Paper 2 Chemistry

6 Mark Questions

(Higher Triple)

N.B: The level of each question has been given to show you the difficulty. The level 3 questions will require you to think outside the box and use your knowledge in possibly unseen circumstances. Generally speaking, level 2 questions make up the first half of the paper and level 3 questions make up the second half of the paper.

Index:

C8 Rates of Reaction

Q1. Lv3

Sodium thiosulfate solution reacts with dilute hydrochloric acid.

The solution becomes cloudy as the reaction takes place.

The equation for the reaction is:

$$Na_2S_2O_3(aq) + 2\,HCl(aq) \longrightarrow 2\,NaCl(aq) + SO_2(g) + H_2O(l) + S(s)$$

Plan an investigation to show how the concentration of the sodium thiosulfate solution affects the rate of the reaction with dilute hydrochloric acid.

Your plan should give valid results. **(6)**

Top tips for planning:

- *Write bullet points like you would a method – made up of key points from the practical*
- *What key things happen in the practical which will affect the outcome of the experiment e.g. does it matter if you don't correctly measure out the volume of acid?*
- *Write in a logical order e.g. you can't record the time taken BEFORE you have added the two chemicals together*
- *What measurements will you take during the setup and as the experiment proceeds? (mention the variables)*

Sample Student Answer

MEASURE OUT 20CM^3 OF SODIUM THIOSULPHATE AND ADD IT TO A CONICAL FLASK. PLACE THE CONICAL FLASK ABOVE A PIECE OF WHITE PAPER WITH A BLACK CROSS ONN IT. MEASURE OUT 20CM^3 OF HYDROCHLORIC ACID. ADD THE ACID TO THE CONICAL FLASK WHILST STARTING THE STOPCLOCK. STOP THE STOPCLOCK WHEN THE BLACK CROSS IS NO LONGER VISIBLE. REPEAT THIS AGAIN TO GET AN AVERAGE OF YOUR RESULTS. THEN REPEAT THE EXPERIMENT AGAIN USING DIFFERENT CONCENRATIONS OF SODIUM THIOSULPHATE.

Q2. Lv3

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Ethanol can also be made by reacting ethene with steam in the presence of a catalyst.

$$C_2H_4(g) + H_2O(g) \rightleftharpoons C_2H_5OH(g)$$

Figure 1 shows how the percentage yield of ethanol changes as the pressure is changed at three different temperatures.

Figure 1

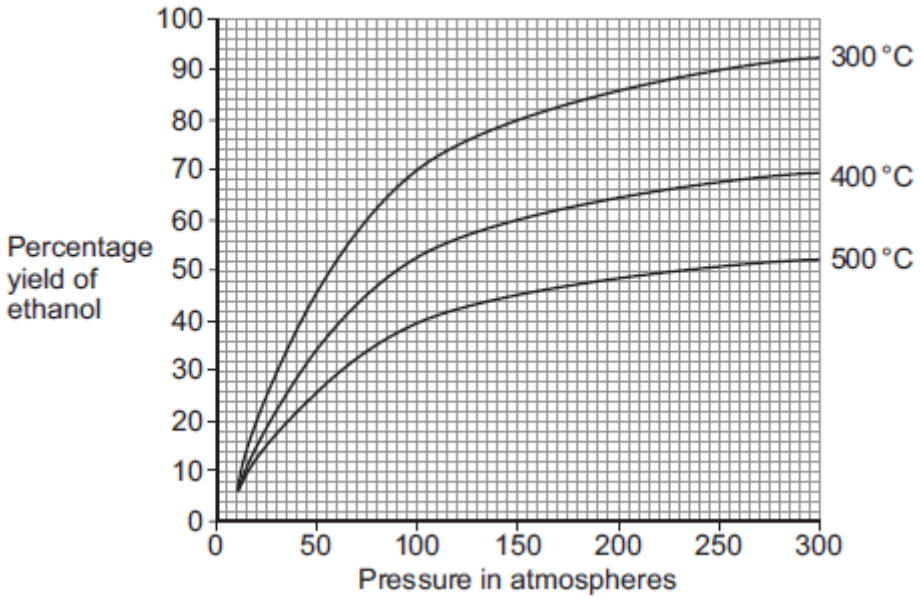
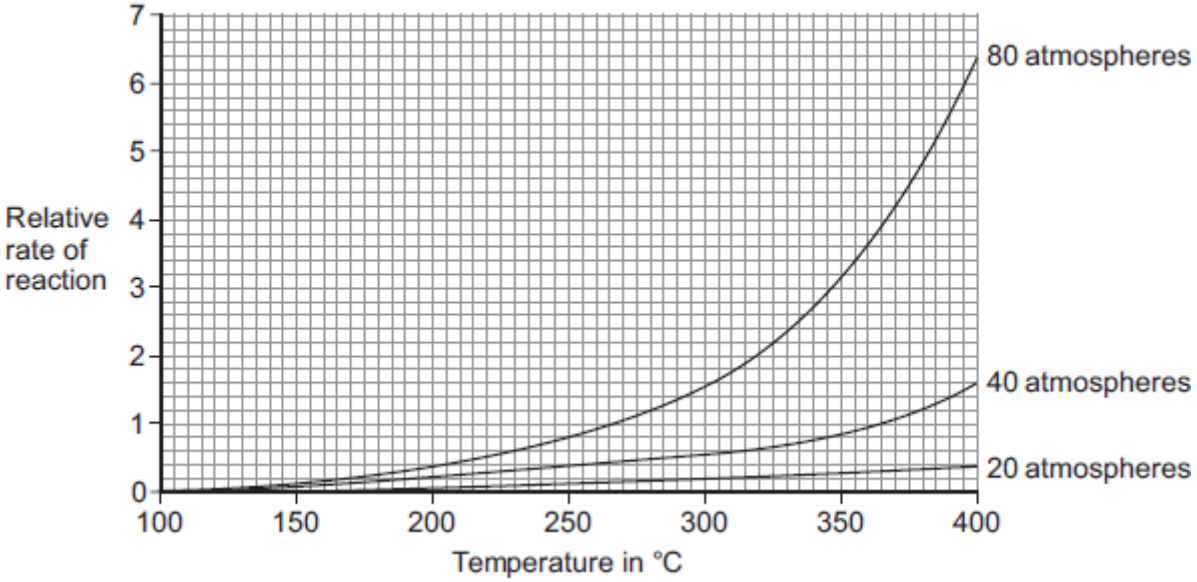


