YEAR 12 CHEMISTRY 2003

QUESTION/ANSWER BOOKLET

NAME: _____

TEACHER: _____

TIME ALLOWED FOR THIS PAPER:

Reading time before commencing	Ten minutes
Working time for paper	Three hours

MATERIAL REQUIRED/RECOMMENDED FOR THIS PAPER:

TO BE PROVIDED BY THE SUPERVISOR

This Question/Answer Booklet
Separate Multiple Choice Answer Sheet
Separate Chemical Data Sheet

TO BE PROVIDED BY THE CANDIDATE

Standard Items	Pens, pencils, eraser or correction fluid, ruler.
Special Items	Calculators satisfying the conditions set by the Curriculum Council.

IMPORTANT NOTE TO CANDIDATES:

NO OTHER ITEMS MAY BE TAKEN INTO THE EXAMINATION ROOM.
NO MOBILE PHONES ARE TO BE TAKEN INTO THE EXAMINATION ROOM.
IT IS YOUR RESPONSIBILITY to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. Please check carefully, and if you have any unauthorised material with you, hand it to the supervisor BEFORE reading any further.

STRUCTURE OF THE PAPER:

Part	Format	Number of Questions	Questions to be Attempted	Marks Allocated	Suggested Time	Student Mark
1	Multiple Choice	30	ALL	60 (30%)	45 min	/60
2	Short Answers	13	ALL	70 (35%)	65 min	/70
3	Calculations	5	ALL	50 (25%)	50 min	/50
4	Extended Answer	2	choose one	20 (10%)	20 min	/20
			TOTAL	200 (100%)	180 min	**%**

INSTRUCTIONS TO CANDIDATES:

Reading Time: The examiners recommend that candidates spend the reading time mainly reading the Instructions to Candidates and Parts 2, 3 and 4.

PART 1 - Multiple Choice Section.

Use a 2B, B or HB pencil to answer questions on the separate Multiple Choice Answer Sheet provided. **Do not** use a ballpoint pen or ink pen.

There is only one correct answer for each question. If you consider that two or more of the alternative responses are correct, choose the one you think is best. If you think you know an answer, mark it even if you are not certain you are correct. Marks **WILL NOT** be deducted for incorrect answers.
FEEL FREE TO WRITE OR DO WORKING ON THE QUESTION PAPER. Many students who score high marks in the Multiple Choice Section do this.

PARTS 2, 3 and 4.

Use a ballpoint or ink pen. **Do not** answer in pencil.
Write your answers in this Question/Answer Booklet.

At the end of the examination, make sure your name is written on the front of your Question/Answer Booklet and on your separate Multiple Choice Answer Sheet in the spaces provided. Write your name on any pages which may have become detached.

CHEMICAL EQUATIONS.

For full marks, **chemical equations** should refer only to those species consumed in the reaction and the new species produced. These species may be **ions** [for example $Ag^{+}_{(aq)}$], **molecules** [for example $NH_{3(g)}$, $NH_{3(aq)}$, $CH_3COOH_{(l)}$, $CH_3COOH_{(aq)}$] or **solids** [for example $BaSO_{4(s)}$, $Cu_{(s)}$, $Na_2CO_{3(s)}$].

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PART 1: MULTIPLE CHOICE SECTION (30% of paper)

Answer questions in Part 1 on the **separate Multiple Choice Answer Sheet** provided, using a 2B, B or HB **pencil**. Each question in this part is worth 2 marks.

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1. Which one of the following **electron configurations** represents a neutral atom in an **excited** state?

   A $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$
   B $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
   C $1s^2 2s^2 2p^4 3s^2$
   D $1s^2 2s^2 2p^6 3s^2 3p^4$

2. An atom has the ground state electron configuration $1s^2 2s^2 2p^6 3s^2$.
   The electron configuration of the **next atom** in the same group on the Periodic Table would be -

   A $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
   B $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$
   C $1s^2 2s^2 2p^6 3s^2 3p^2$
   D $1s^2 2s^2 2p^6 3s^2 3p^1$

3. An element is a shiny solid at room temperature and pressure that conducts electricity. It reacts with dilute sulfuric acid to produce hydrogen gas and a pale green solution. This pale green solution changes to yellow when an oxidant is added. The **element** is most likely to be -

