1989

CHEMISTRY

YEAR 12

TRIAL EXAM

CHEMISTRY ASSOCIATES
P.O. BOX 2227
KEW, VIC., 3101
AUSTRALIA
TEL:(03) 9817 5374 **FAX: 9817 4334**

email: chemas@vicnet.net.au

Internet: http://www.vicnet.net.au/~chemas/education.htm

CANDIDATE'S NAME_____

CHEMISTRY ASSOCIATES

YEAR 12 CHEMISTRY TRIAL EXAMINATION 1989
(not to be used before Monday August 7, 1989)
Time allowed for examination = 3 hours.

MULTIPLE CHOICE ANSWER SHEET SECTION A

Instructions: (1) Mark letters with a single pencil line
EXAMPLE A B C ~~D~~
(2) Completely erase any mistakes.
(3) One and only one letter should be marked for each item.

(1)	A	B	C	D	(21)	A	B	C	D
(2)	A	B	C		(22)	A	B	C	D
(3)	A	B	C	D	(23)	A	B	C	D
(4)	A	B	C	D	(24)	A	B	C	D
(5)	A	B	C	D	(25)	A	B	C	D
(6)	A	B	C	D	(26)	A	B	C	D
(7)	A	B	C	D	(27)	A	B	C	D
(8)	A	B	C	D	(28)	A	B	C	D
(9)	A	B	C	D	(29)	A	B	C	D
(10)	A	B	C	D	(30)	A	B	C	D
(11)	A	B	C	D	(31)	A	B	C	D
(12)	A	B	C	D	(32)	A	B	C	D
(13)	A	B	C		(33)	A	B	C	D
(14)	A	B	C	D	(34)	A	B	C	D
(15)	A	B	C	D	(35)	A	B	C	D
(16)	A	B	C	D	(36)	A	B	C	D
(17)	A	B	C		(37)	A	B	C	D
(18)	A	B	C	D	(38)	A	B	C	D
(19)	A	B	C	D	(39)	A	B	C	D
(20)	A	B	C	D	(40)	A	B	C	D

DETACH THIS ANSWER SHEET AT THE START OF THE EXAMINATION

CHEMISTRY ASSOCIATES CANDIDATE'S NAME _____

YEAR 12 CHEMISTRY TRIAL EXAMINATION 1989

Time allowed for examination = 3 hours

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

SECTION	NUMBER OF QUESTIONS	NUMBER OF QUESTIONS TO BE ANSWERED	PERCENTAGE
A	1 (40 items)	1 (40 items)	33
B	9 (numbered 2 to 10)	9 (numbered 2 to 10)	67

There is a Multiple Choice Answer Sheet attached to the front of this booklet.

DIRECTIONS TO CANDIDATES

(1) Answer ALL questions.

(2) Section A questions must be answered on the Multiple Choice Answer Sheet provided.

(3) Section B questions must be answered in the spaces provided.

(4) Approved calculators may be used.

(5) To answer certain questions, you may need to refer to the data sheet on the back of this page

(6) At the end of the examination, place the Multiple Choice Answer Sheet inside the back cover of this booklet and hand them in.

(7) Please ensure that you write your name on this booklet AND on the Multiple Choice Answer Sheet.

SPECIFIC INSTRUCTIONS FOR SECTION A

(1) Section A, Question 1, consists of 40 multiple choice items and is worth 40 marks or about 33% of the total marks available for this examination.You should therefore spend about 60 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.

(4) Jottings should be done in the WORKING SPACES in this booklet.

