Q1.

This question is about the structure of the atom.

(a) Complete the sentences.

Choose answers from the box.

Each word may be used once, more than once, or not at all.

electron	**ion**	**neutron**
nucleus	**proton**	

The centre of the atom is the ________________________ .

The two types of particle in the centre of the atom are the proton

and the ________________________ .

James Chadwick proved the existence of the ________________________ .

Niels Bohr suggested particles orbit the centre of the atom. This type of particle

is the ________________________ .

The two types of particle with the same mass are the neutron

and the ________________________ .

(5)

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

	Mass number	Percentage (%) abundance
Isotope 1	63	70
Isotope 2	65	30

(b) Calculate the relative atomic mass (A_r) of element **X** using the equation:

$$A_r = \frac{\text{(mass number × percentage) of isotope 1 + (mass number × percentage) of isotope 2}}{100}$$

Use the table above.

Give your answer to 1 decimal place.

____

____

A_r = ____________________

(2)

(c) Suggest the identity of element **X**.

Use the periodic table.

Element **X** is ____

(1)

(d) The radius of an atom of element **X** is 1.2×10^{-10} m

The radius of the centre of the atom is $\frac{1}{10000}$ the radius of the atom.

Calculate the radius of the centre of an atom of element **X**.

Give your answer in standard form.

____

____

____

____

Radius = ____________________ m

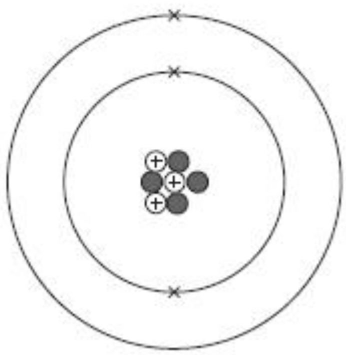
(2)

(Total 10 marks)

Q2.

This question is about atomic structure.

The figure below represents the structure of a lithium atom.



(a) Name the particle in the atom that has a positive charge.

____

(1)

(b) Name the particle in the atom that has the smallest mass.

____

(1)

(c) Complete the sentences.

Choose the answers from the box.

3	**4**	**7**	**10**

The mass number of the lithium atom is ____________________.

The number of neutrons in the lithium atom is ____________________.

(2)

(d) What are lithium atoms with different numbers of neutrons called?

Tick (✓) **one** box.

Compounds ☐

Ions ☐

Isotopes ☐

Molecules ☐

(1)

(e) Name the particle in the atom discovered by James Chadwick.

__________________________ .

(1)

(f) An element has two isotopes.

The table shows information about the isotopes.

	Mass number	**Percentage (%) abundance**
Isotope 1	10	20
Isotope 2	11	80

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

Use the equation:

$$A_r = \frac{(\text{mass number} \times \text{percentage}) \text{ of isotope 1} + (\text{mass number} \times \text{percentage}) \text{ of isotope 2}}{100}$$

Give your answer to 1 decimal place.

____

Relative atomic mass (A_r) = ________________________

(g) The radius of an atom is 0.2 nm

The radius of the nucleus is $\frac{1}{10000}$ the radius of the atom.

Calculate the radius of the nucleus.

Give your answer in standard form.

____

____

____

____

Radius = ______________________ nm

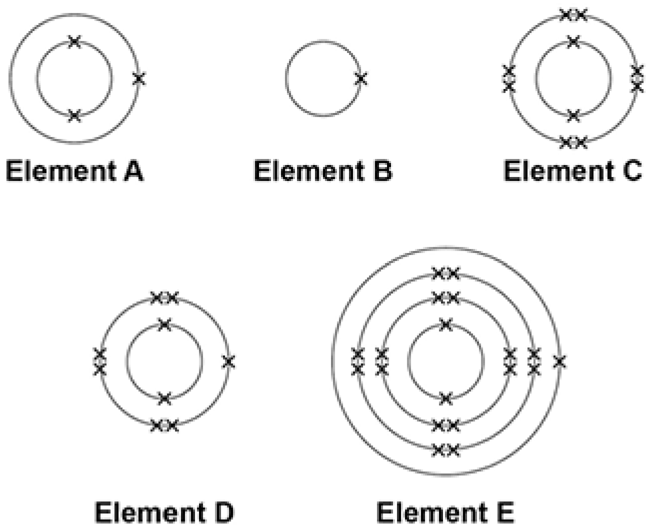
(2)

(Total 10 marks)

Q3.

The electronic structure of the atoms of five elements are shown in the figure below.

The letters are **not** the symbols of the elements.



Choose the element to answer the question. Each element can be used once, more than once or not at all.

Use the periodic table to help you.