   A mercury
   B copper
   C iron
   D iodine

4. The successive **ionisation energies** for an element, E, are shown below.

Reaction	**Energy (kJ mol^{-1})**
To form E^+ from E	1012
To form E^{2+} from E^+	1903
To form E^{3+} from E^{2+}	2914
To form E^{4+} from E^{3+}	4958
To form E^{5+} from E^{4+}	6276
To form E^{6+} from E^{5+}	21270
To form E^{7+} from E^{6+}	25400
To form E^{8+} from E^{7+}	29860

   Element E is most probably:

   A aluminium
   B phosphorus
   C nitrogen
   D chlorine

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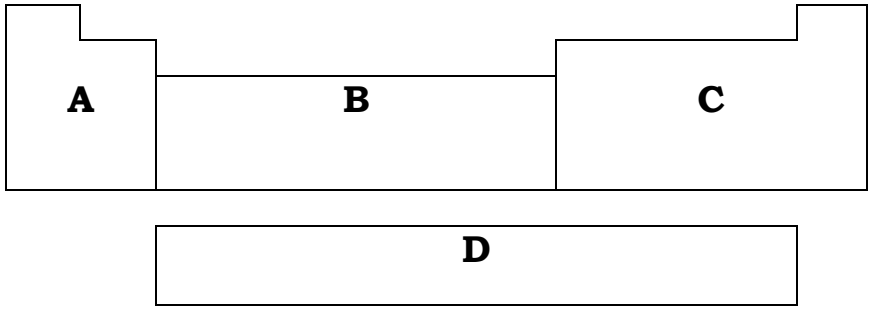
5. Four sections of the periodic table have been labelled A, B, C and D.



The section that has progressive filling of ***f* orbitals** is -

A **A**
B **B**
C **C**
D **D**

6. The amount of arsenic in a poison can be determined by precipitation of the arsenic as its sulphide, As_2S_3. If 0.246 g of As_2S_3 is obtained from 1.50 g of poison, then the **percentage by mass of arsenic** in the poison is -

A 1.50%
B 1.00%
C 4.99%
D 10.0%

7. The waste water produced by a paper mill contains NaOH at a concentration of 2.0 mol L^{-1}. What is the **volume** of HCl(aq) of pH = 1 that you would have to add to 500 L of waste water to raise its pH to 7?

A 1.0×10^4 L
B 1.0×10^3 L
C 7.0×10^3 L
D 5.0×10^2 L

8. 0.380 mol of an organic compound has a mass of 44.8 g. Its empirical formula is $C_2H_3O_2$. What is its **molecular formula**?

A $C_2H_3O_2$
B $C_4H_6O_4$
C $C_3H_4O_3$
D $C_4(H_2O)_3$

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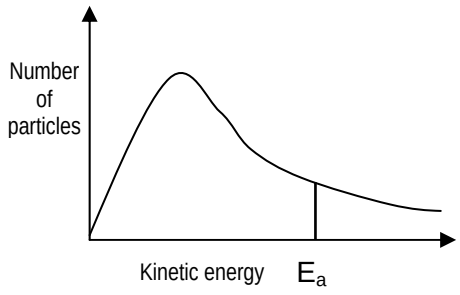
9. Which one of the following is a **secondary alcohol**?

A Ethanol
B Methoxymethane
C 3-pentanol
D 1,2-ethanediol

10. Which one of the following does **not** represent a pair of **isomers**?

A Ethyl butanoate and butyl ethanoate
B 2-methyl-2-propanol and 2-butanol
C *Cis*-1,2-difluoro-1-butene and *trans*-1,2-difluoro-1-butene
D 2-methylhexane and 5-methylhexane

The diagram below is a **kinetic energy distribution curve** for a reaction showing the activation energy.



11. If a **catalyst** was added, what effect, if any, would this have on the system?

A The peak energy distribution curve would be shifted to the left.
B The peak energy distribution curve would be shifted to the right.
C The activation energy required would be raised so that fewer molecules would collide successfully.
D The activation energy required would be lowered so that more molecules would collide successfully.

12. Select the correct description of the **cathode** and **cathode reaction** in an aluminium smelter pot.

	CATHODE	CATHODE REACTION
A	Carbon lined steel tank	$Al^{3+}_{(aq)} + 3e^- \longrightarrow Al_{(l)}$
B	Graphite blocks	$C_{(s)} + 2O^{2-}_{(l)} \longrightarrow CO_{2(g)} + 4e^-$
C	Steel tank lined with graphite	$Al^{3+}_{(l)} + 3e^- \longrightarrow Al_{(l)}$
D	Brick lined steel tank	$C_{(s)} + 2O^{2-}_{(aq)} \longrightarrow CO_{2(g)} + 4e^-$

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13. Which one of the following reactions would **not go in the forward direction** to any appreciable extent?

