Name ..... Teacher .....

2012

AP 3

Chemistry

General Instructions
• Reading time – 5 minutes
• Working time – 2 hours
• Write using black or blue pen
• Draw diagrams using pencil
• Board-approved calculators may be used
• A data sheet and a Periodic Table are provided.

Total marks – 68
Part A – 15 marks
• Attempt Questions 1–15
• Allow about 30 minutes for this part

Part B – 53 marks
• Attempt Questions 16-28
• Allow about 1 hour and 30 minutes for this part

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Part A – 15 marks
Attempt Questions 1–15
Allow about 30 minutes for this part

Use the multiple-choice answer sheet for Questions 1–15.

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1. "Rinse first with water, then the solution to be held in it"

For which two items of equipment, used in titration, does this instruction apply?

(A) Volumetric flask and burette
(B) Reaction (conical) flask and pipette
(C) Pipette and burette
(D) Reaction (conical) flask and burette

2. An unknown colourless solution is tested with three common indicators – methyl orange, bromothymol blue and phenolphthalein.

The results showed:

Indicator	Colour in the presence of the solution
Methyl orange	Orange
Bromothymol blue	Yellow
Phenolphthalein	Colourless

The solution can be classified as
(A) Mildly basic
(B) Very basic
(C) Mildly acidic
(D) Very acidic

3. Calculate the pH of the solution when 25.0ml of 0.750mol L^{-1} hydrochloric acid solution is added to 10ml of 0.500mol L^{-1} barium hydroxide solution.

(A) 0.456
(B) 0.602
(C) 1.862
(D) 2.058

4. Which of the following substances is acidic?

(A) Orange juice
(B) Ammonia
(C) Laundry detergents
(D) Distilled water

5. A student uses a pH meter to obtain the pH for solutions of sodium hydroxide and sodium carbonate. The pH reading for each solution is 10.2.

The student can correctly conclude.

(A) Both solutions are weak acids
(B) Each solution has the same concentration
(C) Only the sodium hydroxide contains OH^- ions
(D) Both solutions have $[H_3O^+]$ of $1 \times 10^{-10.2}$mol L^{-1}

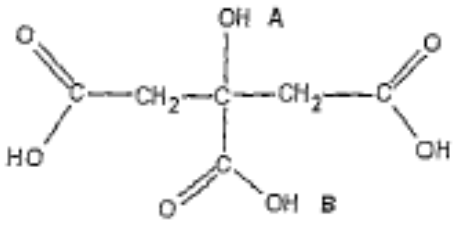
6. Which of the following correctly identifies a base and its conjugate acid in the equation below?

$$NH_2^- + HF \leftrightarrow NH_3 + F^-$$

	Base	Conjugate Acid
(A)	NH_2^-	NH_3
(B)	HF	F^-
(C)	NH_3	F^-
(D)	F^-	NH_2^-

7. The pH of a 0.0115mol L^{-1} solution of H_2SO_4 is closest to.
   (A) 0.9
   (B) 1.2
   (C) 1.6
   (D) 1.9

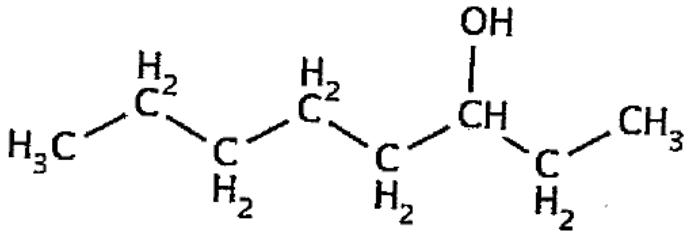
8. The diagram below shows a molecule of citric acid.



Which of the two types of functional groups labelled A and B, will react with NaOH?

