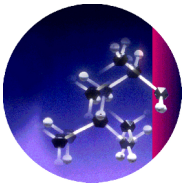

CHEMOLOGY EDUCATION SERVICES

Name:_____

CHEMISTRY - Year 12
UNIT 3 TRIAL EXAM – 2008

Time allowed: 1 hour 30 minutes

QUESTION AND ANSWER BOOKLET

Structure of booklet

Section	Number of questions	Number of questions to be answered
A	21 multiple choice Questions	21 multiple choice Questions
B	8	8

Directions to students

Materials
Question and answer booklet of 19 pages. Answer sheet for multiple choice Questions
An approved calculator may be used.

Data Pages may be found at
http://www.vcaa.vic.edu.au/vce/studies/chemistry/chem1_sample_2008.pdf

The Task
Pleasure ensure that you write your name on the multiple choice answer sheet and this answer booklet.
Answer **all** Questions from Section A, which should be answered on the sheet provided.
Answer **all** questions from Section B, which should be answered in this booklet in the spaces provided.
There is a total of 84 marks available.All answers should be written in English.

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SECTION A

Specific instructions for Section A

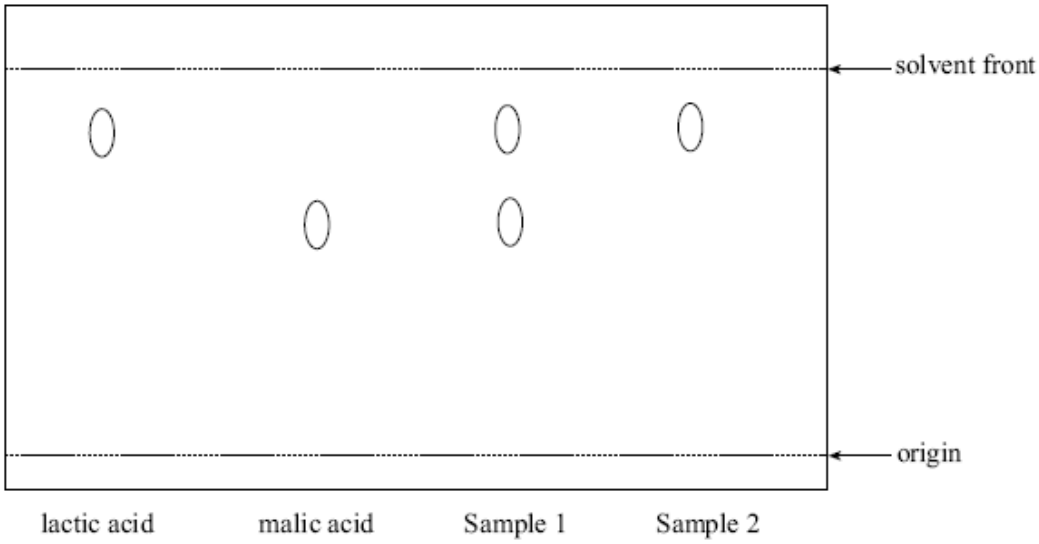
Section consists of 21 multiple choice Questions. Section A is worth approximately 25% of the marks available. You should spend about 30 minutes on this section.

Choose the response that is **correct** or **best answers the question,** and mark your choice on the multiple choice answer sheet provided.

No credit will be given for a Question if two or more letters are marked for that Question. Marks will not be deducted for incorrect answers and you should attempt every Question.

Question 1

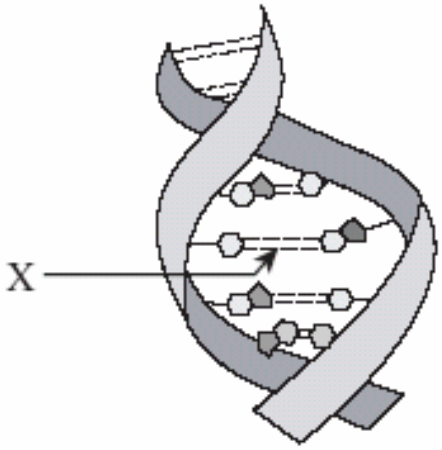
A process known as malo-lactic fermentation occurs in some wines. During this process malic acid is converted into lactic acid. The extent of malo-lactic fermentation in one wine over a period of time was analysed by thin layer chromatography using a polar stationary phase.
Two samples of the wine were spotted onto the chromatography plate.
Reference samples of lactic acid and malic acid were also spotted onto the plate.
The chromatogram obtained is shown below:



Which one of the following is true?

