



DEPARTMENT OF
EDUCATION

HIGHER SCHOOL
CERTIFICATE
EXAMINATIONS

CHEMISTRY

19 October 2010

Time allowed
2 hours & 30 minutes
(08.00 – 11.00)

Candidates are advised to
fully utilise the allocated
time

C 10

INSTRUCTIONS TO CANDIDATES: (To be read out by the External Invigilator)

Check that there is a 11-page question paper, an 8-page answer sheet and a 2-page data sheet in this booklet.

There are 30 questions in this paper. Attempt ALL questions.

The Examination is divided into two sections:

Section A: Multiple-Choice (Questions 1 to 20) consists of 20 multiple-choice questions. Choose the best answer for each question, and write the **LETTER** of your choice, A, B, C, D or E, in the **grid** on the **Answer Sheet**.

If you decide to change an answer, make your correction as shown below so that it is clear to the markers what your final answer is. Do NOT use correction fluid on your answer sheet.



You are advised to spend only 45 minutes on Section A.

Section B: Short-Answer (Questions 21 to 30) consists of 10 questions worth 8 marks each. Write your answers in the **spaces provided** on the **Answer Sheet**.

All working **must** be shown for Section B. Marks are awarded for correct working.

Calculators may be used.

The Answer Sheet is in the middle of the Examination Booklet. Remove the Answer Sheet from the booklet and write your name, candidate number and school name on the **Answer Sheet**.

Candidates are advised to spend the first 10 minutes reading through this paper.

Hand in the Answer Sheet and the Examination Booklet separately. The Examination Booklet together with the Data Sheet will remain as the school property.

EXTRA TIME WILL NOT BE ALLOWED TO COMPLETE THE EXAMINATION UNDER ANY CIRCUMSTANCES.

PENALTY FOR CHEATING OR ASSISTING OTHERS TO CHEAT IN NATIONAL EXAMINATIONS IS NON-CERTIFICATION.

DO NOT TURN OVER THE PAGE AND DO NOT WRITE UNTIL YOU ARE TOLD TO START

SECTION A (Questions 1 to 20)

Choose the best answer for each question, and write the LETTER of your choice, A, B, C, D or E, in the GRID on the ANSWER SHEET.

QUESTION 1

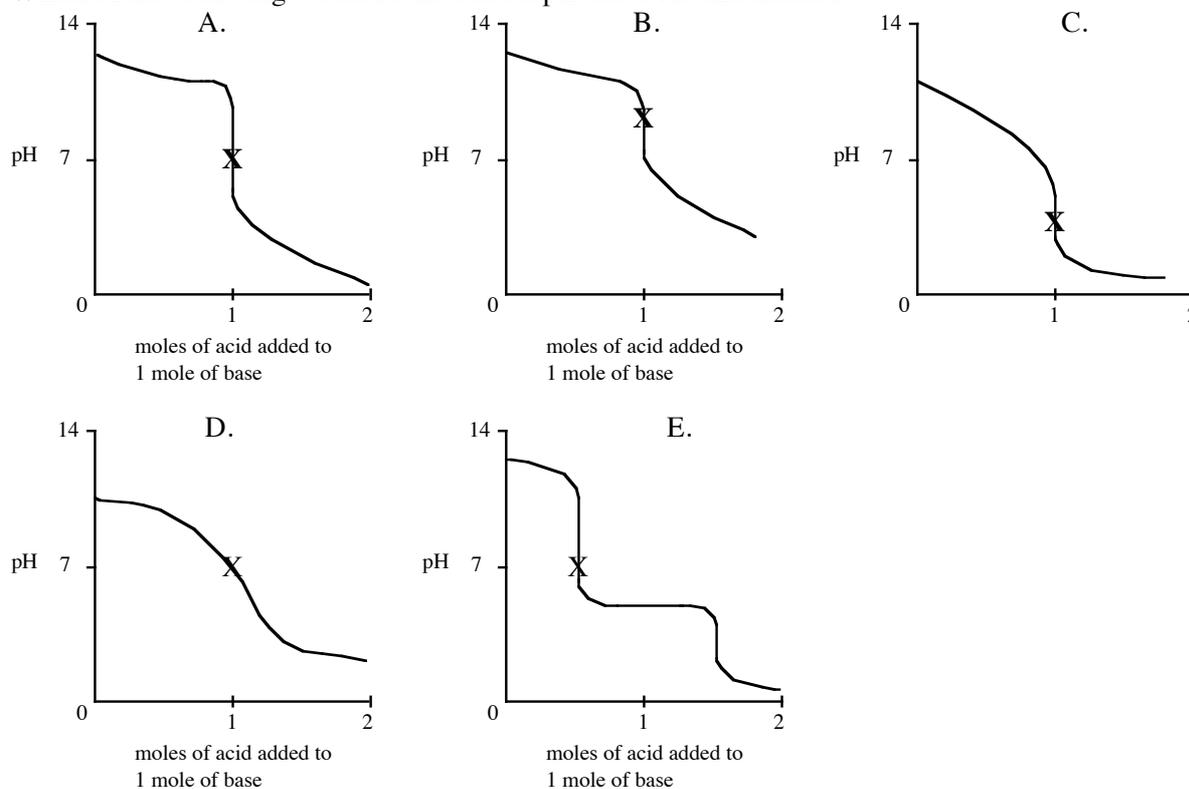
Which of the following compounds is the **strongest** acid?