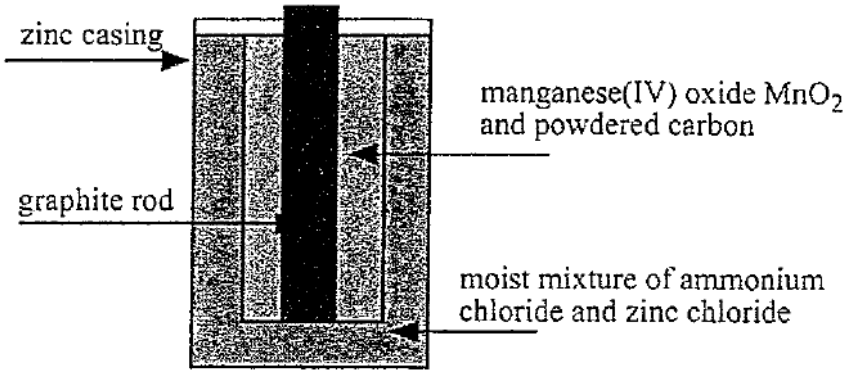
(A) A only
(B) A and B
(C) B only
(D) Neither of these functional groups

9. What is the systematic name for the following compound?



(A) Heptan-5-ol
(B) Heptan-3-ol
(C) Octan-5-ol
(D) Octan-3-ol

10. The diagram below shows a dry cell battery

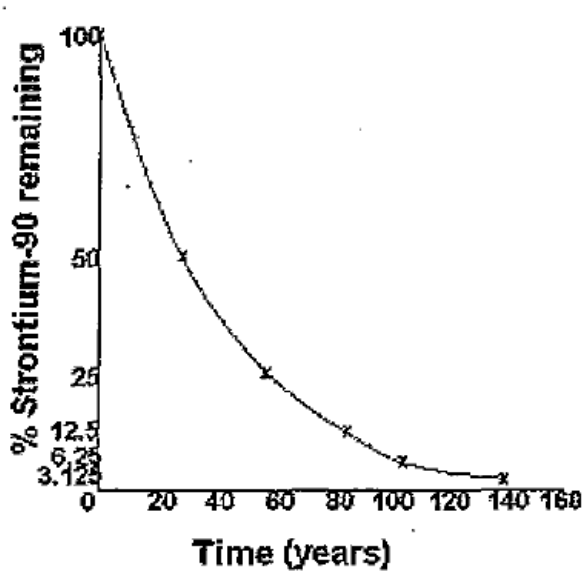


$$Zn(s) + 2\ MnO_2(s) + ZnCl_2(aq) + 2\ H_2O(l) \rightarrow 2\ MnO(OH)(s) + 2\ Zn(OH)Cl(aq)$$

Which of the following statements is correct for this dry cell battery?

(A) The manganese (IV) oxide is the electrolyte
(B) The graphite rod is the anode
(C) Graphite is reduced at the cathode
(D) Zinc is oxidised to zinc (II) at the anode

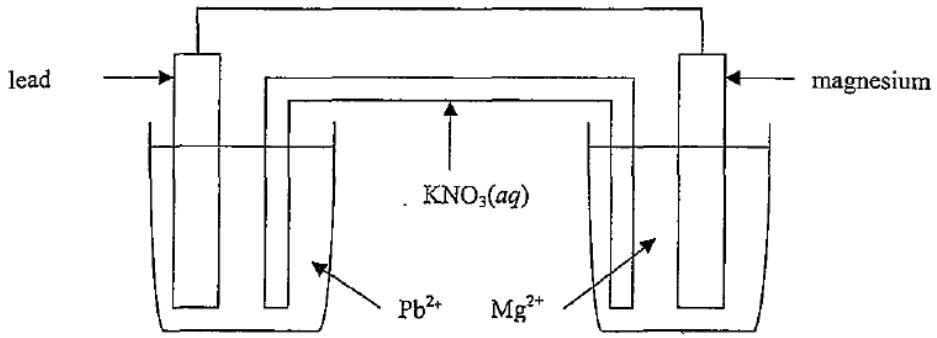
11. The graph shows the radioactive decay of strontium-90.



What is the approximate half-life of strontium-90?

(A) 30 years
(B) 50 years
(C) 80 years
(D) 140 years

12. The diagram below represents a galvanic cell.



Which of the following half-equations represents the reaction at the cathode?

(A) $Mg^{2+}_{(aq)} + 2e^- \longleftrightarrow Mg_{(s)}$
(B) $Mg_{(s)} \longleftrightarrow Mg^{2+}_{(aq)} + 2e^-$
(C) $Pb^{2+}_{(aq)} + 2e^- \longleftrightarrow Pb_{(s)}$
(D) $Pb_{(s)} \longleftrightarrow Pb^{2+}_{(aq)} + 2e^-$

13. A Transuranic element is produced when:

(A) Nuclei with 92 protons break up into smaller atoms
(B) A small nucleus is forced into large nucleus so that the total number of protons becomes greater than 92.
(C) More than 92 hydrogen nuclei are forced together to make a single nucleus.
(D) Two nuclei containing at least 47 protons are forced together to form a single nucleus.

