Section I
75 marks

Part A – 15 marks
Attempt Questions 1-15
Allow about 30 minutes for this part

Use the multiple choice answer sheet on page **7**

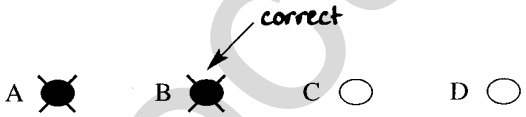
Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

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.

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.



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1. Consider the following reactions:

(i) $Ag^+ + Cl^- \rightleftharpoons AgCl$

(ii) $CH_4 + O_2 \rightarrow CO_2 + 2\,H_2O$

(iii) $Mg + 2\,HCl \rightarrow MgCl_2 + H_2$

(iv) $Mg(OH)_2 + HCl \rightarrow MgCl_2 + H_2O$

Which of the reactions can be considered an acid-base reaction(s).

(A) (i), (ii), (iii), (iv)

(B) (i), (iii) and (iv) only

(C) (iv) only

(D) (i) only

2. Which of the following equations represent the Haber process?

(A) $N + 3H \rightarrow NH_3$ $\Delta H = -91$ kJ

(B) $N_2 + 3H_2 \rightarrow 2NH_3$ $\Delta H = -91$ kJ

(C) $N_2 + 3H_2 \rightleftharpoons 2NH_3$ $\Delta H = +91$ kJ

(D) $N_2 + 3H_2 \rightleftharpoons 2NH_3$ $\Delta H = -91$ kJ

3. An unknown solution may contain one or more of the following ions: Mg^{2+}, SO_4^{2-}, CO_3^{2-}, Pb^{2+}, Cl^-
The solution gave a white precipitate with $Ba(NO_3)_2$ but no reaction with H_2SO_4.

Which of the ions may be present ?

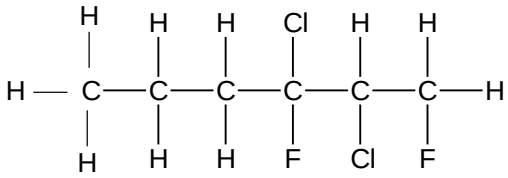
(A) Mg^{2+} and Cl^-

(B) Pb^{2+} and Cl^-

(C) Mg^{2+} and SO_4^{2-}

(D) Mg^{2+} and CO_3^{2-}

4. Consider the following haloalkane:



Which of the following is an isomer of the compound ?

(A) 1,1-dichloro-2-fluorohexane

(B) 1,2,5-trichloro-2-fluorohexane

(C) 1,3-dichloro-2,3-difluorohexane

(D) 2,3-dichloro-1,3-difluorohexane

5. A chemist wants to test for the presence of iron (III) ions in a water sample collected outside a factory. Which anion could be used to test for the presence of iron (III) ions in the water?

(A) SO_4^{2-}

(B) NO_3^-

(C) OH^-

(D) Cl^-

6. What is the product of adding bromine water to 2-hexene?

(A) 2,3-dibromohexene

(B) 2,3-dibromohexane

(C) 1,2-dibromohexane

(D) 1,2-dibromocyclohexene

7 Where on the Periodic Table would you most likely find elements which form basic oxides?

(A) Group 1

(B) Group 6

(C) Period 2

(D) Period 3

8. Which elements on the Periodic Table have radioisotopes?

(A) Only those elements after uranium.

(B) Only the actinides.

(C) Only elements with unstable proton-neutron ratio.

(D) Only metallic elements

9. A student constructed a galvanic cell using two different metals and electrolytes of the nitrates of the metals, under standard conditions.

Which combination of metals would give the greatest potential difference?

