

Name: \_\_\_\_\_

## Using Resources part 5 AQA Triple Chemistry

Class: \_\_\_\_\_

Date: \_\_\_\_\_

---

Time: **58 minutes**

Marks: **58 marks**

Comments:

---

1.

Water sold in plastic bottles has a high 'carbon cost'.

The 'carbon cost' depends on the amount of carbon dioxide emitted in making and transporting the product.

The more carbon dioxide emitted, the higher the 'carbon cost'.

(a) Plastic water bottles are made from a polymer.

The polymer is made from ethene.

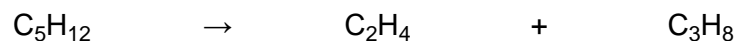
Ethene is made by cracking hydrocarbons.

(i) Name the polymer made from ethene.

---

(1)

(ii) Ethene can be made by cracking the hydrocarbon pentane, C<sub>5</sub>H<sub>12</sub>.



Explain why there is a 'carbon cost' for the process of cracking a hydrocarbon.

---

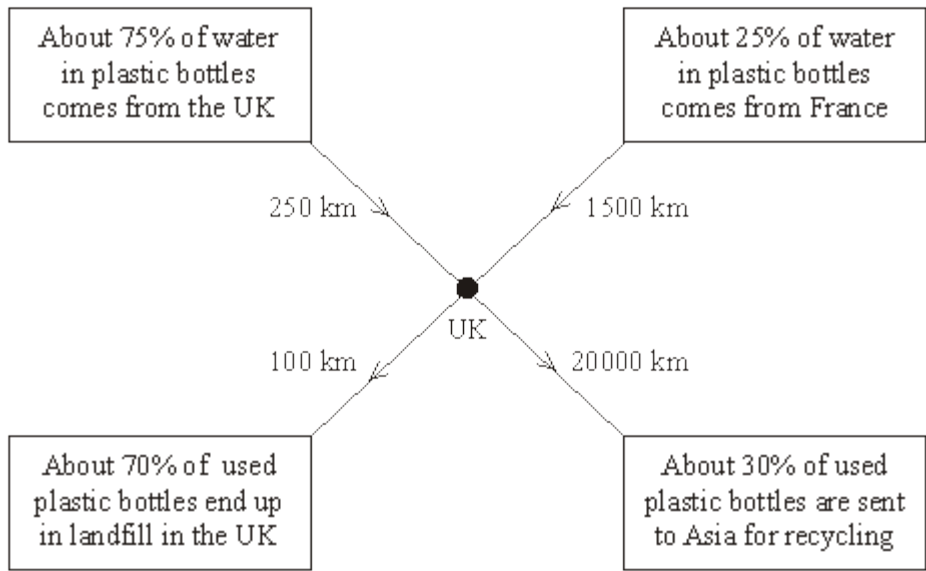
---

---

---

(2)

- (b) The diagram shows information about water sold in plastic bottles in the UK. The diagram also shows the average distances that water and plastic bottles are transported.



Suggest how the high 'carbon cost' of water sold in plastic bottles could be reduced.

---

---

---

---

---

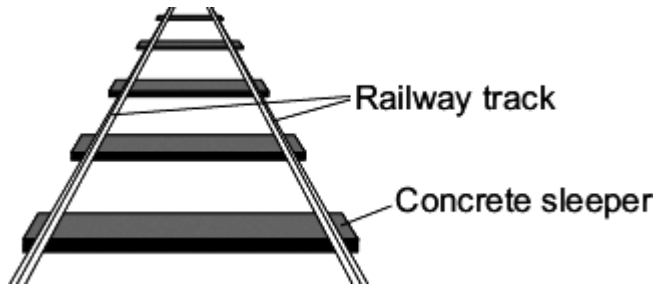
---

---

(3)  
(Total 6 marks)

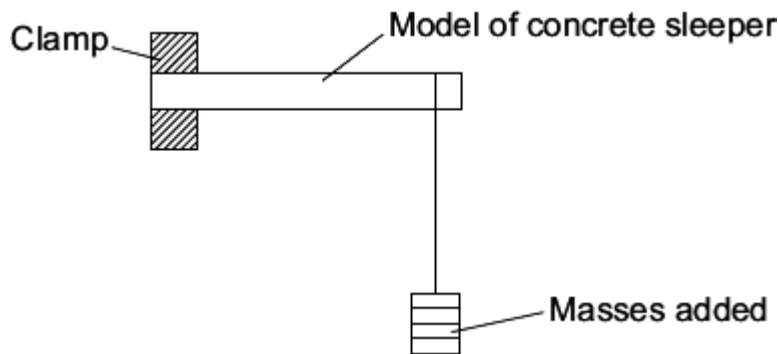
2.