14. Calculate the mass of carbon dioxide formed when 74.4 L of oxygen gas at 100kPa and 25 ºC completely combust a sample of ethanol.

(A) 44 g
(B) 50 g
(C) 88 g
(D) 132 g

15. Cellulose is a biopolymer. It is formed:

(A) By polymerisation of α-glucose monomer units.
(B) By a process of addition polymerisation
(C) As a long branched chain of monomer units
(D) With the elimination of a water molecule as the pairs of monomer join.

Section I (continued)

Part B – 55 marks
Attempt Questions 21–31

Allow about 1 hour and 40 minutes for this part
Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.

Show all relevant working in questions involving calculations.

Question 16 (2 marks)

Buffer solutions are important in natural systems

(a) Explain why a mixture of sodium chloride and hydrochloric acid cannot form a buffer solution.

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(b) Outline the importance of buffer solutions in a natural system.

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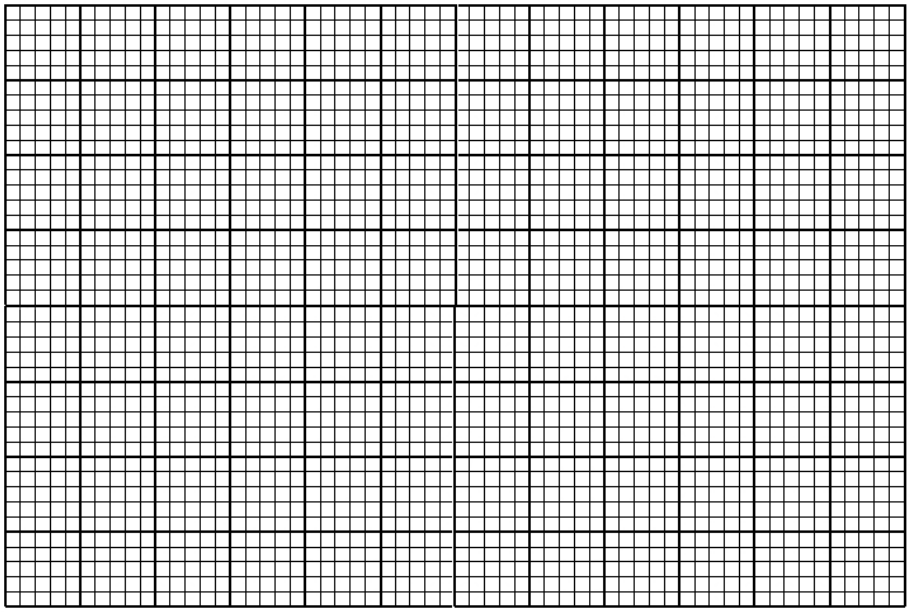
Question 17 (6 marks)

A student measures the pH of a can of soft drink, immediately after it is opened, then at 15 minute intervals. The table below shows the data obtained.

Time (min)	0	15	30	45	60	75	90	105	120
pH	4.5	5.9	6.5	6.7	7.1	7.3	7.4	7.4	7.5

(a) Plot the data on the grid below.

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(b) Compare the initial hydrogen concentration with that after 2 hours

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(c) Explain the changing pH of the soft drink in terms of Le Chatelier's principle, and the properties of carbon dioxide.