A Lactic acid adsorbs more strongly to the stationary phase than malic acid.
B Malic acid has a larger R_f value than lactic acid.
C Lactic acid is less soluble in the mobile phase than malic acid.
D Malo – lactic fermentation had occurred in sample 2.

Question 2
The diagram below represents a section of DNA.



What type of chemical bond is indicated by **X**?

A. Ionic
B. peptide
C. covalent
D. hydrogen

Question 3
How many oxygen atoms are present in 0.0500 mol carbon dioxide?

A. 3.01×10^{22}

B. 6.02×10^{22}

C. 6.02×10^{23}

D. 1.20×10^{24}

Question 4
What is the conjugate acid of the base $HAsO_4^{2-}$?

A. AsO_4^{3-}
B. $H_2AsO_4^{2-}$
C. $H_2AsO_4^{-}$
D. H_3AsO_4

Question 5
What are the oxidation numbers of the elements in sulfuric acid, H_2SO_4?

	Hydrogen	Sulfur	Oxygen
A.	+1	+6	−2
B.	+1	+4	−2
C.	+2	+1	+4
D.	+2	+6	−8

Question 6
A fixed mass of an ideal gas has a volume of 800ml under certain conditions. The pressure (in kPa) and temperature (in K) are both doubled. What is the volume of the gas after these changes with other conditions remaining the same?

A. 200 ml
B. 800 ml
C. 1600 ml
D. 3200 ml

Question 7
Which methods will distinguish between equimolar solutions of a strong base and a strong acid?

I. Add magnesium to each solution and look for the formation of gas bubbles.
II. Add aqueous sodium hydroxide to each solution and measure the temperature change.
III. Use each solution in a circuit with a battery and lamp and see how bright the lamp glows.

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

Question 8
Information related to a titration experiment is given in the balanced equation and table below.

$H_2SO_4(aq) + 2KOH(aq) \rightarrow K_2SO_4(aq) + 2H_2O(l)$

Titration Experiment Results

volume of $H_2SO_4(aq)$ used	12.0 mL
concentration of $H_2SO_4(aq)$	?
volume of KOH(aq) used	36.0 mL
concentration of KOH(aq)	0.16 M

Based on the equation and the titration results, what is the concentration of the $H_2SO_4(aq)$?

A. 0.12 M
B. 0.24 M
C. 0.16 M
D. 0.96 M

Question 9
Which compound is a member of the same homologous series as
1 -chloropropane?

A. 1-chloropropene
B. 1-chlorobutane
C. 1-bromopropane
D. 1,1-dichloropropane

Question 10
Which formula is a correct representation of pentane?

A. $CH_3CH_2CHCH_2CH_3$

B. $(CH_3CH_2)_2CH_3$

C. $CH_3(CH_2)_3CH_3$

D. $CH_3(CH_3)_3CH_3$

Question 11
What is the organic product of the reaction between ethanol and ethanoic acid?

A. CH_3CHO

B. CH_3COOCH_3

C. $CH_3CH_2COOCH_3$

D. $CH_3COOCH_2CH_3$

Question 12
The sequence of bases in one strand of a DNA molecule is C C G T A C. Which of the following represents the sequence of bases created on this strand during replication?

A. C C G T AC
B. G G C U T G
C. G G C A T G
D. G G C A U G

Question 13
Which statement about Atomic Absorption Spectroscopy (AAS) is correct?

A. AAS is an effective qualitative technique but it cannot be used for quantitative analysis.

B. AAS measures the wavelengths of light emitted when electrons fall back to their ground state.

C. In AAS, white light is shone through a vaporised sample in order to observe which wavelengths are absorbed.

D. The wavelength of light used in AAS matches one of the spectral lines produced when the sample is analysed by a flame test.

