1993

CHEMISTRY

UNIT 3

TRIAL EXAM

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VCE CHEMISTRY 1993

CAT 1: Chemistry in a Practical Context

SECTION A. MULTIPLE CHOICE ANSWER SHEET

ABSENT

SURNAME
GIVEN NAME(S)
STUDENT NUMBER

How to complete this form

Please use an **HB PENCIL** only.
If you make a mistake, **ERASE** the incorrect answer.
DO NOT just cross it out.

Enter your Student Number in the box above.

All answers must be completed with a single pencil mark.
ONLY ONE answer per line.

Instructions

Complete **ALL** the questions.

Marks will **NOT** be deducted for incorrect answers.

NO mark will be given if more than **ONE** answer is completed for any question.

USE HB PENCIL ONLY.

	One answer per line		*One answer per line*	
1	A B C D	11	A B C D	
2	A B C D	12	A B C D	
3	A B C D	13	A B C D	
4	A B C D	14	A B C D	
5	A B C D	15	A B C D	
6	A B C D	16	A B C D	
7	A B C D	17	A B C D	
8	A B C D	18	A B C D	
9	A B C D	19	A B C D	
10	A B C D	20	A B C D	

Please DO NOT fold, bend or staple this form

DETACH THIS ANSWER SHEET AT THE START OF THE EXAMINATION

CHEMISTRY ASSOCIATES STUDENT NUMBER _____

CHEMISTRY CAT 1 TRIAL
CHEMISTRY IN A PRACTICAL CONTEXT
(not to be used before Monday May 31, 1993)
Time allowed for test = 90 minutes.

CHEMISTRY CAT 1 TRIAL
CHEMISTRY IN A PRACTICAL CONTEXT

Structure of examination paper: Number of booklets = 1
Number of Sections = 2

Directions to students

Materials
Question and answer booklet of 18 pages, including data tables on page 2.
Multiple choice answer sheet.
An approved calculator may be used.

The task
Answer all items from Section A.
Section A items should be answered on the multiple-choice answer sheet provided.
Answer all questions from Section B.
Section B questions should be answered in this booklet in the spaces provided following each question.
All written responses should be in English.

At the end of the task
Please ensure that you write your **student number** in the space provided on this booklet and your **name and student number** in the space provided on the multiple-choice answer sheet.
Place the multiple-choice answer sheet inside the back cover of this booklet and hand them in.

SPECIFIC INSTRUCTIONS FOR SECTION A

(1) Section A, Question 1, consists of 20 multiple choice items and is worth 20 marks and therefore about 33% of the total marks available for this examination.You should therefore spend about 30 minutes on Section A.

(2) Choose the response you consider is correct or best, and mark your choice on the Multiple Choice Answer Sheet according to the instructions on that sheet.

(3) A correctly answered item scores 1, an incorrect item scores 0. No credit will be given for an item if two or more letters are marked for that item. Marks will NOT be deducted for incorrect answers and you are urged to attempt every item.

DATA

TABLE 1: RELATIVE ATOMIC MASS ($^{12}C = 12.00$)

Element	Symbol	Atomic No.	Relative Atomic Mass
Aluminium	Al	13	27.0
Barium	Ba	56	137.3
Bromine	Br	35	79.9
Calcium	Ca	20	40.1
Carbon	C	6	12.0
Chlorine	Cl	17	35.5
Copper	Cu	29	63.5
Iron	Fe	26	55.9
Hydrogen	H	1	1.0
Lithium	Li	3	6.9
Magnesium	Mg	12	24.3
Nitrogen	N	7	14.0
Sodium	Na	11	23.0
Oxygen	O	8	16.0
Phosphorus	P	15	31.0
Silver	Ag	47	107.9
Sulfur	S	16	32.1
Strontium	Sr	38	87.6
Zinc	Zn	30	65.4

TABLE 2: PHYSICAL CONSTANTS

Avogadro Constant (N_A)	6.023×10^{23} mol^{-1}
Gas Constant (R)	8.31 J K^{-1} mol^{-1}
Molar Volume of gas at STP	22 400 cm^3 mol^{-1} = 22.4 dm^3 mol^{-1}
Pressure	1 atmosphere = 101 325 Pa
Ionisation constant of water	$K_w = 1 \times 10^{-14}$

