CHERRYBROOK TECHNOLOGY HIGH SCHOOL

2013
Higher School Certificate
AP3 Examination

Chemistry

Total marks - 70

Part A
Total marks (15)
Attempt Questions 1 – 15
Allow about 25 minutes for this part

Part B
Total marks (55)
Attempt Questions 16 – 27
Allow about 1 hour and 35 minutes for this section

General Instructions

- Reading time – 5 minutes

- Working time – 2 hours

- Board approved calculators may be used

- Write using black or blue pen

- Draw diagrams using pencil

- A data sheet and a Periodic Table are provided

- A multiple choice answer sheet is attached at the back of the paper

- Write your student number and/or name at the bottom of every page

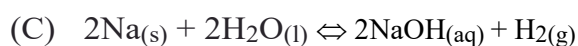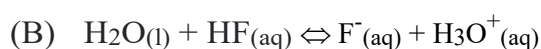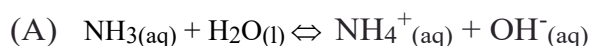**This paper MUST NOT be removed from the examination room**

STUDENT NUMBER/NAME: ……………………..

Section I - Total marks (15)

Attempt Questions 1 – 15
Allow about 25 minutes for this part

Select the alternative A, B, C or D that best answers the question and indicate your choice with a cross (X) in the appropriate space on the multiple choice answer sheet provided at the back of this paper.

1. Which of the following reactions illustrates water acting as a Bronsted-Lowry acid?

(A) $NH_{3(aq)} + H_2O_{(l)} \Leftrightarrow NH_4^+{}_{(aq)} + OH^-{}_{(aq)}$

(B) $H_2O_{(l)} + HF_{(aq)} \Leftrightarrow F^-{}_{(aq)} + H_3O^+{}_{(aq)}$

(C) $2Na_{(s)} + 2H_2O_{(l)} \Leftrightarrow 2NaOH_{(aq)} + H_{2(g)}$

(D) $H_2CO_{3(aq)} + H_2O_{(l)} \Leftrightarrow HCO_3^-{}_{(aq)} + H_3O^+{}_{(aq)}$
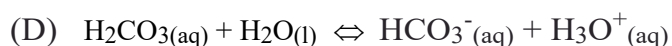
2. Hydrogen gas can be produced by the reaction of methane with steam, as shown below.

$$CH_{4(g)} + 2H_2O_{(g)} \Leftrightarrow CO_{2(g)} + 4H_{2(g)} \qquad \Delta H = +166 \text{ kJ mol}^{-1}$$

Which set of conditions increases the **equilibrium yield** of hydrogen?

(A) lower pressure and higher temperature

(B) higher pressure and lower temperature

(C) higher pressure and higher temperature

(D) lower pressure and lower temperature

3. 0.94g of heptane is burnt in excess of oxygen to produce carbon dioxide gas and water vapour. The product is collected and cooled back to 0˚C and 100 kPa. The volume of carbon dioxide gas collected is:

(A) 2.5 L

(B) 1.3 L

(C) 1.5 L

(D) 2.0 L.

STUDENT NUMBER/NAME: …………………..

4.   What did the Brønsted-Lowry definition of acids have as a significant improvement over earlier definitions. What did it identify?

   (A) Acids contain hydrogen.

   (B) Acids contain oxygen.

   (C) Acids are electron-pair acceptors.

   (D) Acids are proton donors.

5.   A student was shown a demonstration in which a sample of an element was heated strongly in air. The powder produced by the reaction was then added to water, and the resulting solution was mixed and gently warmed to dissolve some of the white powder. When tested with a pH probe connected to a data logger, the resulting solution had a pH of 8.3.

   Which of the following elements could have been used?

   (A) C

   (B) N

   (C) S

   (D) Mg

6.   A solution of a monoprotic strong acid has a pH of 2.2. A student dilutes 15 mL of the solution to 1000 mL. What is the final pH of the solution?

