Name: _____

Atomic Structure

Instructions

- Use black ink or ball-point pen.
- Answer all questions.
- Answer the questions in the spaces provided there may - be more space than you need.
- Diagrams are **NOT** accurately drawn, unless otherwise - indicated.
- You must show all your working out.

Information

- The marks for each question are shown in brackets use - this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end

1. This question is about models of the atom.

(a) Atoms were first thought to be tiny spheres that could not be divided.

Which particle was discovered to change this model of the atom?

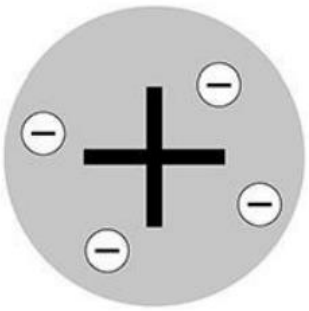
Tick (✓) one box.

Electron ☐

Neutron ☐

Proton ☐

(b) The diagram below shows another model of the atom.



What is the name of this model of the atom?

_____

(c) A scientist fired particles at gold atoms.

Some of these particles were scattered.

The results led to a different model of the atom.

Which type of particle was fired at the gold atoms?

Tick (✓) one box

Alpha ☐

Electron ☐

Neutron ☐

Proton ☐

(d) Which scientist first suggested that electrons orbit the nucleus at specific distances?

Tick (✓) one box.

Bohr ☐

Chadwick ☐

Mendeleev ☐

(e) The model of the atom used today has three subatomic particles:

- electrons
- neutrons
- protons.

Complete the sentences.

Atoms of the same element have the same atomic number because they

have the same number of _____.

Atoms of the same element can have different mass numbers because they have different numbers of _____.

Atoms have no overall charge because they have the same number of _____ and _____.

(f) The radius of a nucleus is approximately 1×10^{-14} m

The radius of an atom is approximately 1×10^{-10} m

A teacher uses a ball of radius 1 cm to represent the nucleus.

What could represent the atom on the same scale?

Tick (✓) one box.

A ball of radius 10 cm ☐

A sports arena of radius 100 m ☐

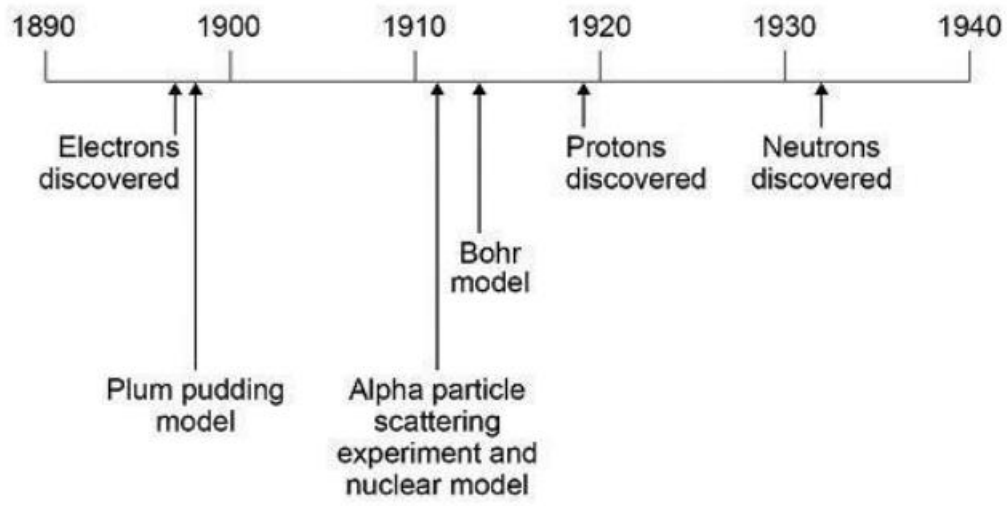
An island of radius 10 km ☐

A planet of radius 1000 km ☐

(Total 8 marks)

2. This question is about the development of scientific theories.

The diagram below shows a timeline of some important steps in the development of the model of the atom.



(a) The plum pudding model did not have a nucleus.

Describe three other differences between the nuclear model of the atom and the plum pudding model.

1 _____

_____

_____

2 _____

_____

_____

3 _____

_____

_____

(b) Niels Bohr adapted the nuclear model.

Describe the change that Bohr made to the nuclear model

(c) Mendeleev published his periodic table in 1869.

Mendeleev arranged the elements in order of atomic weight.

Mendeleev then reversed the order of some pairs of elements.

A student suggested Mendeleev's reason for reversing the order was to arrange the elements in order of atomic number.

Explain why the student's suggestion cannot be correct.

Use the diagram above.

(d) Give the correct reason why Mendeleev reversed the order of some pairs of elements.

(Total 8 marks)

3. This question is about atomic structure.

(a) Atoms contain subatomic particles.

The table below shows properties of two subatomic particles.

Complete the table

Name of particle	Relative mass	Relative charge
neutron		
		+1

An element X has two isotopes.

The isotopes have different mass numbers.

(b) Define mass number.

(c) Why is the mass number different in the two isotopes?

(d) The model of the atom changed as new evidence was discovered.

The plum pudding model suggested that the atom was a ball of positive charge with electrons embedded in it.

Evidence from the alpha particle scattering experiment led to a change inthe model of the atom from the plum pudding model.

Explain how.