In the UK, railway sleepers were made from wood. They are now often made from concrete.



A scientist was asked to find the best concrete mixture to use so that railway sleepers would not break easily. The scientist made:

- a mould to make small models of concrete sleepers
- concrete mixtures using crushed rock, sand, cement and water
- the equipment shown to add 0.1 kg masses until the model sleeper broke.



The scientist's results are shown in the table.

Concrete mixture in % by volume			Total mass added to break the model sleeper in kg				
Cement	Sand	Crushed rock	Test 1	Test 2	Test 3	Test 4	Mean
10	70	20	1.2	1.1	1.3	1.2	1.2
20	60	20	3.0	2.6	2.5	2.4	
30	50	20	3.5	3.3	3.3	3.3	3.3
40	40	20	3.9	3.8	4.0	3.3	3.9
50	30	20	4.2	4.5	4.2	4.3	4.3

- (a) Calculate the mean total mass added to break the model sleeper that has 20 % cement by volume.

---

---

Mean = \_\_\_\_\_ kg

(2)

(b) State **one** conclusion that the scientist could make from these results.

---

---

---

(1)

(c) The scientist sent the results in a report to a company that makes full-size concrete railway sleepers.

(i) Suggest **two** other factors that the company should take into consideration before deciding which mixture to use to make a full-size concrete railway sleeper.

---

---

---

---

(2)

- (ii) The scientist's report claimed that using concrete sleepers instead of wooden sleepers would have less environmental impact.  
Do you agree with the scientist's claim?  
Use your knowledge and understanding to justify your answer.  
Remember to compare using concrete with using wood for the sleepers.

---

---

---

---

---

---

---

---

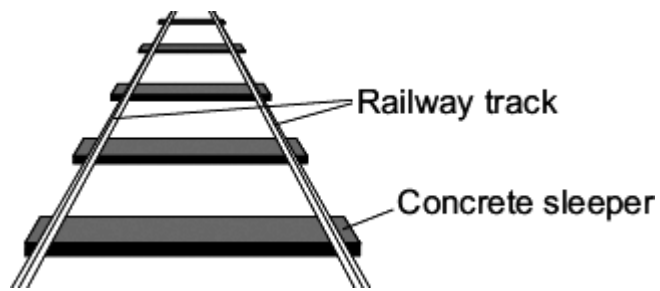
---

---

**(4)**  
**(Total 9 marks)**

3.

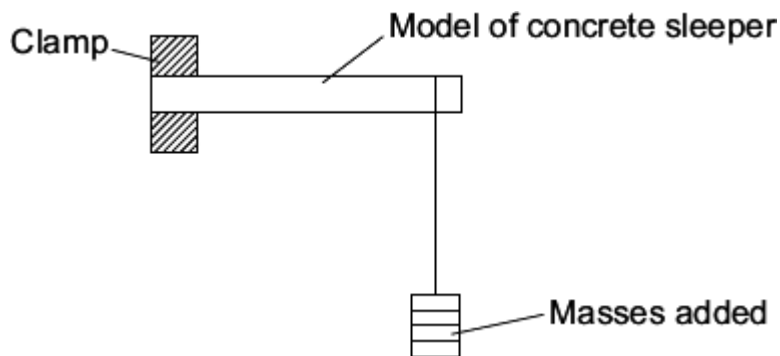
In the UK, railway sleepers are often made from concrete.



A scientist was asked to find the best concrete mixture to use so that railway sleepers would not break easily.

The scientist made:

- a mould to make small models of concrete sleepers
- concrete mixtures using crushed rock, sand, cement and water
- the equipment shown to add 0.1 kg masses until the model sleeper broke.



The scientist's results are shown in the table.