DATA

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

Element	Symbol	Atomic No.	Relative Atomic Mass
Silver	Ag	47	107.9
Aluminium	Al	13	27.0
Arsenic	As	33	74.9
Carbon	C	6	12.0
Chlorine	Cl	17	35.5
Copper	Cu	29	63.5
Hydrogen	H	1	1.0
Helium	He	2	4.0
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
Sulfur	S	16	32.1
Silicon	Si	14	28.1
Zinc	Zn	30	65.4

TABLE 2: E^{o} values at 298 K

Half reaction	E^{o}/V
$Ag^{+}(aq) + e^{-} = Ag(s)$	+0.80
$Fe^{3+}(aq) + e^{-} = Fe^{2+}(aq)$	+0.77
$Fe^{2+}(aq) + e^{-} = Fe(s)$	-0.44
$Cu^{2+}(aq) + 2e^{-} = Cu(s)$	+0.34
$2H^{+}(aq) + 2e^{-} = H_2(g)$	0.00
$Zn^{2+}(aq) + 2e^{-} = Zn(s)$	-0.76

TABLE 3: PHYSICAL CONSTANTS

Avogadro Constant (N_A)	6.023×10^{23} mol^{-1}
Faraday Constant (F)	96 500 C 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

Item 1
An ion formed by a NON-metal will have
A. the same number of protons and electrons.
B. the same number of protons and neutrons.
C. more protons than electrons.
D. more electrons than protons.

Item 2
The combustion of the hydrocarbon octane, C_8H_{18}, is given by the equation:

$$2C_8H_{18}(l) + 25O_2(g) = 16CO_2(g) + 18H_2O(g) ; \quad \Delta H = -10{,}900 \text{ kJ mol}^{-1}$$

When 114 g of octane is burnt with excess oxygen, the energy released would be
A. 5450 kJ.
B. 10,900 kJ.
C. 21,800 kJ.

Item 3
According to the theory of nucleogenesis, all of the elements less massive than iron were formed
A. during the gravitational collapse of a hydrogen gas cloud.
B. before the formation of helium.
C. immediately after the formation of iron.
D. during a supernova explosion.

Item 4
Which one of the following statements is correct?
Transition metals
A. have high melting points.
B. form white oxides.
C. cannot be magnetized.
D. show only one specific oxidation state.

Item 5
Which pair of elements whose atomic numbers are given below, are in the same group of the Periodic Table?
A. 13, 33
B. 8, 16
C. 7, 12
D. 15, 16

Item 6
Methyl benzene can be produced by the action of chloromethane on benzene in the presence of a catalyst such as aluminium chloride. The molecular formula of methyl benzene is
A. $C_6H_5CH_4$
B. $C_6H_5CH_3$
C. $C_6H_6CH_4$
D. $C_6H_6CH_3$

Item 7

Of the following, the compound with the LARGEST percentage by mass of nitrogen is

A. NH_4NO_3

B. $(NH_4)_2SO_4$

C. $NaNO_3$

D. NH_3

Item 8

When 5 cm^3 of 0.01M sodium hydroxide is mixed with 15 cm^3 of 0.03M sodium hydroxide, the molarity of the resulting solution is

A. 0.015

B. 0.025

C. 0.035

D. 0.045

Item 9

In a particular galvanic cell, lead sulfate, $PbSO_4$, is deposited on both electrodes according to the equations:

(1) $Pb(s) + SO_4^{2-} = PbSO_4(s) + 2e^-$

(2) $PbO_2(s) + 4H^+ + SO_4^{2-} + 2e^- = PbSO_4(s) + 2H_2O$

What would be the number of mole of $PbSO_4$ deposited on the CATHODE if a current of 3 A is drawn from the galvanic cell at a potential of 2.1 V for one minute?

A. (2 x 3 x 1 x 60)/96500

B. (3 x 1 x 60)/96500

C. (3 x 1 x 60)/(2 x 96500)

D. 96500/(4 x 3 x 1 x 60)

Item 10

In the partial ionic equation, $2MnO_2(s) + 2NH_4^+(aq) + 2e^- = Mn_2O_3(s) + 2NH_3(aq) + H_2O(l)$ the change in the oxidation number of the element manganese is

A. +2 to +3

B. +4 to +5

C. +4 to +3

D. +1 to +2

Item 11

If the relative atomic mass of an element is 40.00 and it consists of two naturally occurring isotopes, one of which has a percentage abundance of 67.00% and a relative isotopic mass of 40.50, the relative isotopic mass of the other isotope is