(A) copper and silver

(B) manganese and silver

(C) zinc and copper

(D) magnesium and zinc

10. The molar heat of combustion of propane is given in the data book as 2200 kJ mol^{-1}. What does this mean?

(A) 1 g of propane releases 2200 kJ of heat

(B) 44 g of propane releases 2200 kJ of heat

(C) 1 g of propane absorbs 2200 kJ of heat

(D) 44 g of propane absorbs 2200 kJ of heat

11. Which of the following is a common natural source of sulfur dioxide in the atmosphere?

(A) The action of sunlight on S and O_2

(B) Smelting metal ores

(C) Soil bacteria

(D) Volcanoes

12. Which of the following may be used as a catalyst in esterification?

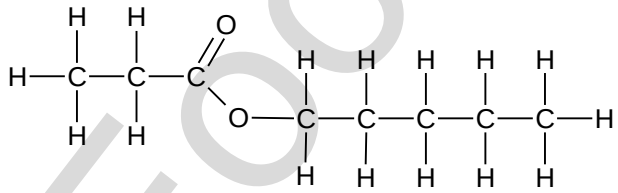
(A) H_2SO_4

(B) C_2H_5OH

(C) CH_3COOH

(D) H_2O

13. What is the name of the ester given below?



(A) butyl pentanoate

(B) pentyl butanoate

(C) propyl pentanoate

(D) pentyl propanoate

14 A soft drink may be decarbonated by heating. In observing the results, the equilibrium between gaseous and dissolved carbon dioxide can be examined.

$$CO_2(g) \rightleftharpoons CO_2(aq)$$

What conclusion can be drawn about this reaction?

(A) The forward reaction is exothermic**.**

(B) Only the reverse reaction rate is increased with heating.

(C) Heat is absorbed in the reaction shown above.

(D) Only the forward reaction rate is increases with heating.

15. Which correctly describes the relationship between an acid and its conjugate base?

(A) They are ions of opposite charge.

(B) They both contain H atom.

(C) They neutralize each other to form a salt.

(D) They have formulae that differ by a proton.

Student Number ……

Section I **Marks-----/15**

Part A

Multiple Choice Answer Sheet

1.	A ○	B ○	C ○	D ○
2.	A ○	B ○	C ○	D ○
3.	A ○	B ○	C ○	D ○
4.	A ○	B ○	C ○	D ○
5.	A ○	B ○	C ○	D ○
6.	A ○	B ○	C ○	D ○
7.	A ○	B ○	C ○	D ○
8.	A ○	B ○	C ○	D ○
9.	A ○	B ○	C ○	D ○
10.	A ○	B ○	C ○	D ○
11.	A ○	B ○	C ○	D ○
12.	A ○	B ○	C ○	D ○
13	A ○	B ○	C ○	D ○
14.	A ○	B ○	C ○	D ○
15.	A ○	B ○	C ○	D ○

Section I (continued)

Part B - 60 marks
Attempt Questions 16 to 26.
Allow about 1 hour and 45 minutes for this part

Answer the questions in the spaces provided

Show all relevant working in questions involving calculations

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Marks

Question 16 (5 marks)

A buffer is known to contain two of these substances:

sodium dihydrogen phosphate sodium hydrogen phosphate
ethanoic acid sodium ethanoate

(a) Define a buffer **1**

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(b) Using an equation, explain how the substances can be used as a buffer. **2**

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(c) Use balanced ionic equations to demonstrate how one of the above compounds can behave as an amphiprotic substance. **2**

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Marks

Question 17 (8 marks)

Sulfate in fertilizer may be analysed gravimetrically by precipitating the sulfate with barium ion and weighing the sulfate produced after filtering and drying. To test the technique, which is exactly what YOU did in the lab, a group of students performed the analysis on pure ammonium sulfate. They obtained the following results.:

Mass of sample of ammonium sulfate: 2.34 g

Mass of filter paper: 0.203 g

Mass of filter paper + 'dried' precipitate: 4.65 g

(a) Calculate:

(i) the theoretical percentage of sulfate in ammonium sulfate **2**

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(ii) the experimental percentage of sulfate in ammonium sulfate **3**

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(b) Assess the accuracy of the above determination. Identify and explain two possible sources of error that can contribute to this particular discrepancy. **3**

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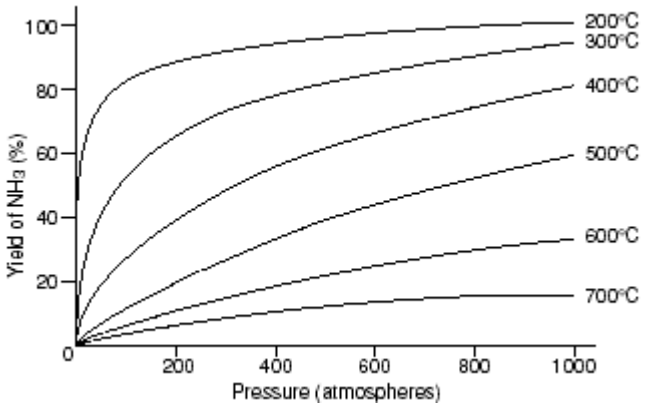
Marks

Question 18 (6 marks)

The graph shows the variation in percentage yield of the product with pressure at various temperatures for the Haber process.



