Student Number: _____

North Sydney Boys High School

Science Faculty

HSC Chemistry 2016

Assessment 3

General Instructions:

Reading time – 5 minutes
Working time – 2 hours 15 minutes (135 minutes)

- Write using black or blue pen
- Draw diagrams using pencil
- Board approved calculators may be used
- This paper has two parts
- Write your student number at the top of every page

Total Marks - 75

Part A: Multiple Choice

- 20 questions
- 20 marks

Part B: Written Response

- 9 questions
- 55 marks

Part A / 20	
Part B / 55	
Total Mark / 75	

This paper MUST NOT BE REMOVED from the examination room

Student Number: _____

Part A – Multiple Choice (20 marks):
Attempt questions 1 - 20
Allow about 35 minutes for this section.

Use the answer grid to record your answer. Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Question 1.

Ethene and propene form polymers which exhibit different properties. The main reason for this variety is attributed to:

(A) Dispersion forces
(B) Polarity
(C) Hydrogen bonding
(D) Dipole-dipole interaction

Question 2.

A student wanted to perform an experiment to determine the concentration of a barium hydroxide solution. They filled a burette with a 0.153 mol L-1 solution of acetic acid, placed a 25.00 mL aliquot of the hydroxide solution into a 100 mL conical flask and added several drops of an indicator. They subsequently titrated the hydroxide with the acid. After a number of repeats, they found that a volume of 18.75 mL of acid was required to reach equivalence point.

Which of the following indicators is the best choice to establish the equivalence point in this experiment?

(A) Methyl red
(B) Phenolphthalein
(C) Litmus
(D) Bromothymol blue

Question 3.

A car is measured to use 5.15 L of fuel per 100 kilometer when driving outside of the city. The car is assumed to be burning octane, which has a Heat of Combustion of -5.33 $MJmol^{-1}$, and a density of 0.703 gmL^{-1}.

The energy generated by the engine to travel one kilometer is closest to:

(A) 1.6 kJ
(B) 48 kJ
(C) 320 kJ
(D) 4.8 kJ

Question 4.

The pH of an unknown solution was found to be 2.3. A 25 mL aliquot of the solution was added to a volumetric flask and topped up with distilled water to the 250 mL mark. What would be the pH of this new solution?

(A) 2.3
(B) 2.8
(C) 3.3
(D) 4.6

Question 5.

10 mL of 0.1 $molL^{-1}$ of the following salt solutions were simultaneously added to a beaker containing a zinc electrode.

- $CuSO_4$
- $AgNO_3$
- $ZnCL_2$

What observations would you expect to see in the beaker?

(A) The zinc electrode appears to dissolve and a white participate forms at the bottom of the beaker.
(B) A deposit forms on the zinc electrode and a white participate forms at the bottom of the beaker.
(C) No reaction is observed at the electrode and a white participate forms at the bottom of the beaker.
(D) No reaction is observed.

Question 6.

2.58 g of calcium carbonate was reacted to completion with 100.0 mL of a 1.00 mol L^{-1} HCl solution. The volume of gas released in this reaction at 25℃ and 100 kPa is closest to:

(A) 0.05 L
(B) 0.1 L
(C) 0.5 L
(D) 1.0 L

Question 7.

Which of the following oxides can be described as a basic oxide.

(A) Na_2O
(B) CO
(C) SO_2
(D) CO_2

Question 8.

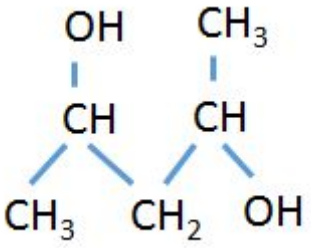
A student has accidently spilled a small quantity of concentrated sulfuric acid on the floor of the lab and on her shirt sleeve.

Which of the following procedures should you implement?

	Sleeve	Floor
(A)	Flush with cold water	Flush with cold water
(B)	Neutralise with sodium carbonate.	Neutralise with sodium hydroxide.
(C)	Neutralise with sodium hydroxide.	Neutralise with sodium carbonate.
(D)	Flush with cold water.	Neutralise with sodium carbonate.

Question 9.

What is the correct IUPAC name for the following molecule?