A $3Sn^{4+}(aq) + 2Cr(s) \rightarrow 3Sn^{2+}(aq) + 2Cr^{3+}(aq)$
B $2Ag^{+}(aq) + Cu(s) \rightarrow 2Ag(aq) + Cu^{2+}(aq)$
C $Sn^{4+}(aq) + 2Fe^{2+}(aq) \rightarrow Sn^{2+}(aq) + 2Fe^{3+}(aq)$
D $2Cu^{+}(aq) \rightarrow Cu^{2+}(aq) + Cu(s)$

14. The **emf (cell voltage)** of an electrochemical cell constructed using standard Ni^{2+}/Ni and Sn^{4+}/Sn^{2+} half cells would be

A 0.41 V, with the Ni electrode positive
B 0.41 V, with the Pt electrode positive
C 0.11 V, with the Ni electrode positive
D 0.11 V, with the Pt electrode positive

15. Which one of the following is a **conjugate acid-base pair**?

A HNO_3 and H_2O
B HNO_3 and NO_3^-
C NH_3 and OH^-
D H_3O^+ and OH^-

The following information refers to the next three questions.

The reactions taking place when a lead-acid accumulator delivers electricity are described by the equations:

Negative electrode: $Pb(s) + SO_4^{2-}(aq) \rightarrow PbSO_4(s) + 2e^-$
Positive electrode: $PbO_2(s) + 4H^+(aq) + SO_4^{2-}(aq) + 2e^- \rightarrow PbSO_4(s) + 2H_2O(l)$

16. As the accumulator **produces electricity**,

A the concentration of H_2SO_4 decreases.
B the number of ions in the solution increases.
C Pb is deposited at the negative electrode
D PbO_2 is precipitated

17. While the accumulator is being **recharged**,

A PbO_2 is formed at the positive electrode.
B Pb is oxidised to PbO_2.
C Pb is oxidised to $PbSO_4$.
D SO_4^{2-} is reduced to H_2SO_4.

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18. As the accumulator is being **recharged**, a gas is also evolved at the positive electrode. The equation which best describes the process most likely to produce the gas is

A $2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-$
B $2H^+(aq) + 2e^- \rightarrow H_2(g)$
C $SO_4^{2-}(aq) \rightarrow SO_2(g) + O_2(g) + 2e^-$
D $2H_2O(l) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$

19. The combustion of **butane** can be described by the equation

$C_4H_{10}(g) + 6½O_2(g) \rightarrow 4CO_2(g) + 5H_2O(l) \quad \Delta H = -2880 \text{ kJ mol}^{-1}$ butane

In this reaction

A 2880 kJ of energy is absorbed for each mole of butane that reacts.
B 2880 kJ of energy is released for each mole of oxygen that reacts.
C 1440 kJ of energy is absorbed for each mole of water that is produced.
D 720 kJ of energy is released for each mole of carbon dioxide that is produced.

20. The equation below represents a reaction in the extraction of chromium from its ore.

$$2Fe_2O_3.Cr_2O_3 + 4Na_2CO_3 + 3O_2 \rightarrow 2Fe_2O_3 + 4Na_2CrO_4 + 4CO_2$$

Which one of the following statements about the **oxidation states (numbers)** of the substances is correct?

A The carbon has been oxidised from a +2 state to a +4 state.
B The iron has been reduced from a +3 state to a +2 state.
C The chromium has been oxidised from a +3 to a + 6 state.
D There is no change in the oxidation state of any of the substances in the reaction.

21. Which one of the following is **least** important in making potassium dichromate a good **primary standard** for oxidation-reduction titrations?

A The coloured solution makes the meniscus easy to see in the burette.
B It is stable and available in very high purity.
C It will oxidise a wide variety of chemical compounds
D The reduced form of the reagent is readily distinguished by its green colour.

22. A catalyst is used in the industrial production of $SO_3(g)$ from $SO_2(g)$ and $O_2(g)$. The **best description** of the effect of a **catalyst** is that it

A increases the proportion of $SO_3(g)$ in the mixture at equilibrium.
B increases the rate of oxidation of $SO_2(g)$.
C decreases the rate of reduction of $SO_3(g)$.
D increases both the rate of oxidation of $SO_2(g)$ and the rate of reduction of $SO_3(g)$.