Concrete mixture in % by volume			Total mass added to break the model sleeper in kg			
Cement	Sand	Crushed rock	Test 1	Test 2	Test 3	Mean
10	70	20	1.1	1.3	1.2	1.2
20	60	20	2.6	2.5	2.4	
30	50	20	3.3	3.3	3.3	3.3
40	40	20	3.8	4.0	3.3	3.9
50	30	20	4.5	4.2	4.3	4.3

(a) (i) Calculate the mean total mass added to break the model sleeper that has 20%

cement by volume.

---

Mean = \_\_\_\_\_ kg

(1)

- (ii) Choose **one** result in the table that the scientist should check and test again.

Result: % cement by volume \_\_\_\_\_ Test number \_\_\_\_\_

Explain why you chose this result.

---

---

(2)

- (iii) What is the relationship between the total mass to break the model sleeper and the percentage (%) of cement by volume in the concrete mixture?

---

---

(1)

- (iv) Suggest **one** other variable that the scientist should have recorded in the table of results.

---

(1)

- (b) The scientist thought that full-size railway sleepers should be made from 30% cement, 50% sand and 20% crushed rock.

What other information about these three materials is needed before the scientist recommends using this mixture to make a full-size railway sleeper?

---

---

---

---

(2)

(Total 7 marks)

4.

Cans for food and drinks are made from steel or aluminium.  
The main metal in steel is iron.



By Sun Ladder (Own work) [CC-BY-SA-3.0 or GFDL],  
via Wikimedia Commons

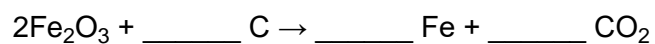
(a) Iron is extracted by heating a mixture of iron oxide and carbon in a blast furnace.

(i) Name this type of reaction.

\_\_\_\_\_

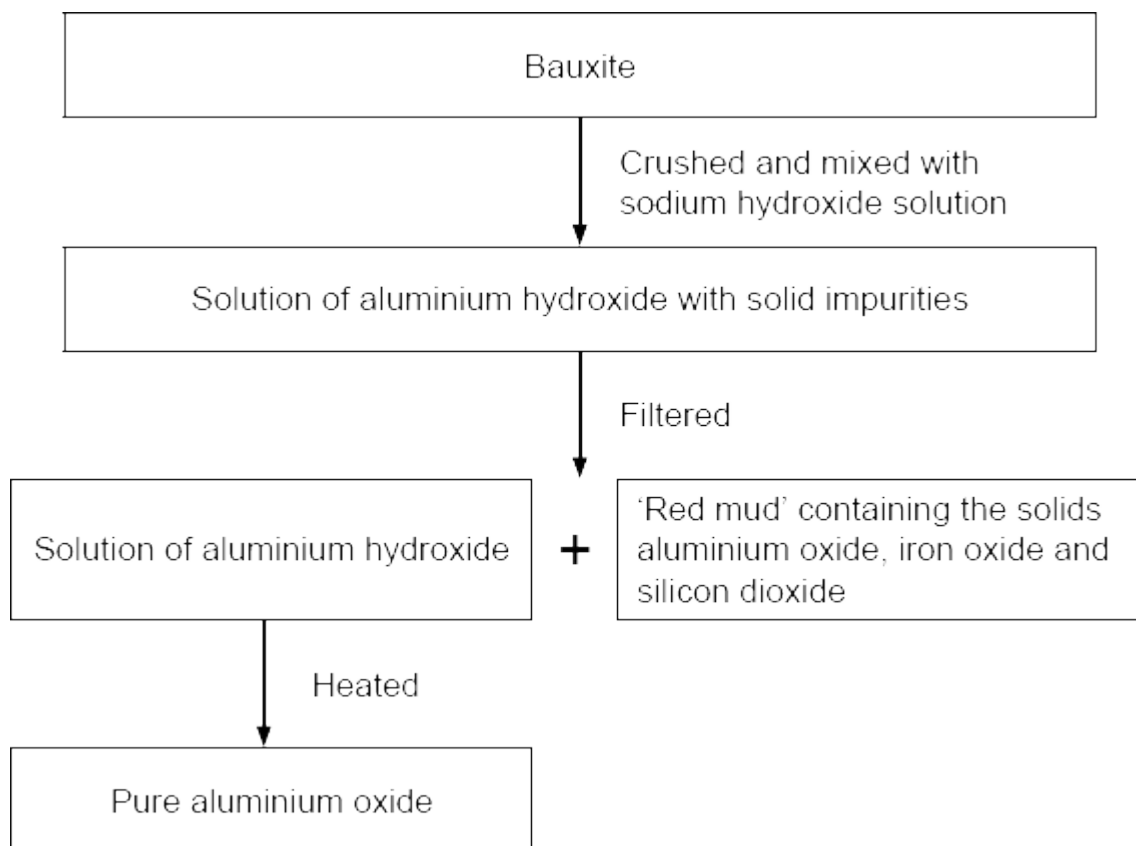
(1)

(ii) Balance the symbol equation for this reaction.