- A. HCl B. HBr C. HI
D. H₂O E. H₂S

QUESTION 2

A strong base in a beaker was titrated with a weak acid from a burette. The pH of the equivalence point (X) was measured using a pH meter.

Which of the following would be the correct pH curve for this titration?



QUESTION 3

Which of the following gives the correct number of shared electrons in nitrogen, oxygen and chlorine gases respectively?

- A. 2; 4; 1 B. 2; 4; 2 C. 6; 4; 2
D. 4; 6; 2 E. 2; 2; 2

QUESTION 4

In a titration activity, a basic solution in a beaker was titrated with an acid solution from a burette. The volume of acid used was recorded as shown in the table.

Titration No.	Initial reading	Final reading
1	9.00 ml	20.00 ml
2	24.00 ml	35.00 ml
3	36.00 ml	48.00 ml

What is the average volume of acid used?

- A. 11.00 ml B. 11.33 ml C. 11.66 ml
D. 11.50 ml E. 12.00 ml

QUESTION 5

Which of the following is NOT true of methanol?

- A. It fits the general formula ROH, where R = CH₃
B. It is used as a solvent.
C. It is a fuel that burns to produce carbon dioxide and water.
D. It is a common drink used during parties.
E. It is a dipole molecule.

QUESTION 6

Two miscible liquids, "A" and "B", when mixed together form a homogenous liquid mixture.

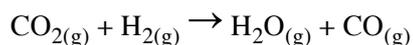
Liquid "A" has a boiling point of 78°C while liquid "B" has a boiling point of 98°C.

What would be the most appropriate method to use to physically separate the two liquids?

- A. centrifuging B. using a separating funnel
C. filtration followed by sublimation D. distillation
E. sublimation only

QUESTION 7

If the following system is in equilibrium,



which of the following will cause the equilibrium to shift to the left?

- A. increase H₂ and increase CO B. decrease H₂ and increase H₂O
C. increase CO₂ and decrease CO D. decrease CO₂ and decrease H₂O

QUESTION 8

Respiration is a process that is

- A. exothermic and occurs only in animal cells.
- B. exothermic and occurs in both plant and animal cells.
- C. endothermic and occurs only in plant cells.
- D. endothermic and occurs in both plant and animal cells.
- E. similar to photosynthesis.