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23. Which one of the following substances is used to control the **pH** in the extraction of gold by the **carbon-in-pulp process**?

A Sodium cyanide
B Oxygen
C Activated carbon
D Sodium hydroxide

24. If the hydroxide ion concentration in an egg white is $10^{-6.48}$ mol L^{-1}, the **pH** of the egg white is

A 2.16
B 6.48
C 7.52
D 11.8

25. Which one of the following statements **best explains** why sodium hydroxide has a higher melting point than ammonia?

A The bonding in sodium hydroxide is stronger than the bonding in ammonia.
B Sodium hydroxide has ionic and covalent bonds whereas ammonia only has covalent bonds.
C The intermolecular dispersion forces and hydrogen bonding in ammonia are weaker than the ionic bonds in sodium hydroxide.
D The molar mass of sodium hydroxide (39.998) is much higher than the molar mass of ammonia (17.034)

26. Which one of the following species acts as an **acid** when ammonia gas is bubbled through an aqueous solution of potassium chloride?

A H_2O
B Cl^-
C NH_3
D None of the above because it is not an acid-base reaction.

27. Which list of chemicals contains **all amphoteric** substances?

A	Zn	$Cu(NH_3)_4^{2+}$	$Al(OH)_3$
B	Cr_2O_3	Zn	Al_2O_3
C	NiO	CuO	$Zn(NH_3)_4^{2+}$
D	$Cu(NH_3)_4^{2+}$	$Zn(NH_3)_4^{2+}$	$Al(OH)_4^-$

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28. Which one of the following substances will have a **pH greater than 7** when dissolved in water?

A Calcium nitrate
B Potassium ethanoate
C Ammonium bromide
D Magnesium hydrogensulfate

29. Why is **cryolite** used in the Hall-Heroult smelting process for aluminium extraction?

A Cryolite, Na_3AlF_6, contains aluminium making it easier to extract.
B Cryolite lowers the melting point of the mixture to about 1000°C so less electrical energy is required.
C Cryolite reacts with the alumina to produce more heat so less electricity is required.
D Cryolite helps to remove silica impurities and is an ionic substance that will conduct electricity when molten

30. Which one of the following substances contain **four lone pairs of electrons** (i.e. unshared or non-bonded pairs) in its valence shells?

A Water
B Carbon dioxide
C Ammonium ion
D Chloroethane

END OF PART 1

PART 2: SHORT ANSWER SECTION (35% of paper)

Answer questions in Part 2 in the spaces provided below.

1. Write equations for any reactions that occur in the following situations. If no reaction occurs write **"*no reaction*"**. In each case describe ***in full*** what you would observe, including any colours, odours, precipitates (give the colour), gases evolved (give the colour or describe as colourless).

   Your equations should refer only to the actual species involved.
   These species may be **ions** [for example $Ag^{+}_{(aq)}$], **molecules** [for example $NH_{3(g)}$, $NH_{3(aq)}$, $CH_3COOH_{(l)}$, $CH_3COOH_{(aq)}$] or **solids** [for example $BaSO_{4(s)}$, $Cu_{(s)}$, $Na_2CO_{3(s)}$].

(a) Ethanal is treated with an acidified potassium permanganate solution.

EQUATION: _____

_____

_____

OBSERVATION: _____

_____

[3 marks]

(b) Solid aluminium oxide is treated with excess sodium hydroxide solution.

EQUATION: _____

OBSERVATION: _____

[3 marks]

(c) An ammonia solution is added dropwise into a copper sulfate solution until it is in excess [two equations and associated observations are required].

EQUATIONS: _____

_____

_____

OBSERVATIONS: _____

_____

_____

[4 marks]

(d) Nickel pellets are dropped into a warm solution of chromium(III) nitrate.

EQUATION: _____

OBSERVATION: _____

[2 marks]

