Name: _____

Class: _____

Date: _____

Using Resources part 1 AQA Triple Chemistry

Time: **66 minutes**

Marks: **63 marks**

Comments:

1. Cement, concrete and steel are building materials.

Cement contains calcium oxide.

Calcium oxide reacts with water to produce calcium hydroxide.

The equation for the reaction is:

$$\text{calcium oxide} + \text{water} \rightleftharpoons \text{calcium hydroxide}$$

(a) How does the equation show that this reaction is reversible?

_____

_____

(1)

(b) The forward reaction is exothermic.

What type of reaction is the reverse reaction?

_____

(1)

(c) When excess water is added to 20 g of calcium oxide, 23 kJ of energy is released.

Calculate the energy released when excess water is added to 4 g of calcium oxide.

_____

_____

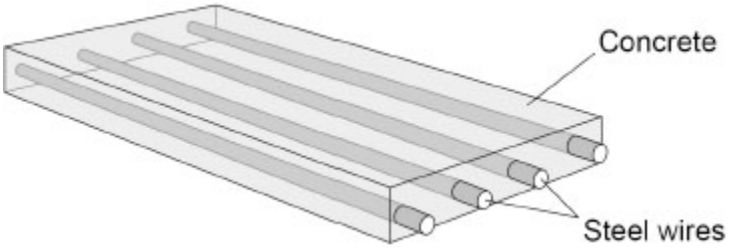
_____

Energy released = _____ kJ

(2)

Pre-stressed concrete contains steel wires within the concrete.

The figure below shows the structure of a piece of pre-stressed concrete.



(d) Pre-stressed concrete is a composite.

Draw **one** line from each component of a composite to a material in pre-stressed concrete.

Component of composite	**Material in pre-stressed concrete**
Binder	Concrete
Reinforcement	Pre-stressed concrete
	Steel wires

(2)

(e) Which metal do **all** steels contain?

_____

(1)

(f) Bricks are also building materials.

Bricks are ceramics.

Which material is used to make bricks?

Tick (✓) **one** box.

Aluminium ☐

Clay ☐

Poly(ethene) ☐

(1)

(Total 8 marks)

2. Ammonia is produced in the Haber process.

The word equation for the reaction to produce ammonia is:

nitrogen + hydrogen ⇌ ammonia

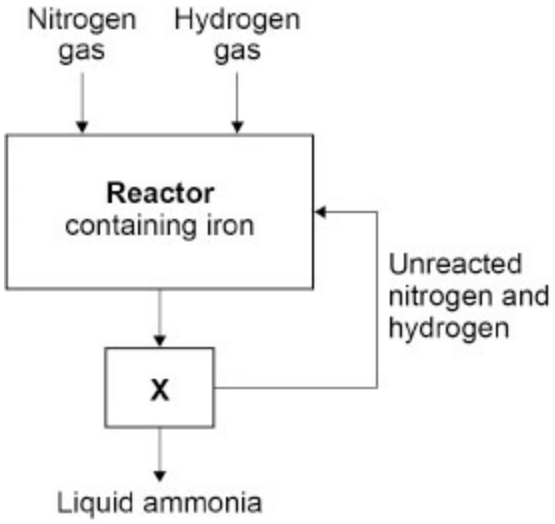
(a) Draw **one** line from each element to a source of that element.

Element	Source of element
	Air
Nitrogen	Clay
	Limestone
Hydrogen	Natural gas
	Sand

(2)

Ammonia is a gas at room temperature.

The figure below shows how ammonia is produced from nitrogen and hydrogen.



(b) Which process takes place at **X** in the figure above?

Tick (✓) **one** box.

Cooling ☐

Filtering ☐

Melting ☐

(1)

(c) Complete the sentence.

Use the figure above.

The iron in the reactor is used as a _____.

(1)

The table below shows the world production of ammonia between 1990 and 2020.

Year	World production of ammonia in arbitrary units
1990	120
2000	130
2010	155
2020	165

(d) How did the world production of ammonia change between 1990 and 2020?

Use the table above.

_____

_____

(1)

(e) Determine the mean change in mass of ammonia produced per year between 2000 and 2020.