A. 39.00
B. 39.25
C. 39.50
D. 39.75

Item 12

Iron(III) oxide (relative formula mass = 159.7) is reduced to metallic iron using aluminium powder as a reductant according to the equation:

$$Fe_2O_3(s) + 2Al(s) = 2Fe(l) + Al_2O_3(s)$$

If 10 g of Fe_2O_3 is reacted with 5.0 g of Al, then

A. Al is in excess by 3.3 g
B. Al is in excess by 1.6 g
C. Fe_2O_3 is in excess by 3.3 g
D. Fe_2O_3 is in excess by 1.6 g

Item 13

The equilibrium between NO(g), O_2(g) and NO_2(g) is described by the equation:

$$2NO(g) + O_2(g) = 2NO_2(g) \qquad \Delta H = -114 \text{ kJ}$$

At a temperature of 500 K , the equilibrium constant is 6.6×10^5.When the temperature of this equilibrium mixture is increased at constant volume, the number of mole of NO_2 in the equilibrium mixture

A. increases.
B. remains the same.
C. decreases.

Item 14

Nitric acid can be manufactured from the element nitrogen using the steps:

1 **2** **3** **4**

$$N_2 \rightarrow\rightarrow\rightarrow\rightarrow\rightarrow NH_3 \rightarrow\rightarrow\rightarrow\rightarrow\rightarrow NO \rightarrow\rightarrow\rightarrow\rightarrow\rightarrow NO_2 \rightarrow\rightarrow\rightarrow\rightarrow\rightarrow HNO_3$$

The step in which there is the SMALLEST CHANGE in the oxidation number of nitrogen is

A. **1**
B. **2**
C. **3**
D. **4**

Item 15
Sulfur dioxide is an acidic gas. It will react with aqueous potassium hydroxide, KOH.
The equation which best shows this is

A. $KOH(s) = K^+(aq) + OH^-(aq)$

B. $SO_2(g) + H_2O(l) = HSO_3^-(aq) + OH^-(aq)$

C. $SO_2(g) + 2OH^-(aq) = SO_3^{2-}(aq) + H_2O(l)$

D. $H^+(aq) + OH^-(aq) = H_2O(l)$

Item 16
A flask contains 0.11 mole of helium at a temperature of 250^{o}C and a pressure of 5 x 10^5 Pa.
The volume of the flask measured in m^3 is

A. $5x10^5/0.11x8.31x523$

B. $5x10^5/0.11x8.31x250$

C. $0.11x8.31x523/5x10^5$

D. $0.11x8.31x250/5x10^5$

Item 17
Which statement about E^0 values is correct?

A. The stronger the oxidant, the more negative the E^0 value.

B. The stronger the oxidant, the more positive the E^0 value.

C. The stronger the oxidant, the closer to zero the E^0 value.

Item 18
Which one of the following best describes the corrosion of aluminium?

A. $Al^{3+}(aq) \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow Al^{2+}(aq)$

B. $Al(s) \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow Al^{3+}(aq)$

C. $Al(s) \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow Al^{2-}(aq)$

D. $Al^{3+}(aq) \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow Al(s)$

Item 19
The elements in Group II of the Periodic Table have

A. atoms with identical chemical properties.

B. atoms with identical physical properties.

C. atoms with the same electronic configuration.

D. atoms with 2 electrons in an 's' subshell.

Item 20
When benzene is burnt in excess oxygen, carbon dioxide and water vapour are formed. The volumes of carbon dioxide and water vapour (measured at the same temperature and pressure) would be in the ratio

A. 1 : 1

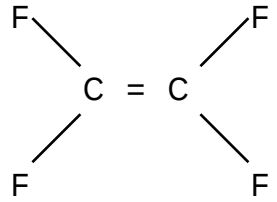
B. 1 : 2

C. 2 : 1

D. 4 : 1

Item 21
In a galvanic cell, that is, a cell that produces energy from spontaneous chemical reactions
A. a reduction reaction occurs at the cathode and the anode is positive.
B. an oxidation reaction occurs at the cathode and the anode is negative.
C. an oxidation reaction occurs at the cathode and the anode is positive.
D. a reduction reaction occurs at the cathode and the anode is negative.

