



INSIGHT

Year 12 Trial Exam Paper

2012

CHEMISTRY

Written examination 1

STUDENT NAME:

QUESTION AND ANSWER BOOK

Reading time: 15 minutes

Writing time: 1 hour 30 minutes

Structure of book

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
A	20	20	20
B	8	8	63
			Total 83

- Students are permitted to bring the following items into the examination: pens, pencils, highlighters, erasers, sharpeners, rulers and one scientific calculator.
- Students are NOT permitted to bring sheets of paper or white out liquid/tape into the examination.

Materials provided

- The question and answer book of 23 pages.
- A data book.
- An answer sheet for multiple-choice questions.

Instructions

- Remove the data sheet from this book during reading time.
- Write your **name** in the box provided.
- You must answer the questions in English.

At the end of the examination

- Place the multiple-choice answer sheet inside the front cover of this question and answer book.

Students are NOT permitted to bring mobile phones or any other electronic devices into the examination.

This trial examination produced by Insight Publications is NOT an official VCAA paper for the 2012 Year 12 Chemistry Written examination 1.

This examination paper is licensed to be printed, photocopied or placed on the school intranet and used only within the confines of the purchasing school for examining their students. No trial examination or part thereof may be issued or passed on to any other party including other schools, practising or non-practising teachers, tutors, parents, websites or publishing agencies without the written consent of Insight Publications.

Copyright © Insight Publications 2012

This page is blank

SECTION A – Multiple-choice questions**Instructions for Section A**

Answer **all** questions in pencil on the answer sheet provided for the multiple-choice questions. Choose the response that is **correct** or that **best answers** the questions.

1 mark will be awarded for a correct answer; no marks will be awarded for an incorrect answer.

Marks are **not** deducted for incorrect answers

No marks will be awarded if more than one answer is chosen for any question.

Question 1

Which of the following statements are examples of a quantitative analysis?

I Watermelon contains 92% water by mass.

II A chocolate bar contains 7.45 g of fat.

III A sample of breakfast cereal contains iron.

- A. I and III only
- B. I and II only
- C. II and III only
- D. I, II and III

Question 2

A 1.00 M standard solution of sodium hydroxide is used to analyse the concentration of hydrochloric acid in brick cleaner. The sodium hydroxide is called a standard solution because:

I sodium hydroxide is a good primary standard

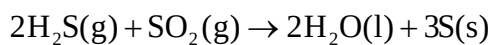
II the concentration of the solution is accurately known

III the concentration of the solution is 1.00 M.

- A. I and II only
- B. II only
- C. I and III only
- D. I, II and III

Questions 3 and 4 refer to the following information.

10.0 g of hydrogen sulfide reacts with 15.0 g of sulfur dioxide in a sealed 4.0 L container under standard laboratory conditions according to the following equation:



Question 3

The mass of sulfur produced, in g, is

- A. 6.27
- B. 14.1
- C. 22.5
- D. 42.3

Question 4

The volume of gas, in L, remaining in the container after the reaction is complete is

- A. 1.9
- B. 2.1
- C. 4.0
- D. 5.2

Question 5

10.0 g of aspirin, $\text{C}_9\text{H}_8\text{O}_4$, is produced from a reaction between salicylic acid and ethanoic anhydride. The mass, in g, of ethanoic acid produced in this reaction and needing to be removed before the aspirin can be put into tablet form is

- A. 1.67
- B. 3.33
- C. 6.67
- D. 10.0

Question 6

To each of three samples of a solution, a different acid–base indicator is added. The following colours are observed.

Indicator	Colour
Phenol red	yellow
Methyl red	yellow
Bromophenol blue	blue

The pH of the solution could be

- A. 5.5
- B. 6.5
- C. 7.5
- D. 8.5

Question 7

The reactants used for the fastest and best yielding synthesis of aspirin are:

- I ethanoic acid
- II ethanoic anhydride
- III salicylic acid

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

Question 8

Consider the following equation:

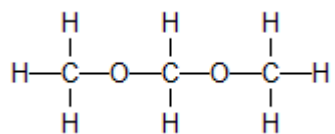


In this reaction

- A. H_2O_2 is undergoing oxidation only.
- B. H_2O_2 is undergoing reduction only.
- C. H_2O_2 is undergoing both reduction and oxidation.
- D. H_2O_2 is not undergoing either reduction or oxidation.

