Improving Processes and Products

Total marks:18

1.

Bioleaching is one method used to extract copper from ores.

Reactions involving bacteria slowly convert copper sulfide to a mixture of copper sulfate solution and sulfuric acid.

i. Describe **two advantages** of extracting copper using bioleaching instead of traditional mining.

1

2

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[2]

ii. Suggest **one** reason why the sulfuric acid produced during bioleaching may be harmful to the environment.

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[1]

2.

(a). The Haber process is used to manufacture ammonia, NH_3

Ammonia is used to make fertilisers, which farmers use on their crops.

Explain why fertilisers are so important in the agricultural production of crops.

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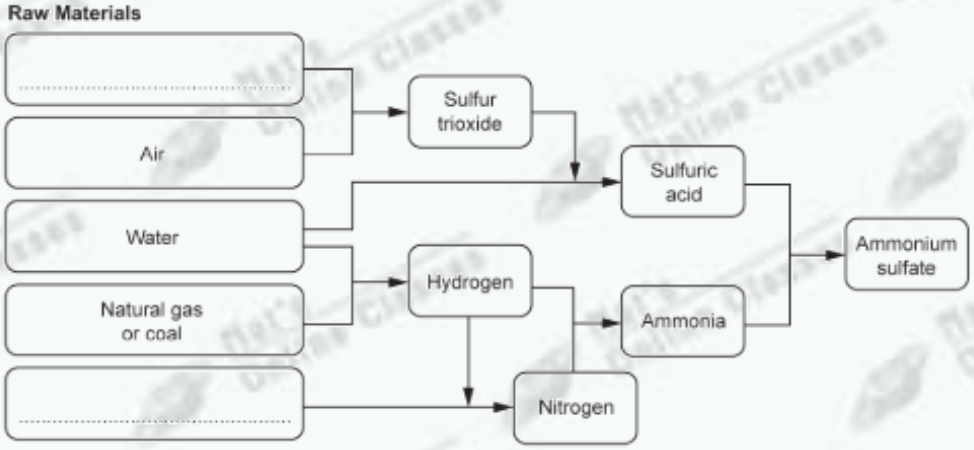
[2]

(b). Ammonium sulfate is a fertiliser made from ammonia and sulfuric acid.

The diagram shows the stages in the industrial production of ammonium sulfate.

Complete the diagram to show the **raw materials** in the production of ammonium sulfate.



[2]

3.

Ammonia is used to make fertilisers such as ammonium sulfate.

A student makes some ammonium sulfate crystals in a laboratory.

She uses a titration method, as shown in the diagram.

She adds an indicator to ammonia solution in a conical flask. She then adds dilute sulfuric acid from a burette until the indicator changes colour.

The student then crystallises the solution. She is left with **impure** ammonium sulfate crystals.

i. What should the student have done to obtain **pure** ammonium sulfate crystals?

---[2]

ii. In industry the same reaction is used to make ammonium sulfate.

The method used is different.

Give **one** reason why the laboratory method to make ammonium sulfate is **not** used in industry.

---[1]

4.

(a). Aluminium is extracted from its ore using electrolysis.

Copper is extracted from its ore by heating with carbon.

Explain why different methods are used to extract aluminium and copper.

---[2]

(b). Molten aluminium oxide contains Al^{3+} and O^{2-} ions.

The electrolysis of molten aluminium oxide makes aluminium and oxygen.

i. Write the **balanced symbol** equation for the electrode reaction that happens at the cathode.

Use the symbol e⁻ to represent an electron.

---[1]

ii. Solid aluminium oxide cannot be electrolysed.

Explain why.

---[1]

5.

(a). Kasia investigates the corrosion of different metals.

She places a small strip of each metal in different samples of air.

She leaves the metals for one week before collecting her results.

Look at her table of results.

Metal	Original appearance of metal	Appearance of metal after one week in			
		moist acidic air	moist alkaline air	dry air	moist air
aluminium	shiny silver	dull silver	dull silver	shiny silver	shiny silver
copper	shiny red-orange	dull red-orange	green red-orange	shiny red-orange	dull red-orange
iron	shiny silver	brown coating	brown coating	shiny silver	brown coating
magnesium	shiny silver	whitish coating	dull silver	shiny silver	dull silver
zinc	shiny silver	dark coating	dark coating	shiny silver	dull silver

Suggest, with a reason, one change to the experimental procedure that would improve the quality of the results.

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[1]

(b). Explain the conclusions that can be made from Kasia's results.

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[3]