James Ruse Agricultural High School

Chemistry Assessment Task 2 – Term 1 2001

Marks:

Time Allowed : 120 minutes Reading time : 5 minutes

Section A: Multiple Choice (1-mark each)

1. A student needs to determine the relative acid strength of 3 weak monoprotic acid; HA, HB, and HC. The acids are of the same concentration. Which is the most suitable technique?

   (A) titration with a strong base

   (B) titration with an equally weak base

   (C) pH measurement using an indicator or a pH meter

   (D) monitoring the pH changes with a pH meter during titration

The following acid base reactions refer to questions 2 and 3

(i) $F^- + BF_3 \rightarrow BF_4^-$
(ii) $HCl + NaOH \rightarrow NaCl + H_2O$
(iii) $CN^- + H_2O \rightarrow HCN + OH^-$

2. Which of the choices correctly classifies each of the given species?

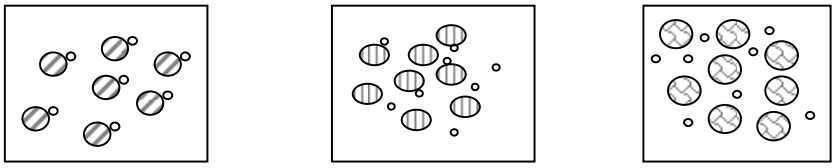
	Species		
	CN^-	NaOH	F^-
A	acid	base	acid
B	base	base	base
C	acid	base	base
D	base	base	acid

3. Which of the choices is a correct conjugate acid-base pair?

	Base	Conjugate acid
A	F^-	BF_4^-
B	F^-	BF_3
C	CN^-	OH^-
D	CN	HCN

The following information refer to questions 4 and 5.

The diagram below shows the ionization of the acids HA, HB and HC:



HA HB H

4. Which choice shows the acid arranged according to increasing pH?

(A) HA, HB, HC

(B) HC, HB, HA

(C) HA, HC, HB

(D) HC, HA, HB

5. Which solution will have the highest pH?

(A) NaA

(B) NaB

(C) HA

(D) HB

7. Some concentrated sulfuric acid is added to ethanol (C_2H_5OH) producing X and Y:

ethanol → X + Y

Chemical W is then added to X to give C_2H_5OH:

W + X → C_2H_5OH

Chemicals W and X are

	X	**Y**
(A)	H_2O (*l*)	C_2H_4
(B)	C_2H_5OH	H_2O(*l*)
(C)	C_2H_4	conc. H_2SO_4
(D)	conc. H_2SO_4	C_2H_4

8. A group of students measured out 100 mL water into a container and heated the water by burning a measured mass of ethanol. Their results are shown below. (Assume a density of 1g/mL for water.

Fuel used	**Amount of water heated (g)**	**Temperature rise (K)**	**Mass of ethanol burnt (g)**	**Heat of combustion (kJ mol^{-1})**
Ethanol	100	10	?	1364

Given that 4.18 J are required to raise the temperature of 1.00 g of water 1 K, the mass of ethanol burnt is

	Mass of ethanol burnt (g)
(A)	3.06×10^{-3}
(B)	0.141
(C)	3.06
(D)	141

9. Some reactions of the metals W, X and Y are given below.

Metal	Reaction with solution of W ions	Reaction with dilute HCl	Reaction with solution of X ions
W	No reaction	Hydrogen formed	Reacts- colour change
X	No reaction	Hydrogen formed	No reaction
Y	Reacts-colour change	Hydrogen formed	Reacts- colour change

(A) Y and W

(B) Y and X

(C) W and X

(D) Y and Y

10. In which of the following equations is the species printed in bold type being reduced?

(A) $Zn^{2+} + \mathbf{Fe(s)} \rightarrow Zn(s) + Fe^{2+}$

(B) $2I^- + \mathbf{Cl_2(g)} \rightarrow I_2 + 2\,Cl^-$

(C) $2\,H^+ + \mathbf{Mg(s)} \rightarrow Mg^{2+} + H_2(g)$

(D) $Mg^{2+} + \mathbf{CO_3^{2-}} \rightarrow MgCO_3(s)$

11. An atom of uranium-238 undergoes radioactive decay.

Decay Sequence	Type of decay	Product nuclide
U-238→W	α-emission	W
W→X	β-emission	X
X→Y	β-emission	Y
Y→Z	α-emission	Z

Which nuclides have the same mass number?

(A) W and Z

(B) X and Z

(C) W,X and Y

(D) X, Y and Z

Section B Short Answer Questions

Question 1 (4 marks)

. In your course, you analysed the development and use of a biopolymer.

(a) Describe a process used industrially to produce a named biopolymer.
(b) Describe two properties of this biopolymer.
(c) Describe the use of this biopolymer.

Question 2: (6 marks)

Complete the table below in your answer book.

Monomer	**Monomer**	**Polymer formed from monomer**	**Uses (state one use of the polymer)**
Name	***Formula***	***Name***	***Uses***
ethene			
vinyl chloride			
acrylonitrile			
styrene			

Question 3 (3 marks)

(a) Evaluate the success of the use of ethanol as an alternative car fuel.
(b) Summarise the chemistry of the fermentation process.