Question 14
A 0.1M HCl solution has a pH of 1.0 .
What volume of water must be added to 90 mL of this solution to obtain a final pH of 2.0?

A. 10 mL

B. 180 mL

C. 810 mL

D. 900 mL

Question 15
The reaction shown below:

$$C_6H_{12}O_6(aq) \rightarrow 2C_2H_5OH\ (l) + 2CO_2\ (g)$$

is best described as:

A. a respiration reaction in the cells of animals.
B. aerobic oxidation of organic matter.
C. fermentation by yeast cells.
D. an endothermic reaction involving glucose.

Question 16
Acid *X* and acid *Y* are both monoprotic weak acids of equal concentration. Acid *X* is a stronger acid than acid *Y*. Which statement about acid X and acid Y is correct?

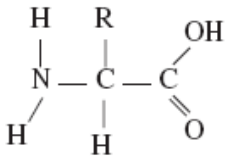
A. Acid *Y* is completely ionised in solution.

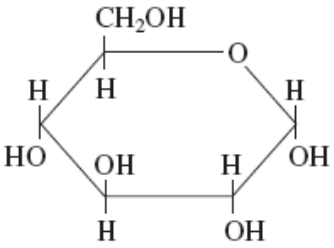
B. The solution of acid *X* is less ionised than the solution of acid *Y*.

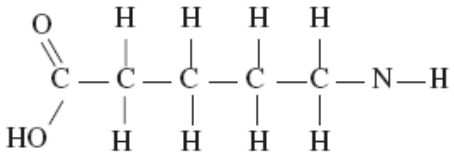
C. The solution of acid *X* has a lower pH than the solution of acid *Y*.

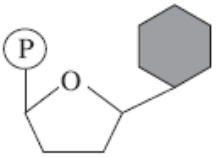
D. 1 mole of acid *Y* requires a greater volume of 1.0M NaOH for neutralisation than 1 mole of acid *X*.

Question 17
A chemical reaction occurs slowly at 37^0 C. When molecule **X** is added, the reaction speeds up. Which of the following is a monomer of molecule **X**?

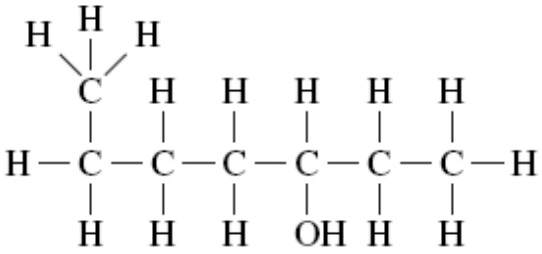
A.


B.


C.


D.


Question 18
What is the IUPAC name for the following compound?



A. Heptan-3-ol
B. 6-methyl hexan-3-ol
C. Hexan-3-ol
D. Heptan-5-ol

Question 19
What type of reaction describes the polymerisation of glucose into cellulose?

A. Addition

B. Hydrolysis

C. Substitution

D. Condensation

Question 20
Glucose $C_6H_{12}O_6$ is a monomer that can form naturally occurring polymers. The approximate atomic weights for the elements that make up glucose are shown in the table.

Element	*Approximate atomic weight*
Carbon	12
Hydrogen	1
Oxygen	16

Using data from the table, what would be the approximate molecular weight of a polymer made from 5 glucose monomers?

A. 810
B. 828
C. 882
D. 900

Question 21
A redox titration is carried out by adding purple $KMnO_4$ solution from a burette to a solution of H_2O_2 in a flask, under acidic conditions. Which of the following would correctly describe the observed colour **and** the product formed in the flask **before** the equivalence point is reached?

