Chemistry

Section II

25 marks
Attempt ONE question from Questions 29–33
Allow about 45 minutes for this section

Answer the question in a SEPARATE writing booklet.

Show all relevant working in questions involving calculations.

3800-1

Marks

Question 29 – Industrial Chemistry (25 marks)

(a) Describe the issues associated with the shrinking world resources of ONE identified natural product that is not a fossil fuel and identify a replacement material used. **2**

(b) The Contact process in the production of sulfuric acid involves the conversion of SO_2 *(g)* into SO_3 *(g)*.

(i) Initially (before any sulfur trioxide had been produced) the concentration of sulfur dioxide was found to be 0.360 mol L^{-1} and the concentration of oxygen was found to be 0.300 mol L^{-1} in a 1.00 L vessel. At equilibrium, the concentration of sulfur trioxide was found to be 0.240 mol L^{-1}. **4**

Calculate the equilibrium constant for the reaction.

(ii) Sketch a graph to show the changes in concentration of sulfur dioxide, oxygen and sulfur trioxide as reaction proceeded until some time after equilibrium had been achieved. **2**

(c) During your practical work you performed a first-hand investigation to gather information about, and to carry out, the process of saponification.

(i) Define the term saponification. **1**

(ii) Outline the procedure used in your investigation and outline how you identified your product. **3**

(iii) Account for the cleaning action of soap. **3**

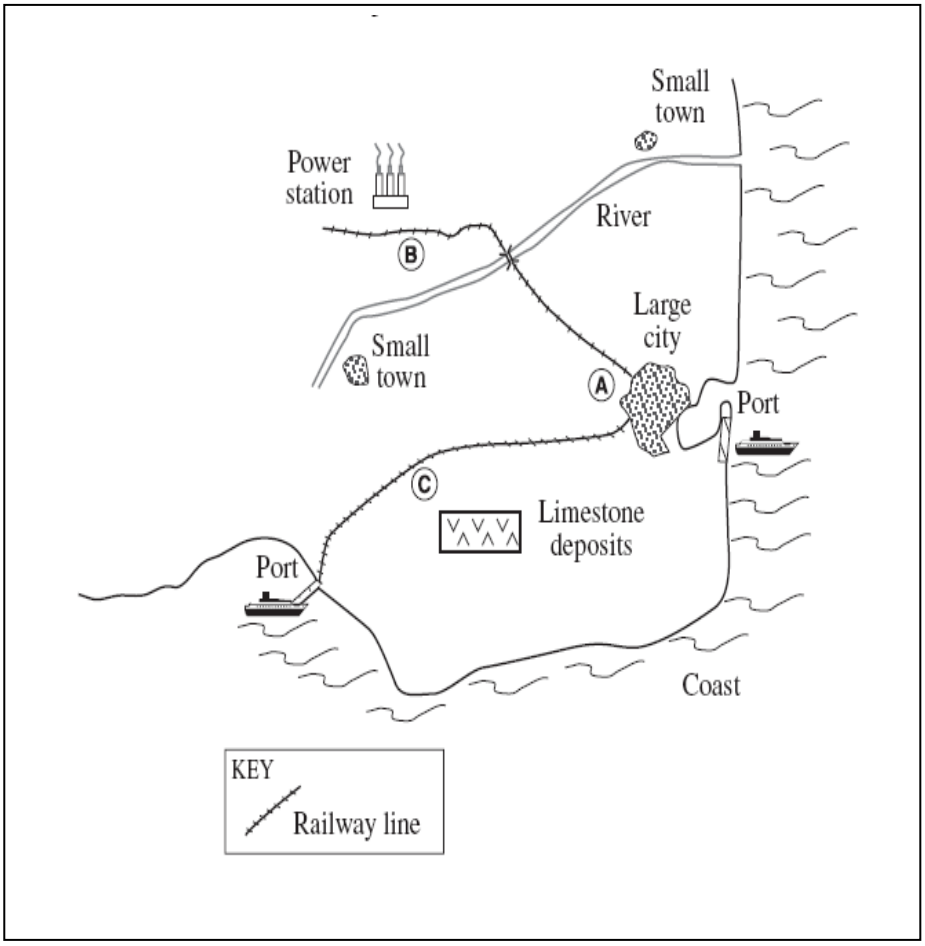
(d) Evaluate the THREE industrial methods for production of sodium hydroxide over the past century, by considering their impact on society and the environment and the chemical reactions and technologies involved. **6**

Question 29 continues on page 27

Marks

Question 29 (continued)

(e) Solvay Solutions Pty Ltd wishes to build a new industrial plant to be used for the production of sodium carbonate. The map shows THREE proposed sites (A, B and C) for the new plant. **4**



Critically assess the suitability of each of the proposed sites, A, B and C, for locating the new plant.

