2011

HSC Half-Yearly Examination

Chemistry

General Instructions
Reading time – 5 minutes
Working time – 1.5 hours

Write using blue or black pen
Draw diagrams using pencil
Approved calculators may be used
Write your student number on each section of this booklet

Total marks 60
This examination has two parts, Part A and Part B.
Part A – 10 marks
Attempt Questions 1 – 10.
Allow about 15 minutes for this part.

Part B – 50 marks
Attempt Questions 11 – 20.
Allow about 1 hour and 15 minutes for this part.

Teacher-in-charge: Ms Jackson, Mrs Davis, Mr Geerling, Mr Peck

Task Weighting: 20%

Multiple choice answer sheet

This sheet **should** be separated from the rest of the paper for your convenience.

Ensure that you place your student number on this page.

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

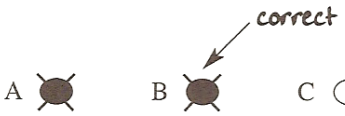
Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

A ○ B ● C ○ D ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ● B ⊗ C ○ D ○

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word **correct** and drawing an arrow as follows.



Part A

1. A ○ B ○ C ○ D ○
2. A ○ B ○ C ○ D ○
3. A ○ B ○ C ○ D ○
4. A ○ B ○ C ○ D ○
5. A ○ B ○ C ○ D ○
6. A ○ B ○ C ○ D ○
7. A ○ B ○ C ○ D ○
8. A ○ B ○ C ○ D ○
9. A ○ B ○ C ○ D ○
10. A ○ B ○ C ○ D ○

Part A.

10 marks

Attempt questions 1 - 10.

Allow about 15 minutes for this part.

Record your answers on the separate multiple-choice answer sheet that is on the back of the exam title page.

You should DETACH this page for your convenience.

Ensure your student number is written on it.

1. Compound X was tested using a range of indicators, producing a yellow colour with methyl orange, red with litmus, yellow with bromothymol blue and colourless with phenolphthalein. It can be deduced that compound X is:

(A) highly acidic
(B) weakly acidic
(C) neutral
(D) weakly basic

2. Evidence that can be used to indicate an increase in atmospheric concentrations of acidic oxides include:

(i) increased levels of photochemical smog
(ii) ice core samples
(iii) air quality measurements
(iv) carbon radioisotope concentrations

Which of these pieces of evidence allows us to deduce that the levels of nitrogen oxides in the atmosphere have increased?

(A) (i) only
(B) (i) and (iii)
(C) (ii) and (iv)
(D) all four

3. Which of the following pairs would form a buffer solution?

(A) H_2SO_4 / HSO_4^-
(B) H_3O^+/H_2O
(C) $NaHCO_3$ / Na_2CO_3
(D) $NaNO_3$ / NO_3^-

4. Identify the list that contains only basic substances.

(A) Oven cleaner, bleach, baking soda
(B) Soap, bleach, soda water
(C) Blood, oven cleaner, lemon juice
(D) Lemonade, tomato juice, sea water

5. Which of the following best describes a neutralisation reaction?
(A) a proton transfer in which energy is absorbed
(B) an electron transfer in which energy can be released
(C) a proton transfer in which energy is released
(D) an electron transfer in which energy is absorbed

6. What volume of hydrogen gas is produced at 0°C and 100 kPa when 50.00 g of magnesium completely reacts with an excess of dilute hydrochloric acid?
(A) 46.71 L
(B) 50.99 L
(C) 93.42 L
(D) 102.0 L

7. Which of the following compounds is amphiprotic?
(A) hydrogen chloride
(B) trihydrogen phosphate
(C) dihydrogen dioxide
(D) nitrogen trihydride

8. Which of the following is a significant industrial source of ethylene?
(A) Fermentation of sugar
(B) Polymerisation of polyethylene
(C) Cracking of long-chain hydrocarbons
(D) Hydration of ethanol

9. Ethenyl benzene is the systematic name for a commercially significant monomer.
What is the common name of the polymer made from this monomer?
(A) Polystyrene
(B) Polybenzoate
(C) Polyvinylchloride
(D) Polyethenylbenzene

10. A solution of sulfuric acid has a pH of 0.27.
What is the concentration of the acid in mol/L?
(A) 0.27
(B) 0.54
(C) 1.1
(D) 1.4

Part B.

