

Elements, compounds and mixtures

Target level

These materials are primarily intended for the 11–14 age range, but may also be used as revision materials for the 14–16 age range.

Topics

Pure substances and mixtures; elements and compounds.

Rationale

The distinctions between pure substances and mixtures, and between elements and compounds are fundamental in chemistry. The materials comprise a pre-test, a study activity, and a post-test. The study activity is an exercise that focuses first on the distinction between pure substances and mixtures (one or several types of molecule present), and then distinguishes between single substances that are elements and compounds (one or more type of atomic core or nucleus or atom present in the molecule).

These ideas are discussed in Chapter 6 of the Teachers' notes.

During piloting, some teachers found the materials 'very useful', 'very revealing', 'very clear indeed' and 'helpful'. The pre-test revealed 'considerable uncertainty' about definitions. It was also found that some students had difficulty accepting the more complex molecules represented (such as a benzene molecule), and one teacher found that students 'were reluctant to relinquish their own ideas' (the nature of learners' alternative conceptions is discussed in Chapter 1 of the Teachers' notes). Some students saw bonds as concrete structures and expected them to be drawn as solid lines (see Chapter 6).

Teachers reported 'improved understanding' when students used the materials. One teacher thought that student responses were 'considerably more coherent after the exercise', and another commented that 'weaker pupils began to sort out the difference'. Some students reported that they enjoyed the activity, and that it helped them understand what the key terms meant.

Several teachers did not like the introduction of the word 'core' and could substitute 'nucleus' or 'atom' if preferred. Some students in the pilot objected to monatomic molecules being described as molecules (see Chapter 2 of the Teachers' notes for a discussion of the definition of 'molecule'). The exercise was considered too lengthy and repetitive for some students. The full version is provided here, but individual teachers may wish to edit it, to match the age and ability of particular classes.

Details of the DARTs activity can be found in Chapter 5 of the Teachers' notes.

Instructions

There are three sets of worksheets; the pre-test: Elements, compounds or mixtures? (1), the study task: Elements, compounds and mixtures (2), and the post-test: Elements, compounds or mixtures? (3).

If the materials are used after teaching the topic, then the pre-test may be used to diagnose whether or not students will benefit from working through the study task.

Resources

- Student worksheets
- Elements, compounds or mixtures? (1) (pre-test)
- Elements, compounds and mixtures (2) (study task)
- Elements, compounds or mixtures? (3) (post-test)

Feedback for students

A suggested answer sheet for the use of teachers is provided.

Elements, compounds and mixtures – answers

Elements, compounds or mixtures? (1) (Pre-test)

Various definitions of elements and compounds may be used (see Chapter 2 of the Teachers' notes). The following is suggested. Atom or nucleus can be used instead of core.

1. An element is a pure substance which contains identical atoms or molecules with only one type of atomic core.

2. A compound is a pure substance which contains identical molecules with two or more types of atomic core.

3. A mixture is a material which has two or more types of molecules.

Clearly these definitions only apply to molecular materials, and will need to be extended to ionic and metallic materials later.

4. Compound - one type of molecule; each molecule has more than one type of atomic core.

5. Element – one type of atom or molecule, with only one type of atomic core.

6. Element – one type of atom or molecule, with only one type of atomic core.

7. Mixture (of two compounds) – two types of molecule present.

8. Mixture (of two elements) – two types of atom present.

9. Compound - one type of molecule; each molecule has more than one type of atomic core.

Elements, compounds and mixtures (2) (Study task)

1. Single substance

2. Single substance

3. Mixture

4. Mixture ... molecule

5. Single substance ... molecule

6. Compound ... [atomic] core [or atom or nucleus] ...

7. Element ... [atomic] core [or atom or nucleus] ...

8. Compound

9. Mixture

10. Element

Elements, compounds or mixtures? (3) (Post-test)

1. Compound
2. Element
3. Mixture
4. Compound
5. Mixture
6. Element

Elements, compounds or mixtures? (1)

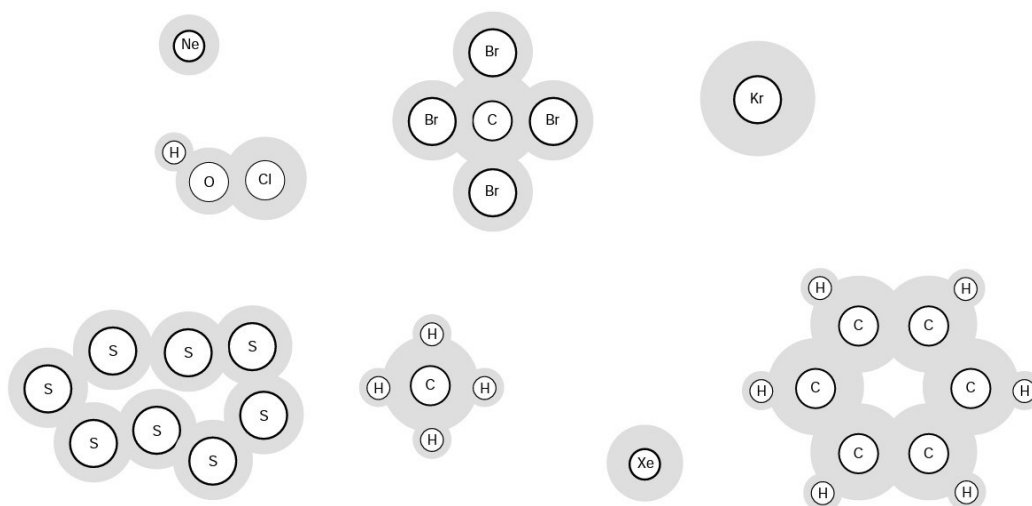
In science, it is important to know the difference between elements, compounds and mixtures. Try to explain what you think each of these words means:

1. An element is

2. A compound is

3. A mixture is

On the following sheets you will find six diagrams showing the particles in some samples of materials. The different particles are shown as:

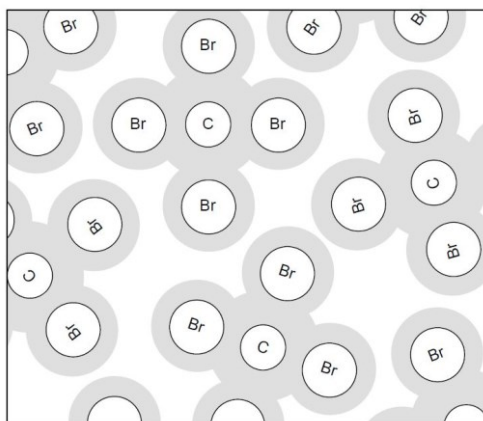


Each diagram is meant to show either an element, a compound or a mixture.

Decide whether each diagram represents an element, a compound, or a mixture, and explain your reasons.

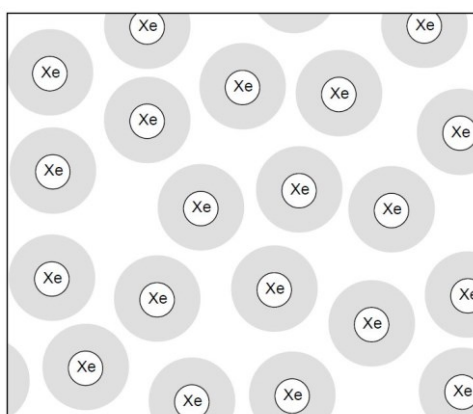
4. The diagram below shows particles in _____

I think this because



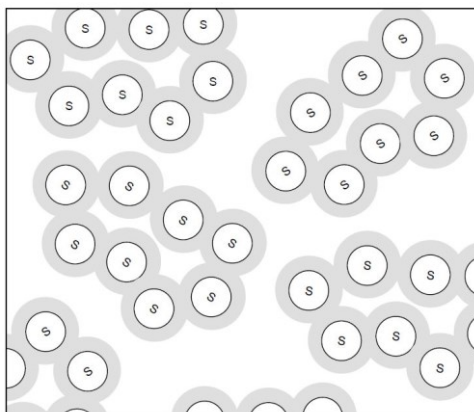
5. The diagram below shows particles in _____

I think this because



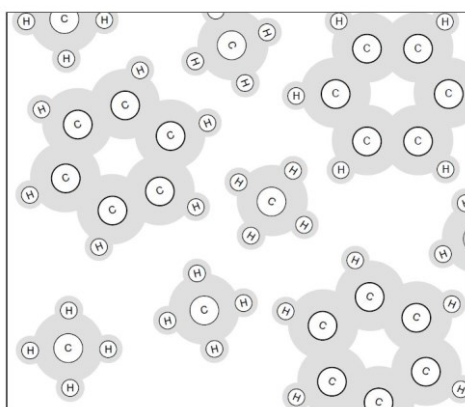
6. The diagram below shows particles in _____

I think this because



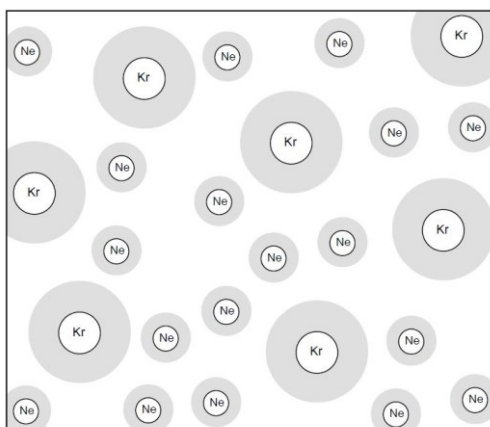
7. The diagram below shows particles in _____

I think this because



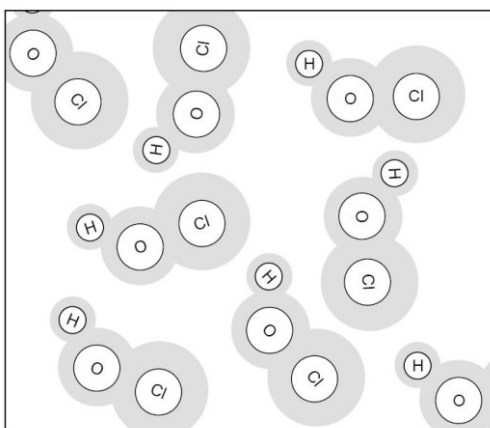
8. The diagram below shows particles in _____