Item 22
Polytetrafluoroethylene is formed from the monomer, tetrafluoroethylene,which has the structural formula



The empirical formula of polytetrafluoroethylene is
A. CF
B. CF_2
C. C_2F
D. C_2F_4

Item 23
Which one of the following lists contains only oxides which are neutral?
A. CO , NO ,N_2O
B. CO , P_4O_{10} , SO_3
C. SiO_2 , NO_2 , SO_2
D. CO_2 , NO , SO_3

Item 24
The compounds ethane and ethylene are similar in the fact that
A. they are both saturated molecules with the empirical formula CH_2.
B. they are both planar molecules with bond angles of approximately 120^o.
C. they are both unsaturated molecules that readily undergo addition reactions.
D. they are both hydrocarbons.

Item 25
The cracking of petroleum fractions is necessary in addition to fractional distillation because distillation does not produce
A. any of the lighter fractions.
B. any of the heavier fractions.
C. a sufficient amount of the lighter fractions.
D. a sufficient amount of the heavier fractions.

Item 26
Which one of the following is **NOT** part of the mixture called 'photochemical smog'?
A. nitrogen dioxide
B. peroxyacetyl nitrate (PAN)
C. ozone
D. oxygen

Item 27
In a volumetric analysis, the correct technique is essential for accurate results. The correct preparation of a pipette for volumetric analysis is:
A. Rinse with the solution to be used.
B. Rinse with distilled water.
C. Rinse with distilled water and dry thoroughly.
D. Dry thoroughly.

Item 28
Diamond and graphite can both be described as giant molecules. The structures of these two materials are similar in that they both contain
A. long chains of carbon atoms.
B. carbon atoms with single covalent bonds only.
C. only carbon atoms with 6 neutrons.
D. carbon atoms arranged in 6-membered rings.

Item 29
In the production of nitric acid by the Ostwald Process, one of the steps involved is

$$4NH_3(g) + 5O_2(g) = 4NO(g) + 6H_2O(g)$$

Assuming complete reaction according to this equation, the mass of nitrogen monoxide produced from 1.0 kg of ammonia is
A. (4000/17) x 30
B. (1000/17) x 30
C. (4000/30) x 17
D. (1000/30) x 17

Item 30
The energy required to remove an electron completely from an atom is called the first ionisation energy. Which one of the following atoms would have the greatest first ionisation energy?
A. sodium
B. magnesium
C. aluminium
D. silicon

Item 31
In the helical structure of DNA, the nitrogen bases are joined together by
A. covalent bonding.
B. ionic bonding.
C. dispersion forces.
D. hydrogen bonding.

Item 32
In which of the following pairs of molecules does sulfur show the oxidation numbers -2 and +6 respectively?
A. H_2S and SO_3
B. SO_2 and H_2SO_4
C. H_2SO_3 and H_2S
D. H_2S and Na_2S

Item 33
Which one of the following elements has **two** allotropic forms?
A. sulfur
B. nitrogen
C. oxygen
D. phosphorus

Item 34
0.5 mol of $Cu^{2+}(aq)$ and 1.0 mol of $Ag^{+}(aq)$ are contained in a beaker of water. What quantity of electricity would be required to deposit all of the copper and silver on the cathode of an electrolytic cell?
A. (1/3) x 96500 C
B. (1/2) x 96500 C
C. (3/2) x 96500 C
D. 2 x 96500 C

Item 35
Concentrated sulfuric acid, $H_2SO_4(l)$, can be used to produce
A. sugar from carbon, hydrogen and oxygen.
B. sulfur from calcium oxide.
C hydrogen chloride from sodium chloride.
D. oxygen from zinc metal.