(a) Based on the graph, what conditions of temperature and pressure give the best yield for this process? Justify your answer. **2**

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(b) In industry, the conditions usually used are 400 ^{o}C and 500 atm pressure. Explain the reason(s) for the use of these conditions. **2**

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(c) Identify the chemical composition of the catalyst used in this reaction and explain its role. **2**

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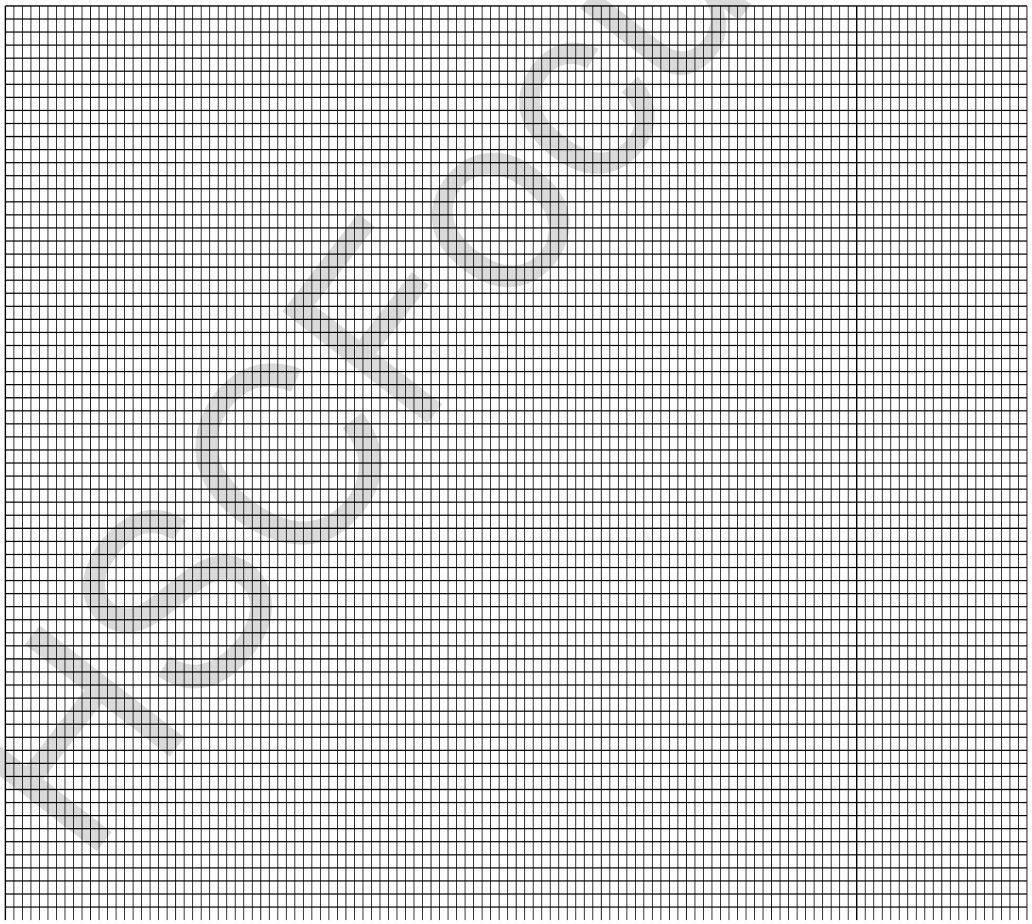
Marks

Question 19 (5 marks)

A group of students were assigned to determine the copper ion content of a certain brand of spring water. They prepared a series of standard copper ion solutions in *distilled* water and analysed the standard solutions and the undiluted spring water with the AAS instrument. They also tested some *distilled* water which they used to prepare the standard solutions. The results are given below:

Solution	*Cu^{2+} ion concentration (ppm)*	*Absorbance*
Standard 1	1.0	0.0521
Standard 2	2.0	0.0634
Standard 3	4.0	0.1205
Standard 4	6.0	0.1834
Standard 5	8.0	0.2467
Spring water	unknown	0.0412
distilled water	unknown	0.0501

(a) Construct a well labelled calibration curve for this determination. **3**



Question 19 continues on page 12

Marks

(b) Comment on the validity of the distilled water as a control. **2**

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Question 20 (2 marks)

Identify and describe two everyday uses of indicators. **2**

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Question 21 (8 marks)

Compare addition and condensation polymers using named examples of each type of polymer. **8**

Marks

Question 22. (6 marks)

Ethylene can be transformed into many useful substances other than plastics.

(a) Complete the table for two substances derived from ethene other than plastics **4**

Name of useful substance	*Use*

(b) Write a balanced chemical equation to describe the formation of one of the substances listed in (a). **2**

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Marks

Question 23 (8 marks)

A student made these observations after doing the reactions:

- Metal X did not react with 1 $molL^{-1}$ solution containing Y^{2+} ions.
- Metal Y in a 1 $molL^{-1}$ solution of Z^{2+} ions formed metal Z
- Metal Z did not react with a 1 $molL^{-1}$ solution of X^{2+}

(a) List the metals X, Y and Z in order of increasing ease of oxidation. **1**

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(b) List the ions in order of increasing ease of reduction. **1**

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(c) Draw a labelled diagram of an electrochemical cell made with two of the above metals that would produce the greatest voltage. Indicate on your diagram which is the anode and cathode and the direction of electron flow. **5**

(d) Write a balanced net ionic equation for the chemical reaction. occurring in the electrochemical cell **1**

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Marks

Question 24 (5 marks)

Consider the properties of three acids.

Acids	*pH*
0.1 $molL^{-1}$ acetic acid	2.9
0.1 $molL^{-1}$ citric acid	2.1
0.1 $molL^{-1}$ hydrochloric acid	1.0

(a) Give the systematic name for citric acid **1**

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(b) Explain the difference in pH between the three acid solutions. **2**

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(c) Calculate the pH after 100mL of 0.1 $molL^{-1}$ hydrochloric acid solution is diluted by the addition of 400mL of distilled water. **2**

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Marks

Question 25 (3 marks)

A source of sulfur dioxide in the atmosphere is the burning of coal in power stations. Calculate the volume of sulfur dioxide released at 25^0C and 100kPa when 10.0 million kg of coal containing 0.01% sulfur, is burnt. **3**

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Question 26 (4 marks)

An ester is prepared in the laboratory by refluxing a mixture of appropriate alkanol and alkanoic acid using acid catalysis.

Identify two potential safety hazards and describe the experimental procedures that may be used to minimize these hazards in the preparation of the ester. **4**

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Chemistry

Section II

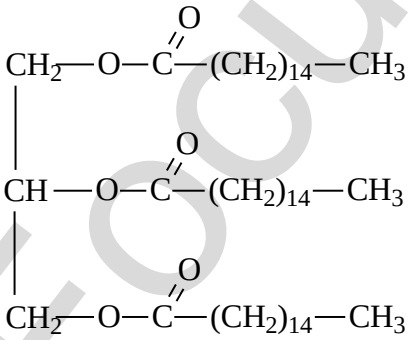
25 marks

Attempt question 27
Allow about 45 minutes for this section

Answer the question in a writing booklet. Extra writing booklets are available.
Show all relevant working in questions involving calculations.

Question 27 – Industrial Chemistry

(a) Glyceryl tripalmitate is a raw material used to make soap…



(i) Construct the structural formula of the soap formed from glyceryl tripalmitate. **1**

(ii) Identify the special type of mixture which forms when the soap is shaken with warm water and a small amount of glyceryl tripalmitate.. **1**