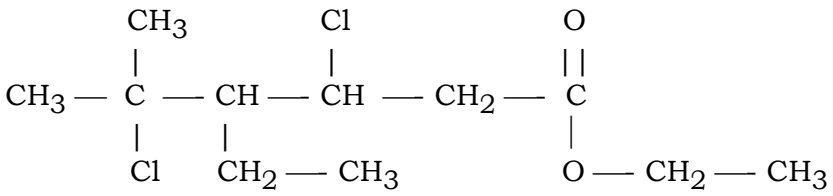
SEE NEXT PAGE

2. For each of the following write either a **FORMULA** or a **NAME** in the space provided.

DESCRIPTION	***Formula or Name***
A crystalline dicarboxylic acid that is used in acid-base and redox titrations as a primary standard.	
A metal that forms covalent compounds with non-metals.	
A gas produced in the electrolysis of molten sodium chloride.	
The monomer used to make polythene tubing.	
An alcohol with three hydroxyl groups.	
A solid covalent substance that conducts electricity.	
A negatively charged complex ion.	
A gas that when dissolved in water has a bleaching effect.	
A metal ion that has the electron configuration – $1s^2 2s^2 2p^6 3s^2 3p^6$.	
A polymer that is used to produce pipes for drainage and reticulation of gardens and also to make imitation leather lounge suites.	

[5 marks]

3. (a) Write the **name** for the following compound:



_____ [2 marks]

(b) **Draw** the **structure** of the following compound (include all atoms):

trans-pent-2-ene-2,3-diol

[2 marks]

4. Explain why carboxylic acids have a **higher boiling point** than alcohols of similar relative molecular mass.

[2 marks]

5. For each species listed in the table below:
   (a) draw **electron dot diagrams** showing **all** valence shell electron pairs
   [for example, H **:** Cl **:**].
   (b) draw a sketch or name the **shape** of the chemical.

Species	**Electron dot diagram**	**Shape (sketch or name)**
BF_3		
CS_2		
PCl_4^+		

[6 marks]

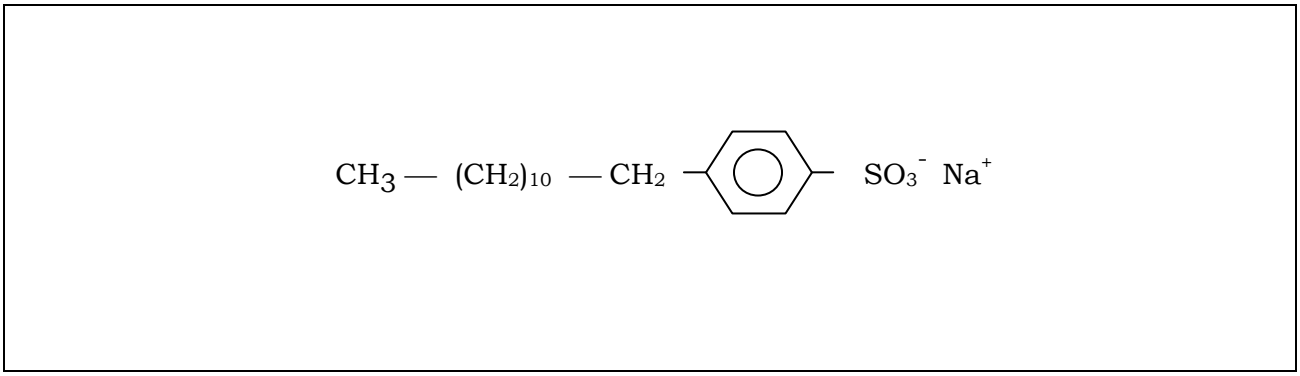
6. (a) **Sketch** all the isomeric dichlorobenzenes in the table below.
(b) Give the IUPAC **name** for each one.
(c) Indicate which are **polar** and which are **non-polar** molecules.

Sketch	Name	Polar/Non-polar

[9 marks]

7. In the box below is a sketch of the detergent, sodium dodecylbenzenesulfonate.
(a) **Draw a circle** around the polar or hydrophilic end of the surfactant ion.
(b) **Draw a box** around the part of the surfactant ion that dissolves in grease.

[2 marks]



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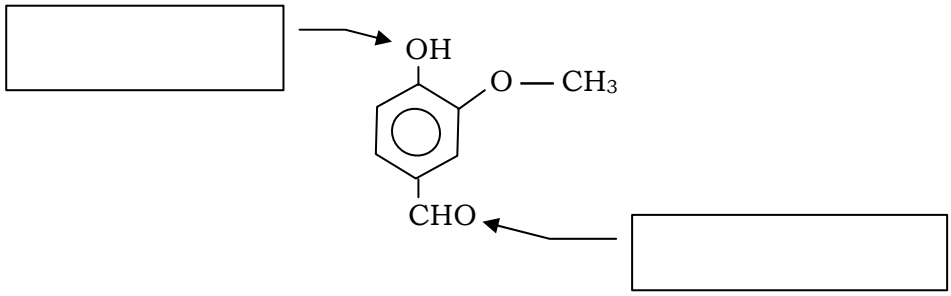
8. Identify the **functional groups** that are shown by arrows in the compound, vanillin, which is responsible for vanilla flavour. Write your answers in the boxes provided.



