

**BINDURA UNIVERSITY OF SCIENCE EDUCATION
CHEMISTRY DEPARTMENT**

COURSE: CH424 ENVIRONMENTAL CHEMISTRY

JAN 2025

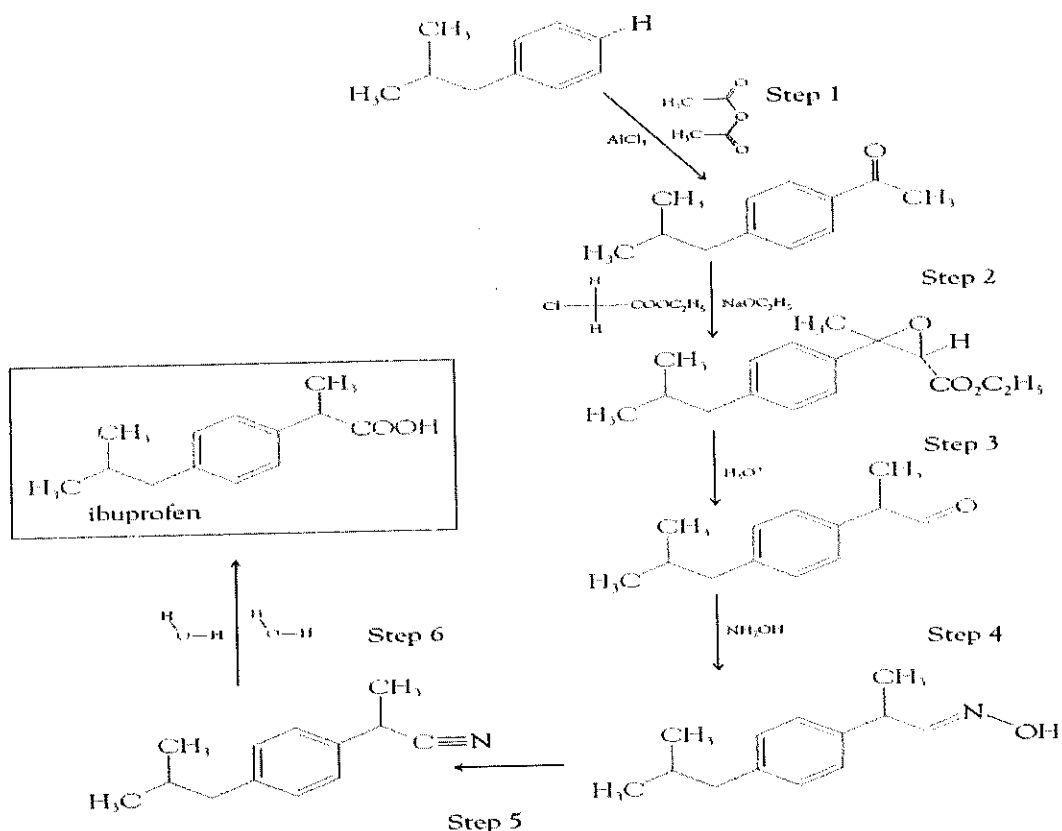
2 HOURS

**ANSWER QUESTIONS ONE AND FOUR OTHERS. TWO FROM EACH OF THE
SECTIONS, A AND B. EACH QUESTION CARRIES 20 MARKS**

1. (a) Discuss the goals of green chemistry. [10 marks]
- (b) Explain why ozone destruction via the reaction of O_3 with atomic oxygen does not occur to a significant effect in the lower stratosphere. [5 marks]
- (c) Other than the rise in temperature, list five signs of global warming caused by the greenhouse effect. [5 marks]

SECTION A: ANSWER TWO QUESTIONS

2. The steps below show the Boots Company synthesis of ibuprofen.



- (i) Calculate the % atom economy. [10 marks]
- (ii) Comment on the suitability of the method for the synthesis of ibuprofen according to the principles of Green Chemistry. [10 marks]
3. (a) Write two reactions that, aside from the catalyzed reactions, contribute most significantly to ozone destruction in the stratosphere. [4 marks]
- (b) A minor route for ozone destruction in the ozone hole involves Mechanism II with bromine as X' and chlorine as X (or vice-versa). The ClO and BrO free radical molecules produced in these processes then collide with each other and rearrange their atoms to eventually yield O_2 and atomic chlorine and bromine.
- (i) Write out the mechanism for this process. [6 marks]
- (ii) By adding up the steps in (i), determine the overall reaction. [5 marks]

- (c) Describe a mechanism by which carbon monoxide is removed from the atmosphere by its reaction with the hydroxyl radical and how the radical is regenerated. [5 marks]
- 4 (a) No controls on the release of CH_3Cl , CH_2Cl_2 , or CHCl_3 have been proposed. What does that imply about their atmospheric lifetimes, compared to those for CFCs, CCl_4 , and methyl chloroform? [8 marks]
- (b) Show that 1 L of water saturated with oxygen at 25 °C is capable of oxidizing 8.2 mg of polymeric CH_2O . [5 marks]
- (c) A 25 mL sample of river water was titrated with 0.0010 M $\text{K}_2\text{Cr}_2\text{O}_7$ and required 8.3 mL to reach the end point. What is the chemical oxygen demand, in milligrams of O_2 per liter, of the sample? [7 marks]

SECTION B: ANSWER ANY TWO QUESTIONS

5. (a) (i) Define the term environmental estrogen. [2 marks]
- (ii) Name the four postulated effects of environmental hormones on human health. [4 marks]
- (b) Define phytoremediation and list the three mechanisms by which it can operate. [4 marks]
- (c) (i) Define the term leachate. [2 marks]
- (ii) Discuss components of the leachate. [8 marks]
6. (a) Discuss the factors that affect amount of dissolved oxygen in water. [8 marks]
- (b) Explain the toxicity of organophosphates. [5 marks]
- (c) What causes the health hazards of smog? [5 marks]
- (d) What are photochemical reactions? [2 marks]
7. (a) List the four pros and cons of wind power. [6 marks]
- (b) Define energy payback. [2 marks]

- (c) List two environmental /social problems associated with the expansion of hydroelectric power. [2 marks]
- (d) What are the advantages and disadvantages of solar cells? [10 marks]

END OF EXAMINATION