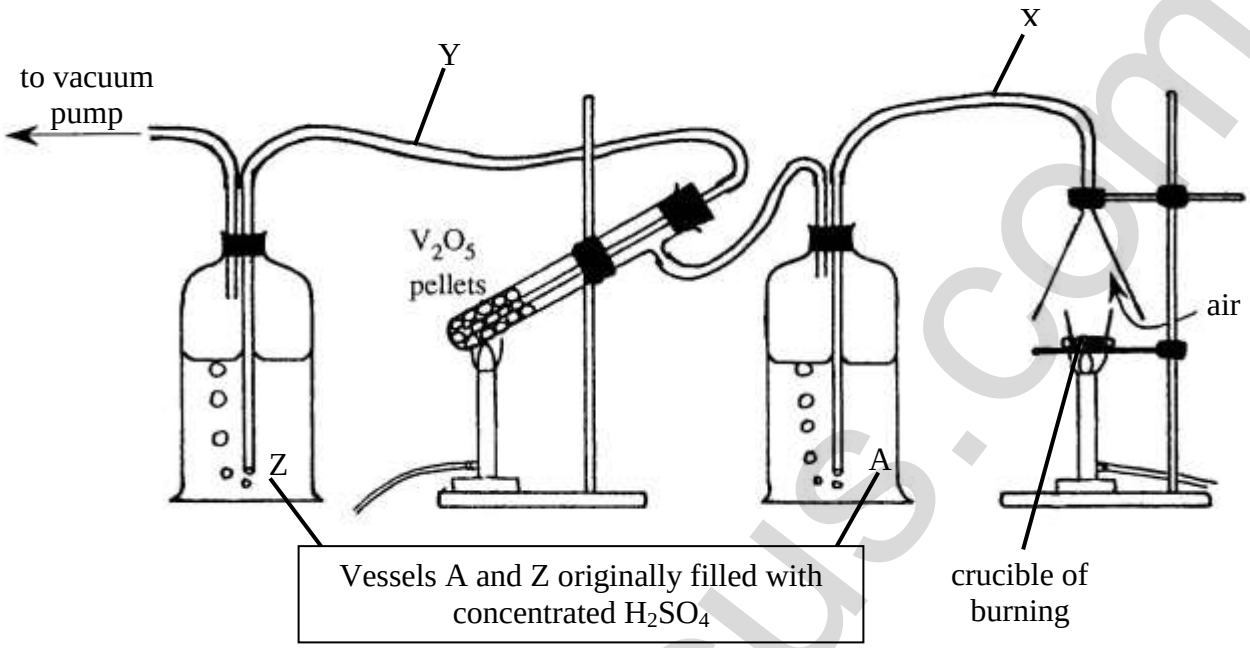
(iii) Other than glyceryl tripalmitate identify another fat or oil which can be used to make soap. **1**

(iv) Compare the environmental impacts of the use of soaps and non–phosphate detergents. **2**

Question 27 continues next page…

Marks

(b) In his quest for the *BHP Science Prize*, Ken Chemiski plans to prepare sulfuric acid using this relatively simple apparatus. Sulfur is burned in a crucible and the gas flow is forced through the apparatus using a vacuum pump.



(i) Evaluate the feasibility of Ken's apparatus to produce sulfuric acid ignoring safety issues **2**

(ii) Compare the gas composition in tube X with tube Y. **2**

(iii) Identify the role of the concentrated sulfuric acid in vessel A **1**

(iv) Construct a chemical equation for the reaction of gas Y as it bubbles through vessel Z. **1**

Question 27 continues next page…

Marks

(c) Chlorine gas can be prepared industrially by this equilibrium reaction…

$$4HCl_{(g)} + O_{2(g)} \rightleftharpoons 2Cl_{2(g)} + 2H_2O_{(g)}$$

An industrial chemist performs a small scale synthesis of this reaction in a two litre stainless steel tank and records this data…

	HCl	O_2	Cl_2	H_2O
Initial moles	0.548	0.625	0	0
Final moles at equilibrium	0.200	0.538	0.174	0.174

(i) Calculate the equilibrium constant from the data. **3**

(ii) Identify how the value of the equilibrium constant could be changed. **1**

(iii) Explain, using Le Châtelier's principle, how a change in volume will affect the equilibrium. **2**

(iv) Calculate the theoretical volume of chlorine produced at 25°C and 100 kPa, if the reaction went to completion. **2**

