1988

CHEMISTRY

YEAR 12

TRIAL EXAM

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CANDIDATE'S NAME_____

CHEMISTRY ASSOCIATES

YEAR 12 CHEMISTRY TRIAL EXAMINATION 1988
(not to be used before Monday August 1, 1988)
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	(20)	A	B	C	D
(2)	A	B	C	D	(21)	A	B	C	D
(3)	A	B	C	D	(22)	A	B	C	D
(4)	A	B	C	D	(23)	A	B	C	D
(5)	A	B	C	D	(24)	A	B	C	D
(6)	A	B	C	D	(25)	A	B	C	D
(7)	A	B	C	D	(26)	A	B	C	D
(8)	A	B	C	D	(27)	A	B	C	D
(9)	A	B	C	D	(28)	A	B	C	D
(10)	A	B	C	D	(29)	A	B	C	D
(11)	A	B	C	D	(30)	A	B	C	D
(12)	A	B	C		(31)	A	B	C	D
(13)	A	B	C	D	(32)	A	B	C	D
(14)	A	B	C	D	(33)	A	B	C	D
(15)	A	B	C	D	(34)	A	B	C	D
(16)	A	B	C	D	(35)	A	B	C	D
(17)	A	B	C		(36)	A	B	C	D
(18)	A	B	C	D	(37)	A	B	C	D
(19)	A	B	C	D	(38)	A	B	C	D

DETACH THIS ANSWER SHEET AT THE START OF THE EXAMINATION

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
Barium	Ba	56	137.3
Bromine	Br	35	79.9
Calcium	Ca	20	40.1
Chlorine	Cl	17	35.5
Copper	Cu	29	63.5
Hydrogen	H	1	1.0
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
Strontium	Sr	38	87.6

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

Half reaction	E^{o}/V
$Ag^{+}(aq) + e^{-} = Ag(s)$	+0.80
$Cu^{2+}(aq) + 2e^{-} = Cu(s)$	+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

CHEMISTRY ASSOCIATES CANDIDATE'S NAME _____

YEAR 12 CHEMISTRY TRIAL EXAMINATION 1988

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 OF EXAMINATION
A	1 (38 items)	1 (38 items)	33
B	10 (numbered 2 to 11)	10 (numbered 2 to 11)	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 38 multiple choice items and is worth 38 marks and therefore 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.

Item 1
An ion formed by a 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
A nucleus contains 3 protons and 4 neutrons and has a nuclear mass of W. If P = the mass of the proton and N = the mass of the neutron on the same scale, the binding energy of this nucleus is given by the expression:
A. $(W-3P+4N) \times c^2$
B. $(3P+4N-W) \times c^2$
C. $(W-3P-4N) \times c^2$
D. $(3P+4N+W) \times c^2$

Item 3
According to the theory of nucleogenesis, all of the elements heavier 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 pair of elements whose atomic numbers are given below, are in the same group of the Periodic Table?
A. 33 , 35
B. 11 , 12
C. 11 , 20
D. 17 , 35

Item 5
The element which forms the most stable nucleus is
A. hydrogen
B. iron
C. silicon
D. helium

Item 6
Nitrobenzene can be produced by the action of concentrated nitric acid on benzene in the presence of sulfuric acid. The molecular formula of nitrobenzene is
A. $C_6H_5NO_3$
B. $C_6H_5NO_2$
C. $C_6H_6NO_3$
D. $C_6H_6NO_2$

Item 7
Of the following, the compound with the SMALLEST percentage by mass of nitrogen is
A. NH_4NO_3
B. $(NH_4)_2SO_4$
C. $NaNO_3$
D. NH_3

Item 8
In a particular galvanic cell, lead sulfate, PbSO4, 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 total number of mole of PbSO4 deposited on the electrodes if a current of 3 A is drawn from the galvanic cell at a potential of 2.1 V for one minute?
A. (3 x 1 x 60)/(2 x 96500)
B. (3 x 1 x 60)/96500
C. (2 x 3 x 1 x 60)/96500
D. 96500/(4 x 3 x 1 x 60)

Item 9

In the partial ionic equation, $Cr_2O_7^{2-} + 14H^+ + 6e^- = 2Cr^{3+} + 7H_2O$,
the change in the oxidation number of the element chromium is

