Chemistry HSC - 2006

Assessment Task 1 ID #:_____

Time Allowed: 45 minutes + 2 minutes reading time

- Write your answers in the spaces provided.
- The task is out of a total of 30 marks. The marks in brackets at the end of each question represent the value of that question.
- All diagrams must be drawn in pencil.
- All working should be shown where calculations are required. Marks will be allocated for appropriate working.

1. Around the lab you will find the models of 4 molecules labelled A-D.
Below the models is a key indicating what element each coloured ball used to build the models represents.

(a) Identify and name compounds A and B respectively (using IUPAC nomenclature). (2 marks)

A_____ B_____

(b) Write the molecular formula for compounds C and D respectively. (1 mark)

C_____ D_____

(c) Using full structural formulae, draw a diagram to model the process of polymerisation of compound D. Your diagram must include at least 3 monomer units. (2 marks)

(d) Describe the procedure you would use to dehydrate compound A. Support your answer with an equation written using full structural formulas to model the process. (2 marks)

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(e) Describe a simple chemical test that a student could carry out to distinguish between compounds B and C. Describe the observations that would allow the student to confirm that the test is valid. (4 marks)

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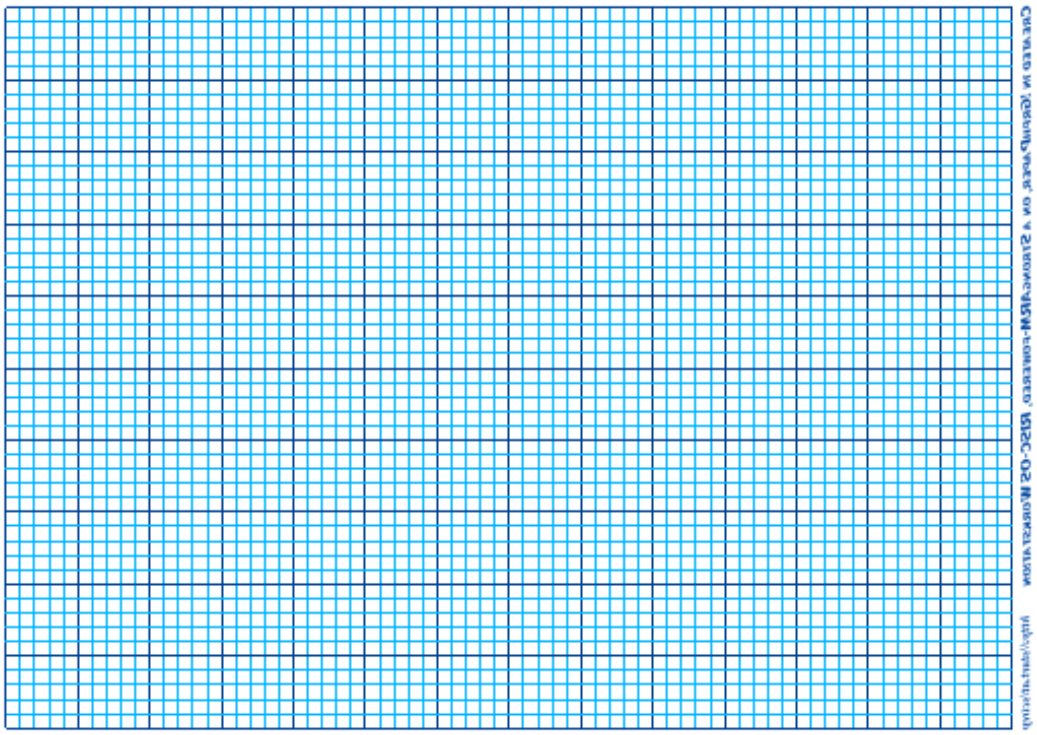
2. The table of data below relates to the heats of combustion of a variety of different alkanols.

Liquid Alkanol	Molar mass (g/mol)	Heat of Combustion (kJ/mol)
methanol		726
ethanol		1367
propanol	60	2021
butanol	74	
pentanol	88	3331
hexanol	102	3984
heptanol	116	4638
octanol	130	5294

(a) Complete the above table by calculating the missing molar masses and filling in the spaces in the molar mass column only. (1 mark)

(b) Plot a line graph of the heat of combustion versus molar mass using the above data. Place the independent variable on the **x** axis and the dependent variable on the **y** axis. Fully label the graph. (4 marks)



(c) Use the graph to estimate the heat of combustion of butanol. Complete the heat of combustion column of the table above by entering the value you interpolate. (1 mark)

(d) The following are the results a student obtained when heating 125.0 g of water with butanol as the fuel for 3 minutes.