SECTION A QUESTION 1

Item 1

During a school laboratory practical experiment, a flask was filled with concentrated sodium hydroxide. During the filling there was a major spill of the alkali so that it spilled over the bench and some ran down on to the floor. The best method for safely removing the spilled alkali would be to

A. cover the spill with concentrated sulphuric acid before collecting and washing down the sink.

B. cover the spill with vinegar before collecting and washing down the sink.

C. cover the spill with common salt before collecting and washing down the sink.

D. mop up the spill with paper towelling and place in the waste paper basket.

Item 2

In an acid-base titration, 0.0500 M H_2SO_4 is in a 50 cm^3 burette. An approximately 0.1 M solution of sodium hydroxide is to be added to the titration flask using a pipette so that the concentration of the sodium hydroxide solution can be determined by titration. The most appropriate volume for the pipette is

A. 2.00 cm^3

B. 5.00 cm^3

C. 10.00 cm^3

D. 20.00 cm^3

Item 3

A solution of 10.0 M hydrochloric acid was placed in a glass dish and left open to the air for several days. During this time, several 5 cm^3 portions of the solution were removed from the dish and the concentration of hydrogen ions present determined by titration with a standard solution of sodium carbonate. The hydrogen ion concentration of the solution in the dish was seen to decrease with time of exposure of the hydrochloric acid solution to the air. The most likely reason for this would be

A. evaporation of hydrogen chloride from the solution.

B. absorption of carbon dioxide from the air.

C. absorption of oxygen from the air.

D. reaction of hydrochloric acid with glass.

Item 4

An equilibrium mixture contains 1.25 mole of hydrogen gas, 2.0 mole of bromine gas and 0.50 mole of hydrogen bromide in a fixed volume, at a constant temperature. The equilibrium constant represented by the equation

$$H_2(g) + Br_2(g) = 2HBr(g)$$

is

A. 0.05

B. 0.1

C. 5.0

D. 10.0

Item 5

Both ammonia gas and nitrogen gas become liquids at low temperatures.
Liquid ammonia has a higher surface tension than liquid nitrogen because

A. ammonia molecules attract each other more strongly than nitrogen molecules.

B. nitrogen molecules attract each other more strongly than ammonia molecules.

C. it is easier to increase the surface area of the liquid ammonia than to increase the surface area of the liquid nitrogen.

D. the bonding inside the ammonia molecule is stronger than the bonding inside the nitrogen molecule.

Item 6

Which one of the following chemicals would reduce the surface tension of liquid water?

A. Na^+Cl^-

B. NH_3

C. $CH_3CH_2CH_2CH_2O^-Na^+$

D. H_2SO_4

Item 7

Ethane and ethene are both hydrocarbons containing two carbon atoms but undergo quite different chemical reactions. The reason for this difference is that

A. ethane contains six hydrogens while ethene contains only four hydrogens.

B. ethane has seven single covalent bonds while ethene has only four single covalent bonds.

C. ethane has no double covalent bonds while ethene has one double covalent bond.

D. ethane is a gas at room temperature and pressure while ethene is a liquid under these conditions.

Item 8

Which one of the following could **not** be produced from ethene by a simple chemical reaction ?

A. polyethylene

B. ethanol

C. dichloroethane

D. methanol

Item 9

The burning of ethene gas in excess air is best described by the chemical equation