(A) 1-methyl-butan-1,3-diol
(B) pentan-2,4-diol
(C) 1,3-dihydroxy-pentane
(D) 1,3-dimethyl-propan-1,3-diol

Question 10.

Which of the following would be used as a catalyst to dehydrate ethanol?

(A) Dilute sulfuric acid
(B) Iron (III) oxide
(C) Zeolyte
(D) Concentrated sulfuric acid

Question 11.

Which of the following reactions can NOT be described as demonstrating a Lavoisier acid?

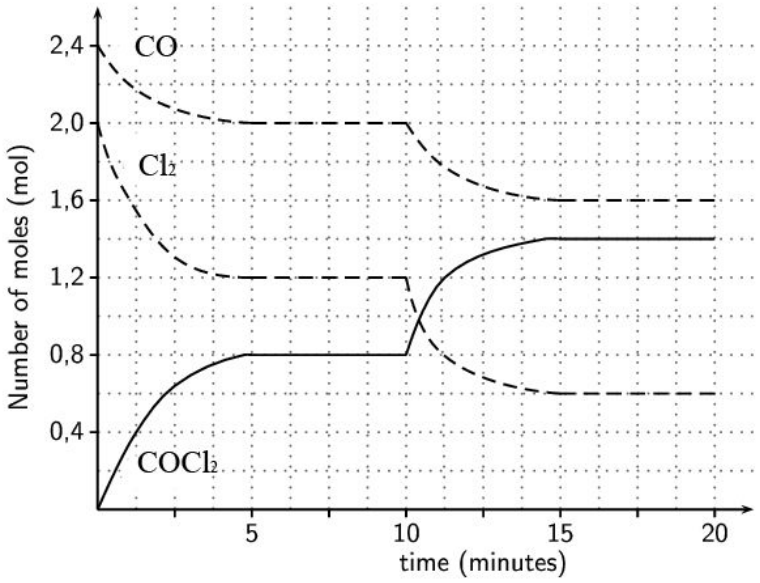
(A) $H_2SO_4(aq) + H_2O(l) \rightarrow H_3O^+(aq) + HSO_3^-(aq)$
(B) $HCl(aq) + H_2O(l) \rightarrow H_3O^+(aq) + Cl^-(aq)$
(C) $HSO_3^-(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + SO_4^{2-}(aq)$
(D) $MgO(s) + 2HNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + H_2(g)$

Question 12.

Phosgene is a chemical compound with the formula $COCl_2$. It can be produced according to the equation:

$$CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g) \qquad \Delta H = -107.6 \text{ kJ mol}^{-1}$$

The following diagram shows the concentration of each species in this reaction over a period of time:



What would be an appropriate explanation for the behaviour of the system at 10 minutes.

(A) The pressure of the system was decreased
(B) The temperature of the system was increased
(C) The volume of the system was increased
(D) The temperature of the system was decreased

Question 13.

Which of the following equations shows the behaviour of an amphoteric salt?

(A) $2NaO(s) + 2HCl(aq) \rightarrow 2NaOH(aq) + H_2(g)$
(B) $NH_4Cl(aq) + NaOH(aq) + \rightarrow NaCl(aq) + H_2O(l) + NH_3(aq)$
(C) $SO_2(g) + H_2O(l) \rightarrow H_2SO_3(aq)$
(D) $ZnO(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2O(l)$

Question 14.

How many isomers of the molecule $C_2H_3Cl_2F$ are there?

(A) 3
(B) 4
(C) 5
(D) 6

Question 15.

The following reaction shows an incomplete combustion of hexanol, However, the left hand side has not been correctly balanced.

$$CH_3(CH_2)_4CH_2OH(l) + ?O_2(g) \rightarrow 2CO_2(g) + 2CO(g) + 2C(s) + 7H_2O(l)$$

How many more oxygen molecules are required to achieve complete combustion?

(A) 2
(B) 3
(C) 5
(D) 6

Question 16.

A titration requires a known concentration of HCl. To determine the concentration of the HCl, it is titrated against a primary standard that was prepared last week.

Which of the following solutions would have been the best choice for this primary standard.?