Question 9

Consider the following molecular structure.



The number of peaks and peak splitting that would be observed when this molecule was subject to high resolution ^1H NMR is

	Number of peaks	Peak splitting
A.	2	One peak split into a triplet, one peak split into a quartet
B.	2	No splitting evident
C.	3	One peak split into a triplet, two peaks each split into a quartet
D.	3	One peak split into a doublet, two peaks each split into a triplet

Question 10

Which of the following correctly describes the types of particles that absorb energy in the different spectroscopic techniques of UV–visible spectroscopy, ^{13}C nuclear magnetic resonance spectroscopy and infrared spectroscopy?

	UV–visible spectroscopy	^{13}C NMR spectroscopy	Infrared spectroscopy
A.	molecules	protons	positive ions
B.	molecules	nucleons	molecules
C.	electrons	protons	positive ions
D.	electrons	nucleons	molecules

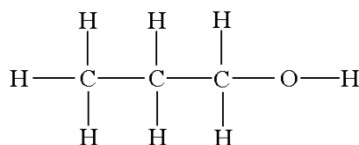
Question 11

Which of the following compounds contains the highest percentage by mass of oxygen?

- A.** Propyl propanoate
- B.** 1-propanol
- C.** Propanoic acid
- D.** 1-aminopropane

Question 12

Propene is reacted with substance X to produce the following structure.



The name of substance X is:

- A. methanol
- B. sodium hydroxide
- C. ethanol
- D. water

Question 13

Which of the following gives the correct systematic name of a compound that is an isomer of heptane?

- A. 1-methylhexane
- B. 2,3-dimethylbutane
- C. 3-methylheptane
- D. 2-methylhexane

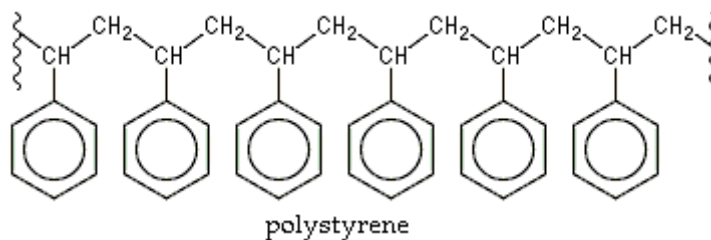
Question 14

Ethyl butanoate, $\text{CH}_3\text{CH}_2\text{OOCCH}_2\text{CH}_2\text{CH}_3$, is used in pineapple flavouring. The formulas for the molecules that react to produce ethyl butanoate are

- A. CH_3COOH and $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
- B. $\text{CH}_3\text{CH}_2\text{COOH}$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- C. $\text{CH}_3\text{CH}_2\text{OH}$ and $\text{CH}_3\text{CH}_2\text{COOH}$
- D. $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ and $\text{CH}_3\text{CH}_2\text{OH}$

Question 15

A section of the structure of polystyrene can be represented by the following formula.



Compared to the percentage by mass of carbon in the polymer, the percentage by mass of carbon in the monomer styrene, from which it is formed, is:

- A. equal
- B. less
- C. greater
- D. unable to be determined from the information given.

Question 16

Which of the following molecules is produced when a triglyceride containing no carbon-carbon double bonds undergoes hydrolysis?

