A. Using the Earth's resources and sustainable development

1. Give two ways that humans utilise the Earth's natural resources? (2)

   Any two from warmth/shelter/food transport [2]

2. What is meant by the term finite resources? (2)

   (Resources that are) being used up [1] faster than they are being made [1]

3. **Extended response question:**

   Look at the table below.

Fuel	Reserves in billions of tonnes	Amount used annually in billions of tonnes
Natural gas	200,000	5
Oil	240	6
Coal	880	8

Show by calculation which fuel, oil or gas will last longer. Explain why the amount of reserves may change and state why the above table does not show that these reserves are finite. (6)

0 marks	*Level 1 (1–2 marks)*	*Level 2 (3–4 marks)*	*Level 3 (5–6 marks)*
No relevant content	***240/6 = 40 years*** ***880/8 = 110 years [1] Coal [1]*** ***OR*** ***New reserves could be discovered/not as much of the fuel could be used year on year [2]*** ***OR*** ***The information does not show how quickly the resources are being made [2]***	***Two of the relevant pieces of information.***	***All three relevant pieces of information.***

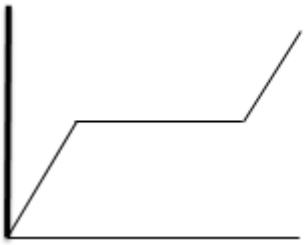
4. What is meant by the term sustainable development and give an example with a justification (4)

   Development that meets the needs of current generations [1] without compromising the ability of future generations to meet their own needs [1]
   Any suitable example e.g.
   Planting a tree when one is cut down [1] so that there are trees for future generations [1]
   Fishing with nets with larger holes to allow juvenile fish to escape [1] allow these fish to reproduce [1]

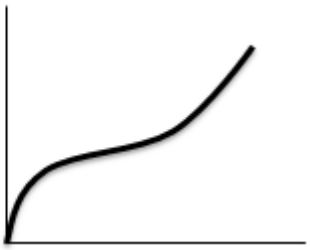
B. Potable water

1. The two graphs below show the temperature as two samples of ice are heated until they melt. Which of these samples A or B is most likely to show potable water? Explain your choice. (3)

A



B



Sample B [1] potable water is not pure [1] so does not have a single melting point [1]

2. **Extended response question:**

Describe and explain the stages used in the production of potable water from ground water. (6)

0 marks	*Level 1 (1–2 marks)*	*Level 2 (3–4 marks)*	*Level 3 (5–6 marks)*
No relevant content	*An appropriate choice of fresh water [1]* *Reduces the amount of treatment needed [1]* *OR* *Passing the water through treatment beds [1]* *Removes larger insoluble matter [1]* *OR* *sterilising [1]* *kills any remaining bacteria [1]*	*Two of the relevant pieces of information.*	*All three relevant pieces of information.*

3. **Extended response question:**

Describe the two most common methods of producing potable water from salty water and explain why these methods are not used in areas with adequate supplies of ground water. (6)

0 marks	*Level 1 (1–2 marks)*	*Level 2 (3–4 marks)*	*Level 3 (5–6 marks)*
No relevant content	*distillation [1]* *water is evaporated and condensed [1]* *OR* *Use of membranes/reverse osmosis [1]* *Salt is separated from the water [1]* *OR* *Desalination requires large amount of energy/purification of ground water requires far less energy [2]*	*Two of the relevant pieces of information.*	*All three relevant pieces of information.*

C. Waste water treatment

1. Describe the similarities and differences between the processing of sewage, agricultural and industrial waste water. (4)

   All [1] require the removal of organic matter [1]
   Sewage and agricultural waste [1] require the removal of harmful microbes [1]/ industrial waste [1] requires the removal of harmful chemicals [1]

2. Give the four stages in the treatment of sewage. (4)

   Screening and grit removal [1]
   Sedimentation to produce sewage sludge and effluent [1]
   Anaerobic digestion of sewage sludge [1]
   Aerobic biological treatment of effluent [1]

D. Alternative methods of extracting metals (HT only)

1. **Extended response question:**

Describe how phytomining and bioleaching are now being used to extract copper and why these methods are being used. (6)

0 marks	*Level 1 (1–2 marks)*	*Level 2 (3–4 marks)*	*Level 3 (5–6 marks)*
No relevant content	*phytomining* *uses plants to absorb copper [1]* *they are burnt the ash contains copper [1]* *OR* *bioleaching* *uses bacteria to produce leachate solutions that contain copper [1]* *copper extracted by displacement or electrolysis [1]* *OR* *Copper ores becoming scarce/limited [1]* *Avoids digging/moving and disposing of rock/traditional methods of mining [1]*	*Two of the relevant pieces of information.*	*All three relevant pieces of information.*

E. Life cycle assessment

1. In the given stages below compare the life cycle assessments for a plastic and a paper bag used for shopping, the first stage has been completed for you.