A. +12 to +6
B. +8 to +6
C. +6 to +3
D. +8 to +3

Item 10

If the relative atomic mass of an element is 20.00 and it consists of two naturally occurring isotopes, one of which has a percentage abundance of 75.00% and a relative isotopic mass of 20.50, the relative isotopic mass of the other isotope is

A. 18.50
B. 18.40
C. 18.30
D. 18.20

Item 11

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 10 g of Al, then

A. Al is in excess by 8.3 g
B. Al is in excess by 6.6 g
C. Fe_2O_3 is in excess by 8.3 g
D. Fe_2O_3 is in excess by 6.6 g

Item 12

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

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

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

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

Item 13

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

1 2 3 4

N_2--------NH_3--------NO--------NO_2--------HNO_3

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

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

Item 14

On spacecraft the cabin atmosphere can be cleansed of carbon dioxide by passing the air through canisters of potassium hydroxide, KOH.

The equation that best describes this reaction is

A. $KOH = K^+ + OH^-$

B. $CO_2 + H_2O = HCO_3^- + OH^-$

C. $CO_2 + 2OH^- = CO_3^{2-} + H_2O$

D. $H^+ + OH^- = H_2O$

Item 15

A flask contains 0.01 mole of helium at a temperature of 25^{o}C and a pressure of 5×10^4 Pa. The volume of the flask measured in cm^3 is

A. $(8.31 \times 298)/5$

B. $(0.01 \times 8.31 \times 5 \times 10^4)/298$

C. $(0.01 \times 8.31 \times 25 \times 10^6)/(5 \times 10^4)$

D. $(8.31 \times 25)/(0.01 \times 5 \times 10^4)$

Item 16

Which one of the following does **NOT** make use of limestone in its manufacture?

A. cement
B. glass
C. sodium carbonate
D. aluminium

Item 17

Which statement about E^0 values is correct?

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

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

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

Item 18

Which one of the following best describes the **corrosion** of iron?

A. $Fe^{3+}(aq)$ $Fe^{2+}(aq)$

B. Fe(s) $Fe^{3+}(aq)$

C. Fe(s) $Fe^{2+}(aq)$

D. $Fe^{2+}(aq)$ Fe(s)

Item 19

The elements in Group IV 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 a p subshell.

Item 20

The amount of the element barium in a solution may be determined experimentally by precipitating the barium as $BaSO_4$ using dilute sulfuric acid. If 24.90 cm^3 of 0.020 M sulfuric acid is needed to precipitate all of the barium as $BaSO_4$, then the mass of barium in the solution is

A. 0.034 g.

B. 0.068 g.

C. 0.116 g.

D. 68.4 g.

Item 21

In an electrolytic cell, that is, a cell that uses energy to produce chemical reactions

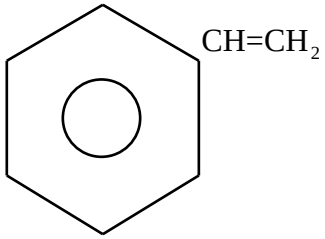
A. a reduction reaction occurs at the cathode and the anode is positive.

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
Polystyrene is formed from the monomer styrene, which has the structural formula



The molecular formula of styrene is
A. C_8H_8
B. C_7H_3
C. C_7H_9
D. C_8H_{14}

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

Item 24
The compounds benzene and ethylene are similar in the fact that
A. they are both saturated molecules with the empirical formula CH.
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 that readily form addition polymers.

Item 25
The reaction between limestone and rainwater in the formation of a limestone cave is best shown by the equation

A. $CaCO_3(s) + CO_2(aq) + H_2O(l) = Ca(HCO_3)_2(aq)$

B. $Na_2CO_3(s) + H_2O(l) = Na_2CO_3(aq)$

C. $Na_2CO_3(aq) + 2H^+(aq) = 2Na^+(aq) + H_2O(l) + CO_2(g)$

D. $CaO(s) + H_2O(l) = Ca(OH)_2(aq)$

Item 26
Which one of the following is **NOT** involved in the formation of photochemical smog?
A. nitrogen oxides
B. hydrocarbons
C. oxygen
D. sulfur dioxide

Item 27
In a volumetric analysis, the correct technique is essential for accurate results. The correct preparation of a burette 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
A. contain strong carbon-carbon single bonds.
B. have a tetrahedral arrangement of atoms around each carbon atom.
C. have 3 carbon atoms bonded to each carbon atom.
D. have layers of carbon atoms held together by dispersion forces.