Figure 2 shows how the rate of reaction changes as the temperature changes at three different pressures.

Figure 2



In one process for the reaction of ethene with steam the conditions are:

- 300 °C
- 65 atmospheres
- a catalyst.

Use the information in **Figure 1** and **Figure 2**, and your own knowledge, to justify this choice of conditions.

(6)

Top tips for planning:

There are 6 marks available and 3 conditions for you to consider. A sensible approach would be to comment on each of the 3 conditions with 2 different remarks e.g. how will adding a catalyst help the reaction? What do they do to the reaction speed? How will a catalyst affect the costs involved in this reaction? Ask similar questions for the other conditions.

Sample Student Answer

THE HIGHEST YIELD IS ACHIEVED AT THE LOWER TEMPERATURE OF 300 DEGREES CELCIUS, ALTHOUGH THIS WILL ALSO GIVE THE SLOWEST REACTION TIME. YIELD AND RATE OF REACTION INCREASE AS THE PRESSURE INCREASES, HOWEVER THIS WOULD COST MORE TO ACHIEVE AND COULD INCLUDE SAFETY RISKS. 65 ATMOSPHERES IS A COMPROMISE BECAUSE OF THIS. USING A CATALYST WILL INCREASE THE RATE OF REACTION ENABLING A LOWER TEMPERATURE TO BE USED AND THEREFORE INCREASE THE YIELD AND REDUCE ENERGY COSTS.

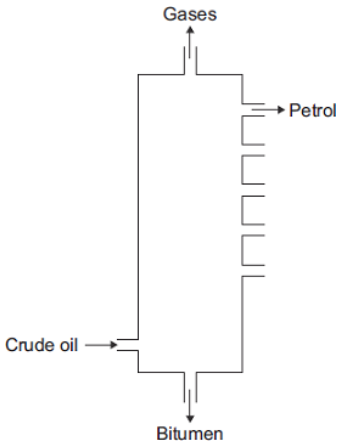
C9-12 Hydrocarbons

Q3. Lv2

Crude oil is a mixture of many different chemical compounds.

Most of the compounds in crude oil are hydrocarbons.

Hydrocarbons with the smallest molecules are very volatile.



In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Describe and explain how **petrol** is separated from the mixture of hydrocarbons in crude oil.

Use the diagram and your knowledge to answer this question.

(6)

Top tips for planning:

Describe (recall process of events)

Explain (give reasons for something happening)

You will need to describe the scientific process of how crude oil is separated in to fractions and explain why the larger fractions are at the bottom of the fractionating column and the smaller fractions are at the top. This links to the carbon chain length and their associative boiling points. Then think about where petrol sits in terms of these properties.

Sample Student Answer

CRUDE OIL IS SEPARATED BY THE PROCESS OF FRACTIONAL DISTILLATION WHICH INVOLVES HEATING AT AROUND 350 DEGREES CELCIUS. THE SMALLER CHAIN MOLECULES WILL VAPORISE AND RISE TO THE TOP OF THE FRACTIONATING COLUMN WHERE MOST OF THEM THEN CONDENSE AS THEY COOL, SOME WILL REMAIN AS GASES. THOSE WITH LONGER CHAINS AND HIGHER BOILING POINTS MAY REMAIN AS LIQUIDS AND BE COLLECTED AT THE BOTTOM OF THE COLUMN. PETROL HAS A RELATIVELY LOW BOILING POINT AND WILL THEREFORE BE FRACTIONATED TOWARDS THE TOP OF THE COLUMN.

Q4. Lv3

Ethanol (C_2H_5OH) is produced from ethene or from sugar cane.

The two different methods to produce ethanol are summarised in the table.

Ethanol from sugar cane is a batch process	Ethanol from crude oil is a continuous process
Sugar cane plants are crushed and soaked in water for one day.	Crude oil is distilled to separate the naphtha fraction.
The sugar solution is separated by filtration.	The naphtha fraction is cracked when the vaporised hydrocarbons are passed over a hot catalyst.
Yeast is added to the sugar solution and fermented for three days.	The ethene produced is separated by distillation.
The solution of water and ethanol produced is separated by filtration.	Ethene is reacted with steam in the presence of a catalyst.
Distillation of this solution produces a 50% solution of ethanol.	This hydration reaction produces 100% ethanol.

Evaluate the issues involved with the production of ethanol from sugar cane compared with the production of ethanol from crude oil.
You should explain why each issue you describe is important.

(5)

Top tips for planning:

Evaluate - Students should use the information supplied, as well as their knowledge and understanding, to consider evidence for and against when making a judgement.