[2 marks]

9. Three solutions of calcium hydroxide were prepared in different flasks using in each case a slight excess of calcium hydroxide, so that some remained undissolved. The system in each case is represented by the equilibrium -

$$Ca(OH)_{2(s)} \rightleftharpoons Ca^{2+}{}_{(aq)} + 2OH^{-}{}_{(aq)}$$

The solutions were then used in the three experiments described below. Write down the equilibrium constant expression for the reaction and in the table state how the equilibrium will shift, and what will be observed in each case.

Equilibrium constant expression

[2 marks]

Experiment	How the equilibrium shifts [shifts right, shifts left or no change]	Observations
A small amount of 10 mol L^{-1} HCl was added to flask 1.		
A small amount of concentrated NaOH(aq) was added to flask 2.		
A small volume of gaseous CO_2 was bubbled through the solution in flask 3.		

[6 marks]

SEE NEXT PAGE

10. Three experiments were performed by passing electricity through different electrolytes using different electrodes. The electrolytes and electrodes used are shown in the table below. Complete the table by writing the **oxidation and reduction half equations** which are most likely to occur at the anode and cathode.

Expt No.	**Electrolyte**	**Electrodes**	**Half-reactions at:**	
			cathode	**anode**
1	1 mol L^{-1} $CuSO_4(aq)$	carbon		
2	KBr(l)	platinum		
3	A mixture of 1 mol L^{-1} $AgNO_3(aq)$ and 1 mol L^{-1} $Cd(NO_3)_2(aq)$	platinum		

[6 marks]

11. A student wishes to standardise an **ethanoic acid** solution by using **sodium hydroxide** as a **primary** standard.

(a) Why is NaOH(s) not suitable as a primary standard? _____

_____

_____

_____

(b) What indicator should be used if the student goes ahead with the experiment? Give a reason.

_____

_____

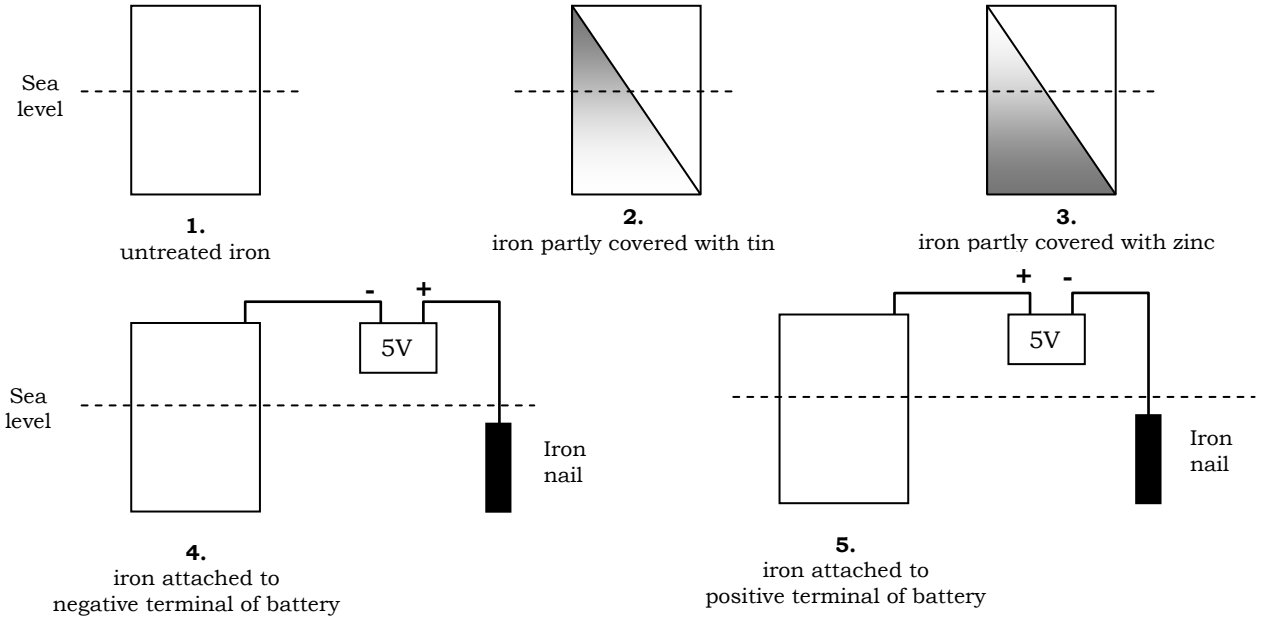
_____

_____

[4 marks]

SEE NEXT PAGE

12. A group of students decided to conduct a mini-research project on **methods of preventing corrosion** of iron structures in a salt water environment. A number of iron plates, numbered 1 to 5, were placed in sea water as shown below.