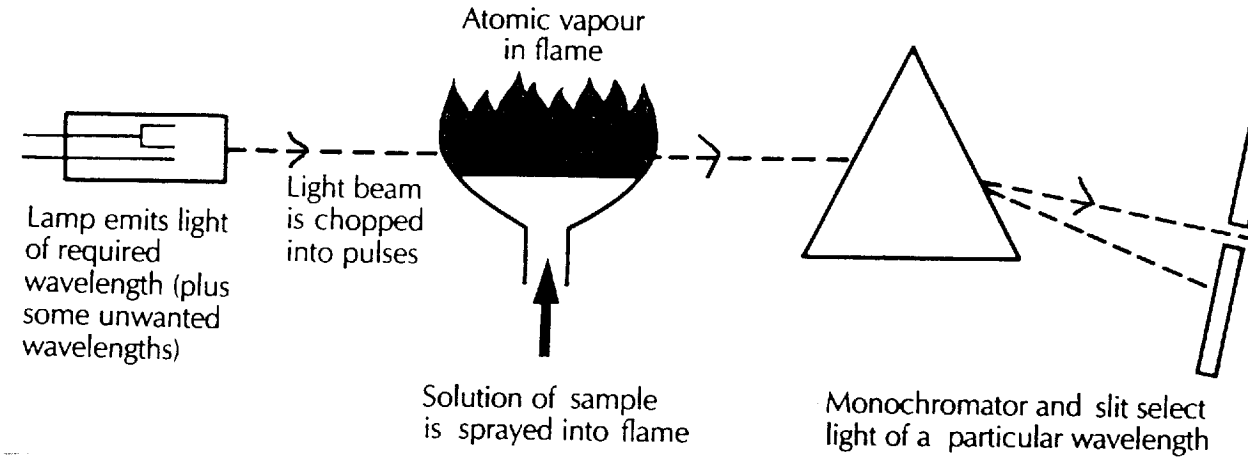
A. $2C_2H_6(g) + 7O_2(g) = 4CO_2(g) + 6H_2O(g)$

B. $2C_2H_6(g) + 5O_2(g) = 4CO(g) + 6H_2O(g)$

C. $C_2H_4(g) + 3O_2(g) = 2CO_2(g) + 2H_2O(g)$

D. $C_2H_4(g) + 2O_2(g) = 2CO(g) + 2H_2O(g)$

Items 10, 11 and 12 refer to the following diagram.



Item 10

The instrument above is best described as

A. a mass spectrometer.

B. an atomic absorption spectrometer.

C. a gas chromatograph.

D. a nuclear magnetic resonance spectrometer.

Item 11

When a solution of the sample is sprayed into the flame

A. all of the light is absorbed by the sample.

B. only a part of the light is absorbed by the sample.

C. light is emitted by the atomic vapour.

D. the atomic vapour moves in the direction of the arrow.

Item 12

The main function of this instrument is to

A. determine the quantity of a particular element in the sample.

B. determine the mass to charge ratio of ions in the sample.

C. determine the quantity of a particular molecule in the sample.

D. determine the ratio of atoms to ions in the sample.

Item 13

The chemical equilibrium $2CO(g) + O_2(g) = 2CO_2(g)$ $\Delta H = -564$ kJ mol^{-1}

is exothermic in the forward direction. In order to increase the fraction of carbon monoxide converted to carbon dioxide at equilibrium, a chemist should

A. raise both the temperature and the pressure.

B. raise the temperature and lower the pressure.

C. lower the temperature and raise the pressure.

D. lower both the temperature and the pressure.

The following information refers to items 14 and 15

20.0 cm^3 of a 0.0010 M solution of sodium hydroxide was added to a 2.00 dm^3 volumetric flask and the volume was made up to 2.00 dm^3.

Item 14
The hydroxide ion concentration in the resultant solution would be

A. 10^{-3} M

B. 2×10^{-3} M

C. 10^{-5} M

D. 2×10^{-5} M

Item 15
The pH of the resultant solution would be approximately

A. 9

B. 10^{-9}

C. 5

D. 10^{-5}

The following information refers to items 16 and 17

A small amount of manganese dioxide (a catalyst) is added to a solution containing 17g of hydrogen peroxide. A vigorous reaction occurs and oxygen gas is produced. The reaction proceeds to completion.

Item 16

When the reaction is completed, the volume of oxygen gas produced at STP would be

A. 2.8 dm^3

B. 5.6 dm^3

C. 11.2 dm^3

D. 22.4 dm^3

Item 17
The purpose of the manganese dioxide catalyst is to

A. increase the equilibrium constant of the reaction.

B. increase the energy required to start the reaction.

C. decrease the energy required to start the reaction.

D. increase the purity of the oxygen gas produced.

Item 18
In the production of nitric acid, an unwanted side reaction is the reaction of ammonia with oxygen to form nitrogen and water. Assuming that this reaction goes to completion, the mass of nitrogen that will be produced from 68 g of ammonia is

