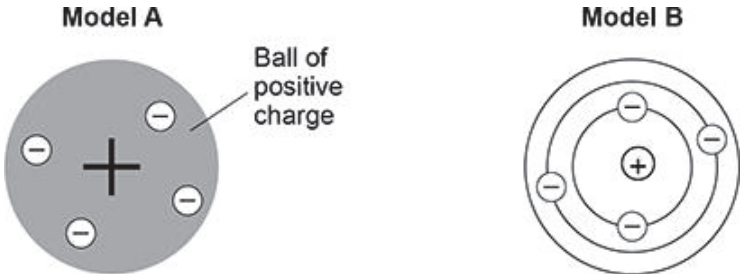
All questions are for both separate science and combined science students

Q1.

This question is about models of the atom.

The figure below shows two early models of the atom.



(a) Name the models of the atom shown in above figure.

Model **A** _____

Model **B** _____

(2)

(b) Compare model **A** with the model of the atom used today.

Use the figure above.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(c) Chadwick's experiments showed the existence of neutrons in an atom.

This led to an understanding of isotopes.

Define the term 'isotopes'.

Refer to subatomic particles in your answer.

_____

_____

_____

_____

(2)

(Total 8 marks)

Q2.

This question is about atoms.

Atoms contain three types of particle:

- electrons
- neutrons
- protons.

(a) Which particle has no electrical charge?

Tick (✓) **one** box.

Electron ☐

Neutron ☐

Proton ☐

(1)

(b) Which particles have the same relative mass?

Tick (✓) **one** box.

An electron and a neutron ☐

An electron and a proton ☐

A neutron and a proton ☐

(1)

(c) The formula of a compound is N_2O

How many of each type of atom are in one molecule of N_2O?

Nitrogen _____

Oxygen _____

(2)

An atom of element **Z** contains:

- 3 electrons
- 4 neutrons
- 3 protons.

(d) Give the name of element **Z**.

Use the periodic table.

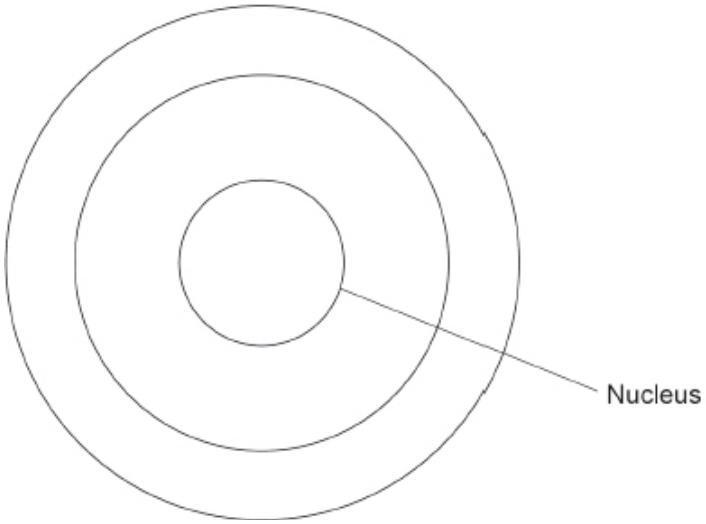
_____

(1)

(e) Complete the figure below to show the position of the particles in an atom of element **Z**.

Use the symbols:

× = electron
● = neutron
○ = proton



(4)

(Total 9 marks)

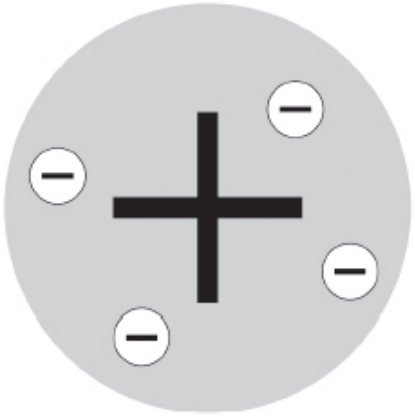
Q3.

Discoveries in chemistry led to a better understanding of atomic structure.