	Observed Colour	Product Formed
A.	remains purple	H_2
B.	remains purple	O_2
C.	becomes colourless	H_2
D.	becomes colourless	O_2

END OF SECTION A

SECTION B

Specific Instructions for Section B

Section B consists of 8 short answer questions (question 1 to 8). You must answer all of these questions. The section is worth 63 marks or approximately 75% of the total. You should spend approximately 60 minutes on this section. The marks allocated and suggested time, are at the end of each question.
Questions should be answered in the spaces provided in this booklet.
You should
* give simplified answers with the appropriate number of significant figures. Unsimplified answers will not receive full marks.
* Show all working in your answers to numerical problems. No marks can be given unless accompanied by working.
* make sure all chemical equations are balanced and that formulas for individual substances include an indication of state. Eg $H_2(g)$, NaCl (s).

Question 1 (7 marks)

The percentage composition by mass of a hydrocarbon is C = 85.6 % and H = 14.4 %.

(a) Calculate the empirical formula of the hydrocarbon. [2 marks]

_____

_____

_____

(b) A 1.00 g sample of the hydrocarbon at a temperature of 273 K and a pressure of 1.01 x 10^5 Pa (1.00 atm) has a volume of 0.399 L.

(i) Calculate the molar mass of the hydrocarbon. [2 marks]

_____

_____

_____

(ii) Deduce the molecular formula of the hydrocarbon. [1 mark]

Question 1 continued

(c) Explain why the **incomplete** combustion of hydrocarbons is harmful to humans. [2 marks]

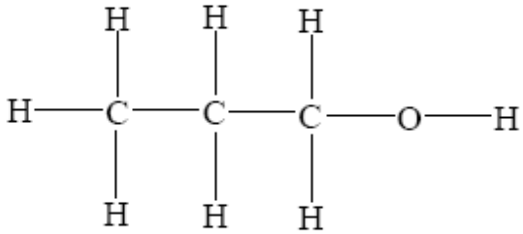
_____

_____

_____

Question 2 (8 marks)

Propan-1-ol has the following structural formula.



(a) Use information in the *Data Booklet* to identify **two** characteristic infrared absorption ranges for propan-1-ol and state the bonds responsible. [2 marks]

_____

_____

_____

(b) Deduce the number of peaks and the ratio of the areas of the peaks in the ^{1}H NMR spectrum of propan-1-ol. [2 marks]

_____

Question 2 continued

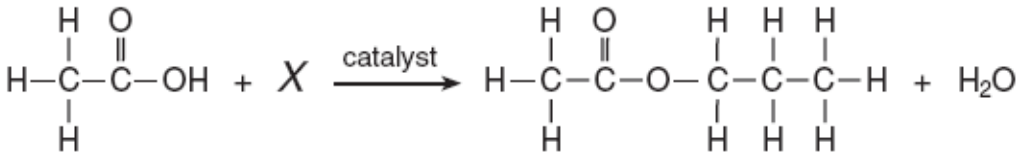
(c) Propan-2-ol is an isomer of propan-1-ol. Draw the structure of propan-2-ol and explain why $_1$H NMR spectroscopy would be more useful than infrared spectroscopy in distinguishing between the two isomers. Explain your answer with reference to both techniques. [4 marks]

_____

_____

_____

Question 3 (4 marks)
The incomplete equation below represents an esterification reaction. The alcohol reactant is represented by X.



a) On the structural formula, circle and label the acid and ester functional group. [2 marks]

b) Write an IUPAC name for the reactant represented by its structural formula in this equation. [1 mark]

_____

c) In the space provided draw the structural formula for the alcohol represented by X. [1 mark]

Question 4 (9 marks)
A source of energy that shows great promise is solar energy.

One method of capturing solar energy is through its conversion to biomass and subsequent conversion to biofuel (biochemical fuel).

a) i) State what is meant by the term *biomass*. [1 mark]

_____

_____

ii) Write an equation to show how glucose is produced with the aid of solar energy. [2 marks]

_____

b) The energy stored in biomass can be released in several ways. Two of these are direct combustion and conversion to ethanol.

i) For **each** of these two methods, give **one** advantage and **one** disadvantage.