(1)

- (b) Aluminium ore, bauxite, contains aluminium oxide, iron oxide and silicon dioxide. Aluminium is extracted by electrolysis of aluminium oxide.



The 'red mud' which is dumped in very large ponds contains:

Name of solid	Percentage (%)
Aluminium oxide	10
Iron oxide	65
Silicon dioxide	25

- (i) 100 tonnes of bauxite produced 50 tonnes of pure aluminium oxide and 50 tonnes of 'red mud'.

What percentage of aluminium oxide did the bauxite contain?

\_\_\_\_\_

Answer = \_\_\_\_\_ %

(1)

- (ii) Apart from the solids shown in the table, name **one** other substance that would be in the 'red mud'.

\_\_\_\_\_

(1)

(iii) The purification of the aluminium oxide is usually done near to the bauxite quarries.

Suggest **one** reason why.

\_\_\_\_\_

(1)

(c) Aluminium is used to make many things including cans.

During one year in the USA:

- 100 billion aluminium cans were sold
- 55 billion aluminium cans were recycled.

Give **one** environmental impact of recycling aluminium cans and **one** ethical or social impact of recycling aluminium cans.

Environmental \_\_\_\_\_

\_\_\_\_\_

Ethical or social \_\_\_\_\_

\_\_\_\_\_

(2)

(Total 7 marks)

5.

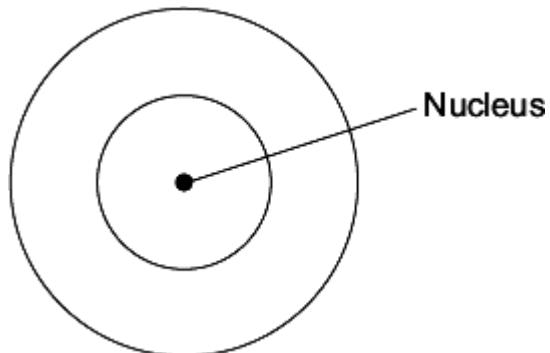
The picture shows a diamond ring.



Photograph supplied by Comstock/Thinkstock

(a) Diamond is a form of carbon. A carbon atom has six electrons.

Draw the electronic structure of a carbon atom.



(1)

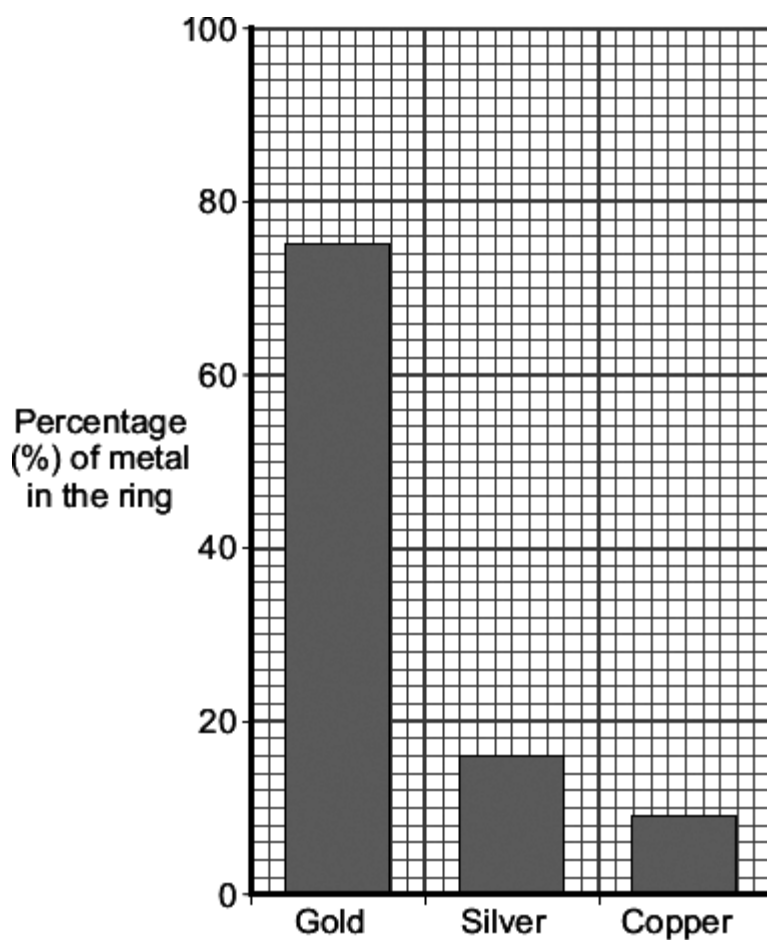
(b) A gold atom has an atomic number of 79 and a mass number of 197.