QUESTION 9

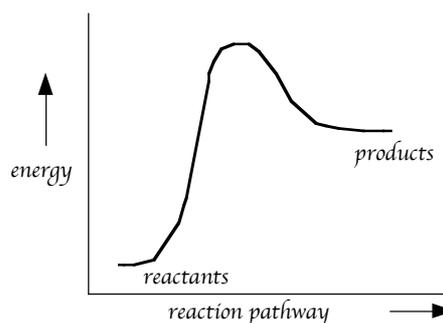
Which of the following occurs during the electrolysis of concentrated NaCl solution?

- A. Oxygen evolves at the cathode.
- B. Oxygen evolves at the anode.
- C. Hydrogen evolves at the anode.
- D. Chlorine evolves at the cathode.
- E. Chlorine evolves at the anode.

QUESTION 10

What does the following reaction coordinate diagram represent?

- A. an endothermic reaction.
- B. an exothermic reaction.
- C. a reaction that is neither exothermic nor endothermic.
- D. a reaction in which a catalyst is used.
- E. a redox reaction.

**QUESTION 11**

Which of the following statements about fossil fuels is NOT true?

- A. they are the remains of plants and animals that lived millions of years ago.
- B. they are made of carbon compounds.
- C. they are used as fuels because they absorb plenty of heat energy when they burn.
- D. they produce carbon dioxide and water vapour as well as energy when they burn.
- E. they are non-renewable.

QUESTION 12

Uranium has two isotopes, Uranium 238 and Uranium 235. How many neutrons are present in an atom of Uranium 235?

- A. 92
- B. 143
- C. 184
- D. 235
- E. 238

QUESTION 17

An element is represented as X_{15}^{31} . Which of the following statements is true? The element X

- A. is a metallic element. B. is an inert gas. C. is a halogen.
D. would have five (5) electrons in the outer shell of its atom.
E. would have two (2) electronic shells in its atom .

QUESTION 18

The correct electronic structure of chlorine is

- A. $1s^2 2s^2 2p^6 3s^2 3p^5$ B. $1s^2 2s^2 2p^7 3s^2 3p^4$
C. $1s^2 2s^1 2p^6 3s^2 3p^6$ D. $1s^2 2s^1 2p^6 3s^1 3p^7$
E. $1s^2 2s^1 2p^7 3s^2 3p^5$

QUESTION 19

Which of the following equations is balanced?

- A. $\text{Ca}(\text{HCO}_3)_2 + \text{H}_3\text{PO}_4 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + \text{H}_2\text{O} + \text{CO}_2$
B. $\text{CaHCO}_3 + \text{H}_3\text{PO}_4 \rightarrow \text{Ca}(\text{PO}_4)_2 + 6\text{H}_2\text{O} + 3\text{CO}_2$
C. $3\text{Ca}(\text{HCO}_3)_2 + \text{H}_3\text{PO}_4 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + 4\text{H}_2\text{O} + 2\text{CO}_2$
D. $3\text{Ca}(\text{HCO}_3)_2 + 2\text{H}_3\text{PO}_4 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + 6\text{H}_2\text{O} + 6\text{CO}_2$
E. $3\text{Ca}(\text{HCO}_3)_2 + \text{H}_3\text{PO}_4 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + 6\text{H}_2\text{O} + 6\text{CO}_2$

QUESTION 20

Which of the following chemical equations is correctly balanced and represents a plausible reaction?

- A. $\text{FeSO}_4 + \text{Cu} \rightarrow \text{Fe} + \text{CuSO}_4$
B. $\text{CuSO}_4 + \text{Fe} \rightarrow \text{Cu} + \text{FeSO}_4$
C. $\text{CuSO}_4 + 2\text{Ag} \rightarrow (\text{Ag})_2\text{SO}_4 + \text{Cu}$
D. $2\text{Pb}(\text{NO}_3)_3 + 3\text{Au} \rightarrow 3\text{Au}(\text{NO}_3)_2 + 2\text{Pb}$
E. $\text{Cu}(\text{NO}_3)_2 + 2\text{Ag} \rightarrow 2\text{AgNO}_3 + \text{Cu}$