End of Question 29

Marks

Question 30 – Shipwrecks, Corrosion and Conservation (25 marks)

(a) (i) Identify the type of corrosion prevention provided by a zinc bar attached to the hull of an iron ship. **1**

(ii) Explain why the presence of a passivating layer on the zinc would make it unsuitable as a means of corrosion prevention for the ship. **2**

(b) Explain the key steps in the process of rusting. Include appropriate equations in your response. **3**

(c) Acidic environments accelerate corrosion.

(i) Identify a source of acidity in the ocean. **1**

(ii) In your course you performed a first-hand investigation of corrosion in different acidic and neutral solutions. Explain how your method allowed a valid comparison of rates of corrosion to be made. **4**

(d) Sir Humphrey Davy was able to produce pure sodium by passing an electric current through molten samples of common salt.

(i) Identify the source of the electricity used in Davy's experiment. **1**

(ii) Explain why the production of sodium metal in Davy's experiment required an electrolyte of molten sodium chloride rather than an aqueous solution of sodium chloride. **2**

Question 30 continues on page 29

Question 30 (continued)

(e) The table below lists details relating to TWO submerged artefacts that are to be recovered for cleaning and preservation. **6**

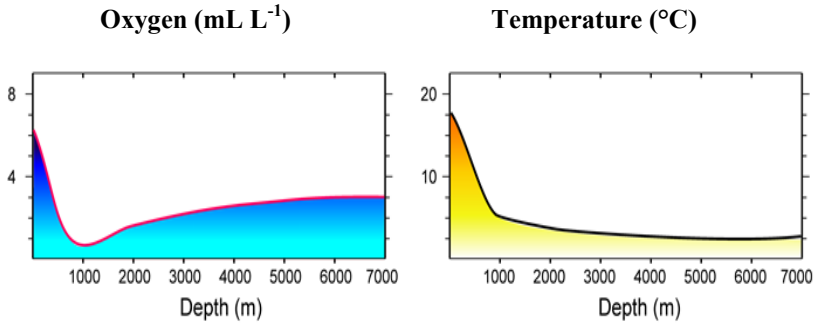
	Artefact 1 ***boiler and engine***	***Artefact 2*** ***anchor***
location	Murray River	Great Barrier Reef
water	fresh water	marine
average depth	8 m	12 m
composition	iron	iron
approximate age	110 years	115 years
average water temperature	18°C	26°C

Discuss the range of procedures that should be used to clean and stabilise EACH artefact, explaining any differences in the treatments required.

(f) (i) Identify the relationship between temperature of water and oxygen solubility. **1**

(ii) Examine the following graphs:

Depth of the Ocean versus Oxygen Concentration and Temperature



Graph A **Graph B**

Adapted from: http://www.rsbs.anu.edu.au/O2/O2_2_Aqua.htm

Explain the shape of Graph A. **3**

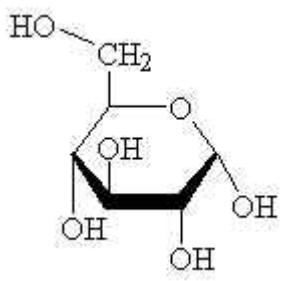
(iii) In your answer booklet, sketch a graph to show the relationship that *would be expected* between depth of ocean and oxygen concentration, *if* temperature were the only factor determining the relationship. **1**

End of Question 30

Marks

Question 31 – The Biochemistry of Movement (25 marks)

(a)



(i) To what class of compounds does this molecule belong? **1**

(ii) You performed a first-hand investigation, using models, computer simulations or diagrams, to compare the molecule shown above with glycogen. **2**

Outline the results of your investigation.

(b) "Protein molecules are very complex structures, determined by their sequence of amino acids." **4**

Analyse this statement, making reference to the nature of bonding and the various levels of protein structure.

(c) During your practical work you performed a first-hand investigation to demonstrate the effect of various factors on the reaction of a named enzyme.