Item 36
Metal R reacts with dilute HCl. Metal P will reduce solutions of both $RSO_4(aq)$ and $QSO_4(aq)$ to the respective metals R and Q.

A **POSSIBLE** order of standard electrode potentials (E^0) is (beginning with the most positive)
A. H_2 > P > Q > R
B. P > Q > R > H_2
C. P > H_2 > R > Q
D. Q > H_2 > R > P

Item 37
When concentrated aqueous ammonia is added to a precipitate of copper(II) hydroxide, the precipitate dissolves to give a deep blue solution. One of the reactions which occurs is
$Cu^{2+}(aq) + 4NH_3(aq) = Cu(NH_3)_4^{2+}(aq)$
The addition of ammonia causes the copper(II) hydroxide to dissolve because

A. $Cu^{2+}(aq)$ is removed from the equilibrium $Cu(OH)_2(s) = Cu^{2+}(aq) + 2OH^-(aq)$.
B. copper(II) hydroxide is more soluble in solutions of high pH.
C. hydrogen bonds are formed between the ammonia and the copper solution.
D. NH_3 is extremely soluble in water.

Item 38
The chemical formula for urea is
A. NH_2CO
B. $(NH_2)_2CO$
C. $(CO)_2NH_2$
D. $CONH_2$

Item 39
In a chemical equilibrium involving hydrogen ions, the balanced equation is

$$A^+(aq) + B^+(aq) = C^+(aq) + H^+(aq)$$

The equilibrium constant for this equilibrium at 25^{o}C is 0.02. Calculate the value of the fraction $[C^+] / [A^+] . [B^+]$ when the pH of the solution is 2.0.The temperature remains constant at 25^{o}C.

A. 0.0002
B. 0.5
C. 2.0
D. 2000.0

Item 40
Pure sand is silicon dioxide, SiO_2. If one grain of sand has a mass of 1 mg, the number of atoms present in one grain is closest to
A. 1.0×10^{19}
B. 3.0×10^{19}
C. 3.6×10^{28}
D. 1.1×10^{29}

END OF SECTION A

SPECIFIC INSTRUCTIONS FOR SECTION B

(1) Section B consists of 9 questions, Questions 2 to 10, and is worth 80 marks and therefore about 67% of the total marks available for the examination. You should therefore spend about 2 hours on Section B. A suggested time allocation is given for each question and the marks allotted to each question are also indicated.

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

(3) 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.

(4) 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.

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

QUESTION 2 (30 minutes, 20 marks)
Where appropriate, diagrams and equations should be included in the answers to parts **a-e** of this question.

a. Graphite and benzene both contain carbon atoms arranged in hexagonal rings but they are quite different from each other in physical and chemical properties. Describe the structures of these substances.

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QUESTION 2 (continued)

b. When the combinations -OH and -COOH are attached to alkyl groups (formula C_nH_{2n-1}), they are known as functional groups. Explain what is meant by 'functional group'. Illustrate your answer with some examples.

c. Sodium and aluminium are metals but with many different properties from metals such as iron and copper. Outline some of these differences.

QUESTION 2 (continued)

d. A steel pipeline buried in damp soil is subject to corrosion. This can be prevented by attaching the negative terminal of a power source to the pipeline. By considering the equation for the corrosion of iron, explain how this protection system works.

e. Ethane (C_2H_6, $M_r = 30$) is a gas at room temperature and pressure and does not dissolve easily in water.On the other hand, methanol (CH_3OH, $M_r = 32$) is a liquid at room temperature and pressure and is completely soluble in water. Explain this difference in properties between ethane and methanol.

QUESTION 3 (18 minutes, 12 marks)

a. A calorimeter is used to study the reaction between 100 cm^3 of 0.5M HCl(aq) and 100 cm^3 of 0.5M NaOH(aq). If the calibration factor of the calorimeter and its contents is 140 J/^oC and the temperature rise during the reaction is 20.0 ^oC, what is the ΔH for the reaction?