50 marks

Attempt questions 11 – 20.
Read the whole of each question before commencing it.
Answer the questions in the spaces provided.
Show full working for questions requiring calculations.
Allow about 1 hour and 15 minutes for this part.

11. (a) Recount the procedure you used to investigate the volume of gas released by a can of soft drink. 2M

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(b) Classify this investigation as destructive or non-destructive. 1M

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12. Explain the change in solubility of carbon dioxide in water as the temperature of the water increases, with reference to Le Chatelier's Principle. 3M

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13. Contrast the theories of acids and bases proposed by Arrhenius and Bronsted-Lowry, with reference to specific examples. 3M

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14. A titration is to be carried out to determine the concentration of a solution of hydrochloric acid. Sodium hydroxide will be used.

a. Suggest an appropriate substance that could be used as a primary standard to determine the concentration of a solution of sodium hydroxide. 1M

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b. Write a method for this titration. Include appropriate rinsing procedures, the indicator to be used and steps to ensure reliability. 3M

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c. The concentration of the solution of sodium hydroxide was determined to be 0.033 mol/L. When titrated with the solution of hydrochloric acid, 0.0060 mol of sodium hydroxide was required to neutralise exactly 25.0 mL of acid. Calculate the concentration of the hydrochloric acid. 2M

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15. A student used a pH probe and data logger to determine the pH of a range of salt solutions. The results obtained were as follows:

Salt solution (0.1 mol/L)	**pH**
Ammonium nitrate	5.52
Sodium hydrogen carbonate	9.43
Sodium chloride	7.00

a. Outline the procedure the student used to calibrate the pH probe. 2M

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b. Outline the importance of calibrating the pH probe before beginning the investigation. 1M

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c. Outline ONE advantage of using a pH probe rather than indicators to determine the pH of the salt solutions. 1M

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d. Explain the results obtained for sodium hydrogen carbonate. Include relevant equations. 2M

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16. A student carried out a first-hand investigation to make the ester, ethyl methanoate. The appropriate chemical substances were placed into a flask and heated under reflux.

a. Identify the chemical substances that would have been placed into the flask to produce this ester. 1M

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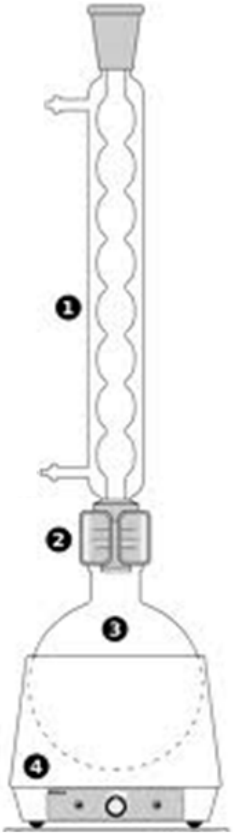
b. Write an equation, using structural formulae, to show the reaction that will take place to produce ethyl methanoate. 1M

c. The diagram shows the apparatus for refluxing.



(i) Identify the part of this apparatus labelled "**1**". 1M

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(ii) Using the letter "X", clearly indicate where water enters this piece of equipment. 1M

d. Explain, with reference to the collision theory, why the mixture in the flask needs to be heated for a length of time. 3M

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e. Evaluate the use of the reflux process in the preparation of the ester. 3M

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17. Polyethylene (PE) is an addition polymer.

a. Outline the meaning of the term "addition polymer". 1M

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b. Outline the steps in the production of polyethylene from its monomer. 3M

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18. Evaluate the impacts of industrial sources of sulfur dioxide on the environment, making use of appropriate chemical equations. 6M

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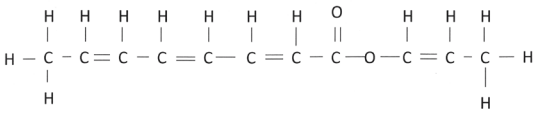
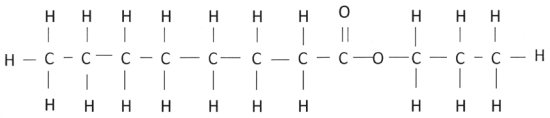
19. Complete the table to contrast the alkanol and alkanoic acid functional groups in carbon compounds. 2M

	Alkanol	**Alkanoic acid**
Name of functional group		
Functional group structural formula		

20. Olive oil is extracted from the fruits of the olive tree and bottled in liquid form for domestic purposes, such as frying.
Olive oil can be further chemically processed to become margarine through an addition reaction called hydrogenation, where hydrogen atoms are added to the molecule, changing some of the properties of the olive oil.