A. 7 g.

B. 14 g.

C. 28 g.

D. 56 g.

The following information refers to items 19 and 20

Potassium permanganate, $KMnO_4$, can be used to oxidise ethanol to acetic acid in the laboratory according to the partial equations:

$$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l) \text{ and}$$
$$C_2H_5OH(aq) + H_2O(l) \rightarrow CH_3COOH(aq) + 4H^+(aq) + 4e^-$$

Item 19

The element being oxidised in this reaction **and** the change in oxidation number of the element is

A. hydrogen; 0 to +1

B. oxygen; -2 to 0

C. carbon; -2 to 0

D. carbon; +2 to +4

Item 20

The mass of ethanol that will be oxidised to acetic acid by 50 cm^3 of 0.1M potassium permanganate is

A. 0.18 g

B. 0.23 g.

C. 0.29 g.

D. 0.36 g.

END OF SECTION A

CHEMISTRY TRIAL CAT 1
CHEMISTRY IN A PRACTICAL CONTEXT

SPECIFIC INSTRUCTIONS FOR SECTION B

(1) Section B consists of 6 short response questions, Questions 2 to 7, and is worth 40 marks and therefore about 67% of the total marks available for the CAT. You should therefore spend about 60 minutes on Section B. A suggested time allocation is given for each question and these time allocations are proportional to the marks available.

(2) Answer all questions.

(3) Answers must be written in the spaces following each question in this booklet.

(4) You should show all working in numerical questions. No credit can be given for incorrect answers unless they are accompanied by details of the working.

(5) Full credit will **not** be given for unsimplified answers. When stating an answer, appropriate precision (number of significant figures) must be used and the units included.

(6) When chemical symbols are used in equations they must be accompanied by correct symbols of state, for example $H_2(g)$ for hydrogen gas.

(7) Chemical equations must be balanced

Question 2 (1 + 2 + 2 = 5 marks, 8 minutes)
Although nitrogen is a very stable molecule, magnesium metal will react with nitrogen gas at high temperatures to produce magnesium nitride (Mg_3N_2)

a. Write a balanced equation for this reaction.

_____

_____

_____

_____

b. What mass of magnesium is needed to produce 100 g of magnesium nitride?

c. What ions would be present in the crystal structure of magnesium nitride?

SECTION B

Question 3 (10 marks, 15 minutes)

"Without sulfuric acid, the chemical industry would not have the flexibility that it requires."

Justify this statement by describing the properties of sulfuric acid and **relate these properties** to the many ways in which sulfuric acid is used. Use chemical equations where appropriate.

SECTION B

Question 4 (5 marks, 8 minutes)
List some of the properties of a water/oil emulsion and some of the properties of an oil/water emulsion.

Explain why a water/oil emulsion and an oil/water emulsion have different properties.

SECTION B

QUESTION 5 (6 marks, 9 minutes)

Methanol, CH_3OH, can be produced commercially by mixing carbon monoxide and hydrogen in a reaction vessel containing a mixture of the metal oxides Cr_2O_3 and ZnO.

In the reaction vessel, equilibrium is reached according to the equation:

$$CO(g) + 2H_2(g) = CH_3OH(g) \; ; \; \Delta H = -91 \text{ kJ mol}^{-1}.$$

For a particular synthesis at temperature T, the equilibrium concentrations of CH_3OH, H_2 and CO in the gas in the reaction vessel were: $[CH_3OH] = 4.00M$; $[H_2] = 0.50M$; $[CO] = 0.30M$.

(a) Calculate the equilibrium constant for the equation given above.

(continued)

QUESTION 5 (continued)

(b) What is the likely purpose of the mixture of Cr_2O_3 and ZnO in the reaction vessel?

(c) Suggest two methods whereby the equilibrium yield of methanol from this process could be increased.

SECTION B

Question 6 (7 marks, 10 minutes)

A laboratory receives a sample of ore containing copper only in the form of copper carbonate, $CuCO_3$. 15.00 g of the ore is reacted with 20.0 cm^3 of 0.250 M H_2SO_4(aq) and the resultant mixture is allowed to stand until reaction is complete. All of the carbon dioxide produced is removed from the solution by heating. The resultant solution is then titrated with a 0.250 M solution of NaOH(aq), and 20.60 cm^3 of the NaOH solution is required to neutralise exactly the remaining acid.

