

Student Number	
Mark / 15	

Chemistry

HSC Course • 2007

Industrial Chemistry + Chemical Monitoring & Management

Theory Test (Part A)

General Instructions

- Reading time – 5 minutes
- Working time – 20 minutes
- 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
- Write your Student Number at the top of this page

Total Marks – 15

- Attempt Questions 1 – 15
- Allow about 20 minutes for this part

Part A – 15 marks

Attempt Questions 1 – 15

Allow about 20 minutes for this part

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.

A ☒ B ☒ C ☐ D ☐
 correct ↗

Answers for Questions 1 – 15				
1	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
2	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
3	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
4	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
5	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
6	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
7	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
8	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
9	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
10	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
11	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
12	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
13	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
14	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
15	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>

► *Mark your answers for Questions 1 – 15 in the Answer Box on page 2.*

- 1 Which of the following is NOT an industrial use of ammonia?
- (A) production of explosives
 - (B) production of fertilisers
 - (C) production of petrol
 - (D) production of polymers
- 2 Which equation represents the industrial synthesis of ammonia?
- (A) $\text{N}^{3+} + 3\text{H}^- \rightarrow \text{NH}_3$
 - (B) $\text{NH}_4\text{OH} \rightleftharpoons \text{NH}_3 + \text{H}_2\text{O}$
 - (C) $4\text{NO} + 6\text{H}_2\text{O} \rightleftharpoons 4\text{NH}_3 + 5\text{O}_2$
 - (D) $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$
- 3 Sodium carbonate has many uses.
Which of the processes requires the use of sodium carbonate?
- (i) pickling of steel
 - (ii) manufacture of superphosphate
 - (iii) glass making
 - (iv) making soaps and detergents
- (A) (i), (ii) and (iii) only
 - (B) (i), (iii) and (iv) only
 - (C) (ii) and (iii) only
 - (D) (iii) and (iv) only
- 4 Cationic detergents are the main component of which types of products?
- (A) fabric softeners and disinfectants
 - (B) laundry and dishwashing detergents
 - (C) personal hygiene
 - (D) pesticides and cosmetics
- 5 Why is the dilution of concentrated sulfuric acid very exothermic?
- (A) The sulfuric acid is being decomposed.
 - (B) The sulfuric acid is being ionised.
 - (C) The sulfuric acid is being oxidised.
 - (D) The sulfuric acid is being reduced.

- 6 Most of the electricity in NSW is produced by coal-fired power plants. During the combustion of coal all of these reactions (A, B, C and D) occur.

Which reaction does not require monitoring?

- (A) $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
- (B) $2\text{C} + \text{O}_2 \rightarrow 2\text{CO}$
- (C) $\text{S} + \text{O}_2 \rightarrow \text{SO}_2$
- (D) $\text{N}_2 + 2\text{O}_2 \rightarrow 2\text{NO}_2$

- 7 Consider the following reaction...



How will the value of the equilibrium constant (K) for the reaction be affected by a twofold increase in the pressure in the system at constant temperature?

- (A) The K value will increase.
- (B) The K value will be halved.
- (C) The K value will not be affected.
- (D) The K value will double.

- 8 Why is a catalyst used in the Haber process?

- (A) Lower reaction vessel temperatures can be used.
- (B) Cheaper, less pure reactants can be used to lower production costs.
- (C) Air pollution emissions are significantly cut.
- (D) It slows down the exothermic reaction reducing the danger of thermal explosions.

- 9 Which of the following reactions shows sulfuric acid behaving as a dehydrating agent?

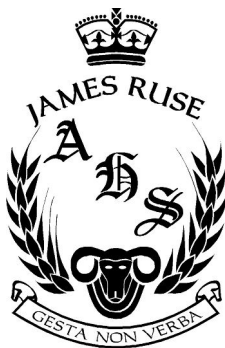
- (A) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O} \rightarrow \text{CuSO}_4 + 5\text{H}_2\text{O}$
- (B) $\text{BaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{HCl}$
- (C) $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$
- (D) $\text{Cu} + 2\text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + \text{SO}_2 + 2\text{H}_2\text{O}$

- 10 Which of the following is NOT essential for the Solvay process?

- (A) ammonia
- (B) brine
- (C) calcium chloride
- (D) limestone

- 11 Which of these analyses could be performed using AAS?
- (A) Monitoring of acidic oxides emitted from an industrial smoke stack.
 (B) Determining the pesticide level in imported fruit juice.
 (C) Investigating lead concentrations in soil along major highways.
 (D) Measuring the phosphate content of laundry detergents.
- 12 Which method describes the correct preparation of $1.8 \text{ mol L}^{-1} \text{ H}_2\text{SO}_4$ from concentrated acid?
- (A) Place 250 mL of demineralised water in a 250 mL volumetric flask, then add 25 mL of concentrated sulfuric acid.
 (B) Place 25 mL of concentrated sulfuric acid in a 250 mL volumetric flask, then add demineralised water to the mark.
 (C) Place 25 mL of demineralised water in a 250 mL volumetric flask, then add 25 mL of concentrated sulfuric acid. Mix carefully, then add demineralised water to the mark.
 (D) Place 200 mL of demineralised water in a 250 mL volumetric flask, then add 25 mL of concentrated sulfuric acid. Mix carefully, then add demineralised water to the mark.
- 13 AAS has been an essential tool in the scientific understanding of the effects of trace elements. What is a trace element?
- (A) A toxic element.
 (B) An element used to track down another element in an analysis.
 (C) An element found in very small concentrations in a sample.
 (D) An element which decomposes and leaves behind a residue which can be detected.
- 14 A student performs a gravimetric analysis of a 1.00 gram sample of lawn fertiliser using a precipitation/filtration technique.
- How could the student increase the reliability of the data collected?
- (A) Use a more accurate balance.
 (B) Repeat the analysis several times.
 (C) Use a finer grade of filter paper.
 (D) Use a larger sample size.
- 15 The table compares galvanic and electrolytic cells. Which choice is correct?