   Extracting and processing raw materials

   Plastic bag – crude oil needs to be extracted from the Earth, this requires energy and may cause pollution
   Paper bag – trees need to be cut down and removed, this causes destruction of forests and loss of habitats, but can be sustainable

   In all cases look for comparisons in need for chemicals/fuel/transport

   Manufacturing and packaging (2)

   Plastic bag – requires the use of energy/non-renewable, catalysts will require transport to place of use
   Paper bag – requires energy/ possibly bleaching/ will require transport/ paper bags are heavier more use of fuels

   Use and operation during its lifetime (2)

   Plastic bag – can be reused a number of times/is flexible so less likely to tear/ waterproof
   Paper bag – ORA from above

   Disposal at the end of its useful life (2)

   Plastic bag – non-biodegradable/will not decay for a long time/OWTTE
   Paper bag – ORA from above

F. Ways of reducing the use of resources

1. Many councils now provide recycling bins to promote recycling. Give three reasons why they do this. (3)

   Any three from - Reduces the use of limited resources [1] reduces the use of energy sources [1] reduces waste [1] reduces environmental impacts [1]

2. Glass bottles can be reused, whereas metal is recycled describe the similarities and differences in these two processes (3)

   Both glass and metal are melted [1] glass is crushed before melting [1] whereas metals are recast/reformed after melting [1]

G. Corrosion and its prevention, alloys as useful materials (Chemistry only)

1. Explain how rusting can be prevented (3).

   Applying a coat that acts as a barrier [1]; e.g. greasing [1], painting [1] or electroplating [1]; Galvanising [1]; sacrificial protection [1]

2. Explain why aluminium does not corrode in the same way as iron (2).

   Oxygen reacts with aluminium at surface [1]; forms an oxide coating [1]; prevents further corrosion [1]

3. Explain what is meant by sacrificial protection (2).

   Coating in a more reactive metal [1]; e.g. zinc [1]; galvanising [1]

4. Design an investigation to show that both air and water are necessary for rusting (4).

   Nail in air and water [1]; nail in water only – boiled water, oil on top [1]; nail in dry air only [1] – anhydrous CaCl [1];

5. Explain how to galvanise iron and why this helps to prevent corrosion (4).

   Coat in more reactive metal [1]; e.g. zinc [1]; provides sacrificial protection [1]; the zinc oxidises not the iron [1]

6. Steels are alloys of iron containing specific amounts of carbon and other metals. Different steels have different properties and can therefore have different uses. Describe the properties of the following steels and give a use for each (6).

   a. High carbon steel ***Strong and brittle [1]; tools and cutters [1]***
   b. Low carbon steel ***Soft and easily shaped [1]; construction/ buildings/ ships/ vehicles [1]***
   c. Steel containing chromium and nickel ***Stainless steel/ does not corrode, hard [1]; cutlery, cookware [1]***

H. Ceramics, polymers and composites (Chemistry only)

1. Explain the difference between soda-lime glass and borosilicate glass (3).

   Soda-lime made by heating sand, sodium carbonate and limestone [1]; borosilicate made by heating sand and boron trioxide [1]; Borosilicate melts at a higher temperature [1]

2. Explain how clay ceramics are made, give two examples of a clay ceramic (4).

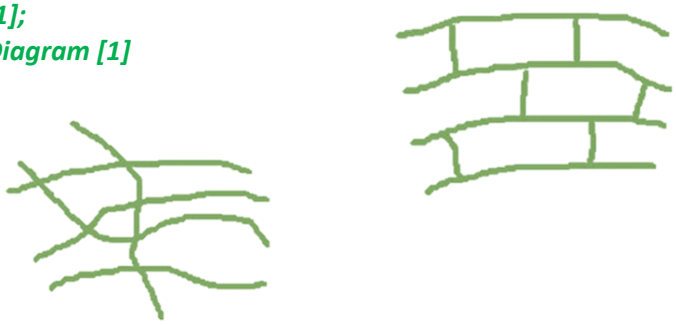
   Shaping wet clay [1]; heating in a furnace [1]; bricks [1]; pottery [1]