- A. $\text{CH}_3\text{CH}_2\text{OH}$
- B. $\text{C}_6\text{H}_{12}\text{O}_6$
- C. $\text{C}_{11}\text{H}_{23}\text{COOH}$
- D. $\text{C}_{19}\text{H}_{31}\text{COOH}$

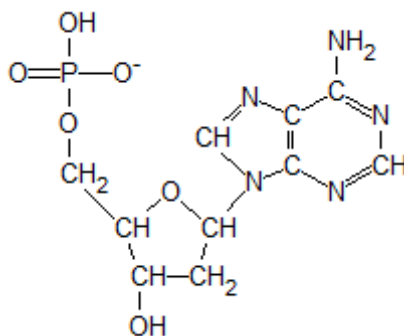
Question 17

The mass, in g, of bromine that will react with 0.010 mol of oleic acid is

- A. 1.6
- B. 3.2
- C. 0.020
- D. 0.010

Question 18

Consider the following structure of a nucleotide.



The name of the base that would form hydrogen bonds with this nucleotide in a complementary strand of DNA is:

- A. adenine
- B. cytosine
- C. guanine
- D. thymine

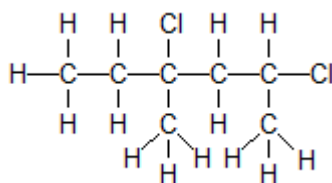
Question 19

A chemist uses fractional distillation to separate a mixture of water, ethanol, propanol and ethylpropanoate. The first fraction collected will contain mostly

- A. water
- B. ethanol
- C. propanol
- D. ethylpropanoate

Question 20

Consider the following molecule.



The systematic name of this molecule is

- A. 3,5-dichloro-3,5-dimethylpentane
- B. 1,3-dichloro-1,3-dimethylpentane
- C. 3,5-dichloro-3-methylhexane
- D. 2,4-dichloro-4-methylhexane

END OF SECTION A

**END OF SECTION A
TURN OVER**

SECTION B – Short-answer questions**Instructions for Section B**

Answer **all** questions in the spaces provided

To obtain **full marks** for your responses you should

- give simplified answers with an appropriate number of significant figures to all numerical questions; unsimplified answers will not be given full marks.
- show all working in your answers to numerical questions. No credit will be given for an incorrect answer unless it is accompanied by details of working.
- make sure chemical equations are balanced and that the formulas for individual substances include an indication of state; for example, $\text{H}_2(\text{g})$; $\text{NaCl}(\text{s})$

Question 1

Below are the molecular formulas of a number of important organic molecules.

A. $\text{C}_6\text{H}_{12}\text{O}_6$	B. $\text{C}_3\text{H}_8\text{O}_3$	C. $\text{C}_5\text{H}_{10}\text{O}_4$
D. $\text{C}_{18}\text{H}_{32}\text{O}_{16}$	E. $\text{H}_2\text{NCH}_2\text{COOH}$	F. $\text{C}_{15}\text{H}_{31}\text{COOH}$
G. $\text{H}_2\text{NCH}(\text{CH}_2\text{SH})\text{COOH}$	H. $\text{C}_{15}\text{H}_{29}\text{COOH}$	I. $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOCH}_3$

In each of the following questions, circle the letter or letters that correspond to the compound/s in the table. The same letter may be used in more than one response.

- a.** Which molecule could be involved in determining the tertiary structure of a protein?

A B C D E F G H I

1 mark

- b.** Which molecule is a trisaccharide?

A B C D E F G H I

1 mark

- c. Which **two** molecules are produced by condensation reactions?

A B C D E F G H I

2 marks

- d. Which molecule is produced when a nucleotide undergoes hydrolysis?

A B C D E F G H I

1 mark

- e. Which molecule is glycerol?

A B C D E F G H I

1 mark

- f. Which **two** molecules could be monomers for the process of condensation polymerisation to form a polypeptide?