Direct combustion [2 marks]

Advantage

_____

_____

Disadvantage

_____

_____

Question 4 continued

Conversion to ethanol [2 marks]

Advantage

_____

_____

Disadvantage

_____

_____

c) Write an equation for the production of ethanol from glucose. [2 marks]

_____

Question 5 (18 marks)
Some organic compounds can undergo dehydration.

(a) State what is meant by the term *dehydration* and give an example of a dehydrating agent. [2 marks]

_____

_____

_____

_____

(b) Two of the isomers of molecular formula C_3H_8O can be dehydrated to form a compound of molecular formula C_3H_6. Give the structural formulas and the names of these three compounds. [5 marks]

c) (i) State the number of peaks and the ratio of their areas in the $_1H$ NMR spectra of C_3H_6 and **one** of the isomers of C_3H_8O. [2 marks]

_____

_____

Question 5 continued

(ii) Use the Data Booklet to identify a strong absorption in the infrared spectrum of C_3H_8O which is not present in C_3H_6, and a strong absorption in C_3H_6, which is not present in C_3H_8O In each case, state the absorption range and the bond responsible. [3 marks]

_____

_____

_____

_____

(d) (i) The compound C_3H_6 can react with bromine. Write an equation for this reaction name the product. State a visible change which accompanies the reaction. [3 marks]

_____

_____

_____

_____

(ii) Give the full structural formula of the product formed in part (d) (i). [1 mark]

(e) Name the type of polymerization reaction which C_3H_6undergoes and draw the structure of a section of the polymer chain formed from three monomer molecules. [2 marks]

_____

Question 6 (7 marks)

Red cabbage Indicator chart

Colour	red		violet		purple		blue		green		yellow		
pH	1	2	3	4	5	6	7	8	9	10	11	12	13	14

(a) State what colour the red cabbage indicator would be in a 0.005M solution of H_2SO_4. Show your working. [2 marks]

_____

_____

_____

_____

(b) Using the red cabbage indicator, what colour would the solution be if 10 mL of 0.005M H_2SO_4 was diluted to 100 mL? [2 marks]

_____

_____

_____

_____

c) What volume of 0.005M KOH is required to neutralise 15 mL of the diluted solution of H_2SO_4.? [3 marks]

_____

_____

_____

_____

Question 7 (8 marks)

(a) 1H NMR spectroscopy can be used to obtain information about the structure of molecules.
State the information that can be obtained from the: [3 marks]

(i) number of peaks.

_____

_____

(ii) chemical shift.

_____

_____

(iii) ratio of peak areas.

_____

_____

(b) The 1H NMR spectrum of a compound with the formula $C_4 H_8 O_2$ exhibits three major peaks with chemical shifts and areas given below.

chemical shift / ppm	peak area
0.9	3
2.0	2
4.1	3

Using information from the Table in the *Data Booklet*, determine the types of proton present in the molecule. [3 marks]

