OCR
RECOGNISING ACHIEVEMENT

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**

**Advanced Subsidiary GCE**

# CHEMISTRY (SALTERS) 2848

Chemistry of Natural Resources

Wednesday **8 JUNE 2005** Morning 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
*Data Sheet for Chemistry (Salters)*
Scientific calculator

| Candidate Name | Centre Number | Candidate Number |
|---|---|---|
| | | |

**TIME** 1 hour 30 minutes

## INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.

## INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- You may use the *Data Sheet for Chemistry (Salters)*.
- You are advised to show all the steps in any calculations.

| FOR EXAMINER'S USE | | |
|---|---|---|
| Qu. | Max. | Mark |
| 1 | 23 | |
| 2 | 27 | |
| 3 | 24 | |
| 4 | 16 | |
| TOTAL | 90 | |

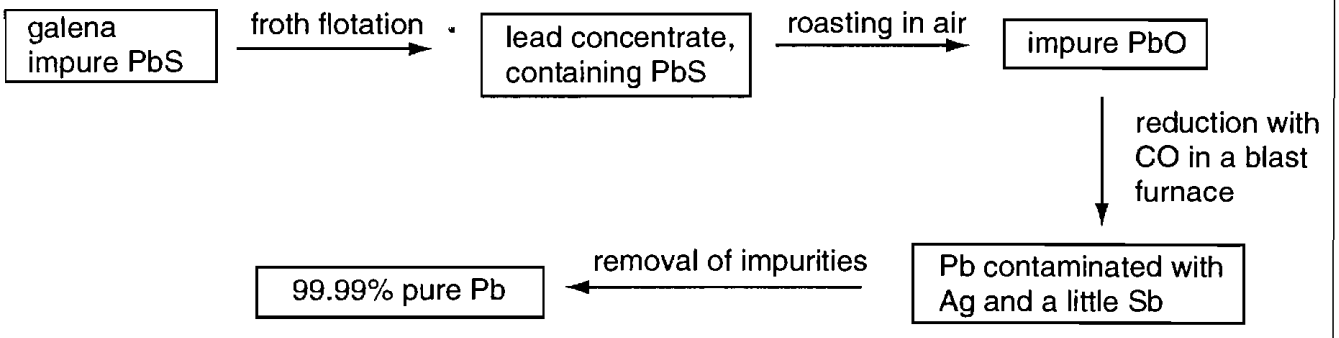
**This question paper consists of 11 printed pages and 1 blank page.**



Registered Charity Number: 1066969
[Turn over

Answer **all** the questions.

**1** The metal lead is extracted from its ore by the following process.




**(a) (i)** What is removed from the galena to produce the lead concentrate?

.....[1]

**(ii)** When PbS is roasted in air, it forms PbO and $SO_2$.
Write a balanced chemical equation for this reaction.

.....[2]

**(iii)** Give the systematic name for PbO.

.....[1]

**(b)** The lead concentrate contains 58% **PbS**.
Calculate the percentage of Pb in the concentrate.
Give your answer to **two** significant figures.
$A_r$: Pb, 207; S, 32

percentage Pb = .....% [3]

**(c) (i)** Use the flow diagram to **name** the **main** impurity element that is present in the lead that comes out of the blast furnace.

.....[1]

**(ii)** Calculate the number of parts per million of impurity in the 99.99% pure lead at the end of the process.

answer .....ppm [2]



[Turn over

**(d)** Antimony, Sb, is removed from the lead by the following reaction.

$Sb(s) + NaOH(aq) + H_2O(l) \longrightarrow NaSbO_2(aq) + 1.5\ H_2(g)$ **equation 1.1**

**(i)** Give the oxidation state of antimony in

Sb .....

$NaSbO_2$ .....[2]

**(ii)** Classify the reaction in **equation 1.1** as redox, precipitation or acid-base.

.....[1]

**(iii)** Describe a potential hazard, apart from the corrosive nature of some of the chemicals, that could arise in carrying out the reaction in **equation 1.1**.
What precautions could be taken?

.....

.....

.....

.....[2]

**(iv)** The electron configuration for Sb ends with $5p^3$. How does the electron configuration for Pb end?

.....[2]

**(v)** Name the 'block' of the Periodic Table in which antimony and lead are **both** found.

.....[1]

**(vi)** Suggest another oxidation state that antimony, Sb, is likely to show in its compounds, in addition to those in **(i)**. Explain how you arrived at your answer.

.....

.....

.....