   (A) 3.0

   (B) 4.0

   (C) 5.0

   (D) 6.0

STUDENT NUMBER/NAME: ……………………..

7. A group of students produced a red solution by boiling red cabbage leaves in water. When dilute sodium hydroxide was added to the solution, it turned purple. When dilute hydrochloric acid was added to the red solution, no colour change occurred.

Which of these substances, when added, is most likely to cause the red solution to change colour?

    (A) Cleaning solution containing ammonia

    (B) NaCl solution

    (C) Vinegar solution

    (D) Orange Juice

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8. Which of the following salts is considered neutral?

    (A) KNO_3

    (B) CaO

    (C) NH_4Cl

    (D) CH_3COONa

9. Which diagram below best represents the polymerisation of ethylene?

    (A) $CHCN=CH_2$ forming $-CHCN-CH_2-CHCN-CH_2-$

    (B) $CH_2=CH_2$ forming $-CH_2-CH_2-CH_2-CH_2-$

    (C) $C_6H_{12}O_6$ forming $-C_6H_{10}O_5-C_6H_{10}O_5-$

    (D) $CHCl=CH_2$ forming $-CHCl-CH_2-CHCl-CH_2-$

10. The molar heat of combustion of 1-propanol is 2016 $kJmol^{-1}$. Which of the following statements is correct for 1-propanol when 5g is combusted?

    (A) 168×10^3 kJ is released

    (B) 168 kJ is released

    (C) 32, 000 J is absorbed

    (D) 24192 J is released

STUDENT NUMBER/NAME: ……………………..

11.   In the compound $HClO_2$ what is the oxidation state of chlorine?

(A) -1

(B) -3

(C) +1

(D) +3

12.   The fuel E-10 consists of 10% ethanol blended with petrol consisting mainly of octane. Which of the following statements best explains the solubility of ethanol in petrol?

(A) Ethanol undergoes hydrogen bonding with petrol which increases its solubility.

(B) Ethanol contains a polar – OH group improving its solubility in hydrocarbons.

(C) Ethanol and petrol are both non-polar molecules and therefore allows solubility.

(D) Ethanol contains a short hydrocarbon chain which is non polar and therefore allows solubility.

13.   Which of the following pieces of equipment is used to detect radiation;

(A) Watson Radioactive Counter

(B) Fractional Distillation Column

(C) Geiger-Muller Counter

(D) Centrifuge

STUDENT NUMBER/NAME: ……………………..

14.   In a darkened laboratory, a student placed, 5mL of hexane into a test tube and 5mL of hex-1-ene into another test tube. Three drops of bromine water were added to both test tubes. After shaking the test tubes, the student immediately recorded his observations.

Test Tube	Observation
1	The reddish colour faded rapidly
2	A coloured layer remained

Which of the following would best represent the species present in test tube 1 and 2 immediately after the reaction?

	Test Tube 1	Test Tube 2
(A)	C_6H_{14}, Br_2	C_6H_{12}, $C_6H_{12}Br_2$
(B)	C_6H_{14}, Br_2, H_2O	C_6H_{12}, $C_6H_{12}Br_2$, H_2O
(C)	$C_6H_{12}Br_2$	C_6H_{14}, Br_2
(D)	C_6H_{12}, $C_6H_{12}Br_2$, H_2O	C_6H_{14}, Br_2, H_2O

STUDENT NUMBER/NAME: …………………..

15. Cellulose is a linear polymer which is a basic structural component of plant cell walls.

Which is the correct representation of part of a cellulose polymer?

