# New Document 1

Name: _____

Class: _____

Date: _____

---

Time: **35 minutes**

Marks: **35 marks**

Comments:

---

## Q1.

This question is about atoms and isotopes.

(a) Atoms contain protons, neutrons and electrons.

A lithium atom has the symbol $^{7}_{3}Li$

Explain, in terms of sub-atomic particles, why the mass number of this lithium atom is 7.

**(3)**

(b) Amounts of substances can be described in different ways.

Complete the sentences.

One mole of a substance is the relative formula mass in

The relative atomic mass of an element compares the mass of an atom of an element with the mass of an atom of

**(2)**

(c) Two isotopes of oxygen are $^{18}_{8}O$ and $^{16}_{8}O$

Describe the similarities and differences between the isotopes $^{18}_{8}O$ and $^{16}_{8}O$

You should refer to the numbers of sub-atomic particles in each isotope.

**(3)**

**(Total 8 marks)**

## Q2.

Scientists found that a compound contained:

22.8% sodium; 21.8% boron; and 55.4% oxygen.

Use the percentages to calculate the empirical formula of the compound.

Relative atomic masses ($A_r$): B = 11; O = 16; Na = 23

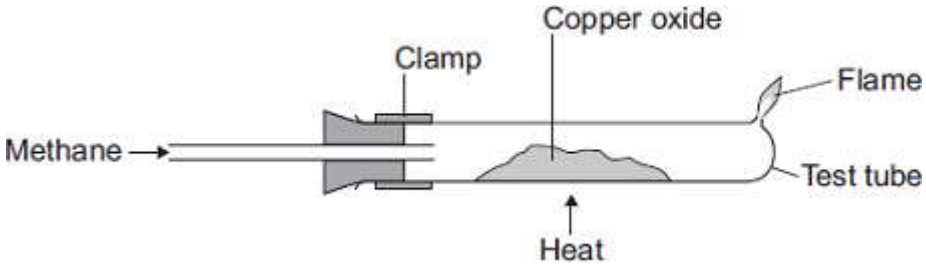
To gain full marks you **must** show all your working.

Empirical formula = _____

**(Total 5 marks)**

## Q3.

This apparatus is used for the reaction of copper oxide (CuO) with methane ($CH_4$).




(a) The symbol equation for this reaction is shown below.

$$4\ CuO(s) + CH4(g) \rightarrow 4\ Cu(s) + 2\ H_2O(g) + CO_2(g)$$

The water and carbon dioxide produced escape from the test tube.

Use information from the equation to explain why.

_____

_____

**(1)**

(b) (i) Calculate the relative formula mass ($M_r$) of copper oxide (CuO).

Relative atomic masses ($A_r$): O = 16, Cu = 64

_____

_____

_____

Relative formula mass ($M_r$) = _____

**(2)**

(ii) Calculate the percentage of copper in copper oxide.

_____

_____

_____

Percentage of copper = _____ %

**(2)**

(iii) Calculate the maximum mass of copper that could be produced from 4.0 g of copper oxide.

_____

_____

Mass of copper produced = _____ g

**(1)**

(c) The experiment was done three times.

The mass of copper oxide used and the mass of copper produced were measured each time.

The results are shown in the table.

| | **Experiment** | | |
|---|---|---|---|
| | **1** | **2** | **3** |
| Mass of copper oxide used in g | 4.0 | 4.0 | 4.0 |
| Mass of copper produced in g | 3.3 | 3.5 | 3.2 |

(i) Calculate the mean mass of copper produced in these experiments.

_____

_____

Mean mass of copper produced = _____ g

**(1)**

(ii) Suggest how the results of the experiment could be made more precise.

_____

_____

**(1)**

(iii) The three experiments gave different results for the amount of copper produced.

This was caused by experimental error.

Suggest two causes of experimental error in these experiments.

1. _____

_____

2. _____

_____

**(2)**

**(Total 10 marks)**

## Q4.

Ammonia is produced from nitrogen and hydrogen.

The equation for this reaction is:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

(a) (i) A company wants to make 6.8 tonnes of ammonia.

Calculate the mass of nitrogen needed.

Relative atomic masses ($A_r$): H = 1; N = 14

_____

_____

_____

_____

_____

Mass of nitrogen = _____ tonnes

**(3)**

(ii) The company expected to make 6.8 tonnes of ammonia.

The yield of ammonia was only 4.2 tonnes.

Calculate the percentage yield of ammonia.

_____

_____

Percentage yield of ammonia = _____ %

**(2)**

(iii) Use the equation above to explain why the percentage yield of ammonia was less than expected.

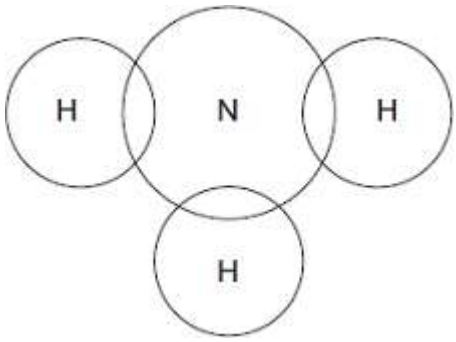
_____

_____

**(1)**

(b) Complete the diagram to show the arrangement of the outer shell electrons of the nitrogen and hydrogen atoms in ammonia.

Use dots (●) and crosses (x) to represent the electrons.




**(2)**

(c) Ammonia dissolves in water to produce an alkaline solution.

(i) Which ion makes ammonia solution alkaline?

_____

**(1)**

(ii) Name the type of reaction between aqueous ammonia solution and an acid.

_____

**(1)**

(iii) Name the acid needed to produce ammonium nitrate.

_____

**(1)**

(iv) The reaction of ammonia with sulfuric acid produces ammonium sulfate.