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

The plum pudding model of the atom was then developed.

The figure below represents the plum pudding model of the atom.



Describe the plum pudding model of the atom.

_____

_____

_____

_____

(2)

(b) Atoms contain electrons, neutrons and protons.

Write these three particles in order of their discovery.

Earliest _____

_____

Latest _____

(1)

Very few atoms of the element tennessine (Ts) have ever been identified.

The atomic number of tennessine is 117

(c) Predict the number of outer shell electrons in an atom of tennessine.

Give **one** reason for your answer.

Use the periodic table.

Number of outer shell electrons _____

Reason _____

_____

(2)

(d) Tennessine was first identified by a small group of scientists in 2010.

Suggest **one** reason why tennessine was **not** accepted as a new element by other scientists until 2015.

_____

_____

(1)

(e) The discovery of isotopes explained why some relative atomic masses are not whole numbers.

Element **R** has two isotopes.

The table below shows the mass numbers and percentage abundances of the isotopes of element **R**.

Mass number	Percentage abundance (%)
6	7.6
7	92.4

Calculate the relative atomic mass (A_r) of element **R**.

Give your answer to 1 decimal place.

_____

_____

_____

_____

_____

Relative atomic mass (1 decimal place) = _____

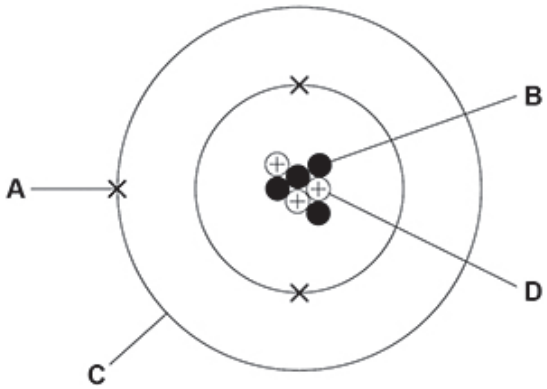
(3)

(Total 9 marks)

Q4.

This question is about atoms.

(a) The figure below represents an atom of an element.



Draw **one** line from each name to the correct label.

Name	Label
	A
Neutron	
	B
	C
Proton	
	D

(2)

(b) An atom of element **Y** has:

- an atomic number of 9
- a mass number of 19.

Give the number of electrons and the number of neutrons in this atom.

Choose answers from the box.

1	9	10	19	28

Number of electrons _____

Number of neutrons _____

(2)

The table below shows information about two isotopes of element **Z**.

	Mass number	**Percentage abundance (%)**
Isotope **A**	39	93.3
Isotope **B**	41	6.7

(c) Calculate the relative atomic mass (A_r) of element **Z**.

Use the table above and the equation:

$$A_r = \frac{\text{(mass number} \times \text{percentage) of isotope A + (mass number} \times \text{percentage) of isotope B}}{100}$$

Give your answer to 3 significant figures.

_____

_____

_____

_____

A_r (3 significant figures) = _____

(3)

(d) Suggest the identity of element **Z**.

Use the periodic table.

Element **Z** _____

(1)

(e) Complete the sentence.

Choose the answer from the box.

electrons	**neutrons**	**protons**

Isotopes of the same element have different mass numbers because the isotopes have different numbers of _____.

(1)

(Total 9 marks)

Q5.

This question is about elements, compounds and mixtures.

(a) Which type of substance is hydrogen?

Tick (✓) **one** box.

Element ☐

Compound ☐

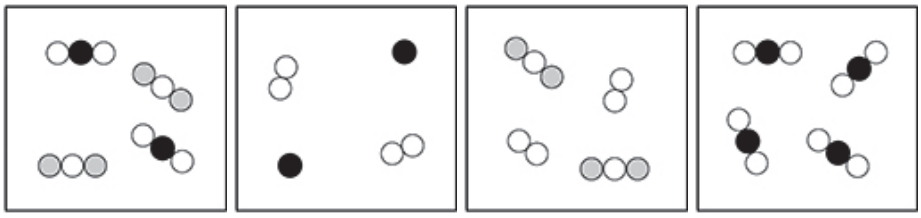
Mixture ☐

(1)

The diagrams in **Figure 1** represent different substances.