.....[2]

**(e)** If the removal of antimony using **equation 1.1** were carried out in a laboratory, the metallic lead could be separated from the solution of sodium antimonate, $NaSbO_2$, by vacuum filtration.

$$Sb(s) + NaOH(aq) + H_2O(l) \longrightarrow NaSbO_2(aq) + 1.5\,H_2(g) \qquad \textbf{equation 1.1}$$

Draw a diagram of the apparatus you would use, labelling the parts of the apparatus and where the lead would be found.

[3]

[Total: 23]

**2** Hydrofluorocarbons, HFCs, are now being used to replace CFCs for many of their uses. They are broken down in the troposphere before they have time to reach the stratosphere. Their disadvantage is that they are greenhouse gases.

**(a) (i)** What does *CFC* stand for?

.....[1]

**(ii)** Give the formula of a CFC. .....[1]

**(iii)** CFCs were once widely used. Give **two** of their uses.

.....

.....[2]

**(iv)** In this question, one mark is available for the quality of spelling, punctuation and grammar.

CFCs cause depletion of the ozone layer. Describe how they do this.

.....

.....

.....

.....

.....

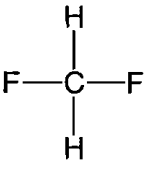
.....

.....[4]

Quality of Written Communication [1]

**(b)** One example of an HFC is $CH_2F_2$. The C–F bond is polar.

**(i)** Mark partial charges (δ– and δ+) on the C and F atoms in the structure below.




[1]

**(ii)** Explain what determines where the partial charges are placed on this molecule.

.....

.....

.....[2]

**(iii)** Does the whole molecule have a dipole? Explain your answer.

.....

.....

.....[2]

**(c)** If molecules of $CH_2F_2$ reach the stratosphere, they do not break down to produce F radicals.

**(i)** Suggest why C–F bonds are **not** broken in the stratosphere.

.....

.....

.....[2]

**(ii)** The bond enthalpy of the C–F bond is +467 kJ $mol^{-1}$.
Calculate the minimum energy (in joules) needed to break a **single** C–F bond.

Avogadro constant, $L = 6.02 \times 10^{23}$ $mol^{-1}$

minimum energy = .....J [2]

**(iii)** Calculate the minimum frequency of radiation needed to break a C–F bond.
Give the appropriate units for your answer.

Planck constant, $h = 6.63 \times 10^{-34}$ J $Hz^{-1}$

minimum frequency = ..... units ..... [3]

**(iv)** Name the **type** of bond breaking that is referred to in **(iii)**.

.....[1]

**(d)** In this question, one mark is available for the quality of use and organisation of scientific terms.

Greenhouse gases absorb infrared radiation in the troposphere. Explain the source of this infrared radiation and what happens to a molecule of $CH_2F_2$ when it absorbs this radiation.

.....

.....

.....

.....

.....

.....

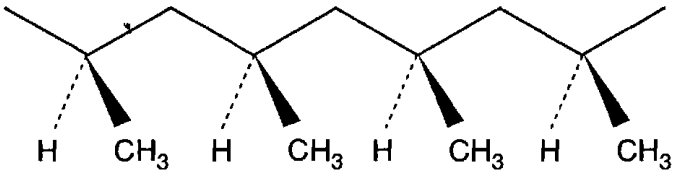
.....[4]

Quality of Written Communication [1]

[Total: 27]

3 Some polymers are *crystalline* which makes them stronger and less flexible than non-crystalline polymers. For example, *isotactic* poly(propene) is crystalline and used to make packaging and containers, whereas *atactic* poly(propene) is used to make roofing materials and weatherproof coatings.

The structure of an isotactic poly(propene) chain is shown below.




**isotactic poly(propene)**

**(a)** Draw the structural formula of a propene molecule.

[1]

**(b)** Poly(propene) was made by Zeigler and Natta as part of a programme studying the polymerising effects of certain sorts of catalyst.

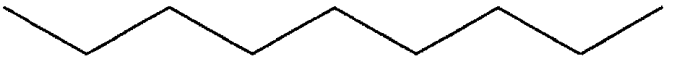
**(i)** What was new about the composition of the catalyst developed by Zeigler and Natta?

.....[1]

**(ii)** Name a polymer that was discovered by accident.

.....[1]

**(c)** **(i)** In *isotactic* poly(propene), the methyl groups are arranged in a regular way along the chain. Complete the diagram below to describe the structure of *atactic* poly(propene) in which the methyl groups are arranged in an **irregular** fashion.



[1]

**(ii)** Name the type of intermolecular force between poly(propene) chains.

.....[1]

**(iii)** The chains in a crystalline region of a polymer are parallel.
Explain why *isotactic* poly(propene) has many crystalline regions whereas *atactic* poly(propene) has few.

.....

.....

.....[2]

**(iv)** Explain in terms of intermolecular forces why the more crystalline structure is less flexible.

.....

.....