(A)

CH_2OH ... CH_2OH ... CH_2OH ... CH_2OH

(B)

CH_2OH ... CH_2OH ... CH_2OH ... CH_2OH

(C)

CH_2OH ... CH_2OH ... CH_2OH ... CH_2OH

(D)

CH_2OH ... CH_2OH ... CH_2OH ... CH_2OH

END OF PART A

STUDENT NUMBER/NAME: ……………………..
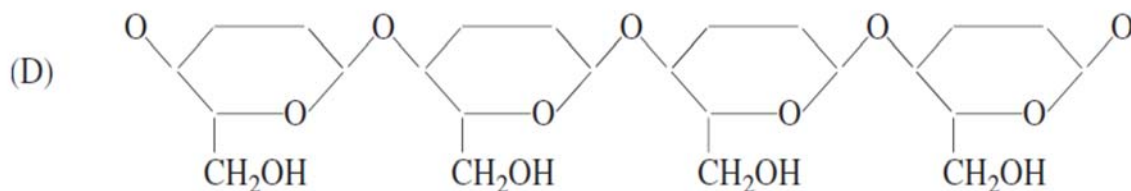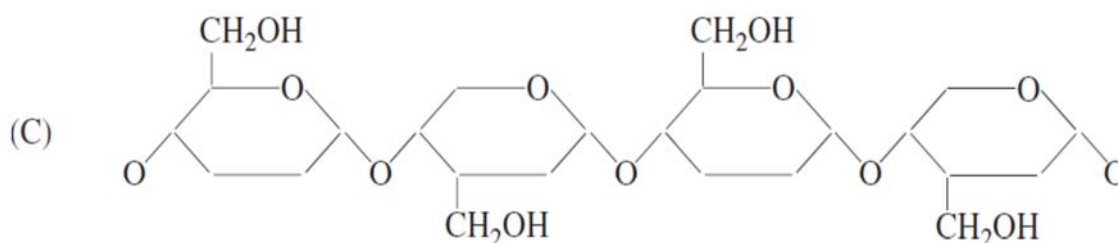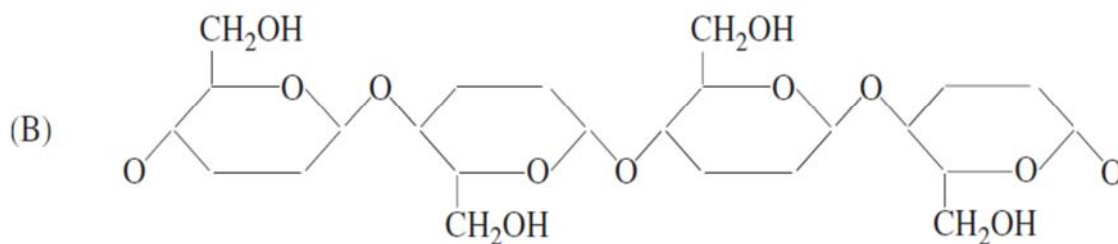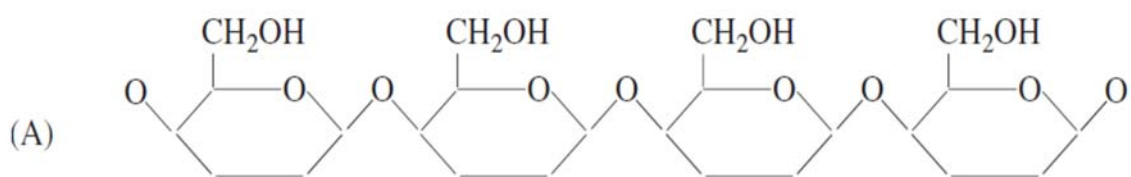
Part B- (55 marks)

Questions: 16- 27

Answer the questions in the spaces provided.

Show all relevant working in questions involving calculations.

Question 16 (4 marks)

a) Describe the conditions necessary for a system to be at equilibrium.   **2**

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b) Consider the following reaction at equilibrium   **2**

$$N_2O_{4\ (g)} \quad \rightleftharpoons \quad 2NO_{2(g)} \qquad \Delta H = +\ 92\ KJ$$
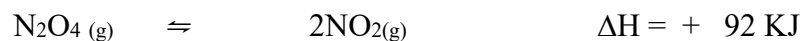
Complete the table below by describing the effect on the equilibrium of the above reaction.