Explain – State reasons for something happening

This question is worth 5 marks, imagine that an advantage and disadvantage for each would be worth one mark and then compare these to decide which you think would be best for the final mark.

Sample Student Answer

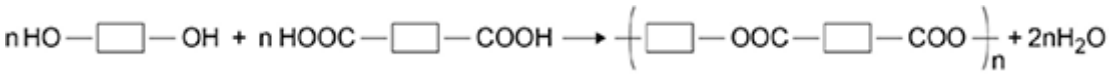
SUGAR CANE IS A RENEWABLE RESOURCE AND ABSORBS CARBON DIOXIDE WHILST GROWING, MAKING IT CARBON NEUTRAL, WHERE AS CRUDE OIL IS NON-RENEWABLE. SUGAR CANE NEEDS A LARGE AMOUNT OF LAND TO GROW THE CROPS AND TAKES TIME TO GROW, IT ALSO HAS A LOWER YIELD THAN THE PRODUCTION FROM CRUDE OIL, WHERE AS CRUDE OIL USES FUEL FOR THE FRACTIONAL DISTILLATION PROCESS AND THEREFORE USES MORE ENERGY. SUGAR CANE WOULD BE MY CHOSEN OPTION OF PRODUCING ETHANOL BECAUSE IT USES LESS ENERGY AND IS CARBON NEUTRAL HELPING REDUCE GLOBAL WARMING WHICH IS A CURRENT CONCERN.

Q5. Lv3

Ethene is used to produce poly(ethene).

Polyesters are made by a different method of polymerisation.

The equation for the reaction to produce a polyester can be represented as:



Compare the polymerisation reaction used to produce poly(ethene) with the polymerisation reaction used to produce a polyester.

(4)

Top tips for planning:

Compare (describe the similarities and/or differences between things, not just write about one)

Before you can attempt to answer this question, you need to be able to identify that this question is asking you to compare the two different methods of polymerisation that are in the specification. Then use this information to discuss the differences/similarities.

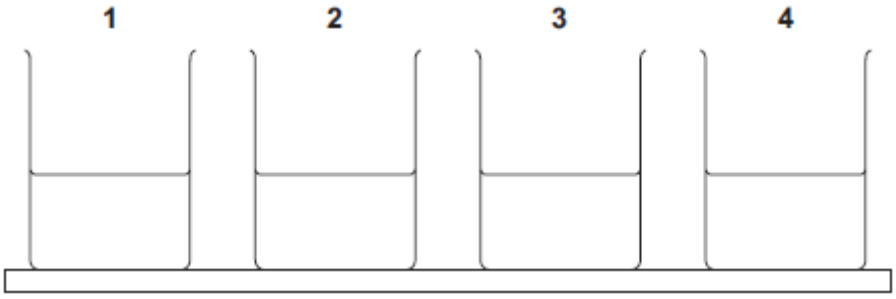
Sample Student Answer

POLY(ETHENE) IS PRODUCED BY ADDITION POLYMERISATION WHEREAS POLYESTER IS PRODUCED BY CONDENSATION POLYMERISATION. THIS MEANS THAT POLY(ETHENE) IS MADE FROM ONE MONOMER (ETHENE) AND A POLYESTER COMES TWO MONOMERS, A DIOL AND A DICARBOXYLIC ACID. POLY(ETHENE) IS THE ONLY PRODUCT IN ADDITION POLYMERISATION, WHEREAS IN THE CONDENSATION POLYMERISATION, WATER IS ALSO PRODUCED.

Q6. Lv3

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

A group of students had four different colourless solutions in beakers **1, 2, 3** and **4**, shown in the figure below.



The students knew that the solutions were

- sodium chloride
- sodium iodide
- sodium carbonate
- potassium carbonate

but did **not** know which solution was in each beaker.

The teacher asked the class to plan a method that could be used to identify each solution.

She gave the students the following reagents to use:

- dilute nitric acid
- silver nitrate solution.

The teacher suggested using a flame test to identify the positive ions.

Outline a method the students could use to identify the four solutions.

You should include the results of the tests you describe. **(6 marks)**

Top tips for planning:

- *Write bullet points like you would a method – detail each test you would use and which chemicals you need for each chemical test*
- *Describe what you would expect to see for each of the tests e.g. how will you know it is an iodide ion and not a chloride ion? What will you see if there is a carbonate ion present? What colour will a sodium and potassium ion be in a flame test?*

TO IDENTIFY THE METAL ION PRESENT, SOAK A SPILL IN THE SOLUTION AND HOLD IN A BUNSEN FLAME. IF THE POTASSIUM ION IS PRESENT A LILAC FLAME WILL BE PRODUCED, IF A SODIUM ION IS PRESENT AN ORANGE FLAME WILL BE PRODUCED.

TO TEST FOR THE CARBONATE ION, ADD DILUTE NITRIC ACID TO A SAMPLE OF ALL FOUR OF THE SOLUTIONS. THOSE SOLUTIONS WITH CARBONATE IONS IN THEM WILL EFFERVESCE (BUBBLE).

TO IDENTIFY THE HALOGEN ION PRESENT IN THE OTHER TWO SOLUTIONS, ADD DILUTE NITRIC ACID FOLLOWED BY SILVER NITRATE TO EACH. THE CHLORIDE ION WILL PRODUCE A WHITE PRECIPITATE WHEREAS THE IODIDE ION WILL PRODUCE A YELLOW PRECIPITATE.

C13 The Earth's Atmosphere

Q7. Lv2

The Earth's early atmosphere was different to Earth's atmosphere today.

Scientists think that the Earth's early atmosphere was like the atmosphere found on Venus today.