Use the table above and the equation:

$$\text{mean change in mass produced per year} = \frac{\text{change in mass produced between 2000 and 2020}}{\text{number of years}}$$

Change in mass = _____ arbitrary units

Number of years = _____

Mean change = _____ arbitrary units per year

(4)

Most of the ammonia produced in the Haber process is used to make fertilisers.

(f) Which is a reason for the change in the world production of ammonia shown in the table above?

Tick (✓) **one** box.

- Change in amount of acid rain ☐
- Change in global temperatures ☐
- Change in world population ☐

(1)

(g) Fertilisers produced using ammonia contain nitrogen.

Which **two** compounds used in fertilisers contain nitrogen?

Use the periodic table.

Tick (✓) **two** boxes.

$Ca(NO_3)_2$ ☐

$Ca_3(PO_4)_2$ ☐

KCl ☐

K_2SO_4 ☐

$(NH_4)_2SO_4$ ☐

(2)

(Total 12 marks)

3. A student investigated the mass of dissolved solids in sea water.

This is the method used.

1. Weigh an empty evaporating basin.
2. Measure 10.0 cm^3 of sea water sample **A** into the evaporating basin using a burette.
3. Heat the evaporating basin until all the water seems to have evaporated.
4. Weigh the evaporating basin and contents.
5. Calculate the mass of dissolved solids in the sample.
6. Repeat steps 1 to 5 with sea water samples **B**, **C** and **D**.

(a) Why did the student use a burette rather than a measuring cylinder to measure 10.0 cm^3 of each sample?

_____

_____

(1)

(b) What was the dependent variable in this investigation?

_____

(1)

(c) Describe how the student could make sure **all** of the water had evaporated in **step 3**.

_____

_____

_____

_____

(2)

(d) How did the student calculate the mass of dissolved solids in each sea water sample?

_____

_____

_____

(1)

The table below shows the results.

Sea water sample	**A**	**B**	**C**	**D**
Mass of dissolved solids in grams	0.35	0.37	0.33	0.34

(e) Calculate the mean concentration of dissolved solids in 10.0 cm^3 samples of sea water **A**, **B**, **C** and **D**.

Use the table above and the equation:

$$\text{mean concentration of dissolved solids (g/dm}^3\text{)} = \frac{\text{mean mass of dissolved solids (g)}}{\text{volume of sample (dm}^3\text{)}}$$

Give your answer in g/dm^3.

Mean concentration = _____ g/dm^3

(5)

(f) Suggest why sea water samples **A**, **B**, **C** and **D** contain different masses of dissolved solids.

(1)

(Total 11 marks)

4. This question is about gold.

18 carat gold is an alloy containing 75% by mass of gold.

(a) Calculate the mass of gold in a 4 g jewellery ring made from 18 carat gold.

Mass = _____ g

(2)

(b) What is the simplest whole-number ratio of the mass of gold : mass of other metals in 18 carat gold?

Tick (✓) **one** box.

1 : 3 ☐ 3 : 1 ☐ 6 : 18 ☐ 18 : 6 ☐

(1)

(c) What other **two** metals may also be present in 18 carat gold?

Tick (✓) **two** boxes.

Copper ☐

Magnesium ☐

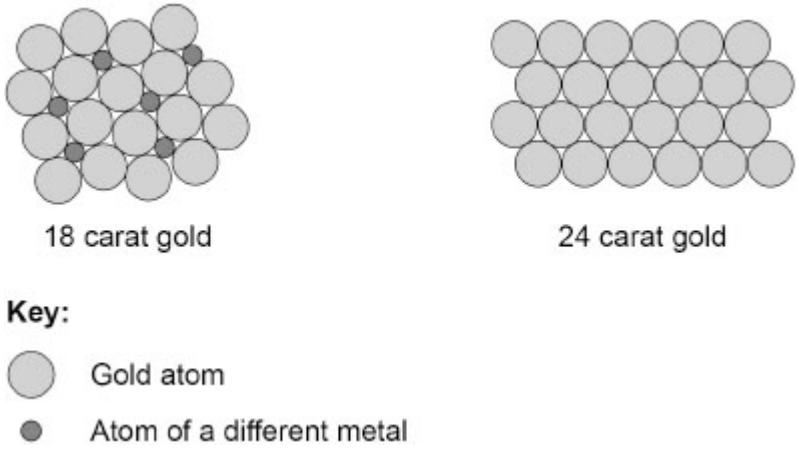
Potassium ☐

Silver ☐

Sodium ☐

(2)

(d) The figure below represents the structure of 18 carat gold and of 24 carat gold.