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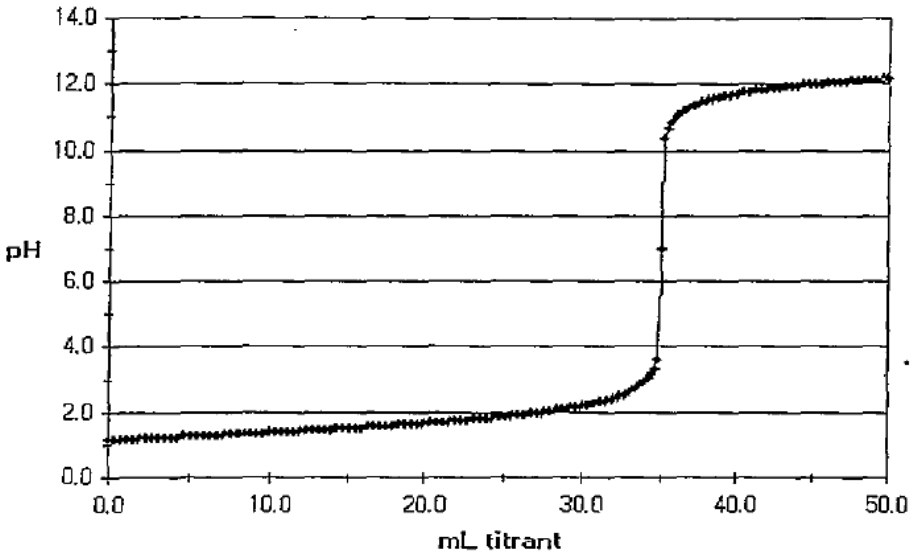
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Question 18 (5 marks)

In order to calculate the concentration of a sample of HCl, a student titrated a 25.0 ml sample of the acid against 0.075M $Ca(OH)_2$ (the titrant).

She used a probe connected to a data logger to monitor the reaction, and her results are shown in the graph below.



(a) Write a balance chemical equation for the reaction that occurs during the titration.

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(b) Use the graph to calculate the concentration of the hydrochloric acid.

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(c) Outline another method the student could have used to estimate the equivalence point of the titration, identifying any specific chemical required and observations made.

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Question 19 (3 marks)

Describe the trend in the acid-base nature of oxides moving from left to right across the periodic table.

Include examples and relevant chemical equations in your answer.

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Question 20 (5 marks)

A chemistry teacher performed a demonstration in which a small mass of copper metal was added to concentrated nitric acid in a gas jar.

The reaction produced 1.50 L of the gas NO_2, at 0°C and 100 kPa. The other products were copper (II) nitrate and water.

(a) Write a balanced equation for this reaction.

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(b) Assuming an excess of nitric acid, calculate the mass of copper needed to produce this much NO_2 gas.

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(c) Write a risk assessment for this demonstration.

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Question 21 (5 marks)

A student prepared the ester, butyl ethanoate, in a school laboratory.

(a) Identify the alkanol used by the student.

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(b) Write a chemical equation for the reaction, using structural formulae.

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(c) Outline why refluxing is used during esterification.

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Question 22 (2 marks)

Ethanol can be produced industrially either by hydration of ethylene or by fermentation.

(a) Write a balanced equation for the industrial production of ethanol by hydration of ethylene.

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(b) Write a balanced equation for the industrial production of ethanol by fermentation.

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Question 23 (6 marks)

Assess the viability of the use of cellulose from biomass as a substitute for carbon chain structures obtained from petroleum to produce fuels and polymers.

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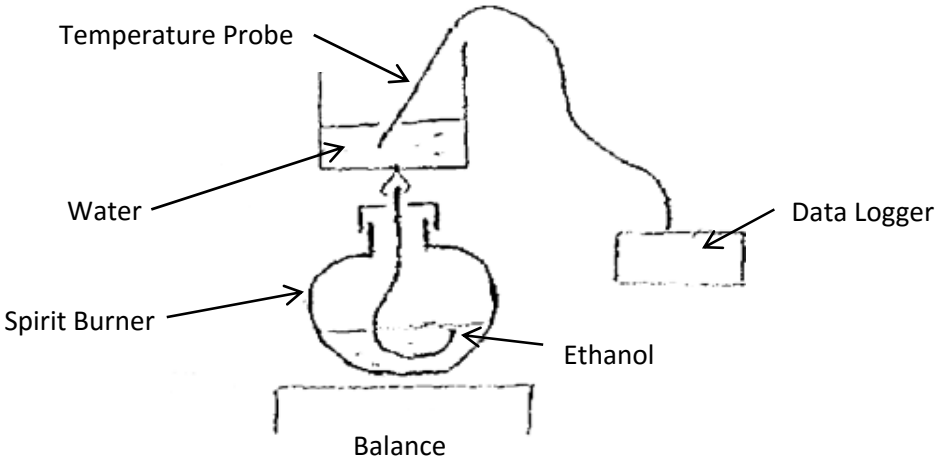
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Question 24 (5 marks)

A quantity of ethanol was placed in a spirit burner, the wick lit and the energy produced used to heat 100 g of water in a beaker. The change in mass of the spirit burner was measured by placing the burner on an electronic balance. The temperature was measured using a probe attached to a data logger. A diagram of the apparatus is shown.