I think this because



9. The diagram below shows particles in _____

I think this because



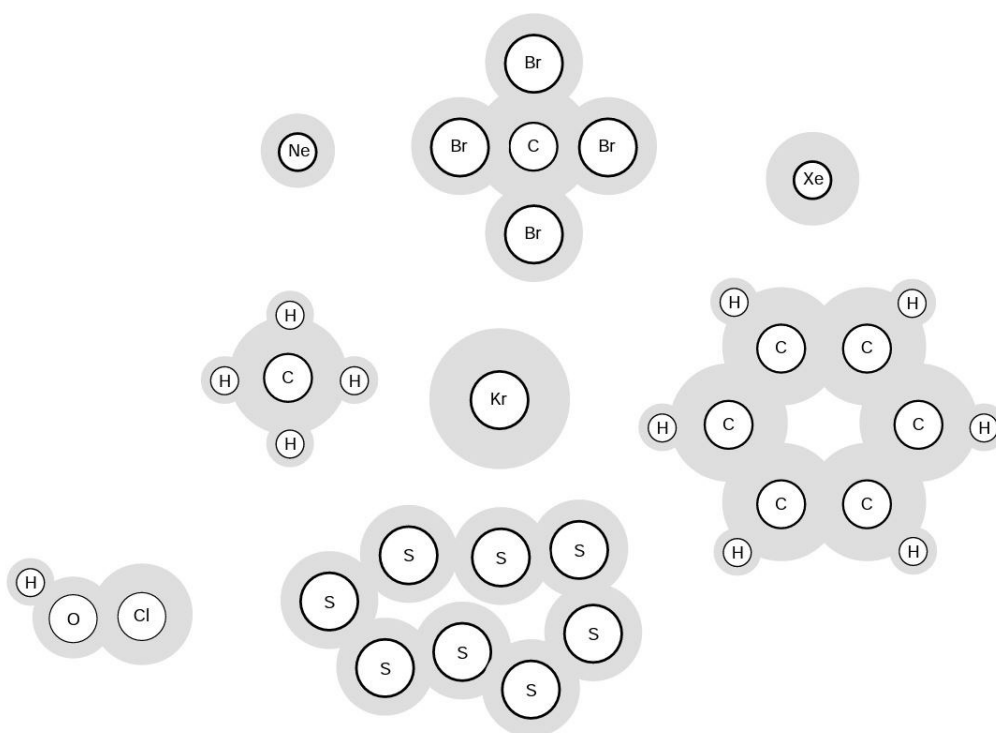
Elements, compounds and mixtures (2)

Pure substances and mixtures

In science, it is important to know the difference between pure substances and mixtures of several substances. Scientists think about the differences in terms of the particles which are in the materials. Scientists believe that all matter (all solids, liquids and gases) is made up from tiny particles that are much too small to be seen.

The tiniest particles are given names like 'electron' and 'proton'. These are arranged into slightly larger (but still very tiny) particles called atoms, ions and molecules. In many materials the particles are called molecules.

Here are some pictures that scientists use to represent atoms and molecules.

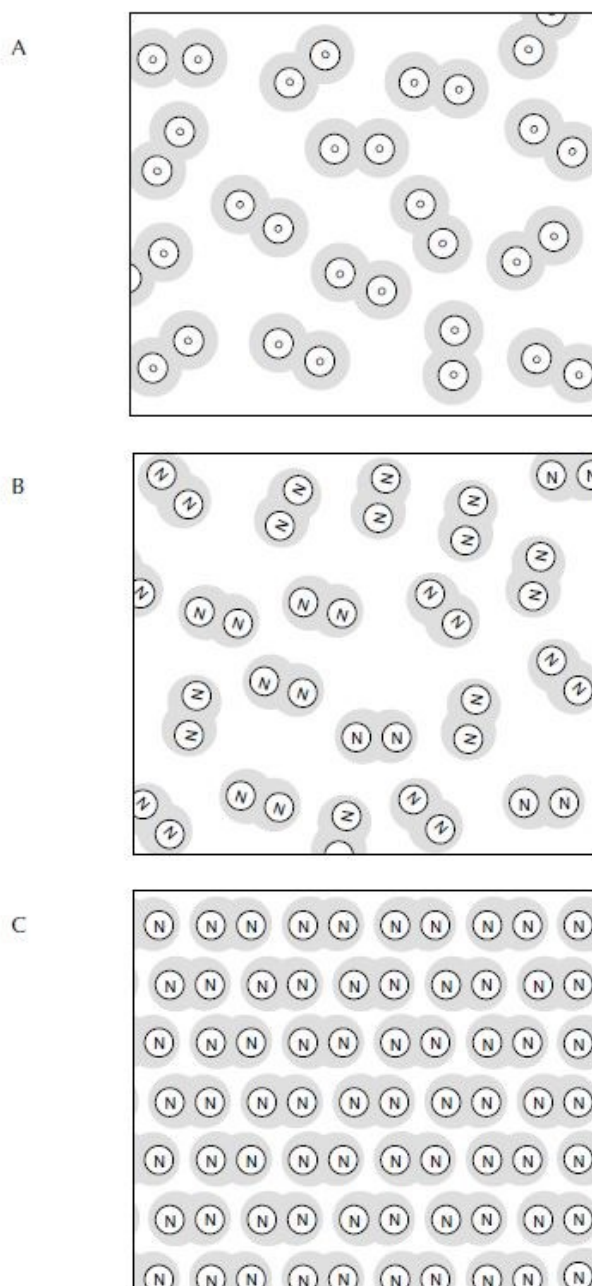


The letters are labels used by scientists to help identify the particles.