(i) Outline the procedure used in the investigation and one safety precaution used. **3**

(ii) Describe the results obtained in the investigation. **2**

(iii) Outline any conclusions reached. **1**

Question 31 continues on page 31

Marks

Question 31 (continued)

(d) (i) Compare the appearance of Type 1 and Type 2 muscle fibres and relate their appearance to the types of exercise for which they are used. **3**

(ii) During vigorous exercise, athletes are not capable of maintaining an adequate supply of oxygen to their muscle tissue. Describe the way in which muscles meet their energy needs in an oxygen-deprived environment. **2**

(iii) Compare the energy output in an oxygen-deprived environment with that during aerobic respiration. **1**

(iv) Describe and account for the symptoms felt by athletes in oxygen-deprived conditions. **1**

(e) (i) Draw a structural formula for glycerol. **1**

(ii) Explain the high viscosity of glycerol. **2**

(iii) Use an equation to explain how glycerol is involved in the formation of fats (TAGs) in living tissues. **2**

End of Question 31

Marks

Question 32 – The Chemistry of Art (25 marks)

(a) Explain how pigments present in a painting can be identified using reflectance spectra. **2**

(b) Discuss how pigments have changed over time in response to recognition of health risks and discoveries of new pigments. Make reference to specific pigments and their colours in your answer. **3**

(c) You performed an experiment to investigate the oxidising strength of potassium permanganate ($KMnO_4$).

(i) Explain how the oxidising strength of potassium permanganate relates to the position of the permanganate ion (MnO_4^-) on the table of standard reduction potentials. **2**

(ii) Explain how the oxidising strength of potassium permanganate relates to its oxidation state. **2**

(iii) When potassium permanganate is reduced to manganese (II) ions, a colour change is observed and the oxidation state of the metal changes.
Relate this change in colour to change in electron configuration of transition metal ions. **4**

(iv) State a safety precaution that was taken during the experiment and explain how it lowered risk. **1**

(d) Outline the relationship between the trend in the successive ionisation energies of an aluminium atom and its electron configuration. **2**

(e) "While almost all the 3d transition metals exhibit variable valency, they usually exhibit a +2 oxidation state. However, one of the metals of the first transition series does not exhibit variable valency and only exists in the 0 and +2 oxidation states." **6**

Analyse these statements, using examples of transition metals as appropriate, and referring to electron configurations of these metals.

(f) "Hydrated ions are examples of co-ordination complexes." **3**

Explain this statement. Include a Lewis formula for a hydrated ion in your response.

Marks

Question 33 – Forensic Chemistry (25 marks)

(a) Outline TWO precautions that are used by forensic chemists when collecting samples and performing analyses and explain why these precautions are important. **2**

(b) The origin of a polysaccharide can be useful information when conducting forensic investigations.

(i) Identify the difference in structure between a named polysaccharide from a plant and a named polysaccharide from an animal. **2**

(ii) Identify the reagents that could be used to distinguish between the two polysaccharides you identified in (i). Describe the positive results you would expect. **2**

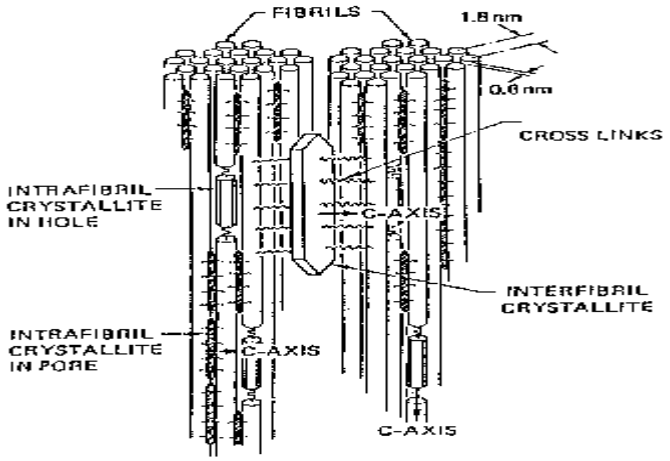
(c) As part of your course you performed a first-hand investigation to separate a mixture of organic materials by chromatography.

(i) Describe the procedure that you used in your investigation. **3**

(ii) Identify the safety precautions that you used. **1**

(iii) Explain how chromatography can be used to separate biological samples. **2**

(d) (i) Identify an example of the type of protein indicated in the diagram below. **1**



http://www.normanallan.com/Sci/images/bon.gif

(ii) Explain how a peptide bond is formed and write an equation, using structural formulae, to show the condensation reaction between two amino acids. **2**

Question 33 continues on page 34

Marks

Question 33 (continued)

(e) "DNA analysis is not infallible in forensic cases." **4**

Discuss this statement.

(f) Sensitive instrumental techniques have been used in recent years to provide forensic evidence about samples. For example, forensic chemists use analytical techniques in providing evidence to convict drug cheats in professional sport. Using this example, or another of your choosing, evaluate the use of TWO instrumental techniques (other than DNA analysis) in providing evidence for forensic investigations. **6**

End of Paper

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Sources

Question 30 (f) (ii)	http://www.rsbs.anu.edu.au/O2/O2_2_Aqua.htm
Question 33 (d) (i)	http://www.normanallan.com/Sci/images/bon.gif

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