Question 4 (6 marks)

A chemist sets up a galvanic cell based on the reaction:

$$Mg(s) + Cu^{2+} \rightarrow Mg^{2+} + Cu(s)$$

(a) Give a sketch showing clearly how the chemist could set up such a cell. Label your diagram clearly, labelling the chemicals used, anode, cathode and the electron flow.

(b) Write the oxidation half equation for the cell.

(c) Write the reduction half equation for the cell.

(d) Assuming standard conditions, calculate the theoretical voltage of the cell.
(e) How does your calculation show that the reaction is spontaneous?

Question 5 (5 marks)

Electrolysis is used for the refining of metals.

(a) Name a metal that is refined by the industrial use of electrolysis.

(b) Consider the electrolysis process used for the refining of the metal you named in (a)

.

(i) State the name of the oxidant.
(ii) State the name of the reductant.
(iii) State the name of the electrolyte used.
(iv) Describe the conditions under which electrolysis must occur for the refining of the metal.
(v) Explain why the conditions you have described in (iv) are needed for the refining of the metal.

Question 6 (6 marks)

(a) (i) Identify a radioisotope used in industry and describe how this radioisotope is used in industry.
(ii) Describe the properties of the radioisotope you have named in (a) (i) that enable it to be used in industry.

(b) (i) State the name of a radioisotope used in medicine and describe how this radioisotope is used in medicine.
(ii) Describe the properties of the radioisotope you have stated in (b) (i) that enable it to be used in medicine.

(c) Describe one problem associated with using radioisotopes in medicine.

Question 7 (6 marks)

(a) Write equations for each of the following:
(i) production of sulfur dioxide
(ii) production of nitrogen dioxide

(b) Give the (industrial or domestic) origin of each gas.

(c) Why should we be concerned about the release of these gases into the environment?

Question 8 (3 marks)

Type of electrochemical cell	Chemistry of cell	Practicality	Environmental impact
	Anode reaction: $Zn(s) + 2\ OH^-(aq) \rightarrow ZnO(s) + H_2O(l) + 2e^-$ *Cathode reaction*: $HgO(s) + H_2O(l) + 2e^- \rightarrow Hg(l) + 2OH^-$		Toxic mercury released to environment
Vanadium redox cell	*Anode reaction:* $VO^{2+} + 2H^+ + e^- \rightarrow VO_2^+ + H_2O(l)$ *Cathode reaction:* $V^{3+} + e^- \rightarrow V^{2+}$	not portable	

Question 9

A group of students needed to determine the mass of carbon dioxide dissolved in a 375 mL of a carbonated drink, The experimental set-up they proposed is shown below.

(a) Write a procedure consistent with the set-up proposed..
(b) Cite the risks (if any) involved in this procedure.
(c) How can the set-up be modified to prevent accidents or dangerous situations but without sacrificing accuracy?
(d) How can the volume of carbon dioxide gas be calculated at a temperature of 25 ^{0}C and 101.3 kPa.

Question 10 (4 marks)

Indicators were used to check the pH of three water samples : seawater, water draining from a mine, and spring water. The results are given below.

	Bromothymol blue	**Methyl orange**	**Phenolphthalein**	**Flower extract**
Sea water	blue	yellow	colourless	green
Mine water	yellow	red	colourless	red
Spring water	yellow	yellow	colourless	yellow

The colour reactions of the indicators were also checked against solutions of known pH . The results are given below:

pH	**Bromothymol blue**	**Methyl orange**	**Phenolphthalein**	**Flower extract**
1	yellow	red	colourless	red
2	yellow	red	colourless	red
3	yellow	red	colourless	red
4	yellow	yellow	colourless	red
5	yellow	yellow	colourless	red
6	yellow	yellow	colourless	yellow
7	green	yellow	colourless	green
8	blue	yellow	colourless	green
9	blue	yellow	colourless	green
10	blue	yellow	colourless	green
11	blue	yellow	colourless	green
12	blue	yellow	colourless	green

(a) What are the pH values of each of the water samples?

(b) At what pH does the flower extract change colour?

Question 11: (6 marks)

A sample of commercial cloudy ammonia is to be analysed for its ammonia content by titration with a solution of HCl. The concentration of the HCl solution was determined by titration with standard Na_2CO_3 solution. Na_2CO_3 was weighed out (1.5001 g) and diluted to 250.00 mL. A 25.00 mL aliquot was transferred to a conical flask and titrated with the HCl solution. The HCl was then used to determine the concentration of ammonia in the window cleaner. The data for the analysis is given below:

Standardisation of the HCl solution

Mass of anhydrous Na_2CO_3: 1.5001 g. The Na_2CO_3 was diluted to 250.00 mL solution

	Trial		
	1	**2**	**3**
Volume Na_2CO_3 solution, (mL)	25.00	25.00	25.00
Volume of HCl used (mL)	26.00	24.55	24.56

Analysis of Window Cleaner

	Trial		
	1	**2**	**3**
Volume of window cleaner (mL)	10.00	10.00	10.00
Volume of HCl used (mL)	23.00	22.43	22.40

(a) Calculate the molarity of the Na_2CO_3 solution.
(b) Calculate the molarity of the HCl solution
(c) Calculate the molarity of the ammonia in the window cleaner.
(d) Which solution/ liquid is used in the rinsing of the following equipment:
  (i) burette
  (ii) 250 - mL volumetric flask
  (iii) conical flask