The table below shows the amounts of carbon dioxide and oxygen in the atmospheres of Venus and Earth today.

Gas	Percentage (%) in Venus' atmosphere today	Percentage (%) in Earth's atmosphere today
Carbon dioxide	96.50	0.04
Oxygen	0.00	20.95

The percentages of carbon dioxide and oxygen have changed from Earth's early atmosphere to Earth's atmosphere today.

Explain the processes that led to these changes.

(6)

Top tips for planning:

Explain (give reasons for something happening)

You could firstly mention the main changes from the table above in terms of whether the percentage of carbon dioxide and oxygen has increased or decreased. Then follow with an explanation of why these changes happened e.g. how would the Earth's temperature cooling affect the amount of CO_2 in the atmosphere?

Sample Student Answer

THE PERCENTAGE OF CARBON DIOXIDE IN THE ATMOSPHERE HAS GREATLY DECREASED, WHEREAS THE PERCENTAGE OF OXYGEN HAS INCREASED.

THE EARTH'S EARLY ATMOSPHERE WAS THOUGHT TO BE MOSTLY DERIVED FROM VOLCANOES WHICH RELEASED WATER VAPOUR. WHEN THE EARTH COOLED, THIS WATER VAPOUR CONDENSED TO FORM OCEANS. CARBON DIOXIDE DISSOLVED INTO THE OCEANS PRODUCING CARBONATES WHICH OVER TIME BECAME LOCKED UP IN SEDIMENTARY ROCKS.

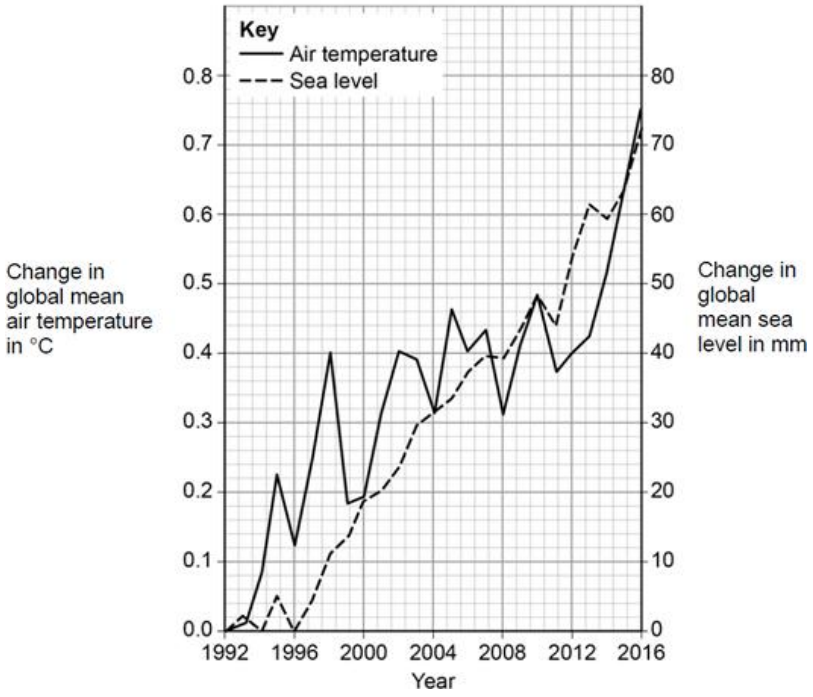
AS PLANT LIFE EVOLVED, THEY ABSORBED CARBON DIOXIDE FROM THE ATMOSPHERE THROUGH PHOTOSYNTHESIS AND RELEASED OXYGEN, HENCE WHY THE LEVELS HAVE INCREASED.

Q8. Lv3

This question is about climate change.

Figure 1 shows the changes in the global mean air temperature and global mean sea level from 1992 to 2016.

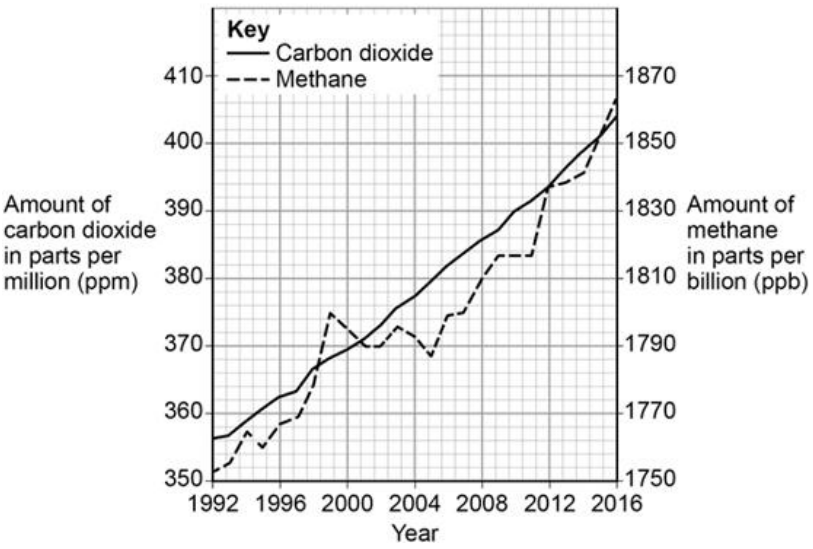
Figure 1



Most scientists think carbon dioxide and methane are a cause of global climate change.

Figure 2 shows the amounts of these gases in the atmosphere from 1992 to 2016.

Figure 2



(b) Describe the changes in **Figure 1** and in **Figure 2**.

Explain how these changes have taken place.