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 oxygen required to convert **1 tonne** of ammonia into products is

A. $(5 \times 10^6 \times 32)/(4 \times 17)$ g.

B. $(4 \times 10^6 \times 32)/(5 \times 17)$ g.

C. $(5 \times 17 \times 32)/(4 \times 10^6)$ g.

D. $(4 \times 10^6)/(5 \times 17 \times 32)$ g.

Item 30
Which of the following pairs of molecules could be obtained from the fractional distillation of crude oil?
A. CH_4 , C_2H_4
B. C_2H_4 , C_6H_6
C. H_2 , CH_4
D. CH_4 , C_3H_8

Item 31
In the helical structure of DNA, the nitrogen bases that are joined together by hydrogen bonding are respectively
A. adenine with guanine and thymine with cytosine.
B. adenine with cytosine and guanine with thymine.
C. adenine with adenine and thymine with cytosine.
D. adenine with thymine and guanine with cytosine.

Item 32
In which of the following pairs of molecules does nitrogen show the oxidation numbers +2 and +5 respectively?

Item 33
Of the elements whose atomic numbers are given below, which one has quite different properties from the others?
A. 12
B. 16
C. 20
D. 38

Item 34
79.8 g of copper(II) sulfate and 84.95 g of silver(I) nitrate are dissolved in 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. 1 x 96500 C
D. (3/2) x 96500 C

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

Item 36
Metal P does not react with dilute HCl. Metal R will reduce solutions of both $PSO_4(aq)$ and $QSO_4(aq)$ to the respective metals P and Q.

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

Item 37
When concentrated aqueous ammonia is added to a precipitate of silver chloride, the precipitate dissolves to give a clear solution. One of the reactions which occurs is
$Ag^+(aq) + 2NH_3(aq) = Ag(NH_3)_2^+(aq)$
The addition of ammonia causes the silver chloride to dissolve because

A. silver chloride is more soluble in solutions of high pH.
B. hydrogen bonds are formed between the ammonia and the silver solution
C. $Ag^+(aq)$ is removed from the equilibrium $AgCl(s) = Ag^+(aq) + Cl^-(aq)$
D. NH_3 is extremely soluble in water.

Item 38
Urea is produced in the body during
A. the synthesis of amino acids.
B. the manufacture of proteins.
C. the breakdown of amino acids.
D. the hydrolysis of proteins.

END OF SECTION A

SPECIFIC INSTRUCTIONS FOR SECTION B

(1) Section B consists of 10 questions, Questions 2 to 11, and is worth 72 marks and therefore about 65% 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 (25 minutes, 15 marks)
The elements nitrogen, phosphorus and sulfur form a number of different **oxides**. Compare and contrast these oxides under the following headings:

(1) oxidation states of the elements in the oxides.
(2) preparation of the oxides.
(3) acidic properties of the oxides.

(An essay is **NOT** required. Credit will be given for all relevant factual information.)

QUESTION 2 (continued)

QUESTION 3 (10 minutes, 6 marks)
"The main group metals such as sodium and aluminium share some properties in common with transition metals such as iron and copper, but in other ways there are significant differences." Illustrate this statement by reference to the properties of sodium, aluminium, iron and copper.

QUESTION 4 (7 minutes, 5 marks)
Write the electronic configurations of the following atoms and ions:

(a) Ca^{2+} _____

(b) O^{2-} _____

(c) N _____

(d) P _____

(e) H^{+} _____

QUESTION 5 (10 minutes, 6 marks)
(a) Draw a sketch diagram of a cell suitable for the production of sodium hydroxide, chlorine and hydrogen. 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.

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QUESTION 6 (6 minutes, 4 marks)

A calorimeter is used to study the reaction between 50 cm^3 of 0.2M HCl(aq) and 50 cm^3 of 0.2M NaOH(aq).

If the calibration factor of the calorimeter and its contents is 140 $J/^oC$ and the calculated heat of reaction is -56.6 kJ mol^{-1}, what is the temperature rise during the reaction?

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QUESTION 7 (14 minutes, 9 marks)
A useful galvanic cell for small articles such as watches makes use of silver oxide and zinc according to the equation:

$Zn(s) + Ag_2O(s) + H_2O(l) = 2Ag(s) + Zn^{2+}(aq) + 2OH^-(aq)$

The e.m.f. of the cell is 1.5V.

(a) Write the partial ionic equations for the reactions occurring at the cathode and anode.

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(b) Name the oxidant and the reductant in the cell.