(a) Which element is hydrogen?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(b) Which element is a halogen?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(c) Which element is a metal in the same group of the periodic table as element **A**?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(d) Which element exists as single atoms?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(e) There are two isotopes of element **A**. Information about the two isotopes is shown in the table below.

Mass number of the isotope	6	7
Percentage abundance	92.5	7.5

Use the information in the table above above to calculate the relative atomic mass of element **A**.
Give your answer to 2 decimal places.

____

____

____

____

____

____

____

Relative atomic mass = ________________________

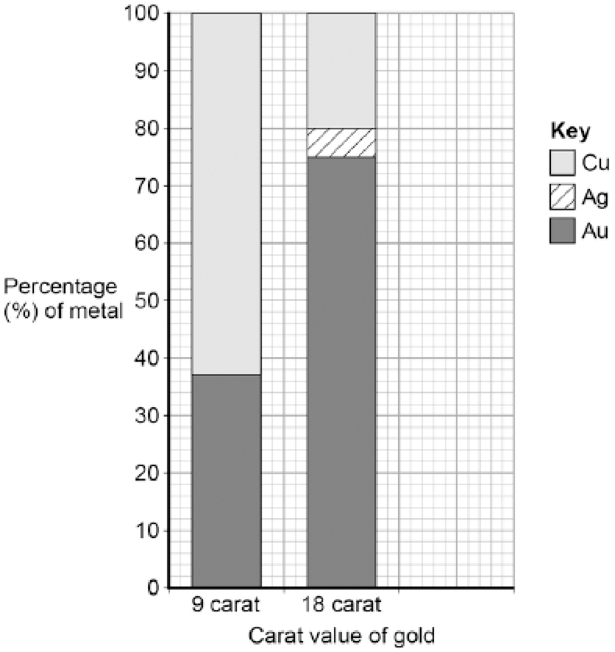
(4)

(Total 8 marks)

Q4.

Gold is mixed with other metals to make jewellery.

The figure below shows the composition of different carat values of gold.



(a) What is the percentage of gold in 12 carat gold?

Tick **one** box.

12 % ☐ **30 %** ☐ **50 %** ☐ **80 %** ☐

(1)

(b) Give the percentage of silver in 18 carat gold.

Use the figure above to answer this question.

Percentage = ______________________________ %

(1)

(c) Suggest **two** reasons why 9 carat gold is often used instead of pure gold to make jewellery.

1. ____

____

2. ____

____

(2)

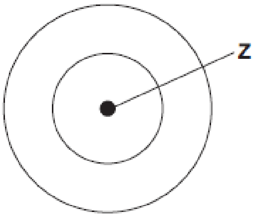
(Total 4 marks)

Q5.

There are eight elements in the second row (lithium to neon) of the periodic table.

(a) **Figure 1** shows an atom with two energy levels (shells).

Figure 1



(i) Complete **Figure 1** to show the electronic structure of a boron atom.

(1)

(ii) What does the central part labelled **Z** represent in **Figure 1**?

____

(1)

(iii) Name the sub-atomic particles in part **Z** of a boron atom.

Give the relative charges of these sub-atomic particles.

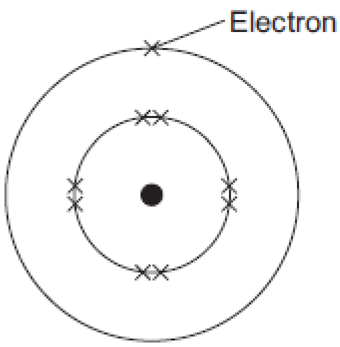
____

____

(3)

(b) The electronic structure of a neon atom shown in **Figure 2** is **not** correct.

Figure 2



Explain what is wrong with the electronic structure shown in **Figure 2**.

____

____

____

____

(3)

Q6.

A student investigated the law of conservation of mass.

The law of conservation of mass states that the mass of the products is equal to the mass of the reactants.

This is the method used.

1. Pour lead nitrate solution into a beaker labelled **A**.
2. Pour potassium chromate solution into a beaker labelled **B**.
3. Measure the mass of both beakers and contents.
4. Pour the solution from beaker **B** into beaker **A**.
5. Measure the mass of both beakers and contents again.

When lead nitrate solution and potassium chromate solution are mixed, a reaction takes place.

This is the equation for the reaction:

$$Pb(NO_3)_2(aq) \quad + \quad K_2CrO_4(aq) \quad \longrightarrow \quad PbCrO_4(s) \quad + \quad 2KNO_3(aq)$$

(a) What would the student see when the reaction takes place?

____

____

(1)

(b) The table shows the student's results.

	Mass in g
Beaker **A** and contents before mixing	128.71
Beaker **B** and contents before mixing	128.97
Beaker **A** and contents after mixing	154.10
Beaker **B** after mixing	103.58

Show that the law of conservation of mass is true.