(6)

Top tips for planning:

Describe - recall process of events

Explain - give reasons for something happening

Comment on the trends you can see from each of the figures given, then link these changes to your understanding of climate change and its impact on the planet.

Sample Student Answer

FIGURE 1 SHOWS THAT GLOBAL MEAN AIR TEMPERATURE HAS RISEN OVERALL AND MEAN SEA LEVELS HAVE RISEN STEADILY. FIGURE 2 SHOWS THAT CARBON DIOXIDE HAS RISEN STEADILY AND METHANE HAS RISEN OVERALL.

THE INCREASE IN CARBON DIOXIDE LEVELS IS DUE TO THE INCREASE IN FUEL COMBUSTION AND DEFORESTATION AS THE HUMAN POPULATION LEVELS RISE. CARBON DIOXIDE IS A GREENHOUSE GAS WHICH TRAPS HEAT FROM THE SUN, WHICH IN TURN HAS LED TO THE RISE IN GLOBAL MEAN AIR TEMPERATURE. THIS RISE IN TURN HAS CAUSED ICE CAPS TO MELT WHICH HAS EXPANDS THE VOLUME OF SEA WATER, MAKING THE SEA LEVELS RISE.

C14 The Earth's Resources

Q9. Lv3

Disposable cups are made from coated paper or poly(styrene).

The table below shows information on the life cycle assessments (LCAs) of disposable cups.

	Coated paper cups	**Poly(styrene) cups**
Raw materials	Wood	Crude oil
Mass of 1 cup in g	8.3	1.9
Energy to produce 1 cup in kJ	550	200
Energy released when 1 cup is burned in kJ	166	76
Biodegradable	Yes	No
Recyclable	No	Yes

(a) Evaluate the use of coated paper compared with poly(styrene) to make disposable cups.

Use the table above and your knowledge and understanding of LCAs.

(6)

Top tips for planning:

Evaluate - Students should use the information supplied, as well as their knowledge and understanding, to consider evidence for and against when making a judgement.

The top marks for an evaluate question come from you being able to link statements together which support your overall judgement of which material to use, there is no right answer and you can conclude either of the materials is best. You should also consider what you know about each of the materials e.g. polystyrene is a plastic which will produce toxic gases if burned. There are lots of hidden costs relating to energy needed to extract materials, transport materials etc.

Sample Student Answer

WOOD IS A RENEWABLE RESOURCE BUT WILL INVOLVE DEFORESTATION, WHEREAS CRUDE OIL IS A NON-RENEWABLE RESOURCE WHICH WILL EVENTUALLY RUN OUT. BOTH MATERIALS REQUIRE ENERGY IN PRODUCTION, WOOD NEEDING THE MOST WHICH MAY INCREASE POLLUTION LEVELS AND USAGE OF MORE FINITE RESOURCES. PAPER CUPS ARE ALSO HEAVIER MEANING THAT TRANSPORTATION WILL NEED MORE ENERGY. IF BURNED, THE PAPER CUPS PRODUCE MORE ENERGY FOR USE ELSWEHERE AND ARE NOT BIODEGRADABLE UNLIKE POLYSYTRENE CUPS. HOWEVER, POLYSTYRENE CUPS CAN BE RECYCLED INTO OTHER PRODUCTS REDUCING THE NEED TO USE MORE FINITE RESOURCES. THEREFORE, IF POLYSYTRENE CUPS ARE RECYCLED RATHER THAN THROWN INTO LANDFILL, THEY ARE THE BETTER MATERIAL FOR USE.

C15 Using Resources

Q10. Lv2

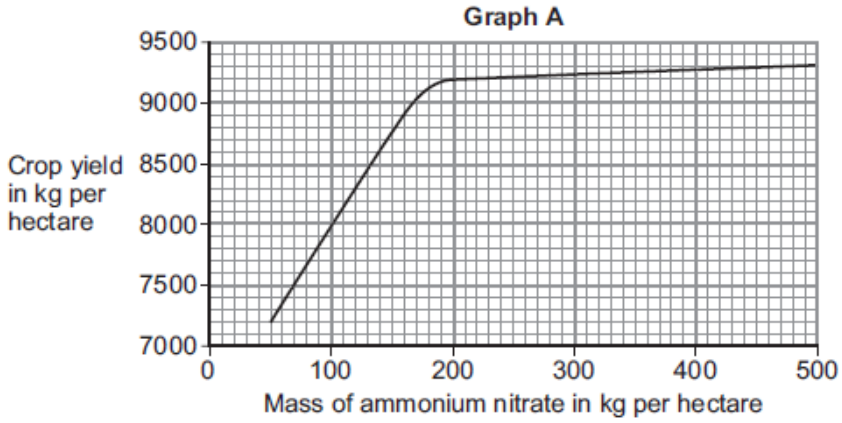
In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

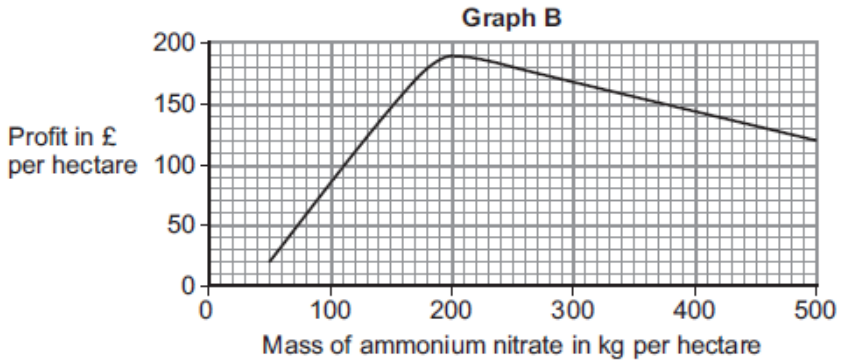
Farmers use ammonium nitrate as a fertiliser for crops.

