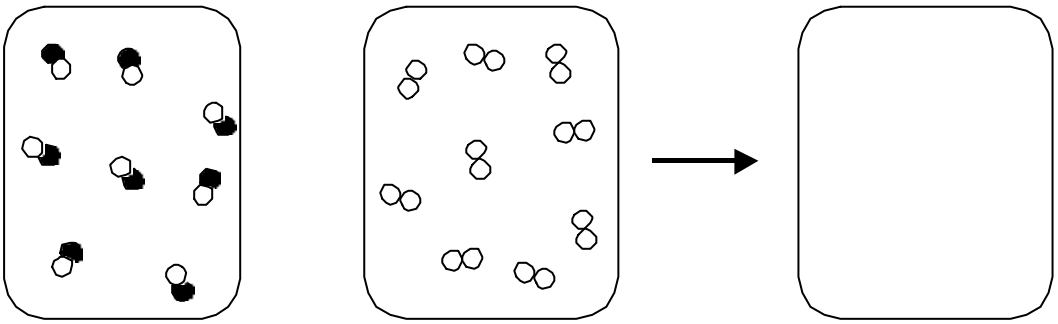
In the diagrams below, different atoms are represented by the symbols ● ○

(a) Two gases A and B are mixed together. Complete the diagram to show a **mixture** of the two gases.



A **B** **Mixture**

(b) The gases are then heated, and react with each other to form a new substance, which is also a gas. Complete the diagram below to show what this **new substance** might look like. (There are several possibilities; draw any one that you think is possible.)

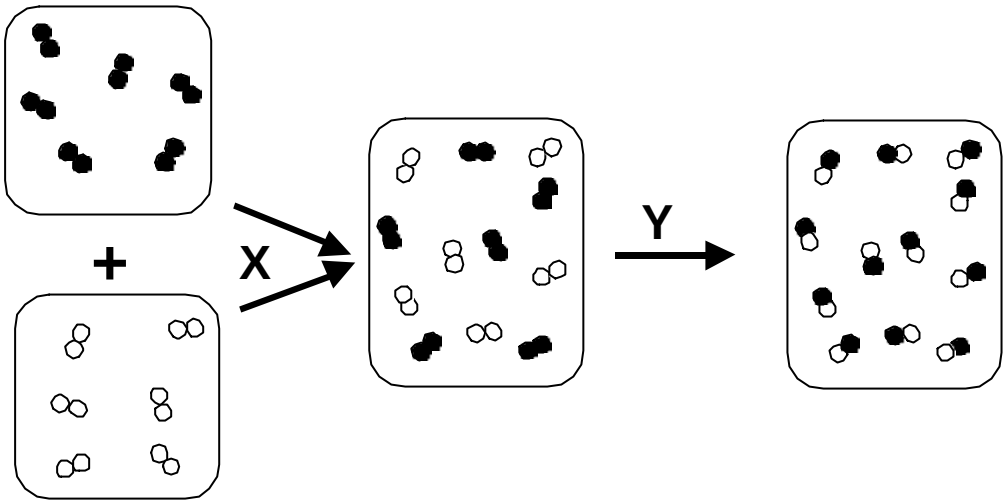


A **B** **New substance**

9

In the diagrams below, the atoms of different elements are represented by the symbols ○ ● .

The diagrams represent the changes which occur when two gases are put together.



(a) Is change X a chemical change?

Tick ONE box (✓) ❑ yes ❑ no

Explain your answer: _____

_____

_____

(b) Is change Y a chemical change?

Tick ONE box (✓) ❑ yes ❑ no

Explain your answer: _____

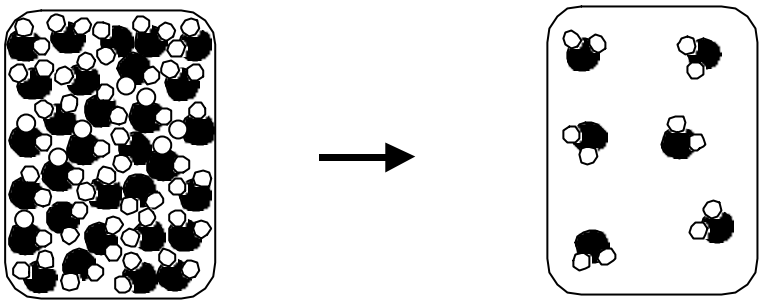
_____

_____

10

In the diagram below, the atoms of different elements are represented by the symbols ○ ● .

The diagram represents the change which occurs when a substance is heated.



(a) Is this a chemical change?

Tick ONE box (✓) ❑ yes ❑ no

Explain your answer: _____

_____

_____