Complete the table to show the name and number of each sub-atomic particle in this gold atom.

Name	Number
Proton	79
Electron	_____
_____	_____

(3)

(c) The bar chart shows the composition of this gold ring.



(i) Give the percentage of the other two metals in this gold ring.

Silver is \_\_\_\_\_ % and copper is \_\_\_\_\_ %

(1)

(ii) This gold ring is not made from 100% gold.

Give **two** reasons why.

1. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

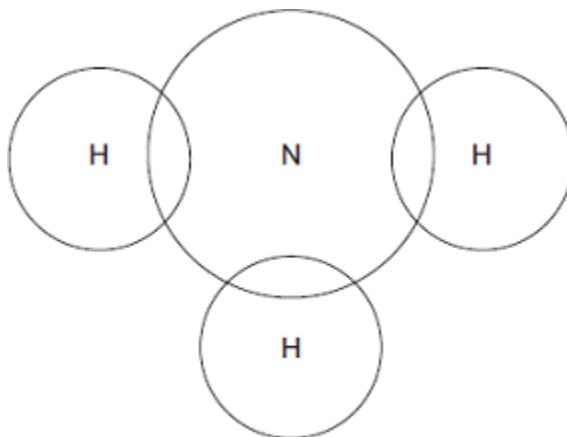
(2)

(Total 7 marks)

6.

(a) Complete the dot and cross diagram to show the electrons in the outer energy levels of ammonia ( $\text{NH}_3$ ).

You may use the periodic table to help you.



(2)

(b) Ammonia can be used to make ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ).

(i) Draw a ring around the correct answer to complete the sentence.

Ammonium nitrate can be made by reacting ammonia with

ethanoic  
hydrochloric  
nitric

acid.

(1)

(ii) State **one** use of ammonium nitrate.

\_\_\_\_\_

(1)

(iii) Calculate the relative formula mass ( $M_r$ ) of ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ).

Relative atomic masses: H = 1; N = 14; O = 16.

---

---

Relative formula mass ( $M_r$ ) = \_\_\_\_\_

**(2)**

(iv) Calculate the percentage by mass of nitrogen in ammonium nitrate.