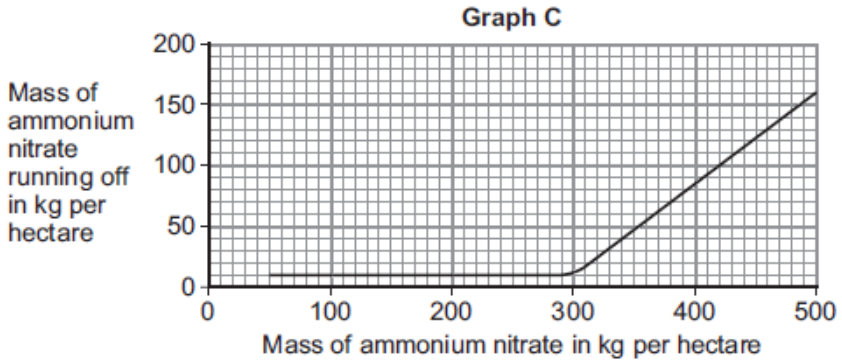
Rainwater dissolves ammonium nitrate in the soil.

Some of the dissolved ammonium nitrate runs off into rivers and lakes.

The graphs **A**, **B** and **C** below show information about the use of ammonium nitrate as a fertiliser. A hectare is a measurement of an area of land.







Suggest how much ammonium nitrate farmers should use per hectare.

Give reasons for your answer. Use information from graphs **A**, **B** and **C**. **(6)**

Top tips for planning:

Suggest – students need to apply their knowledge and understanding to a new situation

You will be expected to use all 3 graphs to gain top marks and may need to consider a compromise in order to get the best yield/profit.

Sample Student Answer

GRAPH A SHOWS THAT YIELD INCREASES WITH THE USE OF FERTILISER UP TO AROUND 200KG AND THEN SLIGHTLY INCREASES. GRAPH B SHOWS THAT PROFIT IS MAXIMISED AROUND 200KG BEFORE SLOWLY DECREASING. GRAPH C SHOWS THAT THE RUN OFF OF FERTILISER IS RELATIVELY SMALL UNTIL 300KG UPWARDS. BASED ON THIS ANALYSIS, 200KG OF FERTILISER WOULD GIVE THE HIGHEST PROFIT AND A LOW RUN OFF. ALTHOUGH IT ISN'T THE HIGHEST YIELD, IT PREVENTS THE DECLINE IN PROFITS FROM WASTEAGE OF FERTILISER AS THERE IS MUCH MORE RUN OFF AND NOT MUCH OF AN INCREASE IN YIELD.

Q11. Lv3

Read the information in the box.

Copper extraction

World demand for copper for the year 2011 was about 20 million tonnes.

World reserves of copper are estimated to be 700 million tonnes.

Most of the copper used is obtained from copper ores, which are mined.

The copper ore chalcopyrite is heated in a furnace to produce copper sulfide, CuS

The furnace is heated by burning fossil fuels.

Air is then blown through the hot copper sulfide, to produce copper and sulfur dioxide.

$$CuS + O_2 \rightarrow Cu + SO_2$$

A scientist made the statement: 'Copper should be recycled'.

Use the information in the box and your own knowledge and understanding to justify the scientist's statement.

(6)

Top tips for planning:

Justify – Use evidence from the information supplied to support an answer.

Link you ideas together to get maximum marks e.g. what are the benefits of recycling? What are the disadvantages of mining? What other processes are involved with a negative impact?

Mark schemes

Rates of Reaction

Sample Student Answer

RECYCLING COPPER WOULD NOT ONLY CONSERVE COPPER SUPPLIES WHICH WILL HAVE RAN OUT IN THE NEXT 35 YEARS (700/20), BUT WILL ALSO CONSERVE SUPPLIES OF FOSSIL FUELS NEEDED IN THE EXTRACTION PROCESS. IT WOULD LEAD TO LESS LAND POLLUTION AS MINING WOULDN'T NEED TO CONTINUE AND THEREFORE NO MORE DESCRTUCTION TO HABITATS, NO NEED FOR FOSSIL FUELS TO HELP THE MINING PROCESS AND NO LAND NEEDED FOR DISPOSAL OF WASTE. IT WOULD ALSO MEAN THAT LESS POLLUTANTS ARE GOING INTO THE ATMOSPHERE AS THERE WOULD BE LESS FOSSIL FUELS BURNING, PRODUCING GREENHOUSES GASES AND NO SULFUR DIOXIDE BEING PRODUCED WHEN EXTRACTING SULFUR REDUCING THE AFFECTS OF ACID RAIN.

Q1. Lv3

Level 3: The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

5–6

Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

method

- measure (indicated) volume of sodium thiosulfate
- place sodium thiosulfate in (conical) flask
- measure (indicated) volume of hydrochloric acid
- place on cross or between light sensor
  or
  connect to a gas syringe
  or
  other suitable method for timing a change
- add hydrochloric acid to (conical) flask
- swirl
- start stopclock / stopwatch
- measure time for cross to become no longer visible
  or
  log light transmission over time
  or
  measure time for fixed volume of gas to be produced
- repeat and find mean
- repeat for different concentrations of sodium thiosulfate
  or change ratio of sodium thiosulfate volume : water volume

control variables

- concentration of hydrochloric acid
- volume of hydrochloric acid
- (total) volume of sodium thiosulfate solution

[6]

Q2. Lv3

Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking Guidance and apply a 'best–fit' approach to the marking.