Calculate the percentage by mass of copper in the sample of copper ore.
(You may assume that $CuCO_3$ is the only substance in the ore that reacts with the acid.)

SECTION B

Question 7 (7 marks, 10 minutes)
Below is a flow chart which shows the reactants, products and processes involved in the production of pure copper from copper ore.

copper ore

process A

$CuFeS_2$

process B

Cu_2S

process C

copper matte

process D

blister copper

process E

pure copper

Identify each of the processes A, B, C, D and E.

Use chemical equations where appropriate.

_____

_____

_____

_____

_____

_____

_____

(continued)

Question 7 (continued)

END OF 1993 VCE CHEMISTRY TRIAL CAT 1

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SUGGESTED SOLUTIONS

QUESTION 1

ITEM 1 ANS B
Vinegar is acetic acid - a weak acid. In large quantities, it will neutralise the sodium hydroxide. Sulfuric acid must not be used since it is so corrosive. Common salt, sodium chloride, will not react with the sodium hydroxide. Spills of alkalis and acids must be neutralised before disposal takes place.

ITEM 2 ANS D
It requires two mole of sodium hydroxide to react with one mole of sulfuric acid as shown in the equation: $H_2SO_4(aq) + 2NaOH(aq) = Na_2SO_4(aq) + 2H_2O(l)$.
The concentration of the sodium hydroxide is double that of the sulfuric acid. Hence, the volume of sodium hydroxide will be approximately the same as the volume of sulfuric acid. Therefore, the most appropriate volume for the pipette is 20 cm^3 so that errors involved in the titration will be kept to a minimum.

ITEM 3 ANS A
Concentrated hydrochloric acid is a solution of hydrogen chloride gas in water. This gas can evaporate from the solution, thereby lowering the concentration of the acid.
The equation is: $HCl(aq) = HCl(g) + aq$.

ITEM 4 ANS B
Since there are equal numbers of mole of gas on both sides of the equation, the volume is not required to determine the equilibrium constant.

$$K = \frac{(0.5)^2}{(1.25 \times 2.0)} = \frac{0.25}{2.5} = 0.1$$ **ANS**

ITEM 5 ANS A
A liquid has a high surface tension when a large amount of energy is required to increase the surface area of the liquid by bringing more molecules from 'inside' the liquid to the surface. An increase in surface area will be more difficult to achieve when there is a strong force of attraction between the molecules. Ammonia molecules attract each other with hydrogen bonding while nitrogen molecules have only weak dispersion forces between them.

ITEM 6 ANS C
Surface tension is reduced in water when a molecule is added that has one polar (charged) end and one non-polar end. The polar end is attracted to the water while the non-polar end is repelled. Hence, the surface of the water is covered by molecules with only weak forces of attraction between them. Therefore, the surface tension is reduced.

ITEM 7 ANS C
It is the double covalent bond which gives ethene its characteristic properties. Ethene tends to undergo addition reactions in which the double bond is removed and replaced with single covalent bonds. For example: $C_2H_4(g) + H_2O(g) = C_2H_5OH(g)$. On the other hand ethane reacts by substitution and the hydrogen atoms are replaced by other atoms.
For example: $C_2H_6(g) + Cl_2(g) = C_2H_5Cl(g) + HCl(g)$.

SUGGESTED SOLUTIONS

ITEM 8 ANS D

Methanol is CH_3OH. It contains only one carbon atom. Since the formula of ethene is C_2H_4 , it would require a complex reaction to produce methanol. On the other hand, polyethylene, ethanol and dichloroethane are easily produced by the following reactions:

(1) $nC_2H_4(g) = (C_2H_4)_n(s)$

(2) $C_2H_4(g) + H_2O(g) = C_2H_5OH(g)$

(3) $C_2H_4(g) + Cl_2(g) = C_2H_4Cl_2(g)$

ITEM 9 ANS C

Ethene has the formula C_2H_4 and in the presence of **excess** air, carbon dioxide will be produced. Equation C is the balanced chemical equation.

ITEM 10 ANS B

This is an atomic absorption spectrometer. As the name implies, it uses the principle of absorption of light by atoms in the gas phase.

ITEM 11 ANS B

When light of the required wavelength passes through the sample, the amount of light absorbed depends on the amount of the particular element present. Hence, in general, only a part of the light is absorbed by the sample.