.....[2]

**(d)** A sample of poly(propene) is shaken with aqueous bromine to see if any unreacted monomer remains.

**(i)** State what colour change you would see when bromine reacts with propene.

from ..... to ..... [2]

**(ii)** The mechanism of the reaction between bromine and propene is described as electrophilic addition. Explain the meaning of the terms *electrophilic* and *addition.*

.....

.....

.....

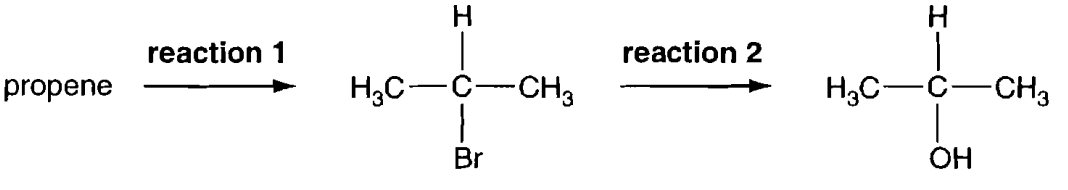
.....

.....

.....

.....[3]

**(e)** Propene can be converted into propan-2-ol by the following route.




**compound A** **propan-2-ol**

**(i)** Give the reagent for **reaction 1**.

.....[1]

**(ii)** Name **compound A.**

.....[1]

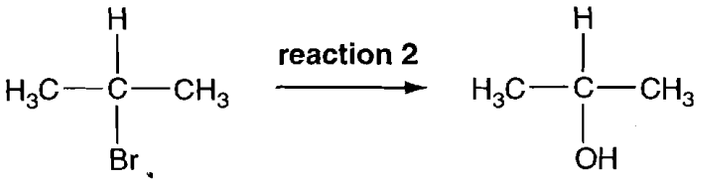
**(iii)** What type of alcohol (primary, secondary or tertiary) is propan-2-ol?

.....[1]

**(iv)** The propan-2-ol can be converted back to propene.
Circle the type of reaction that is involved.

**addition** **elimination** **reduction** **substitution** [1]

**(f)** **Reaction 2** is a slow reaction.




**compound A** **propan-2-ol**

**(i)** Give reagent and conditions for **reaction 2**.

.....

.....[3]

**(ii)** Explain, in terms of molecular collisions, why the rate of reaction increases when the concentration of **compound A** increases.

.....

.....[1]

**(iii)** Explain why the rate of reaction increases when the temperature is raised.

.....

.....

.....[2]

[Total: 24]

**4** Ammonium salts are well-known for their use as fertilisers. They are all very soluble in water. Ammonium sulphate is used as a fertiliser where the soil needs to be made more acidic.

**(a)** Which element in ammonium sulphate is most important for its use as a fertiliser?

.....[1]

**(b)** Ammonium ions, $NH_4^+$, are hydrated in solution.
Draw a diagram to show how water molecules surround an ammonium ion, showing partial charges ($\delta+$ and $\delta-$).

$NH_4^+$

[3]

**(c)** In a solution of ammonium ions, the following equilibrium is set up.

$$NH_4^+(aq) \rightleftharpoons NH_3(aq) + H^+(aq) \qquad \textbf{equation 4.1}$$

**(i)** Explain, using **equation 4.1**, why a solution of an ammonium salt is acidic.

.....[1]

**(ii)** Give the formula of a base in **equation 4.1**.

.....[1]

**(d)** **(i)** Ammonia molecules form hydrogen bonds with each other.
What features of the ammonia molecule cause it to undergo hydrogen bonding with other ammonia molecules?

.....

.....

.....[2]

**(ii)** Ammonia is very soluble in water because of the hydrogen bonds formed between ammonia molecules and water molecules.

Draw a diagram showing an ammonia molecule hydrogen bonded to a **water** molecule. Include lone pairs and partial charges ($\delta+$ and $\delta-$).

[3]

**(e)** A student sets out to titrate a solution of ammonium sulphate with sodium hydroxide solution. She places the ammonium sulphate solution in the burette and 10.0 $cm^3$ of 0.010 mol $dm^{-3}$ sodium hydroxide solution in the flask.

**(i)** Name the piece of apparatus she would use to measure out the sodium hydroxide solution.

.....[1]

**(ii)** How could she tell when the reaction had finished?

.....[1]

**(f)** The experiment showed that the concentration of the ammonium **ions** was 0.020 mol $dm^{-3}$. Calculate the concentration of the solution in grams of $(NH_4)_2SO_4$ per $dm^3$.

$A_r$: N, 14; H, 1.0; S, 32; O, 16

concentration = .....g $dm^{-3}$ [3]

[Total: 16]

**END OF QUESTION PAPER**