END OF SECTION A

SECTION B (Questions 21 to 30)

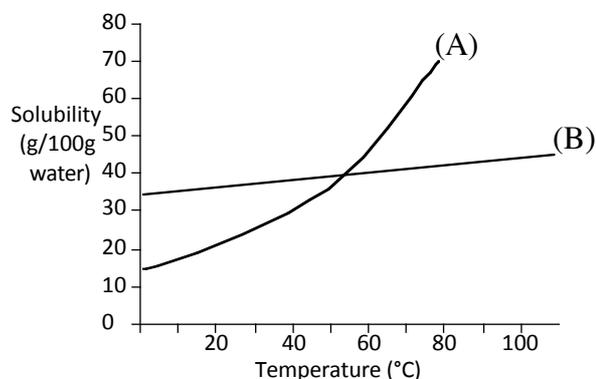
Write your answers in the spaces provided on the ANSWER SHEET.

QUESTION 21

- a) Name the apparatus that would be used to separate a mixture of oil and water. (1)
- b) Crude oil fractions or cuts are separated using _____ process. (1)
- c) Water boils at 100°C at sea level. At higher altitudes will the boiling point be higher or lower? (1)
- d) The graph shows the solubility curves of copper (II) sulphate (A) and sodium chloride (B)

Which substance is more soluble at:

- (i) 30°C? (1)
- (ii) 75°C? (1)



- e) What is *acid rain* commonly composed of? (1)
- f) Which type of reaction, endothermic or exothermic draws energy from its surroundings to facilitate its progress? (1)
- g) What is the formula for the precipitate formed when silver nitrate and sodium chloride solutions are reacted together. (1)

QUESTION 22

- a) What is the mass (approx) in grams of 10 moles of magnesium? (2)
- b) What is the number of atoms in 10 moles of magnesium? (2)
- c) What is the volume (in litres) of oxygen needed for the complete combustion of 10 litres of acetylene at 1500°C and a pressure of 101 kpa assuming temperature and pressure remain constant. (2)
- d) Which of the following has the greatest mass?
- (i) 44.8 litres of neon at STP
- (ii) 0.16 moles of mercury
- (iii) 30 grams of lead (2)

QUESTION 23

- a) Chemical changes result in the formation of new substances, physical changes do not. State whether each change below is a chemical change or a physical change.



- b) Name the substance(s) formed from the following chemical change



- c) Ions are formed when atoms gain or lose electrons

(i) What are positively charged ions called? (1)

(ii) What are negatively charged ions called? (1)

- d) An ionic compound is formed when positively and negatively charged ions react together.

Write the formula for the compound formed when chloride ions react with calcium ions. (1)

QUESTION 24

- a) Which of the following substances would have the lower boiling point?

Explain your answer in terms of chemical bonding.

(i) C_2H_6 or CH_3COOH (2)

(ii) SiO_2 or CO_2 (2)

- b) Which would be the better solvent; petrol (octane) or water for the following:

(i) Hydrogen chloride (g) (1)

(ii) Potassium chloride (s) (1)

(iii) Iodine (s) (1)

(iv) Liquefied Natural Gas (LNG) (1)

QUESTION 25

- a) What is the mass of 1 mole of Sodium sulphate? (1)

- b) The concentration of Sodium chloride in a solution is 10 gL^{-1} . How many grams of salt (NaCl) is found in 500 ml of this solution? (1)