There are many different types of atoms and molecules, and these pictures just show a few examples.

Different substances contain different molecules

The three diagrams below show two different substances. Which two diagrams show the same substance?

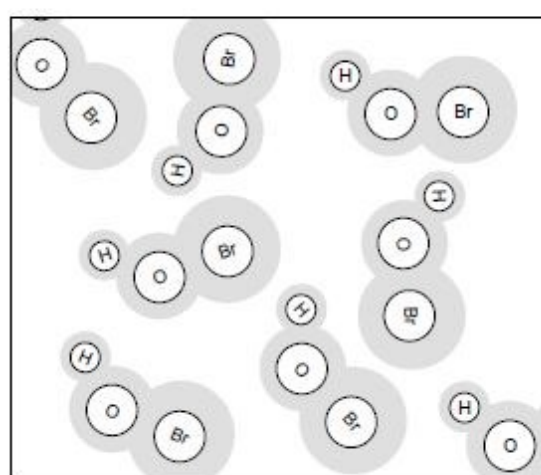
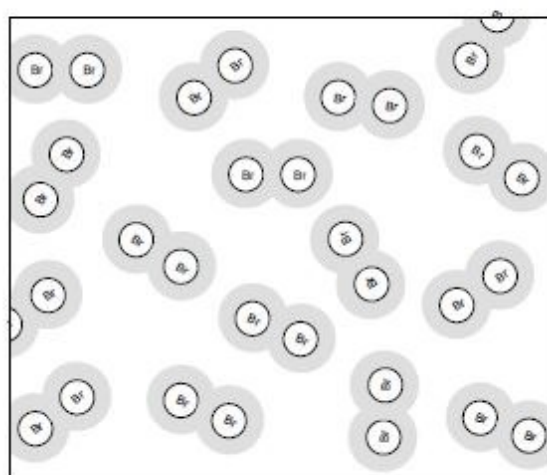
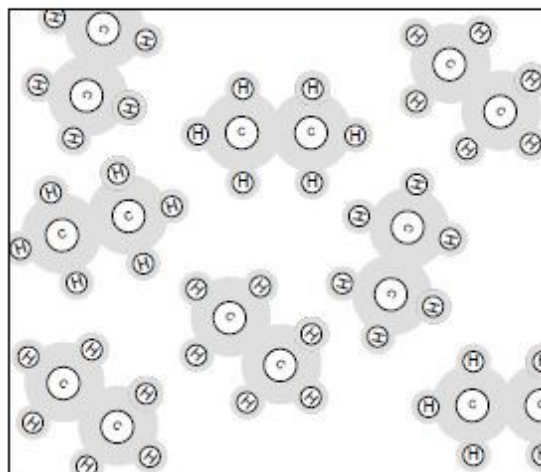
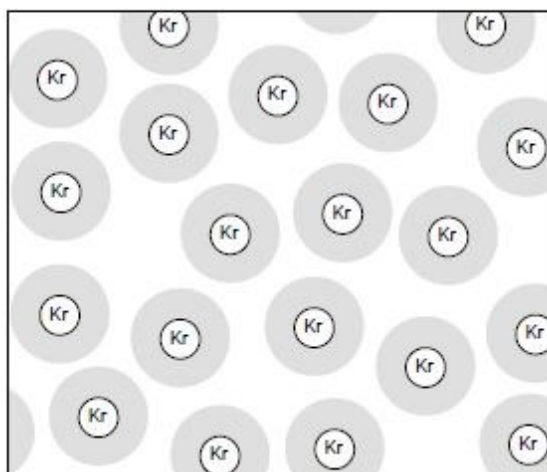
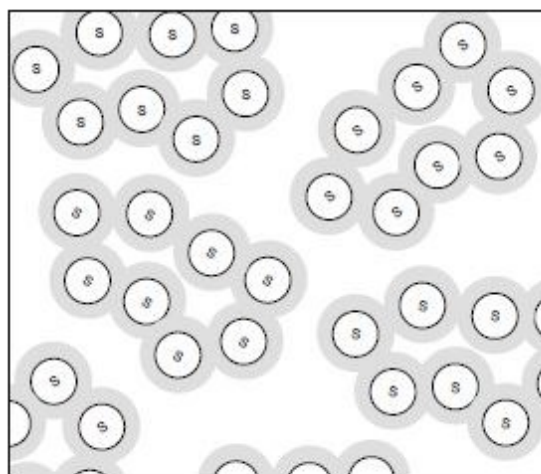
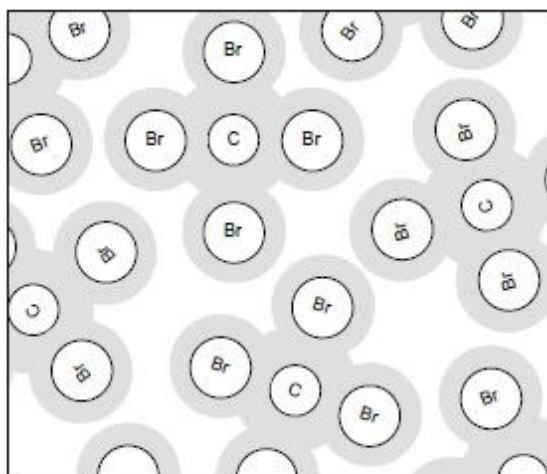


Answer

B and C are the same substance because they contain the same molecules. They look different because they show how the molecules are arranged when the substance is a gas (B) and a solid (C). Diagram A shows a different substance, because it shows different molecules.