Explain why 18 carat gold is harder than 24 carat gold.

_____

_____

_____

_____

_____

_____

(3)

(e) Gold is used to make jewellery.

Give **one** reason why iron is **not** used to make jewellery.

_____

_____

(1)

(Total 9 marks)

5. Doors can be made from aluminium or wood.

(a) The table below gives information about aluminium and wood.

	Aluminium	**Wood**
Raw material	Metal ore from rock	Trees
Relative cost of 1 kilogram of material	87	1
Relative strength	1.3	1.0
Protection	No protection needed to prevent corrosion	Painted to prevent rotting
Disposal	Melted to form new products	Shredded into wood chips for fuel

Evaluate the use of aluminium and of wood for making doors.

(6)

(b) Aluminium has an oxide coating that protects the metal from corrosion.

Explain how the oxide coating protects aluminium from corrosion.

(2)

(c) Doors made from wood need painting to prevent rotting.

Paints are **formulations** made by mixing a solid pigment and a liquid.

Which statement describes the composition of a paint?

Tick (✓) **one** box.

- A fixed mass of pigment and a fixed mass of liquid ☐
- A fixed mass of pigment and a variable mass of liquid ☐
- A variable mass of pigment and a fixed mass of liquid ☐
- A variable mass of pigment and a variable mass of liquid ☐

(1)

(Total 9 marks)

6. This question is about ammonia.

Ammonia is produced from nitrogen and hydrogen in the Haber process.

Hydrogen is produced from methane and steam.

The equation for one of the reactions in the production of hydrogen is:

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3\ H_2(g)$$

The forward reaction absorbs energy from the surroundings.

(a) Explain why a high temperature is used in this reaction.

_____

_____

_____

_____

_____

_____

(3)

(b) Explain why as low a pressure as possible is used in this reaction.

_____

_____

_____

_____

(2)

(c) A nickel catalyst is used in this reaction.

What is the effect of the nickel catalyst on the position of equilibrium?

Tick (✓) **one** box.

Equilibrium position shifts to the left. ☐

No effect on equilibrium position. ☐

Equilibrium position shifts to the right. ☐

(1)

(d) The nitrogen needed in the Haber process is obtained from air.

Calculate the approximate volume of air required to obtain 50 dm^3 of nitrogen.

_____

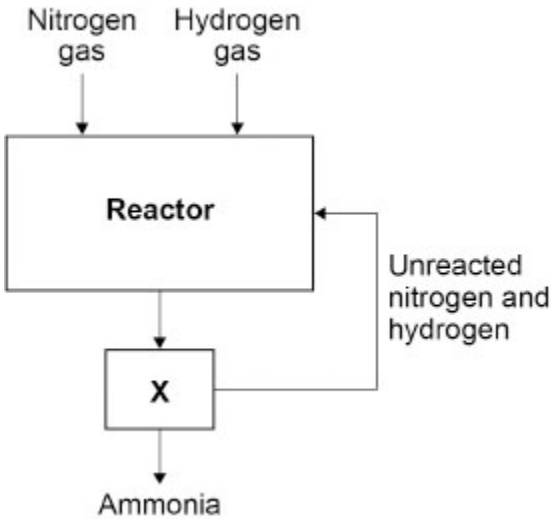
_____

_____

Volume ~ _____ dm^3

(2)

(e) The figure below shows how ammonia is produced from nitrogen and hydrogen.



Explain how the mixture of ammonia, nitrogen and hydrogen is separated at **X**.

(3)

(f) Ammonia is used to produce fertilisers.

Nitrogen is released into the air when bacteria break down fertilisers and dead plant matter.

One of the reactions during the production of hydrogen from methane (natural gas) releases carbon dioxide into the air.

The use of nitrogen to produce ammonia is more sustainable than the use of hydrogen to produce ammonia.

Give **three** reasons why.

1 _____

_____

2 _____

_____

3 _____

_____

(3)

(Total 14 marks)

1.