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(c) One of these galvanic cells delivers a continuous current of 0.15 mA for 100 days. Calculate the mass of Ag_2O consumed during this time.

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QUESTION 7 (continued)

(d) Describe how this cell could be recharged.

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QUESTION 8 (13 minutes, 8 marks)

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

(a) Calculate the equilibrium constant for this equation at 25^oC if the equilibrium concentrations are:

$$[HCOOH] = 10^{-2} M , [H^+] = [HCOO^-] = 10^{-2.87} M$$

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QUESTION 8 (continued)

Sodium formate is added to this equilibrium mixture at 25^{o}C i.e. more $HCOO^-$ is added. Will the pH of the solution increase or decrease? Explain your answer.

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(c) The temperature of the equilibrium mixture is altered. If the new equilibrium constant is $10^{-2.4}$M and [HCOOH] = $10^{-1.7}$M and [$HCOO^-$] = $10^{-2.6}$M, calculate the pH of the solution.

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QUESTION 9 (10 minutes, 6 marks)
In the substances, (1) nitrogen, N_2 (2) ethylene, C_2H_4 (3) methane, CH_4 and (4) silicon carbide, SiC, COVALENT BONDING holds the atoms together.
However, in the element sodium, Na, the bonding is METALLIC.
Using these substances as examples, describe some of the similarities and differences between COVALENT BONDING and METALLIC BONDING.

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QUESTION 10 (10 minutes, 6 marks)
Carbon can be oxidised by sulfuric acid according to the equation:

$$C(s) + 2H_2SO_4(l) = CO_2(g) + 2H_2O(l) + 2SO_2(g)$$

At a temperature 25^{o}C and 100,000 Pa pressure, a total gas volume of 67 dm^3 was produced when 100 cm^3 of sulfuric acid was added to excess carbon.
Calculate the concentration of the sulfuric acid used.

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QUESTION 11 (11 minutes, 7 marks)
"In the structures of both graphite and benzene, there are hexagonal rings of carbon atoms with 'free' electrons."
Describe the structures of graphite and benzene and indicate their similarities and differences.

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END OF 1988 CHEMISTRY YEAR 12 TRIAL EXAM

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

SECTION B

QUESTION 2 (a) oxidation states:

dinitrogen monoxide, N_2O (+1); nitrogen monoxide, NO (+2);

dinitrogen trioxide, N_2O_3 (+3); nitrogen dioxide, NO_2 (+4); dinitrogen tetroxide, N_2O_4 (+4); dinitrogen pentoxide, N_2O_5 (+5); diphosphorus trioxide, P_2O_3 (+3); diphosphorus pentoxide, P_2O_5 (+5);

sulfur dioxide, SO_2 (+4); sulfur trioxide, SO_3 (+6).

(1) the highest oxidation state of each element = the number of outershell electrons.
(2) nitrogen shows the greatest range of oxidation states.

(b) preparation:

$NH_4NO_3 = N_2O + 2H_2O$; $3Cu + 2NO_3^- + 8H^+ = 3Cu^{2+} + 2NO + 4H_2O$;

$2NO + O_2 = 2NO_2 = N_2O_4$; $P_4 + 3O_2 = P_4O_6$; $P_4 + 5O_2 = P_4O_{10}$;

$S + O_2 = SO_2$; $2SO_2 + O_2 = 2SO_3$

In the preparation of NO, 7M nitric acid is used. Equilibrium exists between NO_2 and N_2O_4 and also between SO_2 and SO_3.

(c) acidic properties:

N_2O and NO are neutral oxides but all of the others are acidic.

N_2O_3, N_2O_5, P_2O_3, P_2O_5, SO_2, SO_3 are the acid anhydrides of the corresponding acids, HNO_2, HNO_3, H_3PO_3, H_3PO_4, H_2SO_3, H_2SO_4.

QUESTION 3

The common properties are caused by common metallic bonding-a network lattice of positive ions in a sea of mobile electrons.
(1) shiny; (2) malleable; (3) ductile; (4) good conductors of heat and electricity; (5) form positively charged ions.
The different properties are caused by differences in the crystal lattices.
(arrangement of the ions and electrons). (1) Fe, Cu have higher melting temperatures; (2) Fe, Cu have two oxidation states each; (3) Fe, Cu form coloured compounds; (4) Fe is readily magnetised;(5) Na, Al are stronger reductants

QUESTION 4 (a) $1s^22s^22p^63s^23p^6$; (b) $1s^22s^22p^6$; (c) $1s^22s^22p^3$;
(d) $1s^22s^22p^63s^23p^3$; (e) there are no electrons in H^+.