---

---

---

---

Percentage by mass of nitrogen = \_\_\_\_\_ %

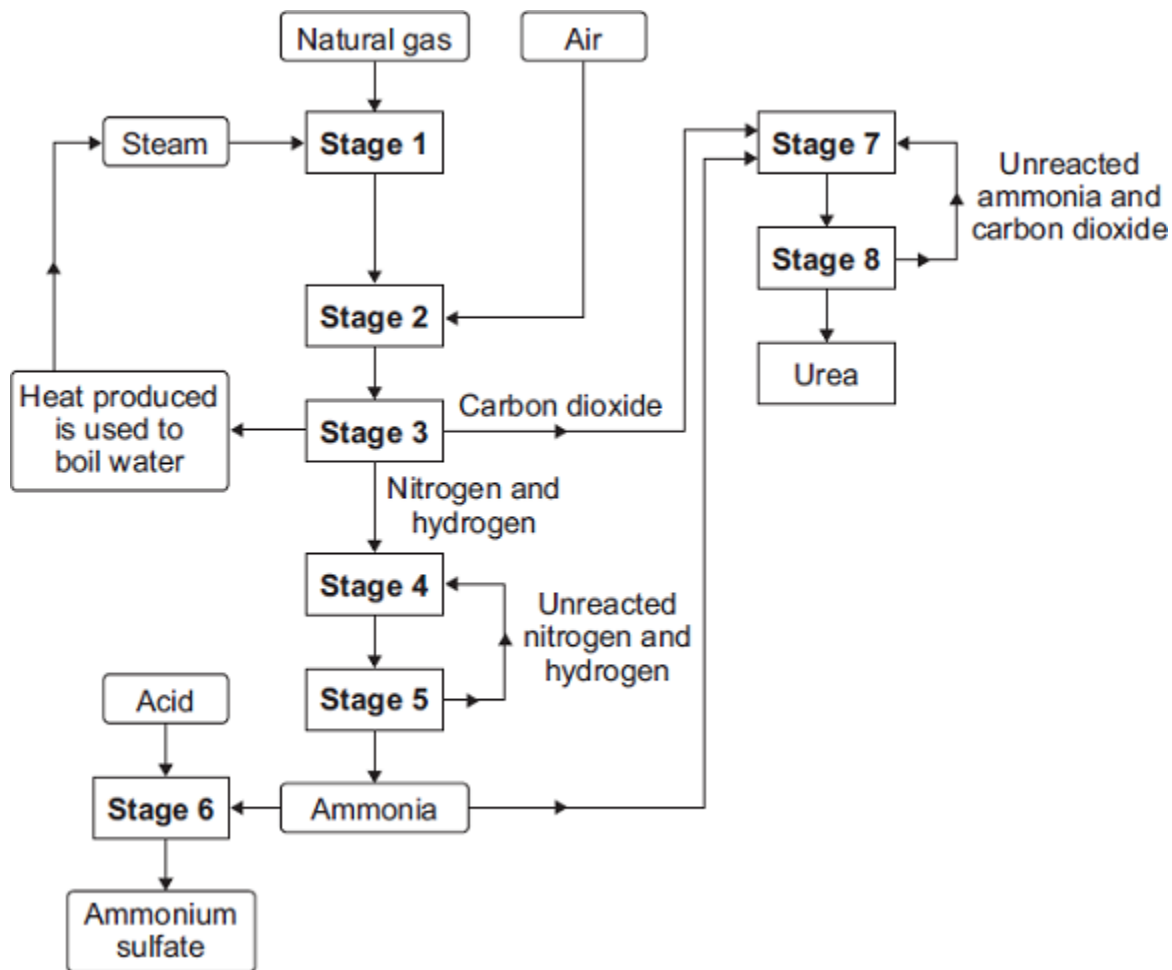
**(2)**



7.

Ammonium sulfate and urea are made from ammonia. These compounds are used by farmers.

The flow diagram shows the stages to make ammonium sulfate and urea.



(a) Give **two** examples from the flow diagram of the efficient use of energy and raw materials.

---

---

---

---

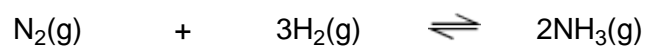
---

---

---

(2)

(b) The equation for the reaction in Stage 4 is shown below.



The forward reaction is exothermic.

State **and** explain:

(i) how a **decrease** in temperature would affect the yield of ammonia at equilibrium

---

---

---

---

---

---

(2)

(ii) how an **increase** in pressure would affect the yield of ammonia at equilibrium.

---

---

---

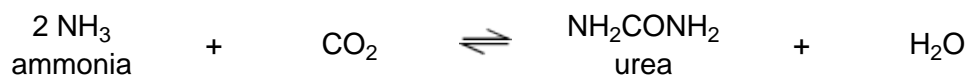
---

---

---

(2)

(c) The equation for the reaction in Stage 7 is shown below.



The table gives the relative formula masses ( $M_r$ ) of the reactants and the products for this reaction.

Formula of reactant or product	Relative formula masses ( $M_r$ )
NH <sub>3</sub>	17
CO <sub>2</sub>	44
NH <sub>2</sub> CONH <sub>2</sub>	60
H <sub>2</sub> O	18

Percentage atom economy can be calculated using:

$$\text{Percentage atom economy} = \frac{M_r \text{ of useful product}}{\text{total } M_r \text{ of all reactants added together}} \times 100\%$$

Calculate the percentage atom economy for the reaction in Stage 7.

