Q1.

A student investigated the temperature change when metal **X** was added to copper sulfate solution.

This is the method used.

1. Add 25 cm^3 of copper sulfate solution to a beaker.
2. Measure the temperature of the copper sulfate solution.
3. Add 1.0 g of metal **X** and stir.
4. Measure the highest temperature reached when metal **X** is added to copper sulfate solution.
5. Repeat steps 1 to 4 with different metals.

Figure 1 shows the apparatus used.

Figure 1

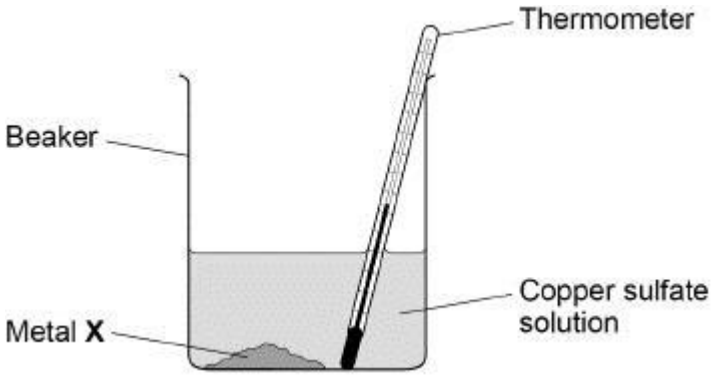
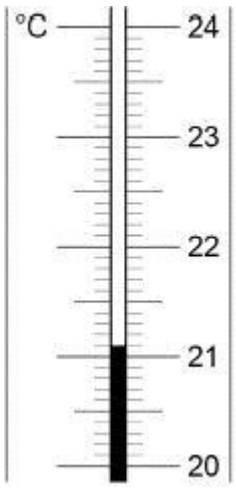


Figure 2 shows the thermometer reading of the copper sulfate solution at the start of the investigation.

Figure 2



(a) The highest temperature reached when metal **X** was added to copper sulfate solution was 35.5 °C

Determine the temperature change when metal **X** is added to copper sulfate solution.

Use **Figure 2**.

Highest temperature = 35.5 °C

Temperature at start = _____ °C

Temperature change = _____ °C

(2)

(b) Give **two** variables the student should keep the same in this investigation.

1. _____

_____

2. _____

_____

(2)

(c) The student repeated the experiment with metal **Y**.

Table 1 shows four results for metal **Y**.

Table 1

	Test 1	**Test 2**	**Test 3**	**Test 4**
Temperature change in °C	9.2	7.3	9.5	9.2

Calculate the mean temperature change for metal **Y**.

Do **not** include the anomalous result in your calculation.

_____

_____

_____

_____

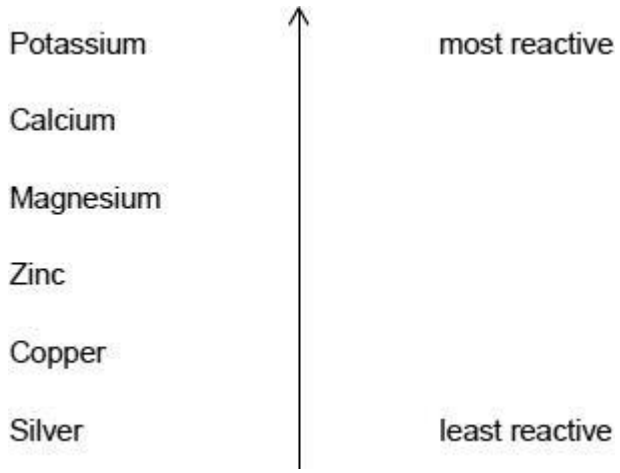
Mean temperature change = _____ °C

(2)

The more reactive the metal added to copper sulfate solution, the greater the temperature change.

Figure 3 shows a reactivity series.

Figure 3



(d) The student repeated the experiment.

The student added:

- magnesium to copper sulfate solution
- an unknown metal **A** to copper sulfate solution.

Table 2 shows the results.

Table 2

Metal	**Temperature change in °C**
Magnesium	12
Metal **A**	8

The student concludes metal **A** is zinc.

Give **one** reason why the student is correct.

Use **Figure 3** and **Table 2**.

_____

_____

(1)

(e) The student did the experiment with silver and copper sulfate solution.

What happens to the temperature of the mixture?

Use **Figure 3**.

Tick (✓) **one** box.

Decreases ☐

Increases ☐

Stays the same ☐

(1)

(f) Suggest **one** reason why the student should **not** add potassium metal to copper sulfate solution.

_____

_____

(1)

(g) 100 cm^3 of the copper sulfate solution contains 1.8 g of copper sulfate.

Calculate the mass of copper sulfate in 25 cm^3 of this copper sulfate solution.