QUESTION 3 (continued)

b. When ethanol undergoes oxidation in the body according to the equation:

$C_2H_5OH(aq) + 3O_2(g) = 2CO_2(g) + 3H_2O(l)$, the ΔH value equals -1370 kJ mol^{-1}.

Calculate the energy produced from 750 g of beer, given that beer is 4.9% ethanol by mass and assuming that ethanol is the only source of energy in the beer.

QUESTION 4 (8 minutes, 5 marks)
Write the electronic configurations of the following atoms and ions:

(a) Mg^{2+} _____

(b) S^{2-} _____

(c) Cl _____

(d) P _____

(e) He _____

QUESTION 5 (13 minutes, 9 marks)

(a) Draw a sketch diagram of a cell suitable for the production of aluminium. Label your diagram carefully to show the cathode and anode, the products at each electrode and any special features of the cell.

(b) Write equations for each of the electrode reactions.

CATHODE_____

ANODE _____

QUESTION 6 (15 minutes, 10 marks)
Many important chemical production processes are based on the principles of DYNAMIC CHEMICAL EQUILIBRIUM. Choose ONE chemical process that is based on these principles and answer each of the questions below.

(a) What is the meaning of dynamic chemical equilibrium?

(b) Name one chemical process in which the yield and rate of production depends on the application of the principles of dynamic chemical equilibrium.

(c) Explain how the yield of this chemical is made as large as possible.

QUESTION 6 (continued)

(d) Explain how the rate of production of this chemical is made as large as possible.

QUESTION 7 (11 minutes, 7 marks)

Bicarbonate of soda ($NaHCO_3$) is the main constituent of indigestion tablets which are used to neutralise excess stomach acid (HCl) according to the equation:

$$NaHCO_3(aq) + HCl(aq) = NaCl(aq) + H_2O(l) + CO_2(g)$$

A particular indigestion tablet weighs 3.0 g and 70% of this tablet (by mass) is $NaHCO_3$. If two tablets exactly are required to neutralise the excess stomach acid, calculate this mass of HCl.
Working must be shown for this question-the final answer alone will not receive full marks.

QUESTION 8 (6 minutes, 4 marks)

Acetic acid is a weak acid which ionises slightly in aqueous solution according to the equation:
$CH_3COOH(aq) = H^+(aq) + CH_3COO^-(aq)$

(a) Calculate the equilibrium constant for this equation at 25^{o}C if the equilibrium concentrations are:

$[CH_3COOH] = 10^{-2}$ M , $[H^+] = [HCOO^-] = 10^{-3.4}$ M

(b) Sodium acetate is added to this equilibrium mixture at 25^{o}C i.e. more CH_3COO^- is added. Will the pH of the solution increase or decrease? Explain your answer.

QUESTION 9 (10 minutes, 7 marks)
There was a large chemical fire at Footscray on Monday, November 28, 1988. In a report in the newspapers the next day, the smoke from the fire was described as containing "mainly carbon, . . . polyethylene particles, carbon dioxide, carbon monoxide, very small amounts of hydrogen chloride and sulfur compounds."

(a) List SIX chemical formulae that could be used to summarise the description from the newspaper above.

(b) Choose ONE of these chemicals and indicate any short term **AND** long term pollution that could be caused by it.

QUESTION 10 (9 minutes, 6 marks)
When zinc metal was used as a reductant in a galvanic cell, the cell produced 3000 coulombs of electricity. Calculate the mass of zinc consumed. **Working must be shown for this question-the final answer alone will not receive full marks.**

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END OF 1989 CHEMISTRY YEAR 12 TRIAL EXAM

CHEMISTRY ASSOCIATES
P.O. BOX 2227
KEW, VIC., 3101
AUSTRALIA
TEL:(03) 9817 5374 FAX: (03) 9817 4334

SECTION A QUESTION 1 1D 2A 3A 4A 5B 6B 7D 8B 9C 10C 11A 12B 13C 14D 15C 16C 17B 18B19D 20C 21D 22B 23A 24D 25C 26D 27A 28B 29B 30D 31D 32A 33C 34D 35C 36D 37A 38B 39C 40B