0 marks
No relevant content

Level 1 (1−2 marks)
At least one statement about the effect of a condition on either rate **or** yield.

Level 2 (3−4 marks)
Correct statements about the effect of at least one condition on rate **and** yield.

Level 3 (5−6 marks)
Correct statements about the effect of at least one condition on rate and yield **and** at least one correct statement about compromise conditions.

Examples of the points made in the response

Temperature
- a higher temperature gives a lower yield
- a higher temperature gives a faster rate

Pressure
- a higher pressure gives a higher yield
- increase in yield gets less as pressure increases
- a higher pressure gives a faster rate
- increase in rate increases as pressure increases

Catalyst
- using a catalyst speeds up reaction
- catalysts allow a lower temperature to be used and so save energy / reduce energy costs

Compromise
- a higher pressure gives a greater yield but increases costs / (safety) risks
- a high pressure gives a faster rate but increases costs / risks
- a high temperature makes reaction faster but reduces yield
- a catalyst makes reaction faster so a lower temperature can be used which will increase the yield

6

C9-12 Hydrocarbons

Q3. Lv2

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance.

0 marks
No relevant content.

Level 1 (1-2 marks)
There is a statement that crude oil is heated **or** that substances are cooled. However there is little detail and any description may be confused or inaccurate.

Level 2 (3-4 marks)
There is some description of heating / evaporating crude oil **and either** fractions have different boiling points **or** there is an indication of a temperature difference in the column.

Level 3 (5-6 marks)
There is a reasonable explanation of how petrol is or fractions are separated from crude oil using evaporating **and** condensing.

If cracking is given as a preliminary or subsequent process to fractional distillation then ignore.

However, if cracking / catalyst is given as part of the process, maximum is **level 2**.

Examples of chemistry points made in the response could include:

- Some / most of the hydrocarbons (or petrol) evaporate / form vapours or gases
- When some of / a fraction of the hydrocarbons (or petrol) cool to their boiling point they condense
- Hydrocarbons (or petrol) that have (relatively) low boiling points and are collected near the top of the fractionating column or hydrocarbons with (relatively) high boiling points are collected near the bottom of the fractionating column
- The process is fractional distillation
- Heat the crude oil / mixture of hydrocarbons or crude oil / mixture is heated to about 350°C
- Some of the hydrocarbons remain as liquids
- Liquids flow to the bottom of the fractionating column
- Vapours / gases rise up the fractionating column
- Vapours / gases cool as they rise up the fractionating column
- The condensed fraction (or petrol) separates from the vapours / gases and flows out through a pipe

- Some of the hydrocarbons remain as vapours / gases
- Some vapours / gases rise out of the top of the fractionating column
- There is a temperature gradient in the fractionating column or the fractionating column is cool at the top and hot at the bottom

6

Q4. Lv3

any **five** from the following bullet points:

allow converse for ethanol from crude oil

To gain full marks there should be both advantageous and disadvantageous issues and their importance

Advantageous issues using sugar cane:

ignore costs – unless specified
ignore safety
ignore simple/low technology process
ignore labour intensive as an advantage
linked importance

- sugar cane/plants absorb carbon dioxide / photosynthesise
  *so is carbon neutral **or** reduce global warming*
- sugar cane / plants are renewable / sustainable
  *and so save resources / oil **or** crude oil is non-renewable*
- low energy process
  *and so it saves fuel **or** / making ethanol from crude oil needs fuel for fractional distillation / cracking*

Disadvantageous issues using sugar cane:

ignore fermentation releases carbon dioxide; destruction of habitats/land to build production plants; types of pollution; waste products

- large areas of land are needed
  which leads to destruction of habitats / forest
- land could be used for food crops
  *may cause food shortages **or** increases the price of food **or** increasing world population*
- slow process
  so limits supply / production of ethanol
- ethanol is impure **or** contains 50% ethanol
  so needs further separation or ethanol from crude oil is 100% pure
- batch process
  so uses more labour

- the crop yield / supply of ethanol is unreliable

  because growth is seasonal / weather dependent ***or*** *possibility of crop failure*

a justified conclusion

compensation mark, *if no other mark awarded allow one mark for two or more issues*

5

Q5. Lv3

any **four** from:

- poly(ethene) produced by addition polymerisation whereas polyester by condensation polymerisation
- poly(ethene) produced from one monomer wheareas polyester produced from two different monomers
- poly(ethene) produced from ethene / alkene whereas polyester from a (di)carboxylic acid and a diol / alcohol
- poly(ethene) is the only product formed whereas polyester water also produced
- poly(ethene) repeating unit is a hydrocarbon whereas polyester has an ester linkage

4

C12 Chemical Analysis

Q6. Lv3

Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks
No relevant content

Level 1 (1 – 2 marks)
Any description of a method used and / or a result given

Level 2 (3 – 4 marks)
Description of workable methods used, with results to identify positive **or** negative ions

Level 3 (5 – 6 marks)
Description of methods used to identify both positive **and** negative ions, with relevant results

examples of the points made in the response

extra information

Test: add (platinum / nichrome) wire (for the flame test)

accept any method of introducing the solution into the flame, eg a splint soaked in the solution or sprayed from a bottle

Result: the sodium compounds result in a yellow / orange / gold flame **or** the potassium compound results in a lilac / purple / mauve flame

student could state that potassium carbonate gives a different colour to the three sodium compounds as long as it is clear that the flame test colour comes from Na^+ or K^+

Test: add dilute nitric acid to all four solutions

allow any acid

Result: sodium carbonate and potassium carbonate will effervesce **or** sodium chloride and sodium iodide will not effervesce

Test: add dilute nitric acid followed by silver nitrate

Result: sodium chloride and sodium iodide produce a precipitate **or** sodium chloride produces a white precipitate and sodium iodide produces a yellow precipitate

accept sodium carbonate and potassium carbonate do not produce a precipitate

[6]

C13 The Earth's Atmosphere

Q7. Lv2

Level 3: Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.