(A) Sodium hydroxide
(B) Sodium hydrogen carbonate
(C) Sodium chloride
(D) Ammonium carbonate

Question 17.

Identify the acid/base conjugate pairs in the following reaction:

$$2HNO_3(aq) + Ca(OH)_2(aq) \rightarrow Ca(NO_3)_2(aq) + 2H_2O(l)$$

	Acid	Conjugate Base	Base	Conjugate Acid
(A)	HNO_3	$Ca(OH)_2$	H_2O	$Ca(OH)_2$
(B)	HNO_3	H_2O	H_2O	$Ca(NO_3)_2$
(C)	HNO_3	$Ca(NO_3)_2$	$Ca(OH)_2$	H_2O
(D)	HNO_3	H_2O	$Ca(OH)_2$	H_2O

Question 18.

Which of the following does NOT contain a coordinate covalent bond?

(A) Ozone
(B) Carbon monoxide
(C) Ammonium ion
(D) Carbon Dioxide

Question 19.

Which of the following mixtures will form a buffer solution?

	Solution A	**Solution B**
(A)	0.1 M phosphoric acid	0.1 M sulfurous acid
(B)	0.1 M sulfuric acid	0.1 M sodium hydroxide
(C)	0.1 M citric acid	0.1 M sodium acetate
(D)	0.1 M phosphoric acid	0.1 M sodium hydrogen phosphate

Question 20.

Which equipment list would be best suited to performing an esterification procedure?

(A) 250 mL volumetric flask, 25 mL pipette, 250 mL conical flask, condensing tube, indicator, 100 mL beaker, dropper pipette, round bottom flask

(B) burette, 250 mL conical flask, condensing tube, indicator, 100 mL beaker, dropper pipette, round bottom flask, boiling chips

(C) 250 mL volumetric flask, 25 mL pipette, burette, indicator, 100 mL beaker, dropper pipette, round bottom flask, boiling chips

(D) 250 mL volumetric flask, 25 mL pipette, burette, 250 mL conical flask, condensing tube, indicator, 100 mL beaker, boiling chips

Student Number: _____

Part B – Written Response (55 marks):
Attempt questions 21 - 29.
Allow about 1 hour and 10 minutes (100 minutes) for this section.

Question 21 (10 marks)

(a) Write an equation to show the formation of PVC from its monomer. **2**

. . . . . .
. . . . . .
. . . . . .
. . . . . .

(b) Write an equation to demonstrate the formation of an ester and name each of the reactants and products using the correct IUPAC nomenclature for all organic substances. **4**

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

Question 21 continues on next page.

Question 21 (continued)

(c) Explain the need for refluxing during the production of an ester and describe the specific purpose of the catalyst used. **4**

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

Question 22 (7 marks)

Global ethylene production was up from 107 million tonnes in 2005 to 141 million tonnes in 2011. By 2013 ethylene was produced by at least 117 companies in 32 countries. To meet the ever increasing demand for ethylene, increases in production facilities have been added globally, particularly in the Middle East and China. Ethylene is produced in the petrochemical industry by steam cracking and also by the dehydration of ethanol produced by fermentation.

(a) Outline the steps involved in the production of ethylene using ONE of the processes mentioned above. **3**

. . . . . .

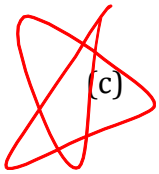
. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .



(c) Explain how the chemistry of ethylene determines its usefulness as a monomer in industry and how the structure of the products manufactured determine their use. **4**

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

Student Number: _____

Question 23 (6 marks)

The following reaction can be used to produce ammonia:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92 \text{ kJ mol}^{-1}$$

Assess the need to optimise and manage the reaction conditions to produce a commercially viable process for the production of ammonia. **6**

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

Student Number: _____

Question 24 (5 marks)

(a) Identify the reductant and oxidant in the following equation and show their oxidation numbers. **2**

$$2MnSO_4(aq) + 5PbO_2(aq) + 3H_2SO_4(aq) \rightarrow 2HMnO_4(aq) + 5PbSO_4(aq) + 2H_2O(l)$$

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(b) Using examples, analyse the relationship between the position of an element in the periodic table and the acidity/basicity of its oxide. **3**

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

Question 25 (6 marks)

"The historical use of leaded gasoline and lead (Pb) in exterior paints in Australia has contaminated urban soils in the older inner suburbs of large cities such as Sydney and Melbourne. There is elevated risk of exposure to Pb originating from inner-city soil dust and its potential for childhood Pb exposures."