SECTION B

QUESTION 2

(a) Graphite is an allotrope of carbon. The hexagonal rings contain carbon atoms joined by single covalent bonds. These hexagonal rings are arranged in layers with weak dispersion forces between them. One free electron per carbon atom makes graphite a conductor. Benzene is a discrete molecule (C_6H_6) with six delocalised electrons per hexagonal ring. Bonding between the carbon atoms is intermediate between single and double covalent bonding. The hydrogen atoms are attached one to each carbon atom by single covalent bonds.

(b) A functional group is an atom or group of atoms which gives a molecule its particular properties. For example, the -OH group is the alcohol group as in the molecules, methanol, CH_3OH and ethanol, C_2H_5OH. The -COOH group is the carboxylic acid group as in the molecules, methanoic acid (formci acid), HCOOH and ethanoic acid (acetic acid), CH_3COOH. Molecules with the same functional group have very similar chemical properties.

(c) Sodium and aluminium are known as **main group** metals with properties such as low melting temperatures, one particular oxidation state per metal, form white compounds, strong reducing ability. Iron and copper are known as **transition metals** with properties such as higher melting temperatures, more than one oxidation state per metal, form coloured compounds, Fe easily magnetized.

(d) The corrosion of iron is shown by the equation: $Fe(s) = Fe^{2+}(aq) + 2e^-$. If iron is to corrode, it must lose two electrons from each iron atom.If the iron metal carries a negative charge (from the negative terminal of an attached power source) it is much more difficult for the iron to lose these electrons. Thus, the corrosion process is prevented.

(e) The ethane molecule is symmetrical with only weak dispersion forces between non-polar molecules. Hence, it is a gas at room temperature and pressure and has very little attraction for the highly polar water molecules. On the other hand, the methanol molecule is not symmetrical and has hydrogen bonding between adjacent methanol molecules. Hence, it is a liquid at room temperature and pressure and is attracted to the highly polar water molecules. That is, it is soluble.

QUESTION 3

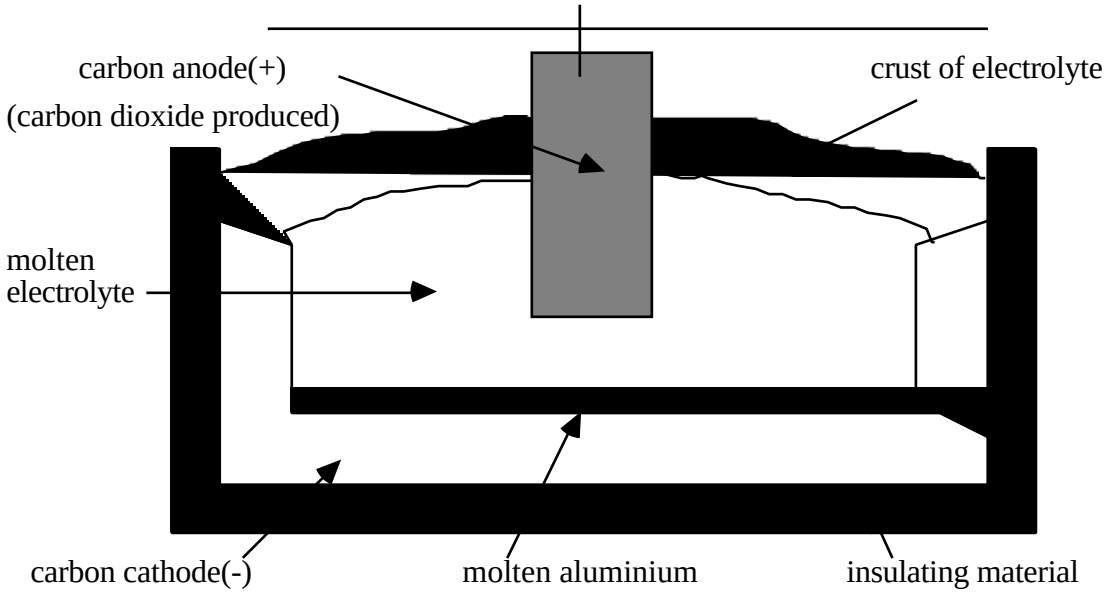
(a) n(HCl) = n(NaOH) = 0.5 x 0.1 = 0.05 mol.
Energy released = 140 x 20.0 J. Hence, ΔH = - (140 x 20.0)/(0.05 x 1000)
= -56.0 kJ mol^{-1} **ANS**

