Name:

Meadowhead School Sixth Form

A-Level Chemistry Transition Work 2023

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 periodic table 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.

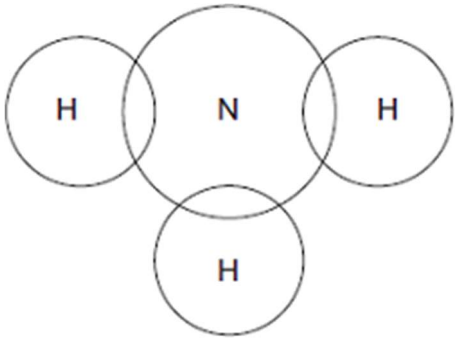
_____

_____

(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.

Write the formula of ammonium sulfate.

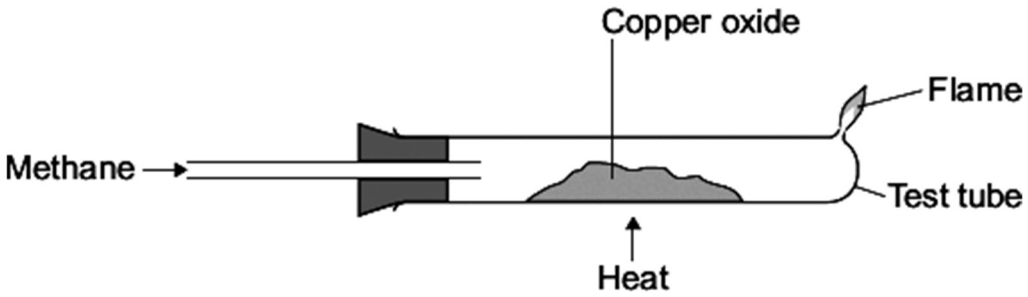
_____

(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.

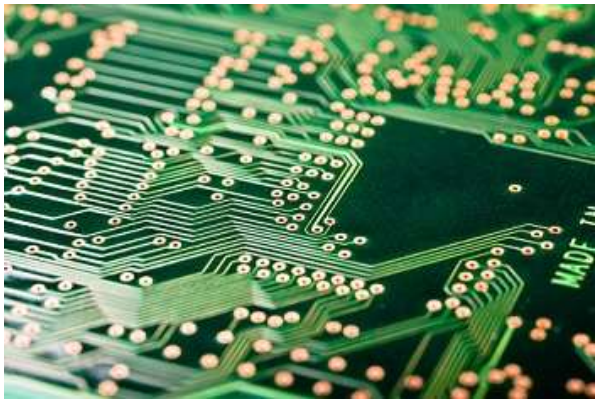
Mass = _____ kg

(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*

accept (ecf)

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

if incorrectly calculated

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

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 $3\frac{1}{3}$ *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

1.8×10^3

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 <u>through the metal / structure</u>

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

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

allow ecf from step 1

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]