Change in Equilibrium	Equilibrium Shift- (Forward or Reverse Reaction)
$[N_2O_4]$ is increased	
$[NO_2]$ is increased	
Temperature is increased	
Pressure is Increased	

STUDENT NUMBER/NAME: ……………………..

Question 17 (3 marks)

A household cleaning agent contains a weak base of general formula NaX. 1.00g of this compound was dissolved in deionised water to make a 100.0 mL solution. A 20.0 mL sample of the solution was titrated with 0.100 mol L^{-1} hydrochloric acid and required 24.4mL of acid for neutralization.

What is the molar mass of this base?

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Question 18 (4 marks)

a) Explain the difference between a strong acid and a weak acid in terms of the equilibrium between the molecule and its ions using the equations of specific examples to support your answer. **3**

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STUDENT NUMBER/NAME: …………………..

b) Define the term, amphiprotic.   **1**

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Question 19 (3 marks)

Describe the effect of buffers with reference to one naturally occurring buffer system. Include relevant chemical equations.

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Question 20 (2 marks)

Car batteries contain the electrolyte sulfuric acid, however other acids are used as food additives. With reference to two acids explain their use as food additives.

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Question 21 (9 marks)

a) There are two methods of production of radioisotopes. The first method involves the use of a nuclear reactor accelerating neutrons at high speed to produce neutron rich isotopes. The second method involves using a cyclotron to make neutron deficient radioisotopes.

Identify which of the above methods would be used to make Oxygen-18. Use an equation to explain your answer.   **3**

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Question 21 continues over the page

STUDENT NUMBER/NAME: …………………..

The remainder of Question 21 does not refer to part "a)" and are to be answered independently.

b) Name a radioisotope with either a medical or industrial application.   **1**

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c) Describe its use and relate this to the chemical properties of the radioisotope.   **2**

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d) Give one problem associated with the use of this radioisotope.   **1**

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e) Explain why a radioisotope with a half life of 10 years, would be unsuitable for use in the medical industry as a treatment/therapy for medical illnesses.   **2**

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Question 22 (6 marks)

In the town of Queenstown, Tasmania the mining of copper from the surrounding countryside has been occurring since the late 1800's. Before the start of mining the area was lush rainforests, however today the landscape resembles a moon-like landscape and the effects of mining can be easily seen. Over a century of mining and smelting of copper sulfide ores has led to this environmental disaster.

Picture A: Area before mining   Picture B: Area after mining

Question 22 continues over the page

STUDENT NUMBER/NAME: ……………………..

Question 22 continued (6 marks)
With the help of equations, explain why smelting of copper sulfide ores has had such a
devastating effect on the Queenstown area and assess the evidence which indicates that
atmospheric concentrations of oxides of sulfur are on the increase on a global scale.

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STUDENT NUMBER/NAME: ……………………..

Question 23 (5 marks)

A galvanic cell was made by connecting two half-cells. One half-cell was made by placing a nickel electrode in a nickel (II) nitrate solution. The other half-cell was made by placing a silver electrode in a silver nitrate solution. The electrodes were connected to a voltmeter and a salt bridge connected each half cell.

a) Calculate the theoretical voltage of this galvanic cell.   **2**

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The following part is unrelated to part a).

b) A student places a long strip of magnesium in a beaker of green iron (II) sulfate solution and left it for 10 minutes. Identify an observation the student would have made when they returned and explain this observation in terms of electron transfer.   **3**

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Question 24 (5 marks)

The biopolymer cellulose may be used on a large scale in the future as a raw material to make chemicals and plastics.

a) Why would cellulose be a good raw material to build petrochemicals?   **1**

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Question 24 continues over the page.