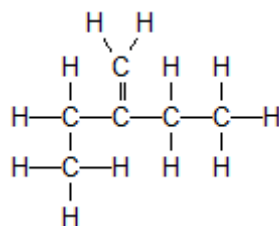
A B C D E F G H I

2 marks

Total 8 marks

Question 2

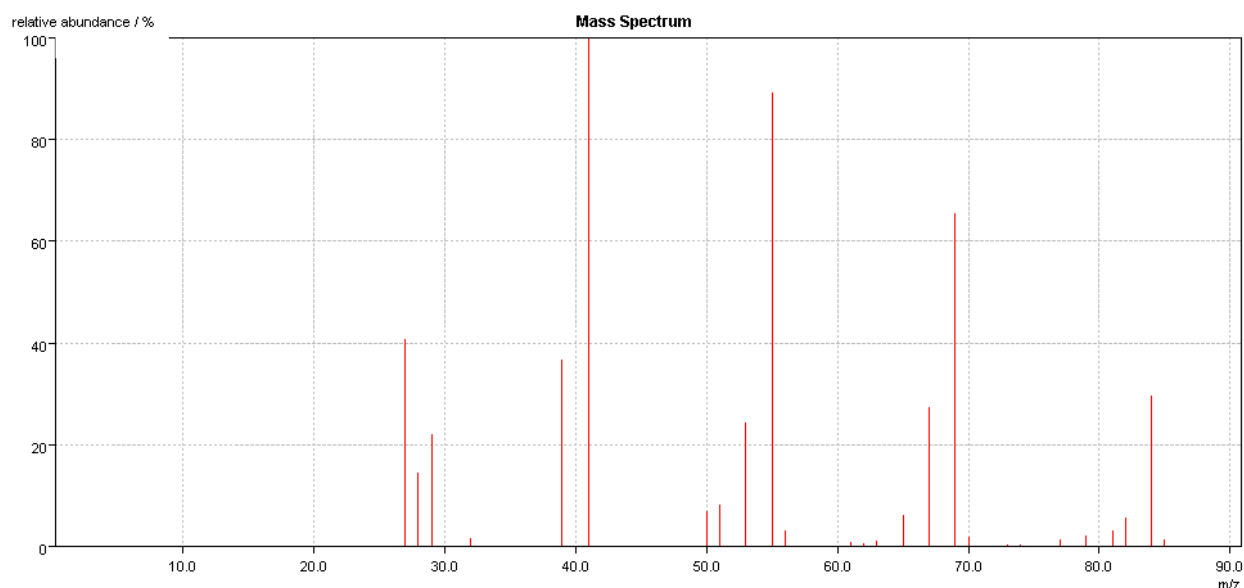
Consider the following molecule.



- a. What is the systematic name of this molecule?

1 mark

- b. The mass spectrum of this compound is shown below.



Source: Royal Society of Chemistry <http://www.le.ac.uk/spectraschool/>

- i. Circle the peak due to the parent molecular ion on the graph above.

1 mark

- ii. Give the formula of the species that produces the peak at $m/z = 84.0$.

1 mark

- iii. Draw the structure of the species that produces the base peak on the mass spectrum above.

1 mark

- iv. Give the m/z of the peak that would be produced by the species that experiences the greatest deflection in the mass spectrometer.

1 mark

1 + 1 + 1 + 1 = 4 marks

- c. This molecule can also be analysed by NMR spectroscopy.

- i. How many peaks would be visible in a low-resolution ^1H NMR spectrum of this compound?

1 mark

- ii. How many peaks would be visible in a ^{13}C NMR spectrum of this compound? Explain your answer.