QUESTION 5 (either the **NELSON CELL** or the **MERCURY CELL** could be used for this answer). See textbooks for diagrams.

NELSON CELL: Anode: $2Cl^-(aq) = Cl_2(g) + 2e^-$

Cathode: $2H_2O(l) + 2e^- = H_2(g) + 2OH^-(aq)$

MERCURY CELL: Anode: $2Cl^-(aq) = Cl_2(g) + 2e^-$

Cathode: $Na^+(aq) + e- = Na(s)$
and then $2Na/Hg(l) + 2H_2O(l) = 2NaOH(aq) + H_2(g) + Hg(l)$

QUESTION 6

The balanced equation is: $HCl(aq) + NaOH(aq) = NaCl(aq) + H_2O(l)$

$n(HCl) = n(NaOH) = 0.2 \times 0.05 = 0.01$

heat evolved = $K \times \Delta T$ and therefore, $56600 \times 0.01 = 140 \times \Delta T$

$\Delta T = (56600 \times 0.01)/140 = 4.04^oC$ **ANS**

QUESTION 7 (a) Cathode: $Ag_2O(s) + H_2O(l) + 2e^- = 2Ag(s) + 2OH^-(aq)$

Anode: $Zn(s) = Zn^{2+}(aq) + 2e^-$

(b) Oxidant is $Ag_2O(s)$ and reductant is $Zn(s)$

(c) $n(Ag_2O) = (1/2) \times n(e^-) = (1/2) \times 0.15 \times 10^{-3} \times 100 \times 24 \times 3600/96500$

$= 6.715 \times 10^{-3}$

$m(Ag_2O) = n(Ag_2O) \times 231.78 = 6.715 \times 10^{-3} \times 231.78 = 1.56$ g **ANS**

QUESTION 8 (a) $K_C = [H^+]\ [HCOO^-] / [HCOOH]$

$= (10^{-2.87} \times 10^{-2.87})/10^{-2} = 10^{-3.74}$ **ANS**

QUESTION 8 (continued)

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

(c) $[H^+] \times 10^{-2.6}/10^{-1.7} = 10^{-2.4}$
Hence, $[H^+] = (10^{-2.4} \times 10^{-1.7})/10^{-2.6} = 10^{-1.5}$ M
Therefore, pH = 1.5 **ANS**

QUESTION 9

(1) Both types of bonding are fundamentally the same since they involve the attraction between positive and negative charges.

(2) Covalent bonding is the sharing of one or more electron pairs between atoms. CH_4 , discrete molecule, single covalent bonds; C_2H_4 , discrete molecule, double covalent bond between the two carbon atoms; N_2 , discrete molecule, triple covalent bond; SiC , giant molecule, network lattice, single covalent bonds.

(3) Metallic bonding is the electrostatic force of attraction between positive ions and mobile electrons. The ions are arranged in a 3-dimensional network lattice.

(4) In covalent substances, the electrons are fixed within the bonds. Hence, they are non -conductors. In metals, the electrons are not tied to any particular ion. Hence, metals are conductors.

QUESTION 10 $n(H_2SO_4) = (2/3) \times n(gas)$. Notice that both CO_2 and SO_2 are gases.
$= (2/3) \times PV/RT$
$= (2/3) \times (10^5 \times 67 \times 10^{-3})/(8.31 \times 298) = 1.803$

Hence, $[H_2SO_4] = 1.803/0.1 = 18$ M **ANS**

QUESTION 11

Graphite is the element carbon. It has a layer lattice structure with strong covalent bonding within the layers and weak dispersion forces between the layers. Each carbon atom is bonded to three other carbon atoms in an hexagonal pattern within the plane. These planes of atoms can slide easily over each other. One electron per carbon is delocalised and can move within the plane when an electric field is applied. Benzene has the molecular formula C_6H_6. It is a planar discrete molecule with an hexagonal arrangement of carbon atoms and one hydrogen atom attached to each carbon atom. The bond angle is 120^o. There are six delocalised electrons shared equally by the six carbon atoms and this gives benzene a relatively stable structure.

END OF 1988 CHEMISTRY YEAR 12 TRIAL EXAM SOLUTIONS

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