

## Test 5: Chemical Monitoring and Management I

Total 26 marks (Suggested time 45 minutes)

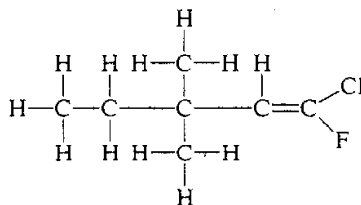
### Directions to students

- 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. In which of the following activities may a practising chemist be involved?
  - (A) Forensic analysis
  - (B) Extractive metallurgy
  - (C) Production of biopolymers
  - (D) All of the above
  
2. During a check of a particular *equilibrium* mixture at a chemical plant producing ammonia, Zita noticed that the yield of ammonia was lower than expected. A possible cause for the lower than expected value is
  - (A) an increase in pressure in the reaction vessel.
  - (B) an increase in temperature in the reaction vessel.
  - (C) a lack of catalytic material.
  - (D) that Zita didn't wait long enough for all the reactants to convert to products.
  
3. Which of the following combinations of biological oxygen demand (BOD) and dissolved oxygen (DO) indicate 'healthy water'?
  - (A) High BOD and Low DO
  - (B) Low BOD and Low DO
  - (C) High BOD and High DO
  - (D) Low BOD and High DO
  
4. Which of the following indicate the correct order for the purification of drinking water?
  - (A) aeration, sedimentation, filtration, flocculation, chlorination
  - (B) chlorination, aeration, sedimentation, filtration, flocculation
  - (C) aeration, flocculation, sedimentation, filtration, chlorination
  - (D) filtration, aeration, sedimentation, flocculation, chlorination

5. Refer to the molecular structure shown below.



The systematic name for this molecule is

- (A) chloro-fluoro-dimethyl-1-pentene.  
(B) 1-chloro-1-fluoro-3,3-dimethyl-1-pentene.  
(C) 1-chloro-1-fluoro-3,3-dimethyl-2-pentene.  
(D) 1-chloro-1-fluoro-3,3-dimethyl-1-pentyne.

## PART B

Marks

### Question 6 (4 marks)

The 'health' of diesel locomotives is monitored by analysis of oil samples taken from the motor. Railway chemists check viscosity and for the presence of water and metals in the oil using atomic absorption spectroscopy. A high concentration of a particular metal is often a good indication of a wearing component. In one such analysis for silver, 5 mL of oil was diluted to 50 mL in a suitable solvent and the following results were obtained.

Standard Solution Concentration (ppm)	Absorption
0.00	0.015
1.00	0.105
2.00	0.195
3.00	0.285
4.00	0.375
Sample	0.230

- (a) Use the above table to plot a graph of absorption against concentration of silver. 2  
(b) Determine the concentration of silver in the diluted sample of oil. 1  
(c) Determine the concentration, in ppm, of silver in the original sample. 1

### Question 7 (6 marks)

The manufacturer of a well-known brand of tomato sauce, Little Pink, claims its sauce is low in salt, with less than 165 mg of sodium per single serve (15 mL) of sauce.

In one quality control analysis, the salt content was determined by diluting 30 mL of sauce with 70 mL of water. A suitable reagent was added to the diluted solution and 1.330 g of a white precipitate was obtained.

- (a) What is a suitable reagent for this analysis? 1  
(b) Write a balanced equation to describe the reaction that formed the precipitate. 1  
(c) Determine the mass of salt present in the sample of sauce. 2  
(d) Is Little Pink's manufacturer living up to their claim? Justify your answer. 2

**Question 8** (5 marks)

Marks

The element oxygen can be found in two allotropic forms, oxygen and ozone.

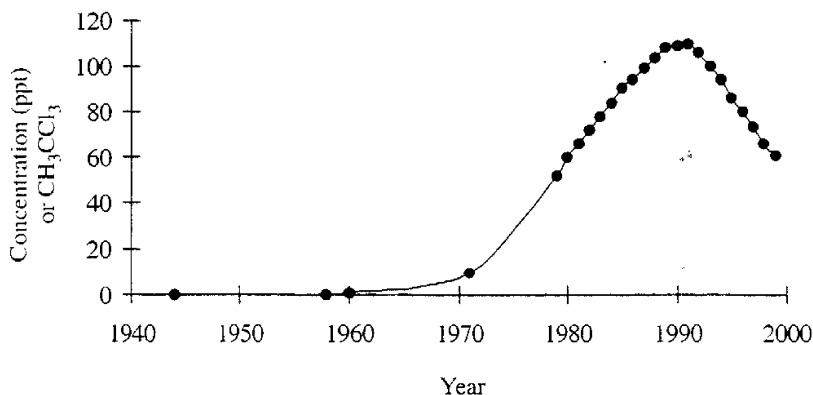
- |     |  |   |
|-----|--|---|
| (a) | Draw structural diagrams of oxygen and ozone.  | 1 |
| (b) | Oxygen is a gas at $-150^{\circ}\text{C}$ while ozone exists as a liquid at that temperature. Explain these facts with reference to your structures from part a. | 2 |
| (c) | Explain the importance of both oxygen and ozone to the continuation of life on earth.  | 2 |

**Question 9** (4 marks)

The Haber process is an example of an industrial process where conflicting requirements must be carefully balanced. Explain why there must be a compromise between optimum conditions for yield and rate, and how these relate to cost. Include references to pressure and temperature in your answer.

**Question 10** (2 marks)

The following graph shows the variation in concentration of 1,1,1-trichloroethane ( $\text{CH}_3\text{CCl}_3$ ) in the atmosphere as determined by analysis of archived air from Cape Grim, Tasmania by CSIRO scientists. Archived air is recovered from core samples of ice.



Adapted from The Science Foundation for Physics (1999) *Millennium Science*, University of Sydney, Sydney

1,1,1-trichloroethane is associated with the production and use of CFCs.

Explain the shape of the curve obtained.