(a) What two plates showed the **least** degree of corrosion? Give reasons.

_____

_____

_____

_____

_____

_____

(b) What two plates showed the **greatest** degree of corrosion? Give reasons.

_____

_____

_____

_____

_____

_____

(c) Which plate is the "**control**" for the experiment?

_____

[7 marks]

13. The Bayer process is used by Alcoa to separate alumina from aluminium ore at several refineries in WA. Answer the following questions about this process.

Question	Answer
(a) What is the name of the **aluminium ore** found in the Darling Range near Perth?	
(b) What is the equation for the first stage of the separation process which is called the **digestion** stage?	
(c) Why is there **no** aluminium smelter in WA when we have so much aluminium ore?	

[3 marks]

END OF PART 2

PART 3: CALCULATIONS SECTION (25% of paper)

The calculations are to be ***set out in detail*** in this Question/Answer Booklet. Marks will be allocated for correct equations and clear setting out, even if you cannot complete the problem. When questions are divided into sections labelled (a), (b), etc you **must** answer in the sections labelled (a), (b), etc. You ***must*** correct final numerical answers to three (3) significant figures *where appropriate*, and you ***must*** provide units where applicable. Information which may be necessary for solving the problems is located on the separate Chemistry Data Sheet.

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1. An unknown organic compound taken from some decaying matter is thought to be either an amino acid or an amine.

   Qualitative analysis shows that the compound definitely contains carbon, hydrogen, nitrogen and *maybe* oxygen.

   A 3.845 g sample of the unknown compound was burnt in a plentiful supply of oxygen and yielded 7.678 g of CO_2 and 4.715 g H_2O.

   Another 5.683 g sample was treated so that all the nitrogen in the compound was converted into ammonia. The mass of NH_3 recovered was 2.196 g.

   (a) Determine the **empirical formula** of the unknown compound.

   [6 marks]

(b) When 1.250 g of the unknown compound is vaporised it occupies 343 mL at 27°C and 103.0 kPa pressure.
Use this information to find the relative **molecular mass** of the compound.
[2 marks]

(c) What is the **molecular formula** of the compound.
[2 marks]

(d) A chemical data book suggests that it could be putrescine, one of the chemicals associated with decaying flesh and spectroscopic analysis indicates amino groups are present. **Draw two** possible isomers and **name** them.
[2 marks]

SEE NEXT PAGE

2. A chemist working for a petroleum company has to determine the *Bromine Number* of a high density lubricating oil. *Bromine Number* is a measure of the number of double bonds in the carbon compounds in the oil. It is usually expressed in milligrams of Br_2 per gram of oil.

Bromine reacts with the carbon-carbon double bonds by an addition reaction. To make certain that complete reaction has taken place, the amount of excess Br_2 left over after the reaction is determined by titration with a standard sodium thiosulfate solution in basic solution.

$$Na_2S_2O_3(aq) + 4Br_2(aq) + 10NaOH(aq) \rightarrow 2Na_2SO_4(aq) + 8NaBr(aq) + 5H_2O(l)$$

or $$S_2O_3^{2-}(aq) + 4Br_2(aq) + 10\ OH^-(aq) \rightarrow 2SO_4^{2-}(aq) + 8Br^-(aq) + 5H_2O(l)$$

The chemist takes 7.75 mL of the high density motor oil (density, 1.60 g mL^{-1}) and adds 25.0 mL of 0.200 mol L^{-1} Br_2 solution to carry out the addition reaction. After the reaction is completed, back-titration of the excess Br_2 required 10.60 mL of 0.0250 mol L^{-1} sodium thiosulfate solution.

(a) Calculate the number of **moles of Br_2 initially added** to the oil.

[1 mark]

(b) Calculate the number of **moles of Br_2** involved in the titration with **$Na_2S_2O_3(aq)$**.