ITEM 12 ANS A

An atomic absorption spectrometer measures the quantity (often in parts per million) of an element present in the flame.

ITEM 13 ANS C

Since this is an exothermic reaction in which the number of mole of gas decreases, the amount of product (carbon dioxide) at equilibrium can be increased by lowering the temperature and raising the pressure.

ITEM 14 ANS C

The concentration of hydroxide ions = $\frac{n}{V} = \frac{0.001 \times 0.02}{2} = 1 \times 10^{-5}$ M **ANS**

ITEM 15 ANS A

The concentration of hydrogen ions = $\frac{10^{-14}}{10^{-5}} = 10^{-9}$ M. Hence, pH = 9 **ANS**

ITEM 16 ANS B

The balanced equation is $2H_2O_2(aq) = 2H_2O(l) + O_2(g)$.

Therefore, $n(O_2) = \frac{1}{2} \times n(H_2O_2) = \frac{1}{2} \times \frac{17}{34} = 0.25$.

Hence, $V(O_2) = 0.25 \times 22.4 = 5.6\ dm^3$ **ANS**

SUGGESTED SOLUTIONS

ITEM 17 ANS C
A catalyst increases the rate of a reaction but does not change the value of the equilibrium constant. It lowers the activation energy of the reaction.

ITEM 18 ANS D
The balanced chemical equation is $4NH_3(g) + 3O_2(g) = 2N_2(g) + 6H_2O(g)$.
Hence, $n(N_2) = \frac{1}{2} \times n(NH_3) = \frac{1}{2} \times \frac{68}{17} = 2$.
Therefore, $m(N_2) = 2 \times 28 = 56$ g **ANS**

ITEM 19 ANS C
In ethanol, the oxidation number of C: $2C + 5 - 2 + 1 = 0$. Hence, $C = -2$. In acetic acid, the oxidation number of C: $2C + 4 - 4 = 0$. Hence, $C = 0$. Therefore, carbon has been oxidised from -2 to 0.

ITEM 20 ANS C
The overall equation for the reaction can be obtained by multiplying the first equation by 4, the second equation by 5 and adding the equations.
Hence, 4 mole of MnO_4^- will react exactly with 5 mole of C_2H_5OH.
That is, $n(\text{ethanol}) = \frac{5}{4} \times n(\text{potassium permanganate}) = \frac{5}{4} \times 0.05 \times 0.1 = 6.25 \times 10^{-3}$. Therefore, $m(\text{ethanol}) = 0.00625 \times 46 = 0.2875 = 0.29$ g **ANS**

QUESTION 2

(a) The balanced equation is $3Mg(s) + N_2(g) = Mg_3N_2(s)$

(b) From the balanced equation: $n(Mg) = 3 \times n(Mg_3N_2) = 3 \times \frac{100}{100.9} = 2.97$.
Hence, $m(Mg) = 2.97 \times 24.3 = 72.2$ g **ANS**

(c) magnesium metal forms Mg^{2+} ions and the non-metal nitrogen forms N^{3-} ions.

SUGGESTED SOLUTIONS

QUESTION 3

(1) sulfuric acid is a strong diprotic acid which ionises according to the equations:

(a) $H_2SO_4(aq) + H_2O(l) = H_3O^+(aq) + HSO_4^-(aq)$

(b) $HSO_4^-(aq) + H_2O(l) = H_3O^+(aq) + SO_4^{2-}(aq)$

(2) sulfuric acid is a dehydrating agent which can be used to dry gases that do not react with it and to remove water from organic compounds such as sugar.

$$C_{12}H_{22}O_{11}(s) = 12C(s) + 11H_2O(g)$$

(3) sulfuric acid has a high boiling temperature and therefore can be used to prepare volatile acids such as HCl and HNO_3.

(4) sulfuric acid is a strong oxidant and undergoes reaction in which the oxidation number of sulfur changes from +6 to either +4 (SO_2) or 0 (sulfur element) or -2 (sulfide ion).

(5) sulfuric acid has a wide variety of uses including
(a) preparation of fertilizers such as ammonium sulfate and "superphosphate".
(b) preparation of drugs and insecticides.
(c) cleaning of metal surfaces.