_____

_____

_____

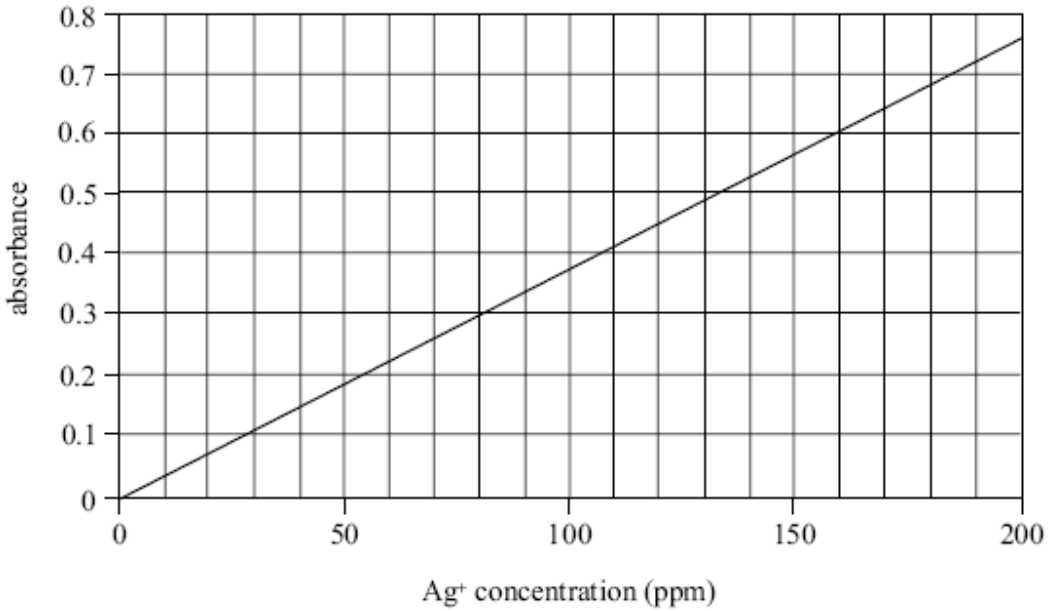
_____

c) Deduce a structure consistent with the information indicated in (b).
[2 marks]

Question 8 (3 marks)

Ancient coins often contain copper and silver. Atomic absorption spectroscopy (AAS) can be used to analyse the composition of ancient coins.

A calibration graph used to determine the silver content of ancient coins is shown below:



The absorbance reading for one ancient coin is 0.23.

a) Using the calibration graph, determine the silver content of the ancient coin. [1 mark]

_____

b) AAS can also be used to determine the copper content of ancient coins.
State two changes that must be made to the procedure in order to determine the copper content. [2 marks]

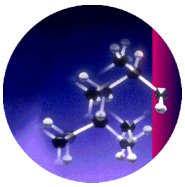
_____

_____

_____

_____

END OF EXAM



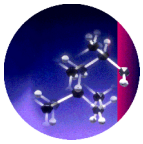
CHEMOLOGY EDUCATION SERVICES

Name:_____

CHEMISTRY EXAM 1
MULTIPLE CHOICE ANSWER SHEET

Shade the box ■ after the letter corresponding to your answer.

1.	A☐	B☐	C☐	D☐	11.	A☐	B☐	C☐	D☐
2.	A☐	B☐	C☐	D☐	12.	A☐	B☐	C☐	D☐
3.	A☐	B☐	C☐	D☐	13.	A☐	B☐	C☐	D☐
4.	A☐	B☐	C☐	D☐	14.	A☐	B☐	C☐	D☐
5.	A☐	B☐	C☐	D☐	15.	A☐	B☐	C☐	D☐
6.	A☐	B☐	C☐	D☐	16.	A☐	B☐	C☐	D☐
7.	A☐	B☐	C☐	D☐	17.	A☐	B☐	C☐	D☐
8.	A☐	B☐	C☐	D☐	18.	A☐	B☐	C☐	D☐
9.	A☐	B☐	C☐	D☐	19.	A☐	B☐	C☐	D☐
10.	A☐	B☐	C☐	D☐	20.	A☐	B☐	C☐	D☐
					21.	A☐	B☐	C☐	D☐



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SUGGESTED SOLUTIONS TO 2008 CHEMISTRY TRIAL EXAM 1

Section A

1 D		**11 D**	
2 D		**12 C**	
3 C	In 0.5mole CO_2 there is 1 mole of O atoms. Thus, 6.02×10^{23} atoms.	**13 D**	
4 C	Bases accept H^+ ions	**14 C**	
5 A		**15 C**	
6 B		**16 C**	Both are weak acids so neither will completely ionise. If X is stronger than Y then X will have a higher $[H^+]$ and a lower pH.
7 A	Mg reacts with acid and not base. NaOH neutralises acid with in an exothermic reaction.	**17 A**	Enzymes are proteins which are composed of amino acids.
8 B	$n(H_2SO_4) = (0.16 \times 0.036) / 2$ $[H_2SO_4] = [(0.16 \times 0.036) / 2] / 0.012 = 0.24M$	**18 A**	
9 D		**19 D**	
10 C		**20 B**	5 X 180 glucose units – (4 x 18) water for condensation reaction between glucose units.
		21 D	Purple MnO_4^- reduced to colourless Mn^{2+} while H_2O_2 oxidised to oxygen.