(b) mass(ethanol) = (4.9/100) x 750
n(ethanol) = (4.9/100) x (750/46)
energy produced = (4.9/100) x (750/46) x 1370 = 1095 kJ **ANS**

QUESTION 4

(a) $1s^22s^22p^6$; **(b)** $1s^22s^22p^63s^23p^6$; **(c)** $1s^22s^22p^63s^23p^5$; **(d)** $1s^22s^22p^63s^23p^3$; **(e)** $1s^2$

QUESTION 5 (a)



(b) CATHODE: $Al^{3+}(l) + 3e^- = Al(l)$ ANODE: $2O^{2-}(l) + C(s) = CO_2(g) + 4e^-$

QUESTION 6

(a) Dynamic chemical equilibrium exists when the rate of the forward reaction is equal to the rate of the reverse reaction. This results in the concentrations of the products and reactants remaining constant once equilibrium has been reached.

(b) The principles of dynamic equilibrium apply to the production of ammonia (HABER PROCESS) the production of nitric acid (OSTWALD PROCESS) and the production of sulfuric acid CONTACT PROCESS)

(c)(One possible answer) In the HABER PROCESS, the yield is maximised by keeping the temperature as low as possible and by using high pressures.

(d) (One possible answer) In the HABER PROCESS, the rate of production of ammonia is maximised by using an efficient catalyst and a high temperature.This temperature is a compromise between yield and rate.

QUESTION 7

m(NaHCO3) in two tablets = 2 x 0.7 x 3.0 = 4.2 g
n(HCl) excess = n(NaHCO3) in two tablets = 4.2/84
Hence, m(HCl) excess = (4.2/84) x 36.5 = 1.825 m(HCl) excess = 1.8 g **ANS**

QUESTION 8

(a) $K_c = [H^+] [HCOO^-] / [CH_3COOH]$

$= (10^{-3.4} \times 10^{-3.4})/10^{-2} = 10^{-4.8}$ **ANS**

(b) The addition of CH_3COO^- will shift the position of equilibrium to the left. More CH_3COOH will be produced and H^+ will be used up. Hence, acidity will decrease.
Hence, pH will increase. **ANS**

QUESTION 9

(a) C(s), $(C_2H_4)_n$(s), CO_2(g), CO(g), HCl(g), SO_2(g) or other sulfur compound.

(b) (One possible choice) Carbon monoxide causes oxygen starvation because it has a greater affinity for haemoglobin than does oxygen. In the long term, it is converted to carbon dioxide which is one of the greenhouse gases that contribute to a temperature increase in the biosphere.

QUESTION 10

n(electrons) = 3000/96500. Zinc reacts according to: $Zn(s) = Zn^{2+}(aq) + 2e^-$.
n(Zn) = (1/2) x (3000/96500) and hence, m(Zn) = (1/2) x (3000/96500) x 65.4 = 1.02 g **ANS**

END OF 1989 CHEMISTRY YEAR 12 TRIAL EXAM SOLUTIONS

CHEMISTRY ASSOCIATES
P.O. BOX 2227
KEW, VIC., 3101
AUSTRALIA
TEL:(03) 9817 5374 FAX: (03) 9817 4334