- *(Environmental Pollution - Volume 159, Issue 1, January 2011)*

Explain the need to monitor lead levels in the environment and outline both a qualitative and quantitative procedure to identify the presence of lead cations. **6**

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

Question 26 (5 marks)

Compare the relative strengths of 0.1 mol L^{-1} solutions of each of the following acids and explain any difference in terms of the degree of ionisation of their molecules. **5**

- Citric acid
- Acetic acid
- Hydrochloric acid

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

Question 27 (5 marks)

The following table shows the melting point of some organic substances.

Substance	Melting Point (°C)
butane	-140
hexane	-96
butanol	-89
hexanol	-53
butanoic acid	-3.4
hexanoic acid	-7.9

With reference to the structure of the molecules, explain the difference in melting point for these substances across both homologous and functional groups. **5**

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

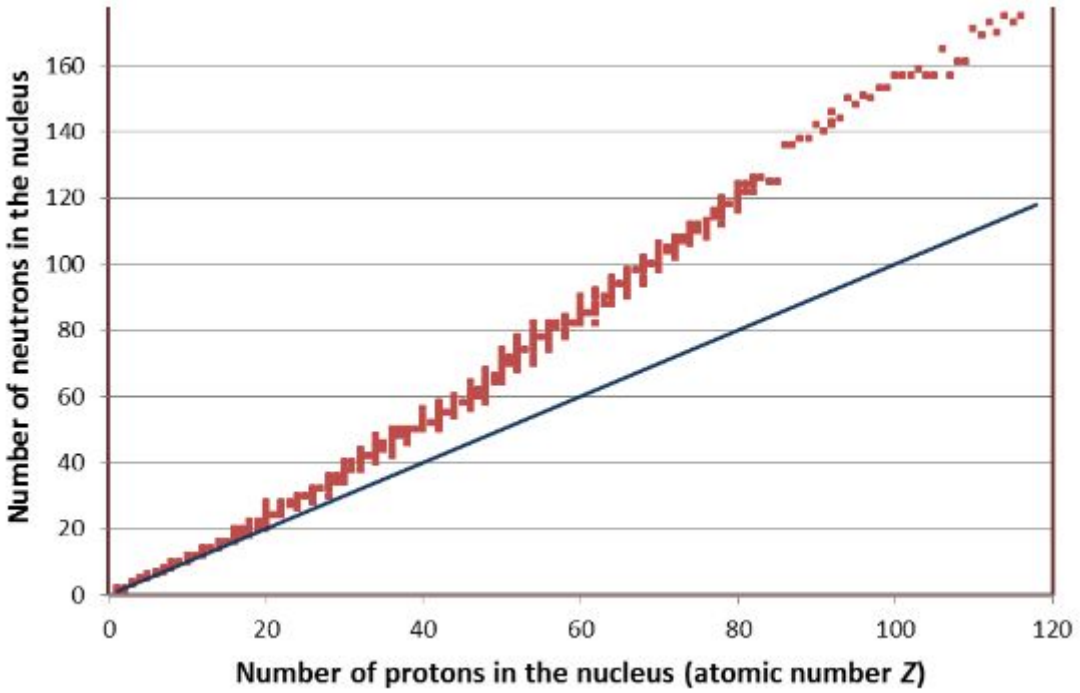
. . . . . .

. . . . . .

. . . . . .

Question 28 (8 marks)

The following diagram shows the distribution of nuclides against atomic number.



(a) Referring to the above diagram, outline the criteria for an isotope to be unstable and describe the decay mechanisms for unstable nuclei. **4**

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

Question 28 continues on next page.

Question 28 (continued)

(b) Identify one use of a radioisotope in industry OR in medicine, describe how it is commercially produced and how it is used. **4**

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

Question 29 (3 marks)

Compare the properties of the O_2 and O_3 molecules and account for the differences on the basis of the molecular structure and bonding. **3**

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

End of Test