Feature	**Olive oil**	**Margarine**
State at 25 ºC	liquid	solid
State at 40 ºC	liquid	liquid
Formula of a molecule		
Classification	Unsaturated	Saturated

a. Explain the state of matter, at room temperature, of each of these substances. 3M

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b. Design an investigation to confirm that olive oil is unsaturated whereas margarine is saturated. Your investigation must be able to be carried out in a school laboratory. 4M

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Marking Guidelines HY Exam - 2011
Year 12 CHEMISTRY

Part A – multiple choice.

1.	B	4.	A	7.	D	10.	A
2.	B	5.	C	8.	C		
3.	C	6.	A	9.	A		

Part B.

11 a.

Marking criteria	*Marks*
Correct procedure recounted	2
Some steps of the procedure recounted OR the full procedure that we did not use in class was recounted	1

11 b.

Marking criteria	*Marks*
Classifies the investigation as destructive testing	1

12.

Marking criteria	*Marks*
States Le Chatelier's Principle and explains the change in solubility of carbon dioxide when temperature increases	3
Explains the change in solubility of carbon dioxide when temperature increases OR states LCP and links an increase in temperature with a shift of equilibrium to the left (towards the reactants) OR states LCP and states that there is a decrease in the solubility of CO_2 in water	2
States LCP OR links an increase in temperature with a shift of equilibrium to the left (towards the reactants) OR states that there is a decrease in the solubility of CO_2 in water	1

13.

Marking criteria	*Marks*
Contrasts Arrhenius' theory of acids and bases to that of Bronsted-Lowry, and provides specific examples that contrast the theories	3
Contrasts Arrhenius' theory of acids and bases to that of Bronsted-Lowry OR describes Arrhenius' theory of acids and bases to that of Bronsted-Lowry, and provides specific examples that contrast the theories	2
Describes Arrhenius' theory of acids and bases OR describes the Bronsted-Lowry theory of acids and bases OR provides specific examples that contrast the theories	1

14 a.

Marking criteria	*Marks*
Identifies a suitable acidic primary standard	1

14 b.

Marking criteria	*Marks*
Includes an appropriate indicator, a logical method for the titration that includes rinsing procedures for pipette, burette and conical flask AND includes steps that ensure reliability, retaining results that lie within 0.1mL	3
Includes a logical method with rinsing procedures and an indicator identified, with repetition included.	2
Includes a logical method for a titration.	1

14 c.

Marking criteria	*Marks*
Calculates the concentration of the HCl as 0.24 mol/L AND /OR	2-1
shows a 1:1 ratio for the reaction between HCl and NaOH (this may be shown with a balanced equation or stated)	

15 a.

Marking criteria	*Marks*
Outlines a procedure for calibration that uses two buffer solutions with differing pH AND mentions rinsing the probe OR gives explicit instructions for the use of the data logger in the procedure.	2
Outlines a procedure that uses two buffers of differing pH	1

15 b.

Marking criteria	*Marks*
Gives a reason for calibrating the probe that indicates improved validity or accuracy. *Please note – It seems that many students NEED to review the concepts of reliability, validity and accuracy. The information that can be used as a source for this review would be the pink science resource booklets issued in year 11.*	1

15 c.

Marking criteria	*Marks*
Outlines one advantage of probes over indicators	1

15 d.

Marking criteria	*Marks*
Includes an explanation of sodium hydrogen carbonate having a pH of 9.43 (cause = HCO_3^- is acting as a B-L base, accepting a H^+ from water which has the effect of producing excess OH^-) AND Shows an appropriate supporting equation that is balanced.	2
Shows an appropriate equation OR offers a reason for a pH of 9.43	1

16 a.

Marking criteria	*Marks*
Identifies ethanol, methanoic acid and concentrated sulfuric acid as the three chemical substances that would be placed into the flask.	1

16 b.

Marking criteria	*Marks*
Writes a correct equation that uses structural formulae (NOT condensed) for all four chemicals. Note that this is an equilibrium reaction.	1

16 c (i).

Marking criteria	*Marks*
Identifies the apparatus as "condenser"	1

16 c (ii).

Marking criteria	*Marks*
"X" points to the lower water inlet on the condenser	1

16 d.