Some materials only contain one type of molecule or atom. These are called single substances (or pure substances).

The following diagrams show some single substances. They are each different substances because they have different types of molecules.

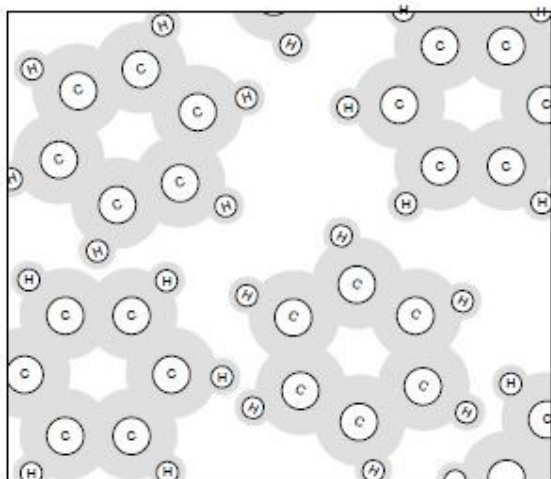


When substances are mixed, their molecules become mixed up. We call the new material a mixture.

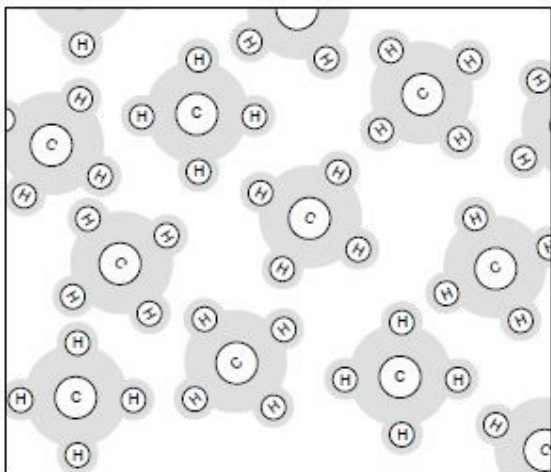
A mixture contains more than one type of atom or molecule.

The following diagrams show the molecules in two pure substances before mixing, and the mixture of molecules afterwards.

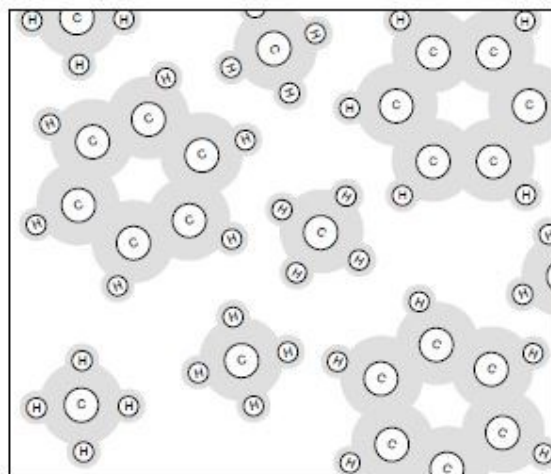
Look at the diagrams closely, and label each of them as either a single substance, or a mixture.



1. _____

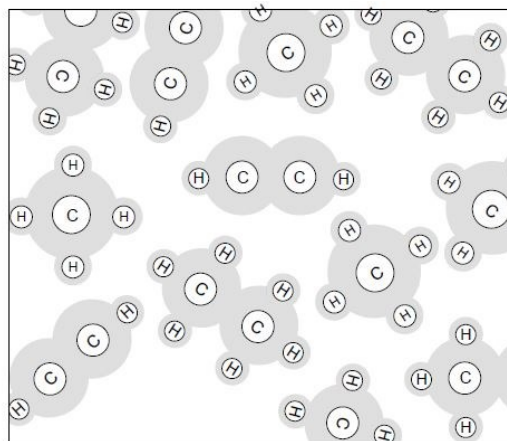
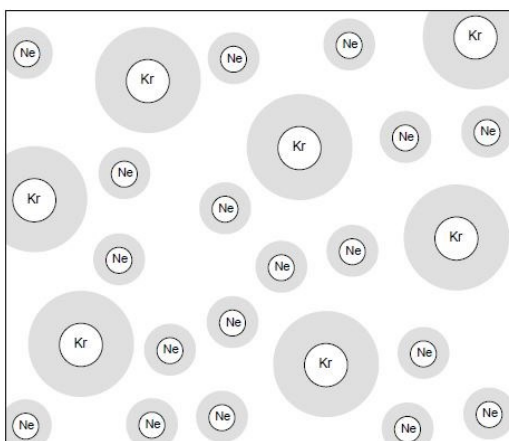