- c) A laboratory technician was asked to prepare 2 litres of 0.02 molar calcium carbonate solution.
- What mass of calcium carbonate should the technician weigh and dissolve? (1)
 - How many moles of calcium carbonate is in 250 ml of the prepared solution? (1)
- d) Barium chloride and sodium sulphate solutions were reacted together to form a precipitate. The balanced equation for the reaction is
- $$\text{BaCl}_{2(\text{aq})} + \text{Na}_2\text{SO}_{4(\text{aq})} \rightarrow \text{BaSO}_{4(\text{s})} + 2\text{NaCl}_{(\text{aq})}$$
- What volume of 0.200M barium chloride solution is required to react with exactly 50.00ml of 0.250M of sodium sulphate? (1)
 - What mass of barium sulphate is produced from the above reaction? (1)
- e) Solid iron (Fe) can be produced by passing hydrogen gas over iron oxide. The equation is as follows
- $$\text{FeO}_{(\text{s})} + \text{H}_{2(\text{g})} \rightarrow \text{Fe}_{(\text{s})} + \text{H}_2\text{O}_{(\text{g})}$$
- How many moles of iron (Fe) would be formed when 2 moles of iron oxide (FeO) are reacted? (1)
 - How many grams of iron oxide (FeO) are required to produce 100 grams of iron (Fe)? (1)

QUESTION 26

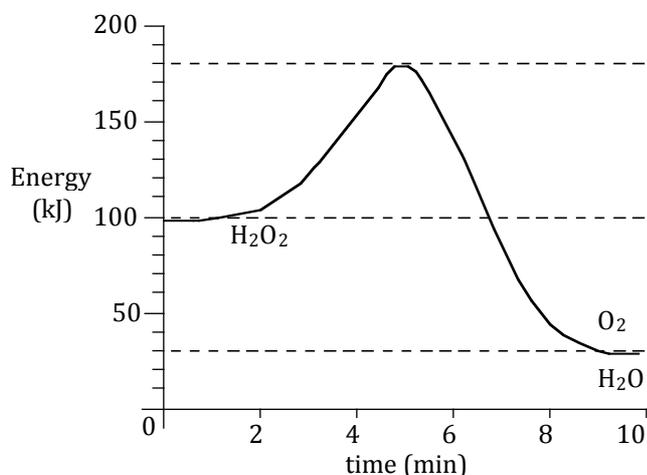
- a) Calculate the pH of the following solutions.
- 0.001 M H_2SO_4 solution (1)
 - 0.001 M $\text{Ba}(\text{OH})_2$ solution (1)
 - 0.1 M NaCl solution (1)
- b) Calculate the pH after 20 ml of 0.01 M hydrochloric acid solution is diluted by the addition of 80 ml of distilled water. (2)
- c) A titration to standardise a HCl solution was performed by taking 50.0 ml hydrochloric acid in a flask with a few drops of phenolphthalein indicator. The burette was filled with 0.15 molar NaOH. The initial reading of the burette was 0.50 ml and the final reading was 30.5 ml. What is the concentration of the solution? (3)

QUESTION 27

- Can Aluminium be produced from its salts in aqueous solution? Give a reason for your answer. (2)
- Can Sodium metal be produced by the electrolysis of aqueous NaCl? Give a reason for your answer. (2)
- What are the products forming at the anode and cathode when electrolysis of aqueous AgNO_3 is carried out? (2)
- In the electrolytic refining of blistered copper, what are the materials used to make the anode and cathode? (2)

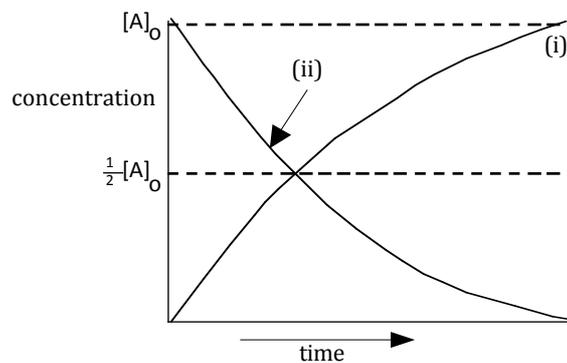
QUESTION 28

- a) Given is the energy reaction diagram for a non-catalysed decomposition of hydrogen peroxide (H_2O_2) to water (H_2O) and oxygen (O_2).