○ ● and ○ represent atoms of three different elements.

Figure 1



A **B** **C** **D**

Use **Figure 1** to answer parts (b) and (c).

(b) Which diagram represents a mixture of compounds?

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(c) Which diagram represents a mixture of elements?

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

Substances can be separated from mixtures by using different methods.

(d) Complete the sentence.

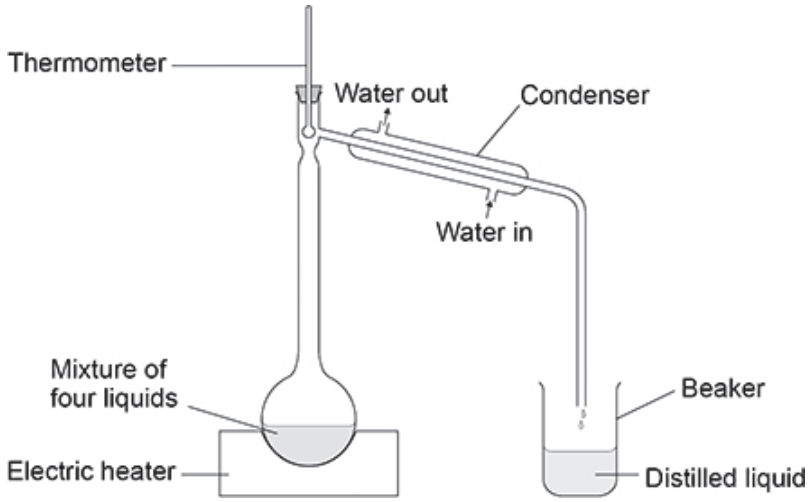
Sand can be separated from a mixture of sand and water by _____.

(1)

A mixture of four liquids was fractionally distilled.

Figure 2 shows the apparatus used.

Figure 2



The table below shows the boiling points of the four liquids in the mixture.

Liquid	Boiling point in °C
A	97
B	138
C	78
D	118

(e) Which liquid in the table would distil and be collected in the beaker first?

Liquid _____

(1)

(f) Suggest what would happen to the temperature of the water as the water flows through the condenser.

_____

_____

(1)

(g) Describe how to obtain sodium chloride crystals from sodium chloride solution by crystallisation.

_____

_____

_____

_____

(2)

(Total 8 marks)

All questions are for both separate science and combined science students

Q1.

This question is about elements in the periodic table.

(a) Argon has the atomic number 18

Explain why argon does **not** form compounds.

Answer in terms of electrons.

_____

_____

_____

_____

(2)

(b) Phosphorus (P) is the element below nitrogen in the periodic table.

Predict the formula of the compound formed between phosphorus and hydrogen.

Formula = _____

(1)

(c) Tellurium is the element with atomic number 52

Predict whether tellurium reacts with metals.

Explain your answer.

Answer in terms of the position of tellurium in the periodic table.

_____

_____

_____

_____

(2)

Barium (Ba) is an element in Group 2 of the periodic table.

Barium reacts with hydrochloric acid.

(d) Suggest **two** observations that could be made when barium reacts with hydrochloric acid.

1 _____

_____

2 _____

_____

(2)

(e) Write a balanced symbol equation for the reaction between barium and hydrochloric acid.

_____ + _____ → _____ + _____

(3)

(Total 10 marks)

Q2.

This question is about groups in the periodic table.

The elements in Group 1 become more reactive going down the group.

Rubidium is below potassium in Group 1.

(a) Rubidium and potassium are added to water.

Predict **one** observation you would see that shows that rubidium is more reactive than potassium.

_____

_____

(1)

(b) Explain why rubidium is more reactive than potassium.

_____

_____

_____

_____

_____

_____

(3)

(c) Complete the equation for the reaction of rubidium with water.

You should balance the equation.

$$Rb + H_2O \rightarrow \quad +$$

(3)

The noble gases are in Group 0.