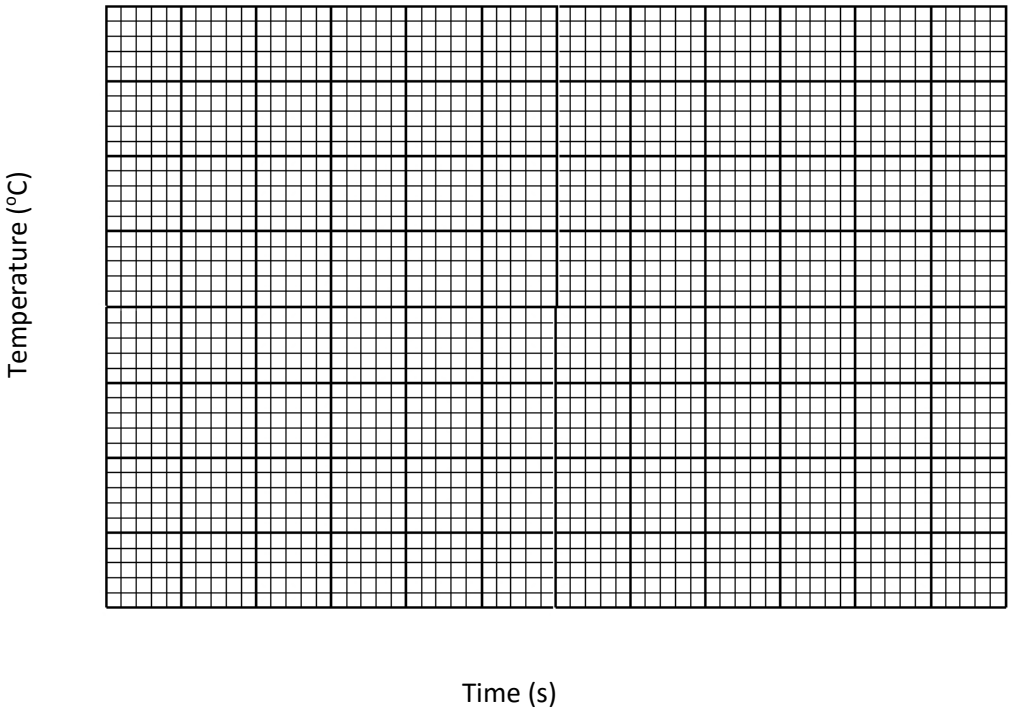


The results are tabulated below.

Time (min)	*Mass of Burner + Alcohol (g)*	*Temperature (^oC)*
0	228.3	24
1	227.8	30
2	227.4	37
3	226.9	44
4	226.5	51
5	226.2	58

(a) Draw a graph of temperature vs. time. Use an appropriate scale.

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(b) Calculate the molar heat of combustion of ethanol using these data.

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Question 25 (2 marks)

a) Write an equation to describe the addition of bromine to ethene.

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b) Draw the isomer of the product of the above reaction and name it.

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Question 26 (2 marks)

Use oxidation numbers to explain why the reaction between zinc and hydrochloric acid is an oxidation –reduction reaction.

$$Zn_{(s)} + 2HCl \longrightarrow ZnCl_{2(aq)} + H_{2(g)}$$

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Question 27 (4 marks)

(a) Name a biopolymer that is currently being manufactured and considered as an alternative to traditional polymers such as polyethylene.

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(b) Identify potential uses of this biopolymer and explain how its properties make it suitable for these uses.

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Question 28 (6 marks)

Study the following galvanic cell.

$$Zn/Zn^{2+}//Ni^{2+}/Ni$$

a) Draw a diagram to show how this cell may be assembled in the laboratory.

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b) Write the oxidation half reaction for this cell

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c) Write the reduction half reaction for this cell

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d) Write the overall equation for the reaction.

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e) Calculate the theoretical value of the cell under standard conditions.

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Name/Number _____

Part A

Total marks (20)

Attempt Questions 1–15

Allow about 30 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 grid below.

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	A	B	C	D
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	A	B	C	D
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