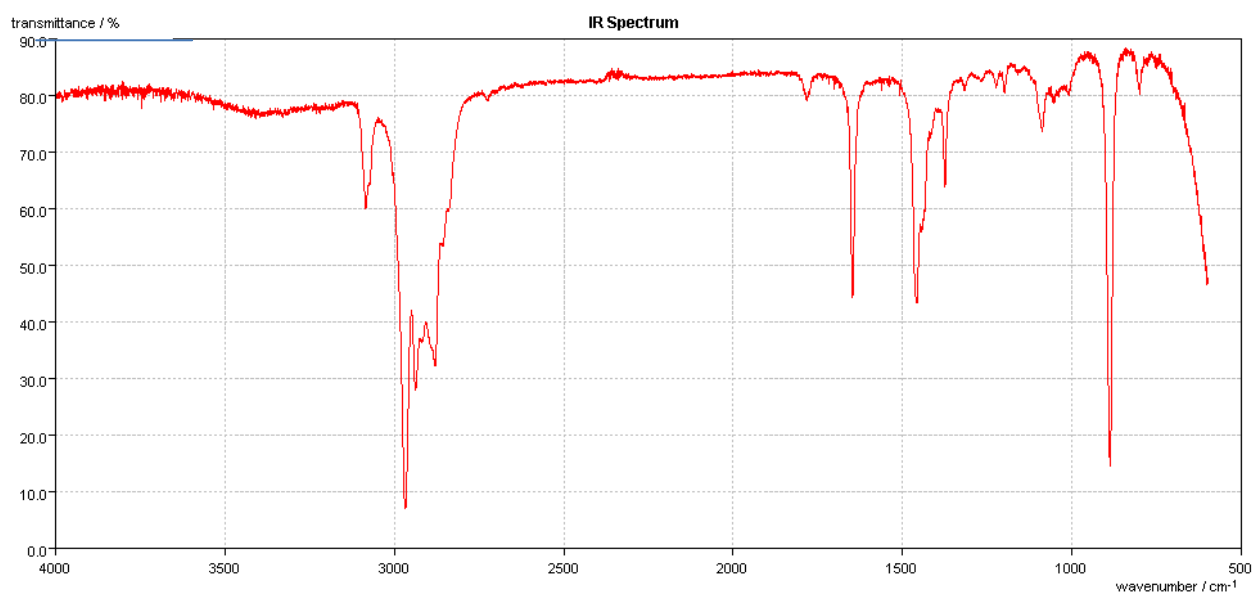
2 marks

1 + 2 = 3 marks

- d. i. Draw the structure of an isomer of this molecule

1 mark

The IR spectrum of the molecule is shown below.



Source: Royal Society of Chemistry <http://www.le.ac.uk/spectraschool/>

- ii. Explain how this IR spectrum could be used to distinguish between the molecule and the isomer you have drawn in **part i**.

2 marks

1 + 2 = 3 marks

Total 11 marks

Question 3

Quantitative analysis of ethanol can be performed using different techniques. These include volumetric analysis and gas chromatography.

- a.** Briefly explain the principles of chromatography.

3 marks

- b.** Briefly explain the principles of volumetric analysis.

3 marks

- c.** Assuming you have full access to all of the equipment and materials needed to perform either technique, describe two considerations for choosing one technique over the other.

2 marks

Total 8 marks

SECTION B – continued
TURN OVER

Question 4

A particular barium halide exists as the hydrated salt $\text{BaX}_2 \cdot 2\text{H}_2\text{O}$, where X is the halogen. The identity of X can be determined by using gravimetric analysis to determine the barium content of the salt.

A 0.4560 g sample of the halide is dissolved in 200.0 mL of deionised water. Excess sulfuric acid is added to the solution, which is then heated and boiled for 45 minutes. A white precipitate of barium sulfate forms. The precipitate is filtered, washed several times with deionised water and thoroughly dried. The mass of the precipitate is found to be 0.4360 g.

- a.** Determine the identity of X.

4 marks

- b.** Briefly outline a way in which you could experimentally confirm that there are two H_2O molecules in the formula for the hydrated salt identified in **part a**.

2 marks

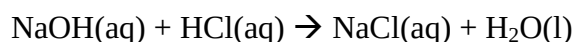
Total 6 marks

Question 5

Plants need nitrogen to produce proteins required for growth and development. Consequently lawn fertilisers contain nitrogen to promote fast and healthy growth of plants. The nitrogen in fertilisers that is present as ammonium ions can be analysed by a back titration.

A student weighed 1.34 g of finely ground fertiliser and then carefully transferred it to a 250 mL volumetric flask. Deionised water was added to dissolve the fertiliser and the solution was made up to the calibration line. A 20.00 mL pipette was used to deliver aliquots of the fertiliser solution to three 250 mL conical flasks. To each flask was added a 20.00 mL aliquot of 0.535 M sodium hydroxide solution as well as 50.00 mL of deionised water. Each mixture was boiled for about 10 minutes until vapour at the neck of the flask no longer turned red litmus paper blue. Two drops of methyl red indicator was then added to each flask, and the flasks were titrated with 0.987 M hydrochloric acid until the endpoint was reached. The three titre volumes were found to be 10.12 mL, 10.18 mL and 9.98 mL.