_____

_____

_____

_____

Mass = _____ g

(2)

(Total 11 marks)

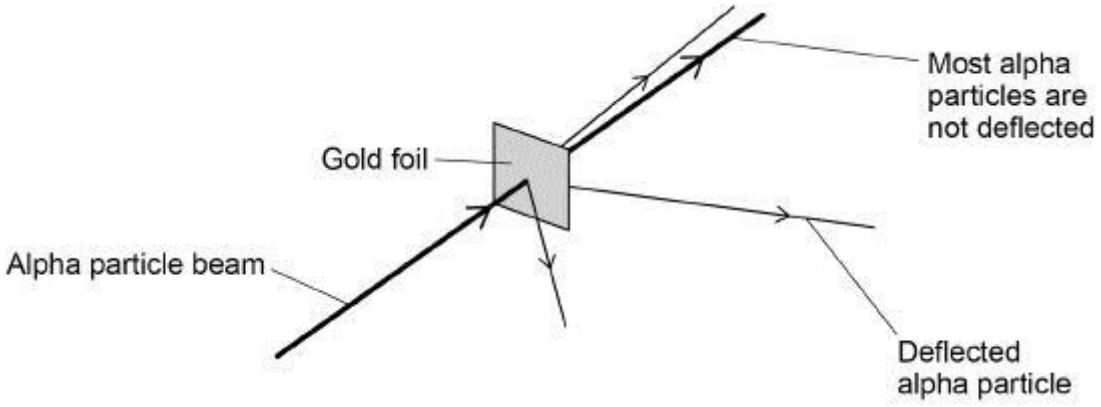
Q2.

This question is about gold and compounds of gold.

In the alpha particle scattering experiment alpha particles are fired at gold foil.

Alpha particles are positively charged.

The diagram below shows the results.



(a) Some alpha particles are deflected.

Complete the sentence.

Choose the answer from the box.

negatively charged	**not charged**	**positively charged**

Some alpha particles are deflected because the nucleus of the atom is _____.

(1)

(b) Why are most alpha particles **not** deflected?

Tick (✓) **one** box.

The atom is a tiny sphere that cannot be divided. ☐

The atom is mainly empty space. ☐

The electrons orbit the nucleus at specific distances. ☐

(1)

(c) What was **one** conclusion from the alpha particle scattering experiment?

Tick (✓) **one** box.

The mass is concentrated at the centre of the atom. ☐

The mass is concentrated at the edge of the atom. ☐

The mass is spread evenly throughout the atom. ☐

(1)

Gold reacts with the elements in Group 7 of the periodic table.

(d) What are Group 7 elements known as?

Tick (✓) **one** box.

Alkali metals ☐

Halogens ☐

Noble gases ☐

(1)

(e) Fluorine, chlorine and bromine react with gold.

Which element will be the most reactive with gold?

Tick (✓) **one** box.

Fluorine ☐ Chlorine ☐ Bromine ☐

(1)

(f) 3.94 g of gold reacts with chlorine to produce 6.07 g of gold chloride.

The word equation for the reaction is:

gold + chlorine → gold chloride

Calculate the mass of chlorine that reacts with 3.94 g of gold.

_____

_____

Mass = _____ g

(1)

(g) Calculate the relative formula mass (M_r) of gold chloride ($AuCl_3$).

Relative atomic masses (A_r): Cl = 35.5 Au = 197

_____

_____

_____

_____

Relative formula mass (M_r) = _____

(2)

(Total 8 marks)

Q1.

(a) 21.1 (°C)

1

14.4 (°C)

allow correct use of an incorrect start temperature

1

(b) any **two** from:

- surface area of metal
- 25 cm^3 / volume of copper sulfate solution
- concentration of copper sulfate solution
- mass / 1 g of metal

ignore amount
ignore temperature
ignore stirring

2

(c) $\frac{9.2 + 9.5 + 9.2}{3}$ or $\frac{27.9}{3}$

1

= 9.3 (°C)

*if no other mark awarded allow **1** mark for 8.8 (°C)*

1

(d) (metal **A** / zinc) is less reactive (than magnesium)
or
(metal **A** / zinc) is lower in reactivity series
or
change in temperature is lower (with metal **A** / zinc)

allow converse

1

(e) stays the same

1

(f) too dangerous
or
too reactive

allow potassium would react with water

1

(g) $\frac{25}{100} \times 1.8$ **or** $\frac{1}{4} \times 1.8$

1

= 0.45 (g)

1

[11]

Q2.

(a) positively charged

1

(b) the atom is mainly empty space.

1

(c) the mass is concentrated at the centre of the atom.

1

(d) halogens

1

(e) fluorine

1

(f) 2.13 (g)

1

(g) 197 + (3 × 35.5)
or
197 + 106.5

1

= 303.5

1

[8]