Section B

Question 1

a) 85.6 /12 : 14.4/1.1 => 7.13 : 14.3 ❶ => 1 : 2 Empirical Formula **CH_2** ❶

b) i) $n = pV / RT = \dfrac{1.10 \times 10^2 kPa \times 0.399}{8.31 \times 273} = 0.178$ mol ❶

$M_r = m / n = 1.00 / 0.017 = 56.3$ Accept range 56.0 – **56.3** ❶

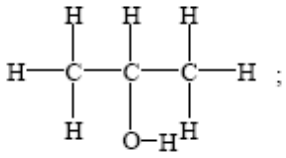
ii) 56.3 / 14 (mas of E/F unit CH_2) = 4 Molecular Formula C_4H_8

c) CO / C produced ❶
CO is toxic/ poisonous/ forms carboxy haemoglobin / interferes with oxygen transport. ❶ or
C (soot) is harmful to respiratory system

Question 2

(a) O—H **and** 3230 to 3550 cm^{-1};
C—O **and** 1000 to 1300 cm^{-1};
C—H **and** 2840 to 3095 cm^{-1}; ***[❶❶ max]***
*Award **[❶]** each for any two*.

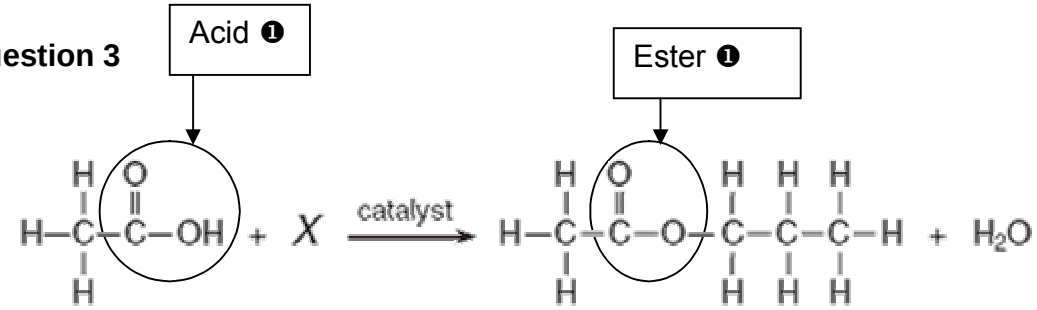
(b) four peaks; ❶ 3:2:2:1;❶

(c)  ❶

1H NMR identifies the number of hydrogen environments;
propan-2-ol has a different number of peaks / 3 peaks / 6:1:1 ratio; ❶❶
infrared spectroscopy shows the same functional groups / same absorptions / isomers have the same bonds; ❶

Question 3

a)



b) Propyl ethanoate ❶

Question 4

(a) i) fuel produced by biological processes / photosynthesis / living things / plants / ❶

ii) $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$; ❶❶
*Award **[1]** for formulas and **[1]** for correct balancing*.

(b)
(i) <u>Direct Combustion</u>

advantage
can obtain a large fraction of the energy available / more efficient / ease of use; ❶

disadvantage
may cause a lot of pollution / expensive to transport / cannot replace liquid fuels; ❶

(ii) Conversion to Ethanol

advantage
liquid fuel has more uses (*e.g.* motor vehicles) / burns more cleanly; ❶

disadvantage
less energy is available from ethanol than from raw plants / time needed for conversion; ❶

Do not accept both an advantage and a converse disadvantage.