3. What factors impact upon the properties of polymers? (2)

monomers they are made of [1]; conditions under which they are made [1]

4. Explain the difference between thermosoftening and thermosetting polymers in terms of their structure (5).

Crosslinks: thermosoftening none, thermosetting has them [1];
Melting point: thermosoftening low, thermosetting high [1];
Melt when heated: thermosoftening yes, thermosetting no [1];
Can be shaped when hot: thermosoftening yes, thermosetting no [1];
Diagram [1]



5. Explain how composites are made (4).

Normally 2 materials [1]; Matrix or binder [1]; binding together fibres or fragments [1]; called reinforcement [1]

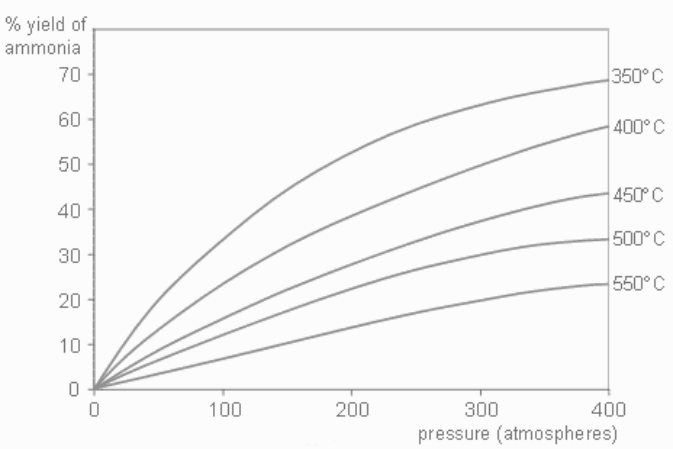
I. The Haber process and NPK (Chemistry Only)

1. Ammonia can be used to produce nitrogen-based fertilisers. It is manufactured on an industrial scale using the Haber process. Explain how ammonia is produced using the Haber process, you should include the following in your response:
   - An equation *nitrogen + hydrogen ⇌ ammonia*
   - A source for each raw material *Nitrogen – air; hydrogen – natural gas*
   - The reaction conditions. *Temperature – 450°C; Pressure 200 atm; iron catalyst*

(6)

0 marks	*Level 1 (1–2 marks)*	*Level 2 (3–4 marks)*	*Level 3 (5–6 marks)*
No relevant content	*One of the three bullet points covered with relevant information*	*Two of the three bullet points covered with relevant information*	*All of the three bullet points covered with relevant information*

2. The following graph outlines the impact of reaction conditions on the percentage yield of ammonia from the Haber process. Describe the conditions which give the highest yield and explain why there is a compromise on these conditions in industry [4].



High pressure [1]; low temperature [1]
High pressure is expensive and dangerous [1]; low temperature gives a low rate of reaction [1]

3. Explain what NPK fertilisers are, include the names of the three main elements they contain (3).

Formulations of salts [1]; containing nitrogen [1]; phosphorus and potassium [1]

4. Describe how ammonia is used in industry. Write a balanced symbol equation for the production of ammonium nitrate (NH_4NO_3) from ammonia and nitric acid (3).

Manufacture ammonium salts and nitric acid [1]
$NH_3 + HNO_3$ → NH_4NO_3 [2]

5. Calculate the percentage (%) of nitrogen in ammonium nitrate (NH_4NO_3) (3).
Relative atomic masses: N 14; H 1; O 16

Relative formula mass of ammonium nitrate = (2 x 14) + (4 x 1) + (3 x 16) = 80 [1]

Relative mass of nitrogen in ammonium nitrate = (2 x 14) = 28 [1]

Percentage of iron in ammonium nitrate = (28 ÷ 80) x 100 = 35% [1]

6. Explain how the soluble fertiliser calcium nitrate is obtained from insoluble phosphate rock (1).

Treated with nitric acid [1]