(6) each of the above uses can be related to a particular property of sulfuric acid e.g. its acidic properties are used in the preparation of fertilizers.

$$2NH_3(aq) + H_2SO_4(aq) = (NH_4)_2SO_4(aq)$$

QUESTION 4

Water/Oil emulsion (water dispersed as droplets throughout oil)
1. greasy
2. mixes with non-polar solvents
3. relatively low electrical conductivity
4. oil soluble dyes will spread and colour the emulsion

Oil/Water emulsion (oil dispersed as droplets throughout water)
1. feels cool on the skin as the water evaporates
2. mixes with water
3. relatively high electrical conductivity
4. water soluble dyes will spread and colour the emulsion.

The properties are different because the material present in the greater amount is different.

SUGGESTED SOLUTIONS

QUESTION 5

(a) The equilibrium constant = $K = \frac{[CH_3OH]}{[CO]\,[H_2]^2} = \frac{4.00}{0.3 \times (0.5)^2} = 53.3\ M^{-2}$ **ANS**

(b) The mixture of Cr_2O_3 and ZnO would act as a catalyst. They would increase the rate of both the forward and the reverse reactions thereby enabling equilibrium to be achieved rapidly.

(c) Since the reaction is exothermic, the equilibrium yield of methanol (as well as the equilibrium constant itself) would be increased by lowering the temperature. Since the reaction involves the formation of a smaller number of mole of gas, the equilibrium yield of methanol would be increased by increasing the pressure.

QUESTION 6

The balanced equation for the reaction is
$CuCO_3(s) + H_2SO_4(aq) = CuSO_4(aq) + H_2O(l) + CO_2(g)$ . . . . . .(1)

Original number of mole of $H_2SO_4(aq)$ = 0.25 x 0.02 = 0.005

The excess sulfuric acid is neutralised by sodium hydroxide according to the equation $H_2SO_4(aq) + 2NaOH(aq) = Na_2SO_4(aq) + 2H_2O(l)$ . . . . . .(2)

Number of mole of $H_2SO_4(aq)$ left over = $\frac{1}{2}$ x n(NaOH)

= $\frac{1}{2}$ x 0.25 x 0.02060

= 2.575×10^{-3}

Number of mole of $H_2SO_4(aq)$ reacting with $CuCO_3(s)$

= $0.005 - 2.575 \times 10^{-3}$

= 2.425×10^{-3}

Hence, from equation (1) $n(Cu) = n(CuCO_3) = n(H_2SO_4)$ reacting = 2.425×10^{-3}

Therefore, mass of copper in ore sample = $2.425 \times 10^{-3} \times 63.5 = 0.154$ g.

Hence, the percentage by mass of copper in the sample of copper ore

= $\frac{0.154}{15.0} \times 100 = 1.03\ \%$ **ANS**

SUGGESTED SOLUTIONS

QUESTION 7

Process A - CONCENTRATING
The copper ore contains only small quantities of the copper mineral. Hence, the first step involves concentrating the copper mineral by the process of froth flotation.

Process B - ROASTING
The concentrate is roasted in air to produce copper(I) sulfide, iron(II) oxide and sulfur dioxide according to the equation

$$2CuFeS_2(s) + 4O_2(g) = Cu_2S(l) + 2FeO(l) + 3SO_2(g)$$

Process C - SMELTING
The iron(II) oxide is removed by reaction with silica acording to the equation
$FeO(l) + SiO_2(s) = FeSiO_3(l)$. This product is iron(II) silicate called 'slag'. The material containing the copper is called 'copper matte'. Both the 'matte' and the 'slag' are liquids in the furnace. The 'slag' floats on top of the 'matte'.

Process D - CONVERTING
In the converter, the 'copper matte' is reduced to metallic copper and the sulfur is removed as sulfur dioxide according to the equation
$Cu_2S(l) + O_2(g) = 2Cu(l) + SO_2(g)$

Process E - ELECTROLYSING
The blister copper is made the anode of an electrolytic cell which also has a pure copper cathode. The anode reaction is: $Cu(s) = Cu^{2+}(aq) + 2e^-$ and the cathode reaction is: $Cu^{2+}(aq) + 2e^- = Cu(s)$. Very pure copper metal is produced.

END OF 1993 VCE CHEMISTRY TRIAL CAT 1 SOLUTIONS

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