Use the data from the table above.

____

____

(2)

(c) What is the resolution of the balance used to obtain the results in the table?

Tick (✓) **one** box.

0.01 g ☐ 0.1 g ☐ 1 g ☐ 100 g ☐

(1)

(d) Calculate the relative formula mass (M_r) of lead nitrate $Pb(NO_3)_2$

Relative atomic masses (A_r): N = 14 O = 16 Pb = 207

____

____

____

____

Relative formula mass = ____________________

(2)

(e) The formula of potassium chromate is K_2CrO_4

The charge on the potassium ion is +1

What is the formula of the chromate ion?

Tick (✓) **one** box.

CrO_4^{+} ☐

CrO_4^{2+} ☐

CrO_4^{-} ☐

CrO_4^{2-} ☐

(1)

(f) Another student also tests the law of conservation of mass using the same method.

The student uses a different reaction.

This is the equation for the reaction.

$$Na_2CO_3(aq) + 2HCl(aq) \longrightarrow 2NaCl(aq) + CO_2(g) + H_2O(l)$$

Explain why this student's results would **not** appear to support the law of conservation of mass.

____

____

____

____

(3)
(Total 10 marks)

Mark schemes

Q1.

(a) nucleus

1

neutron

1

neutron

1

electron

1

proton

1

must be in this order

(b) $(A_r)\frac{(63\times 70)+(65\times 30)}{100}$

1

= 63.6

1

*an answer of 63.6 scores **2** marks*

(c) copper / Cu

*allow ecf from answer to question **(b)***

1

(d) $\frac{1.2\times 10^{-10}}{10\,000}$

or

$1.2 \times 10^{-10} \times 1 \times 10^{-4}$

1

$= 1.2 \times 10^{-14}$ (m)

1

*an answer of 1.2×10^{-14} (m) scores **2** marks*

*a correct answer not in standard form scores **1** mark*

[10]

Q2.

(a) proton

1

(b) electron

1

(c) 7

1

4 1

in this order only

(d) isotopes 1

(e) neutron 1

(f) $$\frac{(10 \times 20) + (11 \times 80)}{100}$$ 1

= 10.8 1

*an answer of 10.8 scores **2** marks*

(g) $$\frac{0.2}{10000}$$ 1

= 2×10^{-5} (nm)

allow 0.00002 (nm) 1

an answer of 2×10^{-5} (nm) scores 2 marks

[10]

Q3.

(a) **B** 1

(b) **D** 1

(c) **E** 1

(d) **C** 1

(e) 92.5 × 6 **and**
7× 7.5 1

$$\frac{607.5}{100}$$ 1

6.075 1

6.08 1

*allow 6.08 with no working shown for **4** marks*

[8]

Q4.

(a) 50

1

(b) 5%

1

(c) any **two** from:

- cost (9 carat is cheaper)
- pure gold is soft
  or
  24 carat gold is soft
  or
  9 carat gold is harder
  allow 9 carat gold is stronger
  allow gold is an alloy in 9 carat gold
- can change the colour

2

[4]

Q5.

(a) (i) electronic structure 2,3 drawn

allow any representation of electrons, such as, dots, crosses, or numbers (2,3)

1

(ii) nucleus

1

(iii) protons and neutrons

*do **not** allow electrons in nucleus*

1

(relative charge of proton) +1

allow positive

1

(relative charge of neutron) 0

allow no charge/neutral

1

ignore number of particles

(b) too many electrons in the first energy level or inner shell

allow inner shell can only have a maximum of 2 electrons

1

too few electrons in the second energy level or outer shell

*allow neon has 8 electrons in its outer shell **or** neon does not have 1 electron in its outer shell*

allow neon has a stable arrangement of electrons or a full outer shell

1

neon does not have 9 electrons **or** neon has 10 electrons

allow one electron missing

allow fluorine has 9 electrons

1

ignore second shell can hold (maximum) 8 electrons or 2,8,8 rule or is a noble gas or in Group 0

max 2 marks if the wrong particle, such as atoms instead of electrons

if no other mark awarded allow 1 mark for the electronic structure of neon is 2,8

[8]

Q6.

(a) precipitate / solid formed

allow colour change

1

(b) total mass before = 257.68 g
total mass after = 257.68 g

1

so the mass of products equals
the mass of the reactants

1

(c) 0.01 g

1

(d) 207 + (2 × 14) + (6 × 16)
or
207 + 2 × [14 + (3 × 16)]

1

= 331

1

*an answer of 331 scores **2** marks*

(e) CrO_4^{2-}

1

(f) carbon dioxide is a gas

allow a gas is produced

1

the gas escapes during the reaction

1

(so) the mass at the end is less than expected

1

[10]