5–6

Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

No relevant content

0

Indicative content

changes

- carbon dioxide has decreased
- oxygen has increased

processes

- volcanic activity released water vapour
- the water vapour condensed to form oceans
- carbon dioxide dissolved in oceans
- carbonates produce sediments
- carbon locked up in sedimentary rocks

- algae and plants evolved / appeared
- algae / plants absorbed carbon dioxide
- by photosynthesis
- which also released oxygen

- carbon locked up in fossil fuels

Q8. Lv3

Level 3 (5-6 marks):
Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.

Level 2 (3-4 marks):
Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.

Level 1 (1-2 marks):
Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

Level 0
No relevant content

Indicative content

description
- global air temperature has risen overall / erratically
- mean sea level has risen (steadily)
- carbon dioxide has risen steadily
- methane has risen overall / erratically

explanations
- (carbon dioxide increase because) increase in fossil fuel combustion
  or
- (carbon dioxide increase because) increase in deforestation
- methane from cattle / landfill / rice plantations
- carbon dioxide and / or methane trap heat
  or
- carbon dioxide and / or methane are greenhouse gases
- polar ice caps melt
  or
- seawater expands

linked explanation
- greenhouse gases linked to temperature rise
- temperature rise linked to seawater level

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C14-15 The Earth's Resources and Using Resources

Q9. Lv3

(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

No relevant content

0

Indicative content

raw materials

- crude oil finite **or** will run out (so will be unavailable for other uses)
- wood is a renewable resource
- wood involves land use for forestry (so less available for agriculture / food)
- wood may involve deforestation (so reduces biodiversity)

manufacturing

- both require energy which may be derived from finite fuels (so they run out more quickly)
- paper more energy intensive (so more pollution is possible)
- the need for more energy for paper potentially releases more carbon dioxide to the atmosphere (so increases global warming)
- paper involves higher water usage (so increases the potential for water pollution)
- paper cups are heavier to transport (so have higher energy requirement)
- packaging requirements similar (so neither has an advantage)

usage

- both single-use (so neither has an advantage)

disposal

- paper releases more energy if incinerated (so more energy can be used for other purposes)
- paper will decompose (so will not remain in landfill)
- poly(styrene) could release toxins on incineration
- poly(styrene) will not decompose (so will remain in landfill)
- poly(styrene) can be used to manufacture other products (so conserves energy **or** finite resources)
- both can cause litter **or** visual pollution

Q10. Lv2

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

Level 3 (5 – 6 marks):
Suggestion with reasons from all three graphs, and linking of ideas which may explain a compromise.

Level 2 (3 – 4 marks):
Suggestion with reasons referring to more than one graph.

Level 1 (1 – 2 marks):
Suggestion with a reference to a graph.

0 marks:
No relevant content.

Examples of chemistry points made in response:
A reasonable suggested amount of fertiliser would be in the region of 200 kg (per ha).
Accept any suggestion from about 180 kg (per ha) to 500 kg (per ha).

Yield:
- Using fertiliser improves yield.
- Yield improved most up to about 200 kg (per ha) of fertiliser.
- Yield only increased slightly above about 200 kg (per ha).

Profit:
- About 200 kg of fertiliser gives the most profit.
- Above about 200 kg (per ha) of fertiliser profit declines.

Run off:
- Run off is at low levels until about 300 kg (per ha) of fertiliser.
- Above about 300 kg (per ha) of fertiliser, run off increases.

Examples of linking of ideas:
- Overall 200 kg gives high crop yield and most profit.
- In conclusion 200 kg gives high crop yield and low run off.
- 200 kg gives most profit and low run off.

Examples of compromise:
- Profits go down after about 200 kg (per ha) of fertiliser because cost of fertiliser is not covered by increased yield.
- 200 kg gives the highest profit although it is not the highest yield.
- 500 kg gives the best yield but has the most runoff.

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Q11. Lv3

Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response.

0 marks
No relevant content

Level 1 (1–2 marks)

Simple list of a limited number of points given, with no linking between ideas

Level 2 (3–4 marks)
A broader set of points made. There will probably not be links between ideas

Level 3 (5–6 marks)
Answer includes linking between ideas, showing the consequence of either not recycling or the advantage of recycling. Answers such as less fossil fuel needed so less carbon dioxide produced **or** less carbon dioxide produced so less global warming

examples of the points made in the response

resources

(recycling) conserves supplies of ores
copper available for longer
as (at present rate of use) copper ores will run out in about 35 years
(recycling) conserves supplies of fossil fuels **or** energy
less fuel used at a lower cost

land pollution
mining scars landscape **or** produces noise pollution
mining destroys wildlife habitats
(recycling) less need to mine ores / fossil fuels
so less habitat destroyed or less scarring of landscape
(recycling) less need to use landfill for waste

atmospheric pollution
burning fossil fuels produces carbon dioxide / greenhouse gas
which (may) cause global warming **or** climate change
extraction produces sulfur dioxide
which causes acid rain
which can kill trees / fish

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