The equation for the reaction of sodium hydroxide and hydrochloric acid is:



- a. i.** Justify why methyl red was used as the indicator for this reaction.

2 marks

- ii.** What colour change would have been observed to indicate the endpoint of the reaction?

1 mark

2 + 1 = 3 marks

- b.** Suggest one reason why a back titration was chosen to analyse the amount of nitrogen in the form of ammonium ions.

1 mark

- c. i.** Write an ionic equation for the reaction between the ammonium ions and sodium hydroxide.

1 mark

- ii.** Explain why red litmus paper was used to test the vapours at the neck of the conical flask.

2 mark

1 + 2 = 3 marks

- d. i.** Determine the average titre of hydrochloric acid.

1 mark

- ii.** Determine the amount, in mol, of sodium hydroxide that reacted with fertiliser solution in the conical flask.

3 marks

- iii.** Calculate the percentage by mass of nitrogen in the sample of fertiliser. Give your answer with the appropriate number of significant figures.

5 marks

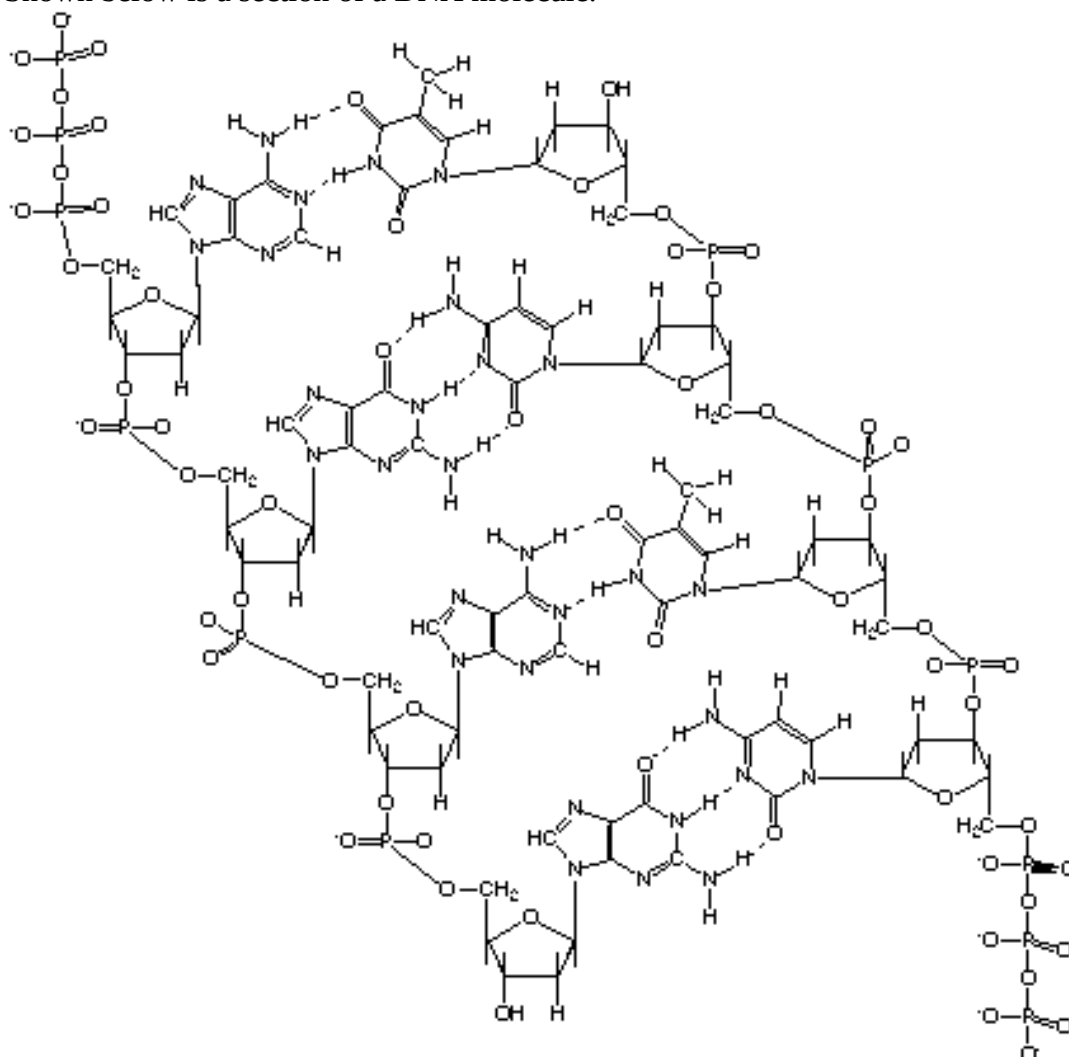
1 + 3 + 5 = 9 marks

Total 16 marks

SECTION B – continued
TURN OVER

Question 6

Shown below is a section of a DNA molecule.



Source: MIT Biology Hypertextbook

<http://202.114.65.51/fzx/wsw/website/mit/lm/nucleicacids/dna.html>

a. On the diagram above:

i. Circle a nucleotide that contains an adenine base.

1 mark

ii. Clearly label and name the two major types of bonding present in the molecule.

2 marks

1 + 2 = 3 marks

b. What type of chemical reaction is responsible for the joining of single nucleotides into a long chain?