[2 marks]

SEE NEXT PAGE

(c) Calculate the ***Bromine Number*** of the oil and express the answer in **mg Br_2 per g of oil.**

[6 marks]

3. An antacid tablet weighs 1.3259 g. The only acid-neutralising ingredient in this brand of antacid is $CaCO_3$. When placed in 12.07 mL of 1.070 mol L^{-1} HCl, the tablet fizzes rapidly as $CO_2(g)$ is given off.

After all of the CO_2 has left the solution, an indicator is added, and then 11.74 mL of 0.5310 mol L^{-1} NaOH is added. The indicator shows that, at this point, the solution is definitely basic.

Addition of 5.12 mL of 1.070 mol L^{-1} HCl makes the solution acidic again.

Then, 3.17 mL of the 0.5310 mol L^{-1} NaOH brings the titration *exactly* to an endpoint, as shown by the indicator.

Calculate the **percentage by mass** of $CaCO_3$ in the tablet.

[7 marks]

SEE NEXT PAGE

SEE NEXT PAGE

4. An electrochemical cell $Zn(s)/Zn^{2+}(aq)||Ag^{+}(aq)/Ag(s)$ is constructed using a completely immersed zinc electrode that weighs 32.65 g and a silver electrode immersed in 855 mL of a 1.35 mol L^{-1} $AgNO_3$ solution.
A steady current of 0.0718 A is drawn from the cell as the electrons move from one electrode to the other through the external circuit.

(a) Write down the **oxidation and reduction half equations**.

[2 marks]

(b) Which reactant is the **limiting reagent** in this cell? [working must be shown]

[3 marks]

(c) How **long** does it take for the cell to be completely discharged?

[3 marks]

(d) What is the **gain in mass** at the cathode?

[3 marks]

(e) What is the **concentration of the $Ag^+(aq)$** when the cell is completely discharged?

[3 marks]

SEE NEXT PAGE

5. The reaction

$$4HF(aq) + SiO_2(s) \rightarrow SiF_4(g) + 2H_2O(l)$$

can be used to release gold that is found in certain quartz (SiO_2) veins of hydrothermal origin. Assume that you mine 2.00 tonne of quartz ore that contains an average of 1.00×10^{-2} % gold by mass and that the gold has a market value of $546 per troy ounce (1 troy ounce = 31.3 g).

Will the process be **economically feasible** if commercial (50.0% by mass) aqueous hydrogen fluoride (density = 1.17 g mL^{-1}) costs 25 cents per litre?
Express your answer as a profit or loss per tonne of quartz ore mined.

[8 marks]

END OF PART 3

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PART 4: EXTENDED ANSWER SECTION (10% of paper)

Answer ONE of the following extended answer questions. Where applicable use equations, diagrams and illustrative examples of the chemistry you are describing.

Marks are awarded principally for the relevant chemical content of your answer, but you will lose marks if what you write is unclear or lacks coherence.
Your answer should be presented in about 1½ to 2 pages.
Begin your answer on the next page and remember to **use a pen**.

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1. One of the most important techniques in analytical chemistry is **volumetric analysis where titrations are used** to find the concentrations of unknown solutions. Much care has to be exercised as the amounts of active reagents are generally extremely small.
Choose ONE of the following titration examples and use it to describe the experimental techniques used in a typical volumetric titration.

   (a) Finding the percentage of iron in steel wire.
   (b) Finding the amount of ethanoic acid in vinegar.

   Set out your answer using the following sub-headings:
   Cleaning glassware.
   Steps and techniques used.
   List of calculation steps used to work out your answer – there is no need to use any numerical data.

   [20 marks]

OR

2. A chemistry teacher has a jar on the front bench labelled *Lucky Dip- Mission Usually Possible*. It contains chocolate frogs and other goodies to give to any student who wants one to eat at lunchtime. The only problem is that wrapped around each *goodie* is a chemical challenge that has to be answered before they receive the edible prize.

   Your mission, should you choose to accept it, is to **prepare brief answers to ALL of the three tasks below** which would assist you to do a five minute presentation during class. Include as much detail as time permits.

   Task 1: In terms of structure and bonding explain the electrical conductivity of metallic, ionic, covalent molecular and covalent network substances. Use examples to assist your explanations.

   Task 2: Isomers and polymers both end in –mers. Explain these terms.

   Task 3: How would you conduct a chemical test to distinguish between ethanol, 2-propanol and 2-methyl-2-propanol?

   [20 marks]

END OF PART 4

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END OF EXAMINATION PAPER