Marking criteria	*Marks*
Outlines the cause and effect relationship AND provides ONE or TWO reasons that links the cause to its effect : *Cause → heating supplies the molecules with more energy* *Effect → speeds up the rate of reaction* *Because → when particles have more energy, they will collide more often AND/OR there will be a higher % of collisions that are successful.*	3
Identifies that heating either increases the energy content of the reactant molecules OR makes the particles move faster AND Outlines an effect of this – either, increases the number of collisions between molecules OR increases the % of collisions that are successful OR increases the rate of reaction.	2
Identifies that heating → increases the energy content of the molecules OR → makes the reactant molecules move faster OR → speeds up the rate of reaction OR	1

→ increases the number of collisions between molecules OR → increases the % of collisions that are successful	

16 e.

Marking criteria	*Marks*
Makes an evaluation that includes the judgement "that the use of the reflux process is useful" and provides a criterion for this judgement "because it minimizes the loss of volatile substances from the reaction vessel". AND Provides TWO reasons to support this judgement → (1) increases the yield since the reactant molecules are able to remain in intimate contact in the reaction vessel (2) allows for the reaction mixture to be heated which will increase the reaction rate (3) allows the reaction to be heated which will increase the yield since the forward, endothermic reaction will be favoured (4) increases safety, since it prevents the escape, into the atmosphere, of flammable gases.	3
Provides TWO reasons as to why the refluxing process is useful	2
Provides ONE reason as to why the refluxing process is useful	1

17 a.

Marking criteria	*Marks*
Provides the two key features of an addition polymer – (i) made by the joining together of many monomer units (ii) the joining happens by an addition reaction OR happens without the loss of any atoms.	1

17 b.

Marking criteria	*Marks*
Identifies the three key steps in the production of polyethylene (initiation, propagation and termination) AND Provides the key features of each of the three steps.	3
Identifies TWO the three key steps in the production of polyethylene AND Provides the key features of each of these TWO steps	2
Identifies ONE the three key steps in the production of polyethylene and provides the key features of each of this step OR Identifies the three key steps in the production of polyethylene	1

18.

Marking criteria	*Marks*
(1) Identifies and provides key features of TWO industrial sources of sulfur dioxide (ie. demonstrates extensive knowledge) (2) Identifies and provides key features of THREE impacts that sulfur dioxide has on the environment (ie. demonstrates extensive knowledge) (3) THREE correct and relevant chemical equations (4) Makes a judgment about the impact of industrial sources of sulfur dioxide on the environment that is consistent with the other information presented	6
1) Identifies TWO industrial sources of sulfur dioxide and identifies THREE impacts that sulfur dioxide has on the environment (2) Demonstrates extensive knowledge of either industrial sources or impacts on the environment by providing details for both identified sources OR by providing details for all three identified impacts (3) Provides TWO correct and relevant equations (4) Makes a judgment about the impact of industrial sources of sulfur dioxide on the environment that is consistent with the other information presented	5
ONE (1M), TWO (2M), THREE (3M) or FOUR (4M) of the following five points → (1) identifies an industrial source of sulfur dioxide (eg. smelting of sulfide ores) (2) identifies another industrial source of sulfur dioxide (eg. combustion of fossil fuels that contain sulfur impurities) (3) identifies one impact of sulfur dioxide on the environment (4) identifies another impact of sulfur dioxide on the environment (5) provides one correct and relevant chemical equation	1 - 4

19.

Marking criteria	*Marks*
Identifies the names and the structures of the functional groups for an alkanol and an alkanoic acid	2
Identifies the names or the structures of the functional groups for an alkanol and an alkanoic acid	1

20 a.

Marking criteria	*Marks*
Explains the state of both the margarine and the olive oil in relation to their intermolecular bond strengths	3
Explains the state of either the margarine or the olive oil in relation to their intermolecular bond strengths	2
Identifies the state of margarine and/or olive oil	1

20 b.

Marking criteria	*Marks*
Designs a method that can be performed in the lab and includes five relevant points that confirms olive oil is saturated and margarine is unsaturated.	4
Designs a method that can be performed in the lab and includes four relevant points that confirms olive oil is saturated and margarine is unsaturated.	3
Designs a method that can be performed in the lab and includes three relevant points that confirms olive oil is saturated and margarine is unsaturated.	2
Designs a method that can be performed in the lab and includes one or two relevant points that confirms olive oil is saturated and margarine is unsaturated.	1