Use the formulae of the ions on the Chemistry Data Sheet.

Write the formula of ammonium sulfate.

_____

**(1)**

**(Total 12 marks)**

Mark schemes

## Q1.

(a) because this lithium atom has

3 protons

**1**

and 4 neutrons

**1**

mass number is total of neutrons and protons

*accept protons and neutrons have a mass of 1*
*accept number of neutrons = 7 - 3(protons)*
*ignore mass of electron is negligible*

**1**

(b) grams

*accept g*

**1**

$^{12}C$

*allow carbon-12* ***or*** *C-12*
*ignore hydrogen* ***or*** *H*

**1**

(c) any **three** from:

*max* ***2*** *if no numbers given*
*numbers if given must be correct*

- both have 8 protons
  *accept same number of protons*
- $^{18}O$ has 10 neutrons
- $^{16}O$ has 8 neutrons
  *accept different number of neutrons or* $^{18}O$ *has two more neutrons for* ***1*** *mark*
- both have 8 electrons.
  *accept same number of electrons*

**3**

**[8]**

## Q2.

**Divide by $A_r$:**

Na = 22.8 / 23

B = 21.8 / 11

O = 55.4 / 16

*if student has calculated moles upside down they can score mp 3 mp 4 and mp 5 as follows:*
*Na 23 / 22.8*
*B 11 / 21.8*
*O 16 / 55.4*

1

**Values**

0.991

*1.01*

1.98

*0.505*

3.46

*0.289*

1

**Divide by the smallest**

1 : 2 : 3.5

*Divide by the smallest (1)*
*3.5 : 1.75 : 1*

1

**Whole number ratio**

2 : 4 : 7

*Whole number ratio (1)*
*14 : 7 : 4*

1

**Empirical formula**

$Na_2B_4O_7$

*Empirical formula (1)*
*$Na_{14}B_7O_4$*
*if no working shown allow **4** marks for $Na_2B_4O_7$*

1

**[5]**

## Q3.

(a) because they are <u>gases</u>

*ignore vapours / evaporate / (g)*
*allow it is a gas*

1

(b) (i) 80 / 79.5

*correct answer with or without working = **2** marks*
*ignore units*
*if no answer **or** incorrect answer then evidence of 64 / 63.5 + 16 gains **1** mark*

2

(ii) 79.375 - 80

*correct answer with or without working = **2** marks*
*if no answer **or** incorrect answer then evidence of*

$\frac{64}{80}$ *or* $\frac{63.5}{79.5}$ *(×100) gains **1** mark*

*accept (ecf)* $\frac{64 \text{ or } 63.5}{\text{answer (b)(i)}}$ *× 100 for **2** marks*
*if answer correctly calculated.*

*if incorrectly calculated evidence of* $\frac{64 \text{ or } 63.5}{\text{answer (b)(i)}}$ *(× 100) gains **1** mark*

**2**

(iii) 3.2

*correct answer with or without working = **1** mark*
*allow (ecf)*
*4 x ((b)(ii)/100) for **1** mark if correctly calculated*

**1**

(c) (i) 3.3

*accept 3.33…….. **or** 3 1 / 3 **or** 3.3•*
***or** 3.3r*

**1**

(ii) (measure to) more decimal places **or** (use a) more sensitive balance / apparatus

*allow use smaller scale (division) **or** use a smaller unit*
*ignore accurate / repeat*

**1**

(iii) any **two** from:

*ignore systematic / human / apparatus / zero / measurement / random / weighing / reading / recording errors unless qualified*

different balances used **or** faulty balance

*ignore dirty apparatus*

reading / using the balance incorrectly

*accept incorrect weighing of copper / copper oxide*

spilling copper oxide / copper

*allow some copper left in tube*

copper oxide impure

*allow impure copper (produced)*

not all of the copper oxide was reduced / converted to copper **or** not enough / different amounts of methane used

*accept not all copper oxide (fully) reacted*

heated for different times
heated at different temperatures

*if neither of these points awarded allow different amounts of heat used*

*accept Bunsen burner / flame at different temperatures*

some of the copper produced is oxidised / forms copper oxide

some of the copper oxide / copper blown out / escapes (from tube)

*ignore some copper oxide / copper lost*

some water still in the test tube

2

**[10]**

## Q4.

(a) (i) $M_r$ of $NH_3$ = 17

*correct answer with or without working gains **3** marks*
*accept correct rounding of intermediate answers*
*can be credited from correct substitution from step 2*

1

**or**

2 (moles of) $NH_3$ = 34

**or**

14 → 17

**or**

28 → 34

(28/34) × 6.8

*allow ecf from step 1*

1

**or**

(14/17) × 6.8

= 5.6

*allow ecf from step 1*

1

(ii) 61.8

*accept 61.76 **or** 62 **or** 61.76…*
*correct answer with or without working gains **2** marks*
*if answer is not correct evidence of 4.2 / 6.8 × 100 gains **1** mark*
*if answer not correct 0.618 or 0.62 gains **1** mark*

2

(iii) reaction is reversible

*accept reaction reaches equilibrium*
*allow reaction does not reach completion*
*ignore some is lost*

1

(b) 3 bonding pairs

*do **not** accept extra electrons on hydrogen*

1

1 lone pair

*accept 2 non-bonding electrons on outer shell of nitrogen*

1

(c) (i) hydroxide / $OH^-$

*accept phonetic spelling*

**1**

(ii) neutralisation

*accept acid-base*

*allow exothermic*

**1**

(iii) nitric (acid)

*allow $HNO_3$*

*ignore incorrect formula*

**1**

(iv) $(NH_4)_2 SO_4$

*allow $(NH_4^+)_2 SO_4^{2-}$*

**1**

**[12]**