1 mark

Total 4 marks

SECTION B – continued

Question 7

- a.** Consider a section of a polypeptide that contains the following three amino acids:

–Gly–Leu–Ser–

- i.** Describe a way in which this section of the polypeptide may contribute to the tertiary structure of a protein.

1 mark

- ii** Describe a way in which this section of the polypeptide may contribute to the secondary structure of a protein.

1 mark

1 + 1 = 2 marks

- b.** Give the name of the link that holds amino acids together in a polypeptide.

1 mark

- c.** Draw the structure of asparagine in a solution of pH 11.

1 mark

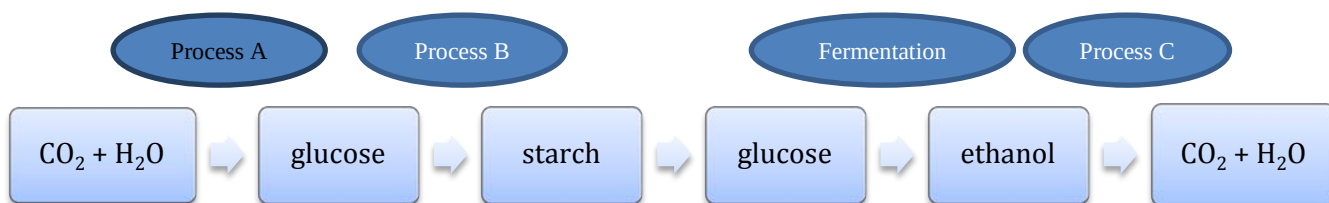
Total 4 marks

SECTION B – continued
TURN OVER

This page is blank

Question 8

Biochemical fuels are fuels derived from plant materials. The flowchart below represents steps in the production and use of ethanol, a biochemical fuel.



- a. Give the name of processes A and B

Process A: _____

Process B: _____

2 marks

- b. Write a balanced equation for the fermentation reaction.

1 mark

- c. Write a balanced chemical equation for process C.

2 marks

- d. Biodiesel is another example of a biochemical fuel. What type of biochemical molecules is biodiesel a mix of?

1 mark

Total 6 marks

END OF QUESTION AND ANSWER BOOK

Disclaimer:

Every effort has been made to trace the original source of material used in this paper. Where the attempt has been unsuccessful, the authors, editors and publishers would be pleased to hear from copyright owners in order to rectify any errors or omissions