

Test 6: Chemical Monitoring and Management II

Total 32 marks (Suggested time 45 minutes)

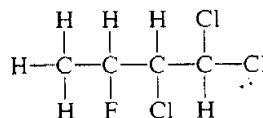
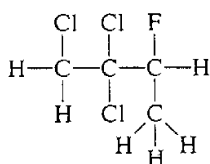
Directions to students

- Answer the following questions on your own paper.
- Part A contains 5 multiple-choice questions, each worth 1 mark. Select the alternative A, B, C or D that best answers the question.
- Part B contains 5 short answer and longer response questions.
- You may use the standard formula sheet supplied.

PART A

1. Which of the following shows a pair of isomers?

(A)



(B) $\text{CH}_2\text{ClCH}_2\text{CH}_2\text{CH}_3$

$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$

(C) 1,2-dichloro-3,4,4-trifluorobutane

1,1-dichloro-2,3,3-trifluoroethylpropane

(D) All of the above.

2. The Haber process is used to manufacture ammonia, NH_3 . Read the statements below and decide which alternative is correct.

- High temperatures are used to increase the equilibrium yield of NH_3 .
- Al_2O_3 is the major catalyst used in the reaction chamber.
- High pressures, up to 35 MPa, force the equilibrium to the right.
- Fractional distillation of liquid air is used to produce N_2 and H_2 for the process.

- (i), (ii) and (iii)
- (iii)
- (i), (ii) and (iv)
- (i), (ii), (iii) and (iv)

Questions 3 and 4 relate to the analysis of lawn fertiliser.

A 6.2 g sample of fertiliser containing mainly $(\text{NH}_4)_2\text{SO}_4$ was analysed by precipitating the SO_4^{2-} as BaSO_4 .

3. If 9.8 g of BaSO_4 was formed then the percentage by mass of SO_4^{2-} will be
 - (A) 65.0
 - (B) 41.2
 - (C) 63.2
 - (D) 72.7

4. Which procedure best describes how the experiment to analyse the sulfate content of lawn fertiliser should be carried out?
 - (A) Dissolve the fertiliser in 100 mL of water, titrate it with standard BaSO_4 , collect the precipitate and weigh it.
 - (B) Dissolve a known mass of $\text{Ba}(\text{NO}_3)_2$ in 100 mL of water, add the fertiliser, titrate any remaining solution with Na_2SO_4 . Weigh the BaSO_4 produced.
 - (C) Dissolve the known mass of fertiliser in a 100 mL volumetric flask and an excess of $\text{Ba}(\text{NO}_3)_2$ solution. Filter off the BaSO_4 precipitate, dry it and record its mass.
 - (D) Dissolve the fertiliser in the minimum volume of water and add an equal mass of $\text{Ba}(\text{NO}_3)_2$. Collect and dry the precipitate and record its mass.

PART B

Marks

Question 5 (10 marks)

Identification of ions present in a compound is carried out using chemical analysis. The following refers to the analysis of a sample of rock.

- (a) It was suspected that the sample contained copper sulfide. Describe how the presence of copper ions could be confirmed using appropriate chemical tests. 4
- (b) Reaction of some of the sample with dilute nitric acid produced a small amount of gas, which turned limewater milky when bubbled through it. Explain the significance of this result. 2
- (c) Addition of 3 mol L^{-1} hydrochloric acid resulted in the formation of a white precipitate. When collected and placed in hot water, the precipitate dissolved. Explain the significance of this result. 2
- (d) Describe one other test that could be carried out to show if copper is present. 2

Question 6 (5 marks)

- (a) Describe briefly how ozone is formed in the atmosphere. Include two chemical equations as part of your answer. 2
- (b) Destruction of ozone high in the atmosphere occurs due to natural causes and human activity. What is the main natural cause of ozone destruction and how is it different from human activity causing ozone destruction? 3

Question 7 (13 marks)

Marks

Sydney Water is responsible for providing a high quality water supply to its customers. They test our water supply for more than 70 characteristics and compare these to current Australian Water Guidelines (1996).

The table shows some of the characteristics tested.

	<i>Turbidity</i> (units)	<i>Fluoride</i> (mg/L)	<i>Iron</i> ($\mu\text{g/L}$)	<i>Aluminium</i> ($\mu\text{g/L}$)
Australian guidelines	≤ 5	≤ 1.5	≤ 300	≤ 200
Warragamba Dam filtration plant	0.1	1.11	≤ 20	unknown

- (a) Describe how turbidity is measured. Comment on the turbidity values shown in the table. 3
- (b) Atomic absorption spectroscopy was used to measure the aluminium ion concentration. A series of solutions of known concentration of aluminium ions was vaporised and analysed after passing through a monochromator. A sample of dam water was then analysed. 3

<i>Absorption</i>	<i>Concentration of aluminium ions</i> ($\mu\text{g/L}$)
0.010	0.00
0.080	5.00
0.150	10.00
0.220	15.00
0.290	20
0.192	sample

Draw a graph of this information and use it to determine the concentration in $\mu\text{g L}^{-1}$ of aluminium ions in Warragamba Dam water.

- (c) To maintain our metabolism it is recommended that we drink at least two litres of water a day. Use the table to determine how many grams of fluorine will be ingested if two litres of water is consumed. 1
- (d) Water can also be tested as it runs into the dams from rivers and as it leaves the dam in pipes. Identify at least three factors that affect the concentrations of ions or oxygen in river water, giving appropriate examples. 6