Question 27 continues next page…

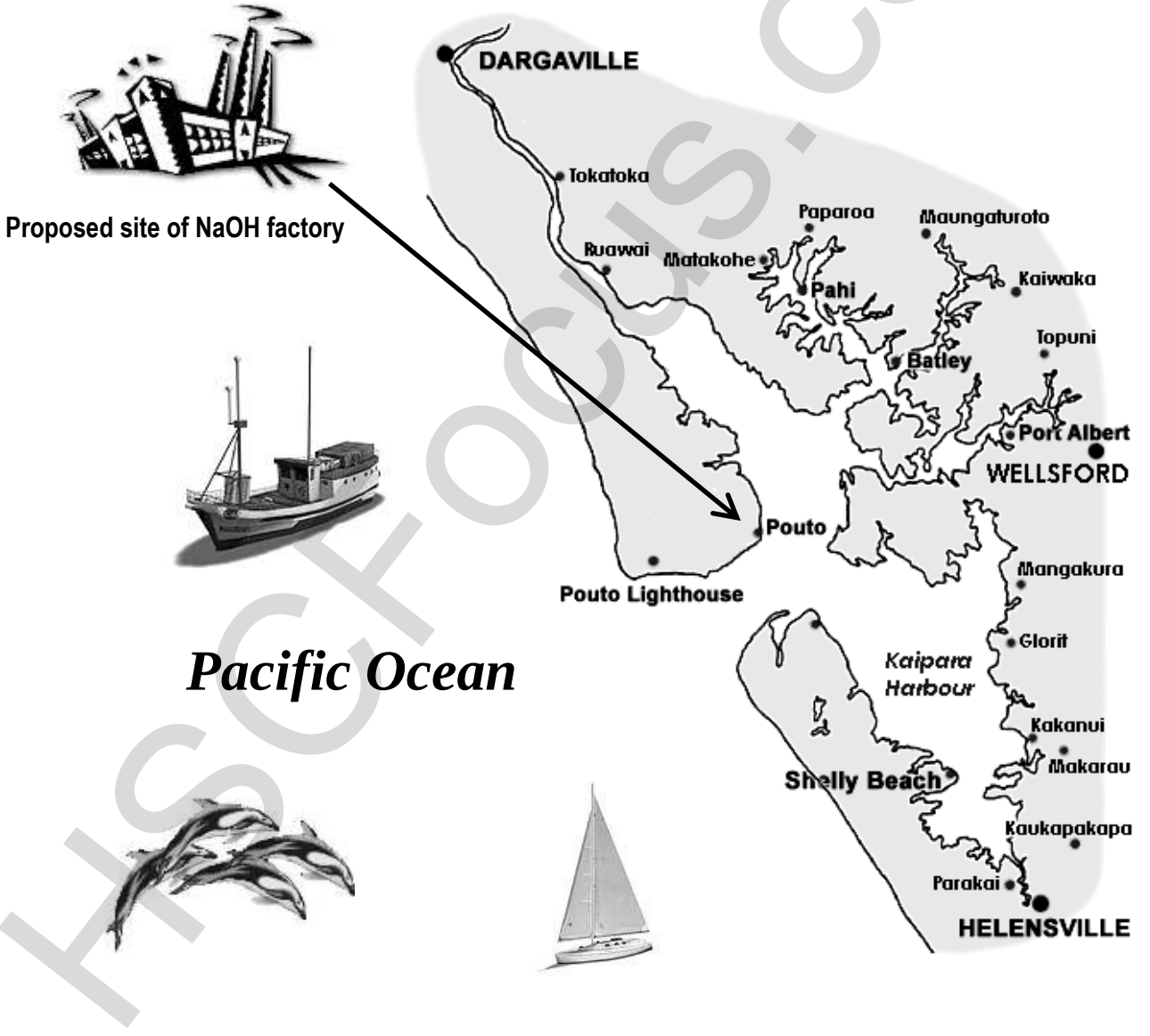
Marks

(d) Kaipara Harbour has a surrounding population of 75,000 with a mixed economy including dairy farming, market gardens, commercial prawn trawling in the harbour and offshore tuna fishing.. Three companies have expressed interest in building a sodium hydroxide production facility at Pouto located in Kaipara Harbour:

HGCL Ltd. has plans for a mercury process plant;
Mem-chlor-tech is proposing a membrane process plant;
and ***Chlorox Industries*** has plans for a diaphragm process plant.

Imagine you are an Environmental Chemist for the Kaipara Regional Planning Authority.

- Write an environmental risk assessment comparing all three plant proposals and
- Make recommendations as to which proposal should be approved. **6**



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