STUDENT NUMBER/NAME: …………………..

b) Cellulose is a condensation polymer. Explain the meaning of the term "condensation polymer".   .   **2**

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c) Rayon and celluloid are polymers derived from modified cellulose. Much research is directed at making new biopolymers. Identify two advantages of biopolymers over fossil fuel derived polymers.   **2**

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Question 25 (6 marks)

The following diagrams show *some* of the components of a student's experimental set up. Answer all parts of this question with reference to the diagram.
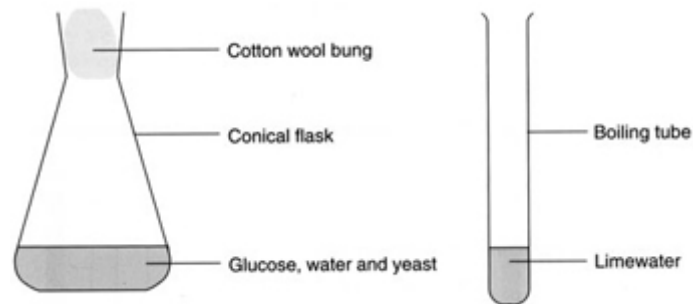
a) Identify the experiment and then outline the procedure you used in class to conduct this experiment.   **3**

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STUDENT NUMBER/NAME: …………………..

Question 26 continues over the page.

b) The following mass changes were recorded for this investigation.

Mass of container before = 205.9g
Mass of container after 3 days = 203.5g

An alcohol was produced in this reaction. Calculate the mass of this alcohol product. Include a balanced chemical equation in your answer.   **3**

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Question 26 (4 marks)

a) Construct a flow chart which shows both materials and processes used in the production of ethanol from biomass. In your flowchart, include the conversion of ethanol to a petrochemically significant molecule.   **3**

b) Write an equation to describe the formation of this petrochemically significant molecule from ethanol   **1**

STUDENT NUMBER/NAME: ……………………..

Question 27 (4 marks)

The following graph shows a decay series. Thorium-232 decays through a series of emissions of alpha or beta particles.
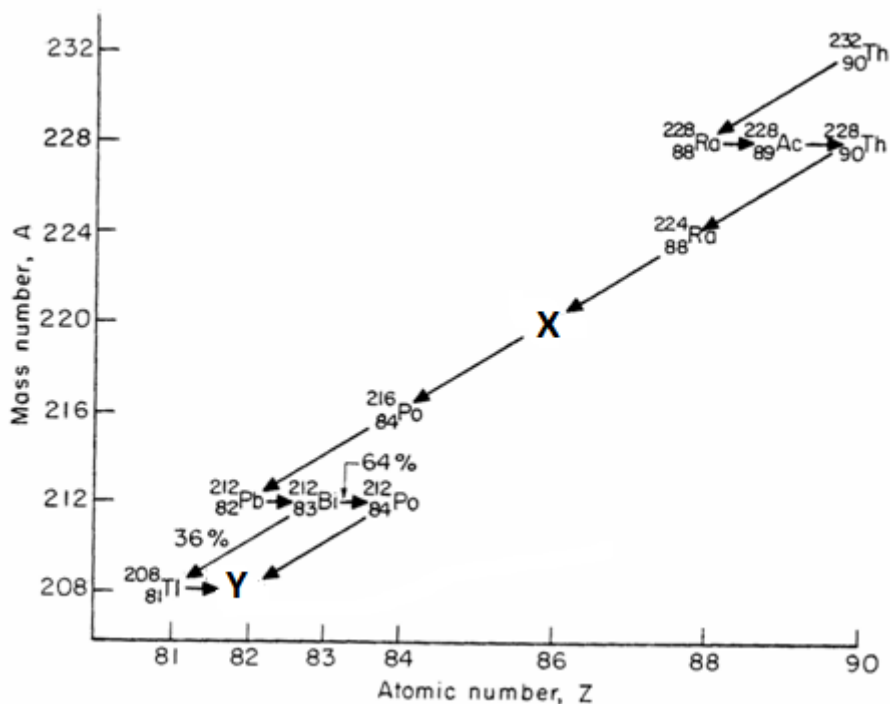
Identify the elements X & Y and what is being represented by the long arrows and the short arrows.   **4**

X: _____

Y: _____

Longer Arrows: _____

Shorter Arrows: _____

END OF TASK

STUDENT NUMBER/NAME: …………………..