(a) (the sign) ⇌

allow a description of the reversible sign

1

(b) endothermic

allow (thermal) decomposition

1

(c)

(energy released =)

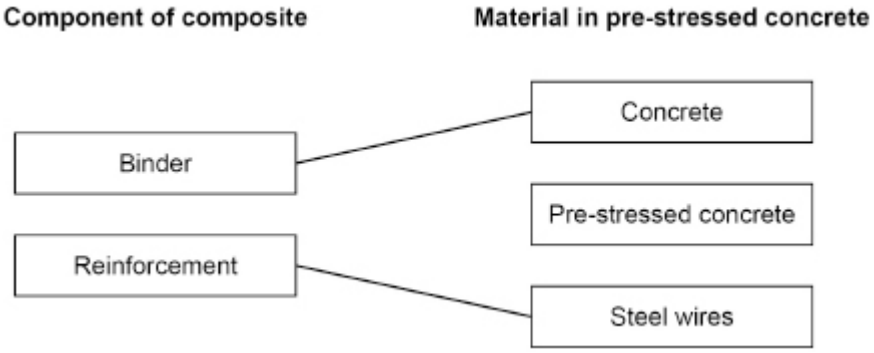
$\frac{4}{20} \times 23$

1

= 4.6 (kJ)

1

(d)



1

do **not** accept more than one line from a box on the left

1

(e) iron

allow Fe

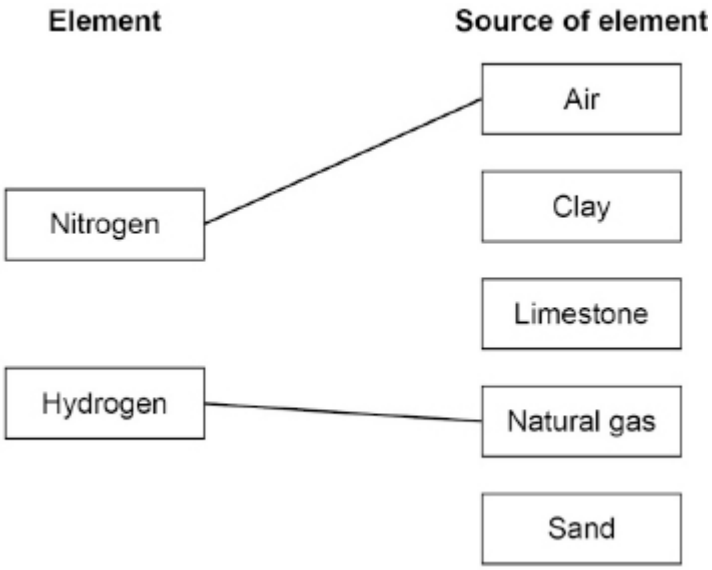
1

(f) clay

1

[8]

2. (a)



1

do **not** accept more than one line from a box on the left

1

(b) cooling

1

(c) catalyst

1

(d) (world production of ammonia) increased

1

(e) (change in mass = 165 – 130 =)
35 (arbitrary units)

1

(number of years = 2020 – 2000 =) 20

1

$$(\text{mean change} =) \frac{35}{20}$$

allow correct use of incorrectly determined change in mass and / or number of years

1

= 1.75 (arbitrary units per year)

allow 1.75 (arbitrary units per year) correctly rounded to at least 2 significant figures

1

(f) change in world population

1

(g) $Ca(NO_3)_2$

1

$(NH_4)_2SO_4$

1

[12]

3. (a) (a burette is) more accurate (than a measuring cylinder)

allow (a burette has) a higher resolution

ignore precise

1

(b) the mass of (dissolved) solids

1

(c) reheat (the evaporating basin and contents)

1

(and reweigh) until constant mass

*allow for **2** marks*

heat to constant mass

1

(d) subtract the mass of the (empty) evaporating basin from the mass of the evaporating basin and contents (at the end of the experiment)

allow subtract initial mass from the final mass

1

(e)

(allow mean mass =)
$\frac{0.35 + 0.37 + 0.33 + 0.34}{4}$

(allow mean mass =)
$\frac{1.39}{4}$

1

= 0.3475 (g)

1

(conversion 10 cm^3 =) 0.01 dm^3

1

(mean concentration =) $\frac{0.3475}{0.01}$

allow correct use of incorrectly determined mean mass
allow correct use of incorrect / no conversion of volume