(Total 8 marks)

4. This question is about mixtures.

(a) Substances are separated from a mixture using different methods.

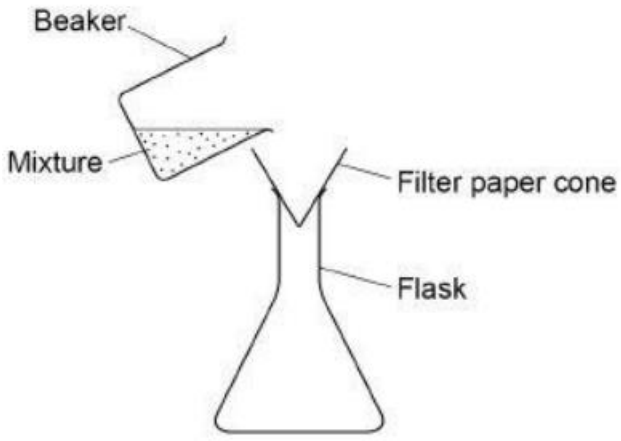
Draw one line from each substance and mixture to the best method of separation.

Substance and mixture	Method of separation
	Chromatography
Ethanol from ethanol and water	Crystallisation
Salt from sea water	Electrolysis
The different colours in black ink	Filtration
	Fractional distillation

(b) A student filters a mixture.

Figure 1 shows the apparatus

Figure 1



Suggest one improvement to the apparatus.

(c) Complete the sentences.

Choose answers from the box.

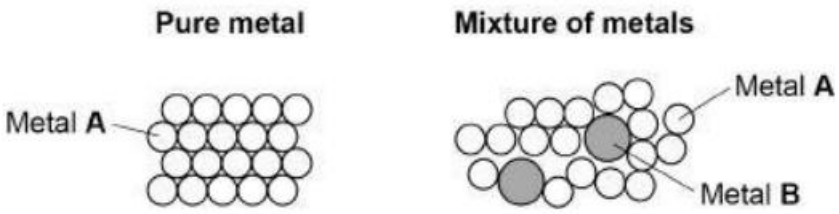
condense	evaporate	freeze	melt	solidify

In simple distillation, the mixture is heated to make the liquid _____.

The vapour is then cooled to make it _____ .

Figure 2 shows the arrangement of atoms in a pure metal and in a mixture of metals.

Figure 2



(d) Calculate the percentage of metal B atoms in the mixture of metals shown in Figure 2.

Percentage of metal B atoms = _____ %

(e) What is a mixture of metals called?

Tick one box.

An alloy ☐

A compound ☐

A molecule ☐

A polymer ☐

(f) Why is the mixture of metals in Figure 2 harder than the pure metal?

Tick one box.

The atoms in the mixture are different shapes. ☐

The layers in the mixture are distorted. ☐

The layers in the mixture slide more easily. ☐

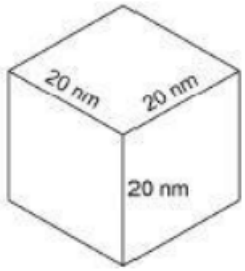
The mixture has a giant structure. ☐

(g) A nanoparticle of pure metal A is a cube.

Each side of the cube has a length of 20 nm.

Figure 3 shows the cube.

Figure 3



What is the volume of the nanoparticle?

Tick one box. (separate only)

20 nm^3 ☐

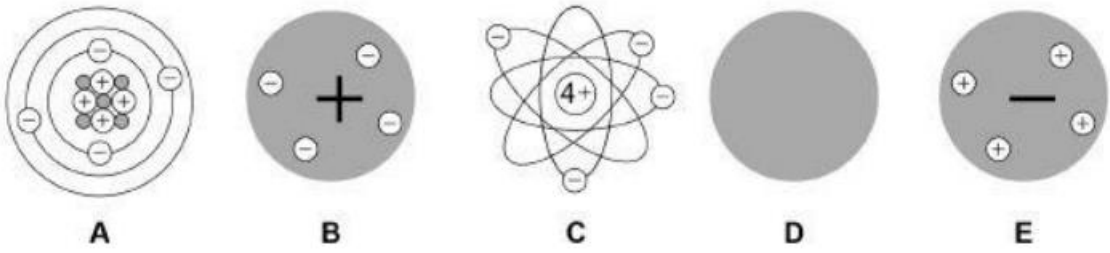
60 nm^3 ☐

400 nm^3 ☐

8000 nm^3 ☐

(Total 11 marks)

5. The diagram below represents different models of the atom.



(a) Which diagram shows the plum pudding model of the atom?

Tick one box

A		B		C		D		E	

(b) Which diagram shows the model of the atom developed from the alpha particle scattering experiment?

Tick one box

A		B		C		D		E	

(c) Which diagram shows the model of the atom resulting from Bohr's work?

Tick one box.

A		B		C		D		E	

(d) Define the mass number of an atom.

(e) Element X has two isotopes. Their mass numbers are 69 and 71

The percentage abundance of each isotope is:

- 60% of ^{69}X
- 40% of ^{71}X

Estimate the relative atomic mass of element X.

Tick one box

< 69.5 ☐

Between 69.5 and 70.0 ☐

Between 70.0 and 70.5 ☐

> 70.5 ☐

(f) Chadwick's experimental work on the atom led to a better understanding of isotopes.

Explain how his work led to this understanding.

(Total 8 marks)