<i>Direction of electron flow</i>		<i>Reaction at electrode</i>	
<i>galvanic</i>	<i>electrolytic</i>	<i>galvanic</i>	<i>electrolytic</i>
(A) anode to cathode	anode to cathode	oxidation at anode	reduction at cathode
(B) anode to cathode	cathode to anode	reduction at anode	oxidation at cathode
(C) cathode to anode	cathode to anode	oxidation at anode	reduction at cathode
(D) cathode to anode	anode to cathode	reduction at anode	oxidation at cathode



Student Number	
Mark / 22	

Chemistry

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Theory Test (Part B)

General Instructions

- Reading time – 5 minutes
- Working time – 30 minutes
- Write using black or blue pen
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Total Marks – 22

- Attempt Questions 1 – 6

► *Show all relevant working in questions involving calculations.*

1 Evaluate the cleaning action of soap in soft and hard water. **(3 marks)**

2 The Frasch process is a widely used method to extract sulfur from deposits.

Analyse potential environmental issues associated with the Frasch process. **(2 marks)**

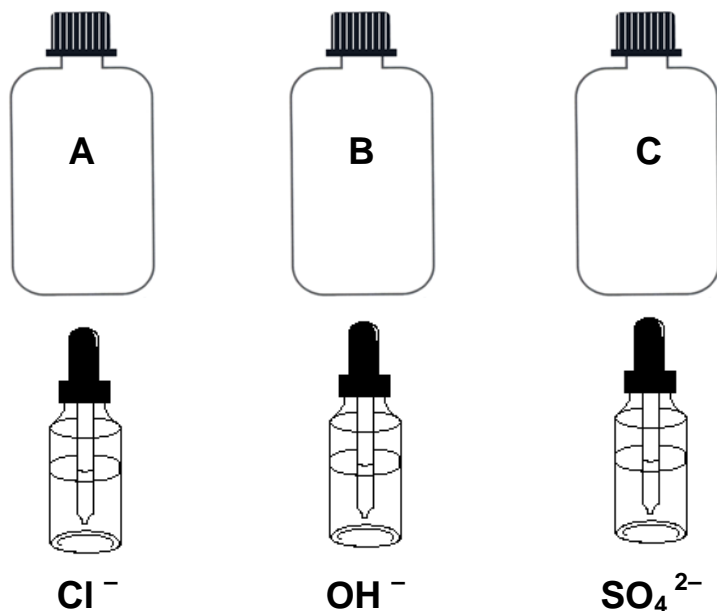
3 Given the reaction... $A + 2B \rightleftharpoons 2C$

When 1.00 mol of A and 1.50 mol of B are placed in a 2.00 L vessel and allowed to come to equilibrium, the equilibrium concentration of C was found to be 0.35 mol L^{-1} .

Calculate the equilibrium constant, K for the reaction showing all your working. **(4 marks)**

- 4 Boris sits for a qualitative analysis prac test. He was given three sample bottles (labelled A, B and C) and three dropper bottles (labelled Cl^- , OH^- and SO_4^{2-}).

The sample bottles were known to contain either Ba^{2+} or Cu^{2+} or Pb^{2+} .



Boris methodically tested the samples and recorded this table of results.

► P = precipitate; NP = no precipitate

	Cl^-	OH^-	SO_4^{2-}	Conclusion
A	P	P	P	
B	NP	P	NP	
C	NP	NP	P	

- (a) Identify samples A, B, C by filling in the correct metal cation in the conclusion column above. **(2 marks)**
- (b) Write the net ionic equation for the chloride precipitate formed by A. **(1 mark)**
- _____
- (c) B can also be detected by a flame test. Identify the characteristic colour of the flame. **(1 mark)**
- _____

6 A university chemistry honours student is involved in a research project to analyse the concentration of mercury in canned tuna. The student extracts a very small, accurately weighed sample of flesh from a tin of tuna and ‘digests’ it by heating in excess concentrated nitric acid. This procedure converts any mercury present into soluble $\text{Hg}^{2+}_{(\text{aq})}$. The treated sample was then transferred to a volumetric flask and water was added to prepare a 1000 mL solution.

An AAS instrument was then fitted with a hollow cathode mercury lamp and its alignment was adjusted to specifications. The prepared tuna mercury sample was then aspirated into the spectroscope's flame and the absorbance value was recorded at the correct wavelength.

Describe what further procedural steps the student must undertake in conjunction with the AAS instrument to determine the mercury concentration in the tuna sample. **(3 marks)**