---

---

---

---

---

---

---

Percentage atom economy = \_\_\_\_\_ %

(2)

(Total 8 marks)

## Mark schemes

- 1.** (a) (i) polyethene / poly(ethene)  
*accept polythene / polyethylene* 1
- (ii) needs heat / energy / high temperature / fuel (for cracking)  
*ignore other processes* 1
- produces carbon dioxide / CO<sub>2</sub>  
*ignore use of CO<sub>2</sub> or 'produces carbon'* 1
- (b) any **three** from:
- use water from local sources **or** water from close to home
  - recycle bottles in the UK / close to home  
*accept do not recycle in other countries / Asia*
  - (reduction in distance travelled) would reduce CO<sub>2</sub> emitted by transport  
*accept use of transport with low / no carbon dioxide emissions*
  - use tap water
  - use glass bottles / waxed cartons / metal bottles  
*do **not** accept 'do not use plastic bottles' without an alternative material*
  - do not put in landfill **or** recycle more
  - reuse / refill plastic bottles
  - tax imported water / plastic bottles (to offset carbon cost)
  - make more / all plastic bottles in UK  
*answers must be about the reduction of carbon cost* 3
- [6]
- 2.** (a) 2.5  
*correct answer with or without working gains 2 marks*  
*if answer incorrect*  
*2.6 / 2.625 / 2.62 / 2.63*  
*or recognise 3.0 as anomalous gains 1 mark*  
*accept answer in table*  
*ignore units* 2

- (b) as the percentage of cement increases the mass needed to break the sleeper increases

*allow 50% cement is the strongest **or** 30% sand is the strongest **or** the highest amount of cement is the strongest*

**or**

as the percentage of sand increases the mass needed to break the sleeper decreases

1

- (c) (i) any **two** from:

- availability of materials
- cost (of materials)
- time needed (for the concrete mixture) to set/harden
- compression strength (of the concrete)  
*accept weight of the train*
- testing full size (concrete railway sleepers)  
*accept any test on full size sleepers*  
*accept 'how well it would last / weather'*

2

(ii) any **four** from:

*maximum of 3 marks if no comparison made*

*ignore yes or no*

negative concrete:

*allow converse statements for wood*

- more fossil fuel / energy / heat (needed to produce cement / concrete)
- cement / concrete resources / limestone not renewable whereas wood is renewable
- quarrying limestone destroys landscapes / habitats whereas growing wood improves landscapes / habitats  
*allow quarrying causes noise pollution / dust / etc.*

- making cement / concrete releases carbon dioxide / greenhouse gases whereas growing wood absorbs carbon dioxide / greenhouse gases / is carbon neutral

*allow making cement / concrete*

*causes global warming / climate*

*change whereas growing wood*

*reduces global warming / climate change*

*ignore loss of trees / deforestation (and resultant effects such as an increase in CO<sub>2</sub>)*

positive concrete:

- (less resources are needed because) cement / concrete sleepers last longer **or** wood rots / needs replacing  
*ignore strength / ease of breaking*  
*ignore weathering / effects of acid rain*

4

[9]

3.

(a) (i) 2.5(kg)

*ignore units*

1

(ii) 40% (cement) **and** Test 3

*ignore units*

1

because it is anomalous or because it is much lower than the other two readings

*accept value not used to calculate mean*

*ignore outlier*

1

(iii) as the percentage of cement increases the mass needed to break the sleeper increases

*allow 'strength' for 'mass needed'*

*allow correct relationship using percentage of sand*

1

(iv) volume/percentage / amount of water

*accept temperature*

1

(b) any **two** from:

- availability (of the raw materials)
- cost of the raw materials
- purity (of the raw materials)

2

[7]

4.

(a) (i) reduction

*accept redox / smelting*

1

(ii) 3 4 3

1

(b) (i) 55

*ignore other units*

(ii) Water

*accept sodium hydroxide*

*accept correct formulae  $H_2O$  or  $NaOH$*

1

(iii) any **one** from:

- save energy / fuel for transporting the ore  
*accept less (cost of) transport allow transported quickly*
- (old) quarries nearby for waste/red mud

1

(c) **Environmental**

any **one** from:

- less mining / quarrying (of bauxite)  
*allow loss of habitat / less qualified noise pollution*
- less landfill space needed / used  
*allow less red mud / waste*
- less use of fossil fuels / energy
- less carbon dioxide produced

1

**Ethical or social**

any **one** from:

- saves resources  
*allow using resources more than once*
- creates (local) employment  
*if answers reversed and both correct award 1 mark*
- more people aware of the need for recycling  
*allow less qualified noise pollution if not given in environmental*

1

[7]

5.