From the diagram

- (i) Calculate the energy change (ΔH) for the reaction. (1)
 - (ii) Determine the energy of formation. (2)
 - (iii) Determine the energy level of the activated complex. (1)
- b) Complete the following sentence.
- In a chemical reaction, energy is required to _____ bonds between the reactants and _____ bonds between the products. (2)
- c) The diagram below shows concentrate curves for the reaction; $2\text{A} \rightarrow 2\text{B} + \text{C}$

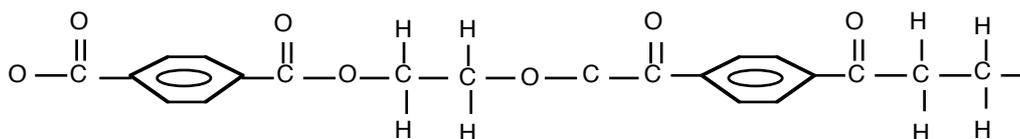


Label correctly the lines (i), (ii) and as 2A or 2B. (2)

QUESTION 29

- a) Write a balanced chemical equation for the oxidation of ethanol to ethanoic acid. (1)
- b) What is the main element mined by the Metallurgical Corporation of China (MCC) in the Ramu area of Madang Province? (1)
- c) Which of the following crude oil fractions, kerosene, petrol, diesel or bitumen has the lowest boiling point? (1)

- d) Part of the structure for a polyester polymer, terylene is shown

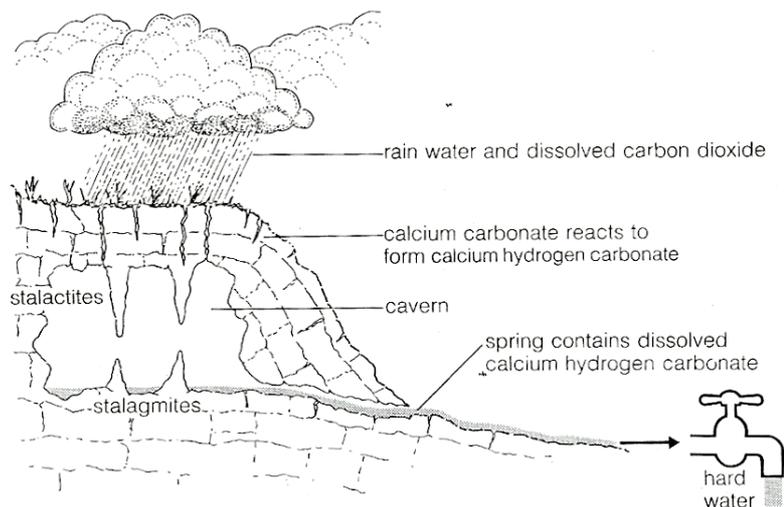


Draw the structure of the two monomers that formed the polymer. (2)

- e) Write the formula for the product formed when fossil fuels are burnt which contributes to global warming through the greenhouse effect. (1)
- f) Large quantities of natural gas are currently found in which province in Papua New Guinea? (1)
- g) Why must the natural gas be liquefied before shipment overseas? (1)

QUESTION 30

- a) Calcium hydrogen carbonate is the most common cause of hard water. It forms when rainwater falls on rocks containing limestone.



The equation for the reaction of limestone in the presence of rainwater and carbon dioxide is



Hard water contains decomposed calcium bicarbonate, $\text{Ca}(\text{HCO}_3)_{2(aq)}$, resulting in the formation of a compound leading to 'scaling' of industrial pipes and boilers.

- i) Write a balanced chemical equation for the decomposition of calcium hydrogen carbonate. (2)
- ii) Write a chemical equation for a method of removing 'scaling'. (2)
- iii) Give one advantage and one disadvantage (apart from scaling), of hardness in water. (2)
- b) Calculate the pH of a solution when 500ml of 0.2M NaOH and 500ml of 0.2M H_2SO_4 are mixed. (2)

END OF EXAMINATION