(d) Which is a correct statement about the noble gases?

Tick (✓) **one** box.

The noble gases all have atoms with eight electrons in the outer shell.	☐
The noble gases have boiling points that increase going down the group.	☐
The noble gases have molecules with two atoms.	☐
The noble gases react with metals to form ionic compounds.	☐

(1)

(e) The table below shows information about the three isotopes of neon.

Mass number	**Percentage abundance (%)**
20	90.48
21	0.27
22	9.25

Calculate the relative atomic mass (A_r) of neon.

Give your answer to 3 significant figures.

_____

_____

_____

_____

_____

Relative atomic mass (3 significant figures) = _____

(3)

(Total 11 marks)

All questions are for separate science students only

Q1.

This question is about sulfuric acid.

(a) Sulfuric acid contains sulfate ions.

Describe the test for the presence of sulfate ions in sulfuric acid.

Give the result of the test. **(chemistry only)**

Test _____

_____

Result _____

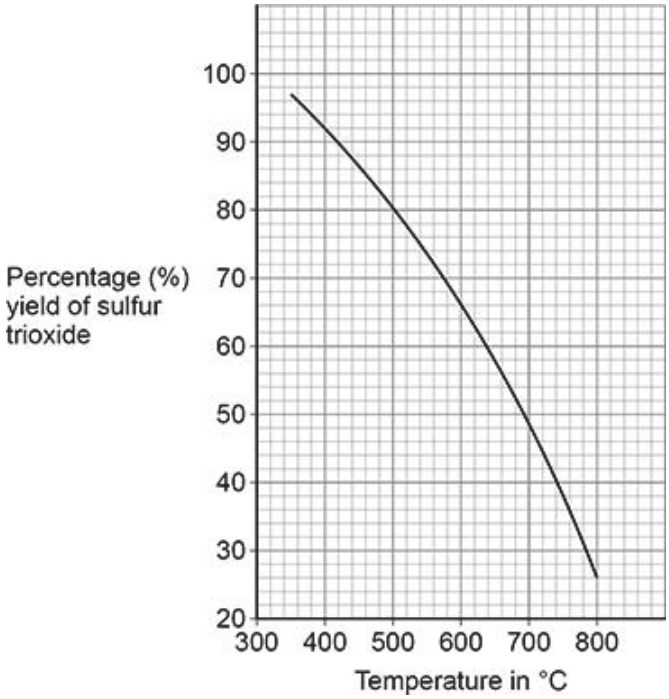
_____

(2)

One stage in the industrial production of sulfuric acid is the reaction of sulfur dioxide with oxygen to produce sulfur trioxide.

This reversible reaction reaches dynamic equilibrium.

The figure below shows the percentage yield of sulfur trioxide in this reaction at different temperatures.



(b) Which statement about the forward reaction is correct?

Use the above figure.

Tick (✓) **one** box.

The yield is greater at higher temperatures because the reaction is exothermic.	☐
The yield is greater at higher temperatures because the reaction is endothermic.	☐
The yield is smaller at higher temperatures because the reaction is exothermic.	☐
The yield is smaller at higher temperatures because the reaction is endothermic.	☐

The equation for the reaction is:

$$2\ SO_2(g) + O_2(g) \rightleftharpoons 2\ SO_3(g)$$

(1)

(c) Explain why the percentage yield of sulfur trioxide in this reaction is greater if the pressure is higher. **(HT only)**

_____

_____

_____

_____

(2)

(d) In industry, the reaction is done at 450 °C and atmospheric pressure.

Under these conditions the yield of sulfur trioxide is 86%.

Suggest **two** reasons why a higher pressure is **not** used.

1 _____

_____

2 _____

_____

(2)

(e) This reaction uses a catalyst to increase the rate of the reaction.

The catalyst is a metal oxide.

Which is the most likely metal in the metal oxide catalyst? **(chemistry only)**

Use the periodic table.

Tick (✓) **one** box.

Aluminium (Al) ☐

Barium (Ba) ☐

Potassium (K) ☐

Vanadium (V) ☐

(1)

(Total 8 marks)