**Name:**

## Meadowhead School Sixth Form

## A-Level Chemistry Transition Work 2022

Please complete these GCSE style questions, and use the mark scheme to mark, check and correct them. Bring the completed booklet to your first lesson.

These questions all involve calculations – an important part of all the A-Level sciences.

We look forward to seeing you after the summer!

**Q1.**

The information on the Data Sheet will be helpful in answering this question.

(a) Calculate the formula mass ($M_r$) of the compound iron (III) oxide, $Fe_2O_3$.

(Show your working.)

_____

_____

_____

_____

_____

**(3)**

(b) Calculate the mass of iron produced when 32g of iron (III) oxide is completely reduced by aluminium.

The reaction is shown in the symbol equation:

$$Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$$

(Show your working.)

_____

_____

_____

_____

Answer = _____ grams

**(3)**

**(Total 6 marks)**

## Q2.

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.

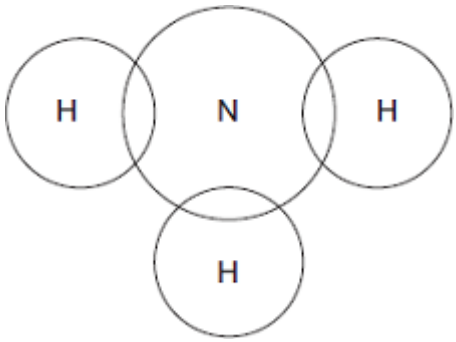
_____

_____

**(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.

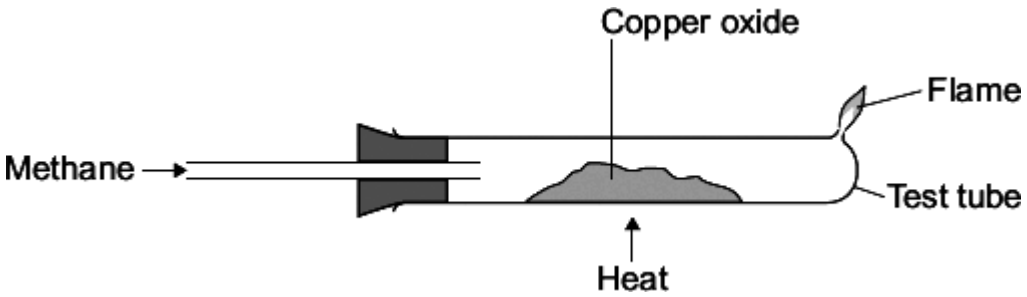
_____

**(1)**

**(Total 12 marks)**

## Q3.

An experiment was done on the reaction of copper oxide (CuO) with methane ($CH_4$).




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

$$4CuO(s) + CH_4(g) \rightarrow 4Cu(s) + 2H_2O(g) + CO_2(g)$$

The water and carbon dioxide produced escapes 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 mass of copper that could be made from 4.0 g of copper oxide.

_____

_____

Mass of copper = _____ g

**(1)**

(c) The experiment was done three times.
The mass of copper oxide used and the mass of copper made was 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 made in g | 3.3 | 3.5 | 3.2 |

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

_____

_____

Mean mass of copper made = _____ g

**(1)**

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

_____

_____

**(1)**

(iii) The three experiments gave slightly different results for the mass of copper made.
This was caused by experimental error.

Suggest **two** causes of experimental error in these experiments.

1. _____

_____

2. _____

_____

**(2)**

**(Total 10 marks)**

## Q4.

This question is about crude oil.

(a) The table shows information about crude oil fractions.

| Crude oil fraction | Number of carbon atoms | Approximate percentage (%) in crude oil | Approximate percentage (%) demand |
|---|---|---|---|
| Gas | 1–4 | 3 | 4 |
| Petrol | 5–10 | 9 | 23 |
| Naphtha | 8–12 | 10 | 5 |
| Kerosene | 9–16 | 14 | 8 |
| Diesel | 15–25 | 16 | 22 |
| Residue | 20–30+ | 48 | 38 |

Explain the advantage of cracking hydrocarbons.

Give **one** example from the table.

**(3)**

(b) Ethene is a product of cracking.

Relative formula mass ($M_r$) of ethene = 28

Calculate the number of moles of ethene ($C_2H_4$) in 50.4 kg

Give your answer in standard form.

Numbers of moles = _____

**(3)**

(c) $C_{21}H_{44}$ can be cracked to produce ethene.

$$C_{21}H_{44} \rightarrow 3C_2H_4 + C_{15}H_{32}$$

Relative formula mass ($M_r$) of $C_{21}H_{44}$ = 296

Calculate the mass of $C_{21}H_{44}$ needed to produce 50.4 kg of ethene.