Question 5

(a) the removal of hydrogen and oxygen in the (atomic) ratio 2 : 1 / removal of water from a compound / removal of H and OH from neighbouring carbon atoms / [illegible]
Do not accept removal of water.
concentrated sulfuric acid / concentrated phosphoric acid / hot Al_2O_3 / hot ceramic; ***[2]***

(b) $CH_3CH_2CH_2OH$;
$CH_3CH(OH)CH_3$;
1-propanol/propan-1-ol **and** 2-propanol/propan-2-ol;
Names must match formulas.
CH_3CHCH_2;
propene;

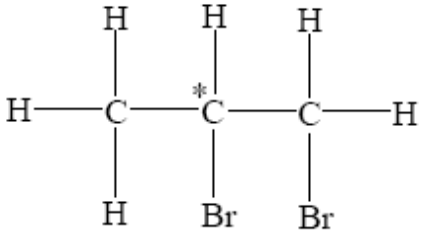
(c) (i)

C_3H_6	three peaks;
	relative areas 3:2:1;
C_3H_7OH	four peaks;
	relative areas 3:2:2:1;
OR	
propan-2-ol	three peaks;
	relative areas 6:1:1;

(ii) C_3H_7OH absorption at $3230-3550\ (cm^{-1})$ due to O—H /
at $1000-1300\ (cm^{-1})$ due to C—O;
C_3H_6 absorption at $1610-1680\ (cm^{-1})$ due to C==C;

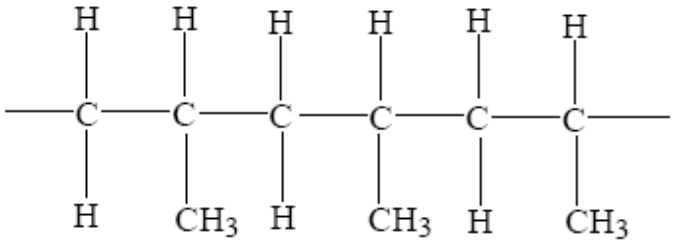
d)

$C_3H_6 + Br_2 \rightarrow C_3H_6Br_2$;
1,2-dibromopropane;
yellow/orange/brown/red colour of bromine disappears / bromine is decolorised; *[3]*
Do not allow "goes clear".

(ii)  / $CH_3C^*HBrCH_2Br$;

e)

addition polymerization;



CH_3 groups can be above or below the horizontal.

Question 6

a) $[H^+] = 2 \times 0.005M = 0.01M$ ❶

pH = -log (0.01) = 2 Indicator is **red**. ❶

b) $C_1 \times V_1 = C_2 \times V_2$

$0.005 \times 10 = C_2 \times 100$

$C_2 = 5 \times 10^{-4}$ M ❶

$[H^+] = 2 \times 5 \times 10^{-4} = 0.001M$

pH = -log (0.001) = 3 Indicator **Violet** ❶

c) $H_2SO_4(aq) + 2KOH(aq) \rightarrow K_2SO_4(aq) + 2H_2O(l)$

$n(H_2SO_4) = (5 \times 10^{-4}) \times 0.015 = 7.5 \times 10^{-6}$ mol ❶

$n(KOH) = 2 \times 7.5 \times 10^{-6}$ mol ❶

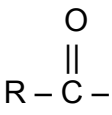
$[KOH] = [2 \times 7.5 \times 10^{-6}$ mol$] / 0.005 = 3.0 \times 10^{-3}$ L = **3.0ml** ❶

Question 7

(a) (i) the number of different hydrogen/proton environments / *OWTTE*; ***[1]***
(ii) the environment of proton / neighbouring group / *OWTTE*; ***[1]***
(iii) the ratio of the numbers of protons in each environment; ***[1]***

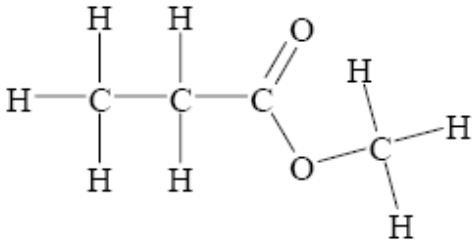
b)
0.9 ppm [H on C attached to a second C / alkyl group] R—CH_3 ❶
2.0 ppm H on C attached to carboxyl C / C of an ester / CH_3—CO—OR ❶

4.1 ppm H on C attached to O of carboxyl group / ester group /



❶

(c) *Structure* ***[2]***



Question 8

a) 60 ppm. (+/- 2) ❶

b) Cu standards need to be produced and their absorption measured to produce a new standard curve. ❶

Silver lamp in AA needs to be replaced with copper lamp. ❶