(a) 2,4

*allow electrons in any position on correct shells*

1

(b) (electron) 79

1

neutron

*allow phonetic spelling*

1

118

1

(c) (i) 16 and 9

*in this order*

1

(ii) any **two** from:  
*ignore reasons about colour / lustre / corrosion / rarity*

- (100% / pure) gold is soft  
*allow layers can slide in pure gold*
- (alloyed) to make the metal hard(er)  
*ignore just 'the ring is an alloy'*  
*allow (alloyed) to stop the layers sliding*  
*allow (alloyed) to make the metal strong*
- gold is expensive **or** alloy is less expensive

2

[7]

6.

(a) three bonding pairs

*do **not** allow non-bonding electrons in hydrogen*  
*ignore any inner shells on nitrogen*

1

two non-bonding electrons

*allow either dots and crosses or combination of both*

1

(b) (i) nitric

1

(ii) fertilisers / explosives

*ignore other uses*

1

(iii) 80

*correct answer with or without working gains 2 marks*  
*if answer incorrect, allow  $14 + (1 \times 4) + 14 + (16 \times 3)$  for 1 mark*

2

(iv) 35

*allow ecf from **(b)(iii)***  
*allow ecf for 1 mark for correct working but incorrect answer.*  
*if answer incorrect, allow  $28 / 80 \times 100$  for 1 mark*  
*if answer is 17.5 % allow 1 mark*

2

- (c) Marks awarded for this answer will be determined by the Quality of Communication (QoC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.

**0 marks**

No relevant content

**Level 1 (1 – 2 marks)**

There are statements about the conditions used. There is no correct explanation of the link between rate or yield and the conditions.

**Level 2 (3 – 4 marks)**

There is a correct explanation of the conditions used that links the conditions to rate or yield

**Level 3 (5 – 6 marks)**

There is an explanation covering at least temperature and pressure, which shows understanding of the compromise between rate **and** yield

**examples of chemistry points made in the response:**

**200 atmospheres pressure**

- high pressure gives a high yield of ammonia
- too high a pressure causes risk of explosion
- high pressure costly to maintain
- a high pressure will cause the rate to be higher
- 4 moles of gas become 2 (or fewer moles of gas in products)

**450 °C**

- high temperature increases the rate of reaction
- optimum temperature
- (forward reaction is exothermic so) a high yield of ammonia requires a low temperature
- but too low a temperature causes the rate of reaction to be too slow

**iron catalyst**

- a catalyst speeds up the reaction
- an iron catalyst allows a lower temperature to be used (saving energy and causing a higher yield)
- iron catalyst increases the rate of reaction equally in both reactions

**others**

- compromise conditions
- unreacted nitrogen and hydrogen is recycled

6

[14]

7.

(a) any **two** from:

- heat water / make steam / boil water **or** heat / steam used in stage 1 or from stage 3
- carbon dioxide from stage 3 used in stage 7 /to make urea
- nitrogen and / or hydrogen recycled
- ammonia and / or carbon dioxide recycled  
*allow unreacted material / gas recycled from stage 5 (to 4)*  
*allow unreacted material / gas recycled from stage 8 (to 7)*  
*NB: if neither of the last two points are awarded unreacted material recycled = 1 mark*

2

(b) (i) increase yield

because (forward) reaction is exothermic

*ignore references to rate*

1

*allow because (forward) reaction gives out heat*

1

(ii) increase yield

*ignore references to rate*

1

because more (gaseous) reactant molecules than (gaseous) product molecules

*accept because greater volume on the left than the right*

1

(c) 76.9 - 77

*correct answer gains 2 marks with or without working*

*allow 77 **or** 76.923...*

*allow 76 **or** 0.77 **or** 0.76923 for 1 mark*

*if answer incorrect allow 1 mark for **either***

$$\frac{60}{\text{attempt at total } M_r \text{ of all reactants}} \times 100$$

**or**

$$\frac{\text{attempt at total } M_r \text{ of area}}{78} \times 100$$

2

[10]