1

= 34.75 (g/dm^3)

allow 34.75 (g/dm^3) correctly rounded to at least 2 significant figures
1

1

alternative approach 1

(conversion 10 cm^3 =)
0.01 dm^3 (1)

(concentrations =)
$\frac{0.35}{0.01}$ $\frac{0.37}{0.01}$ $\frac{0.33}{0.01}$ $\frac{0.34}{0.01}$ (1)

allow correct use of incorrect / no conversion of volume

= 35 37 33 34 (1)

(mean concentration =)
$\frac{35 + 37 + 33 + 34}{4}$ (1)

(allow mean concentration =)
$\frac{139}{4}$

allow correct use of incorrectly determined concentrations

= 34.75 (g/dm^3) (1)

allow 34.75 (g/dm^3) correctly rounded to at least 2 significant figures

alternative approach 2 using total mass and total volume

(total mass =
0.35 + 0.37 + 0.33 + 0.34 =)
1.39 (g) (1)

(total volume =
10 + 10 + 10 + 10 =)
40 cm^3 (1)

(conversion 40 cm^3 =)
0.04 dm^3 (1)

(mean concentration =) $\frac{1.39}{0.04}$

allow correct use of incorrectly determined total mass

allow correct use of incorrect / no conversion of total volume

= 34.75 (g/dm^3) (1)

allow 34.75 (g/dm^3) correctly rounded to at least 2 significant figures

(f) the samples were taken from different places

1

[11]

4. (a)

(mass =) $\frac{75}{100}$ x 4

1

= 3 (g)

1

(b) 3 : 1

1

(c) copper

1

silver

1

(d) (18 carat gold) contains different sized atoms

1

(so the) layers are distorted

1

(so the) layers (of atoms) slide less easily

allow (so the) atoms cannot slide over each other

1

(e) any **one** from:

- iron rusts
- aesthetic reasons

1

[9]

5. (a) **Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.

5-6

Level 2: Some logically linked reasons are given. There may also be a simple judgement.

3-4

Level 1: Relevant points are made. They are not logically linked. 1–2

1-2

No relevant content

0

Indicative content

- aluminium ore is a finite resource
- wood is a renewable resource
- aluminium ore has to be mined / quarried
  - which causes dust / noise pollution
- trees require land for growing
  - which reduces land for farming
  - which can lead to deforestation
- cost of wood is lower
  - so more doors can be obtained for the same cost
- aluminium is stronger
  - so less easily damaged
- aluminium doors do not need painting
  - so less maintenance required
- both are recyclable
  - so resources are conserved
  - so less goes into landfill
  - so less fossil fuels used
  - so less climate change
- judgement

(b) (the oxide coating) acts as a barrier

*do **not** accept sacrificial protection*

1

(that) prevents air / oxygen / water reaching the aluminium / metal

*do **not** accept references to rusting*

*do **not** accept sacrificial protection*

1

(c) a fixed mass of pigment and a fixed mass of liquid

1

[9]

6. (a) the forward reaction is endothermic

1

(so high temperature) shifts the equilibrium (position) to the right

1

(which) increases the yield (of products)

allow (and a high temperature) increases the rate of reaction

1

(b) (low pressure) shifts the equilibrium (position) to the right

allow converse

1

(because) there are more moles on the right

allow (because) there are more molecules on the right

1

(c) no effect on equilibrium position

1

(d)

$$\text{(volume ~)}\frac{50 \times 100}{80}$$

allow a value in the range 78.0 to 80.0 for percentage of nitrogen

1

~ 62.5 (dm^3)

1

(e) (the reaction mixture is) cooled

1

(so that) ammonia condenses / liquefies

1

(but) nitrogen **and** hydrogen are gases

1

(f) any **three** from:

- nitrogen is an abundant gas (in the air)
- the use of nitrogen releases fewer greenhouse gases
- the nitrogen released replaces that used to make ammonia

  allow nitrogen is renewable
- natural gas is a finite resource
- (the use of hydrogen / methane releases) carbon dioxide which contributes to climate change

  allow (the use of hydrogen / methane releases) carbon dioxide contributes to global warming

3

[14]