2. _____

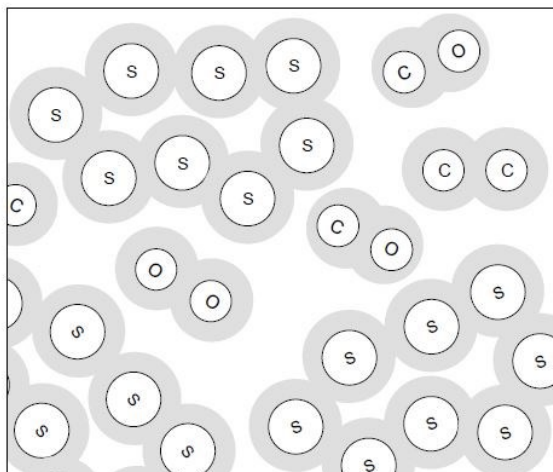


3. _____

Here are some other diagrams showing mixtures:

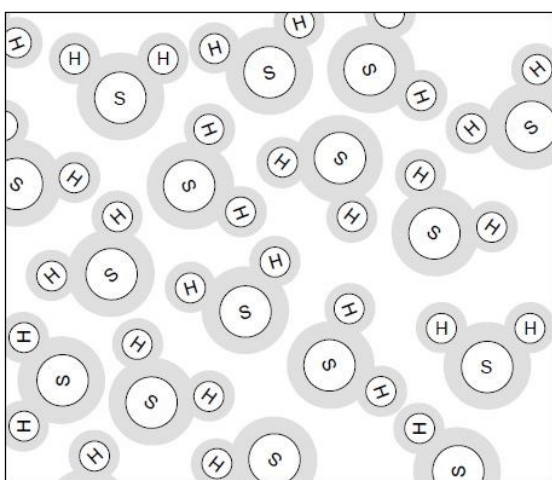


The following two diagrams show a single substance and a mixture. Complete the labels to show you know which is which:



4. This diagram shows a

because there is more than one type of



5 This diagram shows a

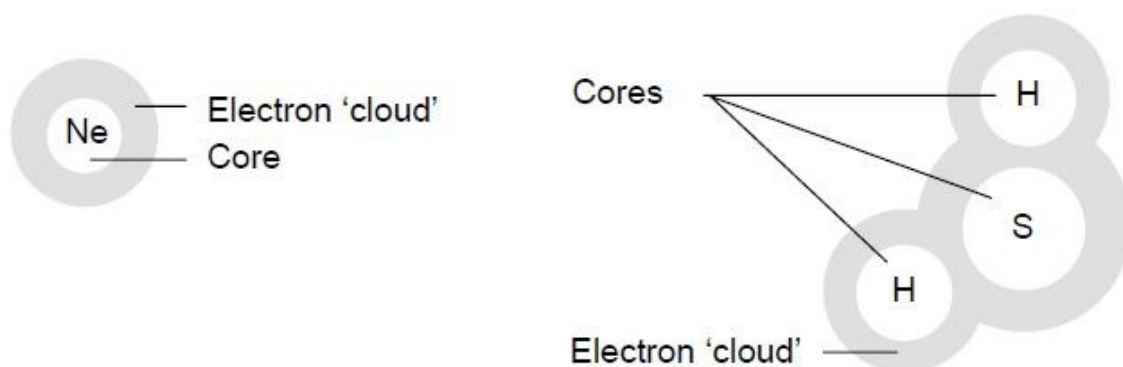
because there is only one type of

Two types of substance - element and compounds

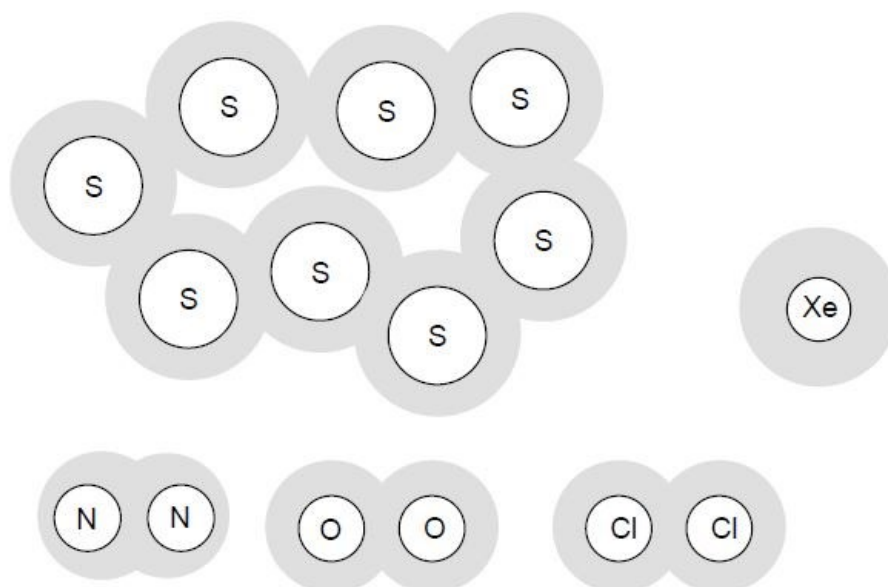
To tell the difference between single substances and mixtures you need to be able to recognise diagrams of different types of atoms and molecules.