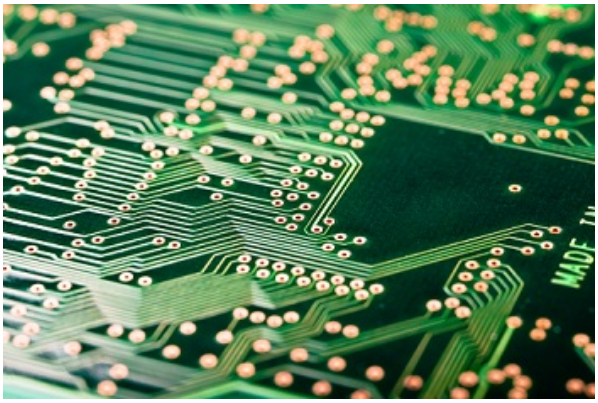
Mass = _____ kg

**(3)**

**(Total 9 marks)**

## Q5.

Etching is a way of making printed circuit boards for computers.



Printed circuit boards are made when copper sheets are etched using iron(III) chloride solution. Where the copper has been etched, only plastic remains.

(a) Copper is a good conductor of electricity.

Explain why.

**(2)**

(b) Iron(III) chloride can be produced by the reaction shown in the equation:

$$2\ Fe + 3\ Cl_2 \rightarrow 2\ FeCl_3$$

(i) Calculate the maximum mass of iron(III) chloride ($FeCl_3$) that can be produced from 11.20 g of iron.

Relative atomic masses ($A_r$): Cl = 35.5; Fe = 56.

Maximum mass of iron(III) chloride = _____ g

**(3)**

(ii) The actual mass of iron(III) chloride ($FeCl_3$) produced was 24.3 g.

Calculate the percentage yield.

(If you did not answer part (b)(i) assume that the maximum theoretical mass of iron(III) chloride ($FeCl_3$) is 28.0 g. This is **not** the correct answer to part (b)(i).)

Percentage yield = _____%

**(1)**

**(Total 6 marks)**

## Q1.

(a) $Fe_2$ [56 × 2] **or** 112
$O_3$ [16 × 3] **or** 48
*each gain 1 mark*

**but** $M_r$ = 160
*gains 3 marks*

**3**

(b) [$Fe_2O_3 + 2A1 \rightarrow 2Fe + A1_2O_3$]

160 → 112 (NB Credit if unworked
(or value from (a)) (or value but should be totalled) from (a))
*gains 1 mark*

**but**
32 g. of $Fe_2O_3$ → 32/160 × 112
*gains 2 marks*

**but** = 22.4
*gains 3 marks*

**3**

**[6]**

## Q2.

(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]**

## Q3.

(a) because they are gases

*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) 80 / 79.87 / 79.9 / 79.375 / 79.38 / 79.4

*correct answer with or without working = **2** marks*

*if no answer **or** incorrect answer*

*then*

*evidence of* $\frac{64}{80}$ ***or*** $\frac{63.5}{79.5}$ *(x100) gains **1** mark*

$\frac{64 or 63.5}{answer(b)(i)}(\times 100)$ *for **2** marks if correctly calculated*

*evidence of* $\frac{64 or 63.5}{answer(b)(i)}(\times 100)$

**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* $3\frac{1}{3}$ *or 3.3 · or 3.3 r*

**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 errors unless qualified
- different balances used **or** faulty balance
  *ignore dirty apparatus*
- reading / using the balance incorrectly **or** recording error
  *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
  *accept Bunsen burner / flame at different temperatures*
- some of the copper made 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) break large molecules into small molecules

**1**

to satisfy demand

**1**

example

**1**

(b) 50.4 kg = 50 400 g

**1**

50 400/28

**1**

$1.8 \times 10^3$

**1**

(c) 1.8/3 = 0.6

**1**

0.6 × 296

**1**

= 177.6 kg

**1**

**[9]**

## Q5.

(a) copper has delocalised electrons

*accept copper has free electrons*
*ignore sea of electrons **or** mobile electrons*

**1**

(electrons) which can move through the metal / structure

*allow (electrons) which can carry a charge <u>through the metal / structure</u>*

1

(b) (i) ($M_r$ $FeCl_3$ =) 162.5

*correct answer with or without working gains **3** marks*

*can be credited from correct substitution in step **2***

1

**or**

2 (moles of) $FeCl_3$ = 325

**or**

112 → 325

$$\frac{11.20}{56} \times 162.5$$

*accept* $\frac{325}{112} \times 11.2$

1

= 32.5

*accept 32.48*

1

(ii) 74.8

*accept 74.77 – 75*

*accept ecf from (b)(i)*

*if there is no answer to part(i)*

***or***

*if candidate chooses not to use their answer then accept 86.79 – 87*

1

**[6]**