Initial mass of burner and fuel = 135.0 g
Mass of burner and fuel after 3 minutes = 134.7 g
Initial temperature of water = 22°C
Final temperature of water = 34°C

(i) Calculate the heat of combustion of butanol in kJ/mol. (3 marks)

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(ii) Calculate the energy released per gram of butanol. (1 mark)

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(e) Account for the difference between the theoretical value and the value determined in the investigation above. (3 marks)

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3. A student carried out an experiment to monitor mass changes during the fermentation of glucose. An unknown mass of glucose was placed in a flask with water and yeast and left for a week. Over a period of 1 week the mass of the flask and contents decreased by 6.7 g.

(a) Write the equation for the fermentation of glucose. (1 mark)

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(b) Calculate the mass of glucose that must have undergone fermentation. (2 marks)

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(c) In carrying out this investigation the student also set up identical apparatus with glucose and water but no yeast. Explain the purpose of this. (2 marks)

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(d) Classify this procedure as destructive or non-destructive testing. (1 mark)

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KEY FOR MOLECULAR MODELS

BLACK = CARBON
WHITE = HYDROGEN
RED = OXYGEN
GREEN = BROMINE
PURPLE = CHLORINE

Marking Criteria

1. (a)

Criteria	Marks
Correctly names molecules A and B as 2-butanol and propene respectively (-0.5 each if the prefix 2- is missing for A OR the prefix 1- has been added for B)	2
Correctrly names either molecule A or B	1

1. (b)

Criteria	Marks
Correctly gives the molecular formula for molecules C and D as C_3H_8 and C_4H_7Cl	1
Correct molecular formula for either C or D	0.5

1. (c)

Criteria	Marks
Draws a segment of the polymer formed when 1-chloro-2-butene is polmerised by either an addition reaction or a codensation reaction.	2
Draws a segment of the polymer formed by the polymerisation of 1-chloro-2-butene but diagram does not show a full structural formula (H atoms may be missing for example or condensed structural formula is given)	1

1. (d)

Criteria	Marks
Outlines the conditions required to dehydrate 2-butanol (using a catalyst such as conc. sulfuric acid and heating the mixture to 180^{o}C) AND Represents the reaction by writing an equation using full structural formula, identifying the products as water and 1-butene (or 2-butene) (-0.5 marks if water is not written as a structural formula)	2
Either of the two points above	1

1. (e)

Criteria	Marks
A. <u>Describes a simple chemical test (such as the 'bromine water test) by</u> (1) outlining an appropriate method AND (2) indicating the variables that need to be controlled to ensure valid results are collected (eg. volume of alkane/alkene used, volume of bromine water added, presence/absence of UV light, shaking) AND B. <u>Describes the observations that would be made to deduce which of B and C is the alkane/alkene</u> (1) colours of all reagants before mixing (alkane and alkene both colourless; bromine water tan/yellow/reddish brown) (OR appropriate observations for the test described) AND (2) colours that will be seen after mixing that allow a deduction to be made	4
Any three of the above points OR A thorough description of the method used (see above) but observations are worded in general terms such as 'the alkene decolourises; the alkane stays the same'	3
Any two of the above points	2
Any one of the above points OR Describes a physical test that could be used to distinguish between an alkane and alkene	1

2. (a)

Criteria	Marks
Two correct values presented in the table (32; 46)	1
One correct value presented in the table	0.5

2. (b)

Criteria	Marks
Correct graph showing the following – Line of best fit Independent vatriable (Heat of combustion) on the vertical axis Axes correctly labelled with units Points plotted correctly and neatly Appropriate scale on axes Graph covering more than 2/3 of the graphing grid	4
Minus one mark for each point missing from the list above	1-3

2. (c)

Criteria	Marks
Correct value (derived from the graph) presented in the table	1

2. (d) (i)

Criteria	Marks
Calculations (with full working) given for the three significant steps – (1) amount of energy released by the 0.3 g of butanol (6270 J) (2) number of moles of butanol that was combusted (0.00405 mol) (3) heat of combustion (1546.6 kJ/mol) NOTE- half mark deducted if units given are incorrect	3
Two steps of the calculations correct	2
One step of the calulations correct	1

2. (d) (ii)

Criteria	Marks
Correct answer with calculations given (20.9 kJ/g)	1

2. (e)

Criteria	Marks
Three significant reasons given and explained . For example – heat is lost to heating the air around the apparatus; combustion of the fuel is incomplete; water radiates out heat it has absorbed. If the reason given is related to imprecise equipment, elaboration of the point had to be given (eg mass was measured to only 1 decimal place)	3
Two significant reasons given and explained	2
One significant reason given and explained	1

3. (a)

Criteria	Marks
Balanced equation including correct catalyst	1

3. (b)

Criteria	Marks
Correct and full working including moles of carbon dioxide, moles of glucose and mass of glucose	2
Correct calculations for one or two steps	1

3. (c)

Criteria	Marks
Identifies the purpose of this apparatus (ie. Is a CONTROL) AND Explains that this ensures that the method is VALID (as it confirms that the mass change is as a result of the actions of the yeast producing carbon dioxide which is released rather than due to other factors)	2
Identifies the purpose of the apparatus	1

3. (d)

Criteria	Marks
Identifies the procedure as destructuve testing	1