But scientists divide single substances into two types: elements and compounds. To spot the difference between elements and compounds you have to look more closely at the atoms or molecules.

Atoms are made of one core surrounded by a 'cloud' of electrons. Molecules are made of two or more cores surrounded by a 'cloud' of electrons.

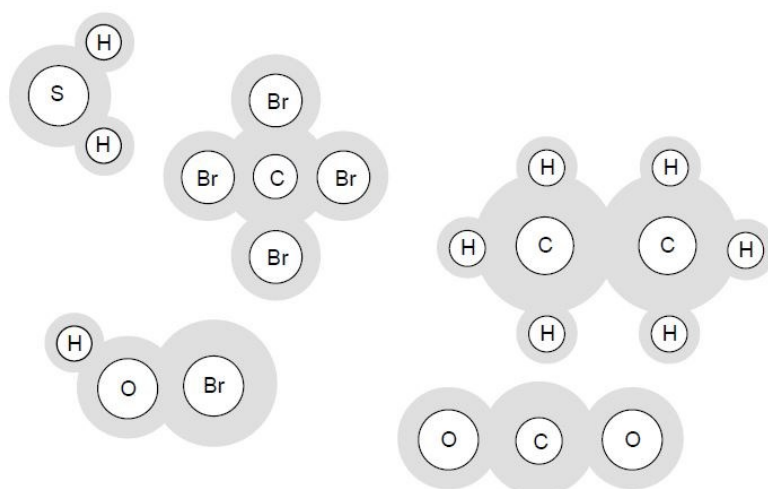


The atoms or molecules that form an element have only one type of core. (Scientists use different letters to represent the different elements).



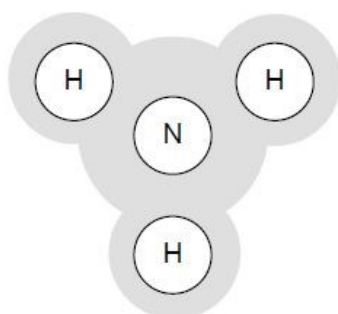
Atoms or molecules that have one type of core

In a compound the molecules have two or more different types of core.



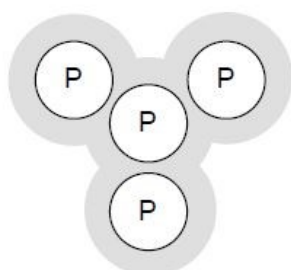
The following two diagrams show a molecule of an element and a molecule of a compound.

Complete the labels to show you know which is which:



6. This diagram shows

because there is more than one type of



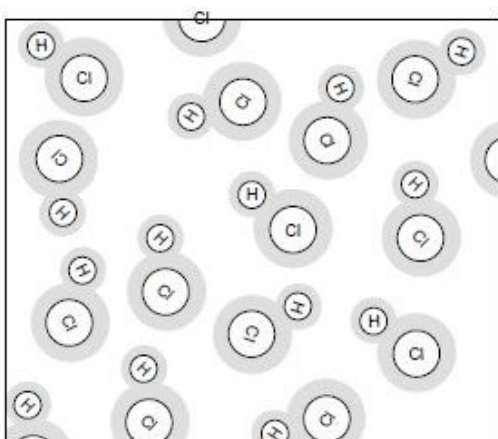
7 This diagram shows

because there is only one type of

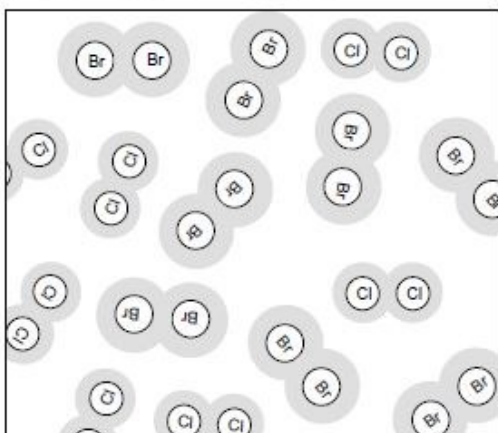
To summarise:

Looking at:	If the same:	If different:
The types of single uncombined atoms	A single substance	A mixture
The types of molecules	A single substance	A mixture
The types of cores in a single molecule	A molecule of an element	A molecule of a compound

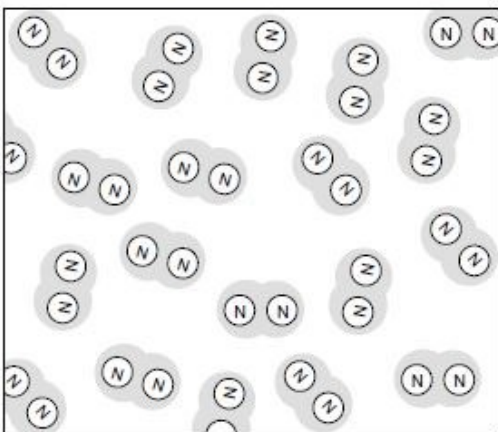
The following diagrams show molecules in a mixture, element and compound. Complete the labels to show you know which is which:



8. _____



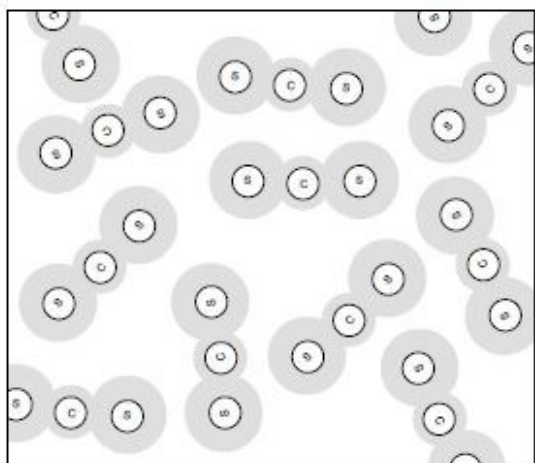
9. _____



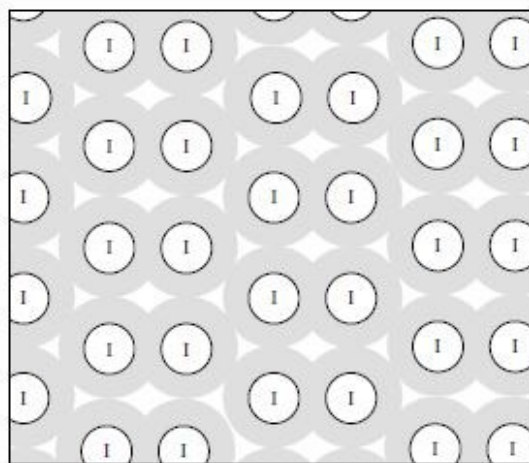
10. _____

Elements, compounds or mixtures? (3)

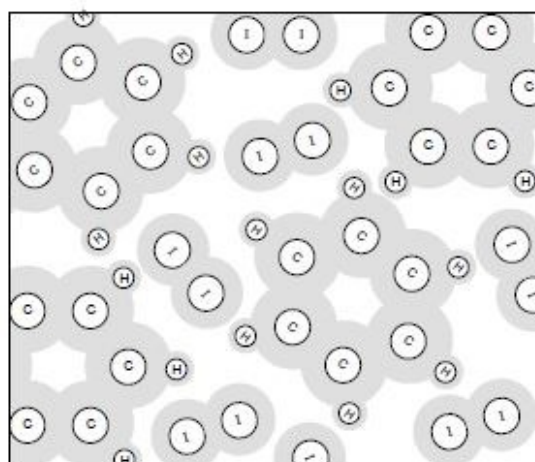
Each of the following diagrams show the particles in a material. For each diagram, write whether you think it represents an element, a compound or a mixture



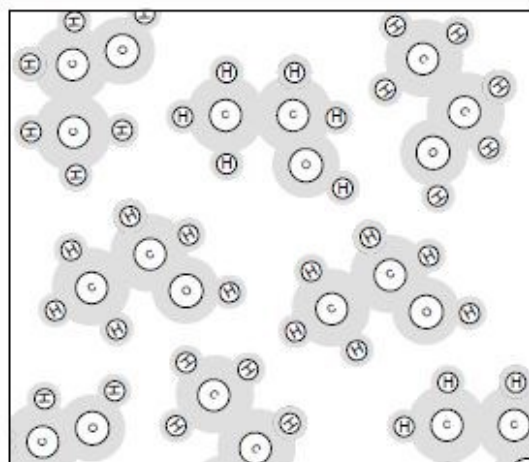
1. _____



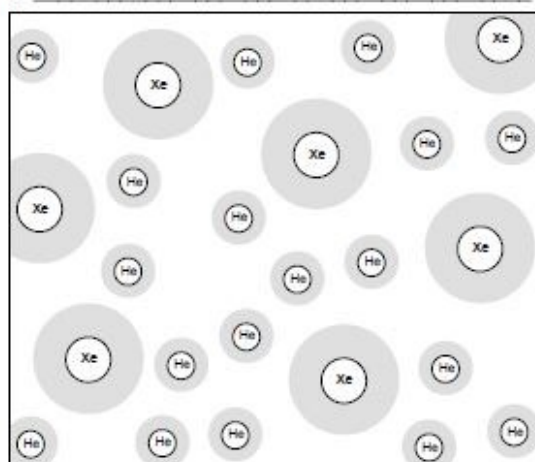
2. _____



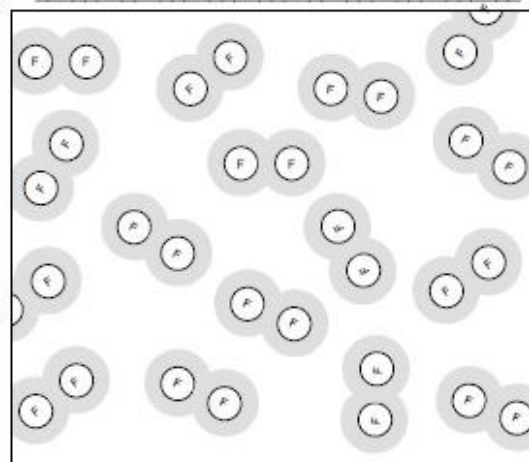
3. _____



4. _____



5. _____



6. _____