

Candidate Name	Centre Number	Candidate Number

WELSH JOINT EDUCATION COMMITTEE
 General Certificate of Education
 Advanced Subsidiary/Advanced



CYD-BWYLLGOR ADDYSG CYMRU
 Tystysgrif Addysg Gyffredinol
 Uwch Gyfrannol/Uwch

332/01

CHEMISTRY CH2

A.M. WEDNESDAY, 7 June 2006

(1 hour 30 minutes)

FOR EXAMINER'S USE ONLY		
Section	Question	Mark
A	1-8	
B	9	
	10	
	11	
	12	
TOTAL MARK		

ADDITIONAL MATERIALS

In addition to this examination paper, you will need a:

- calculator;
- copy of the **Periodic Table** supplied by WJEC. Refer to it for any **relative atomic masses** you require.

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Section A Answer **all** questions in the spaces provided.

Section B Answer **all** questions in the spaces provided.

Candidates are advised to allocate their time appropriately between **Section A (10 marks)** and **Section B (56 marks)**.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The maximum mark for this paper is 66.

Your answers must be relevant and must make full use of the information given to be awarded full marks for a question.

You are reminded that marking will take into account the Quality of Written Communication used in all written answers.

Page 16 may be used for rough work.

No certificate will be awarded to a candidate detected in any unfair practice during the examination.

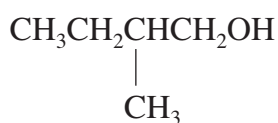
SECTION A

Answer **all** the questions in the spaces provided.

1. Name the main product formed by the addition of HBr to propene. [1]

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2. State which **one** of the following is the systematic name for the compound with the structure

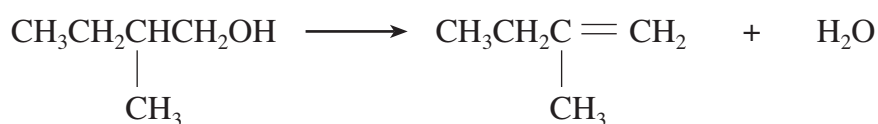


- A 2-hydroxybutane
B 3-methylbutan-4-ol
C 2-methylbutan-1-ol
D methylbutanoic acid

[1]

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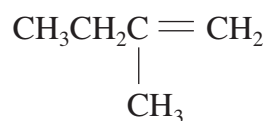
3. Classify the type of reaction occurring below.



[1]

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4. State, giving a reason, whether the compound with structure



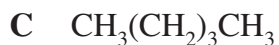
will exhibit geometric (cis/trans) isomerism.

[1]

.....

.....

5. State which **one** of the following compounds is **not** a structural isomer of the others.



[1]

6. Ammonia, NH_3 , can act as a *base*.

State in which **one** of the following reactions ammonia is acting as a base.



[1]

Ammonia is acting as a base in reaction

7. Explain the terms

(i) *homolytic bond fission*,

[1]

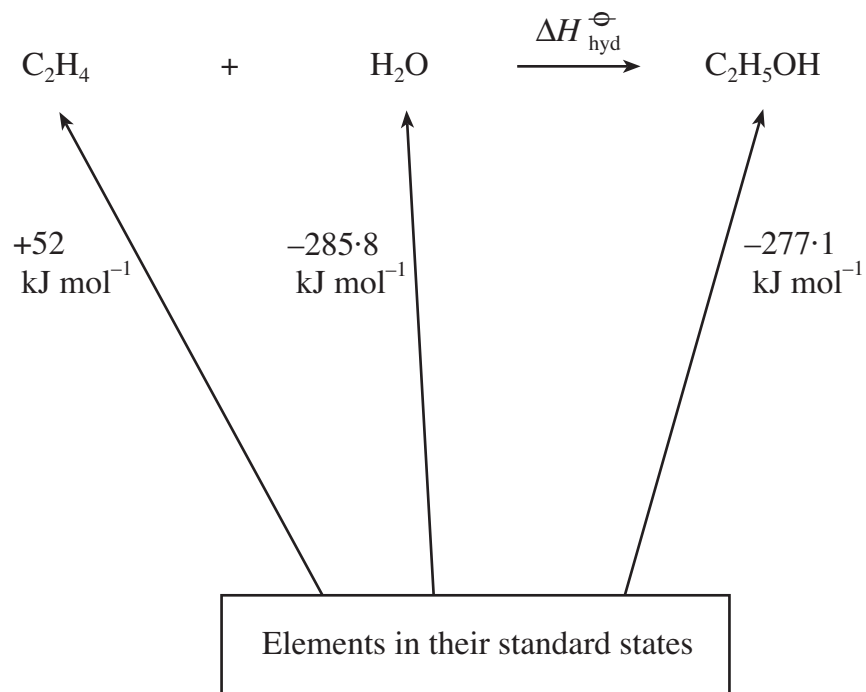
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(ii) *dynamic equilibrium*.

[1]

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.....

8. Use the values given in the enthalpy cycle below to calculate the enthalpy of hydration of ethene, $\Delta H_{\text{hyd}}^{\ominus}$, in kJ mol^{-1} . [2]



Section A Total [10]

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SECTION B

Answer **all** the questions in the spaces provided.

9. (a) Discuss the effect of increasing the temperature on the rate of a chemical reaction. Your answer, with diagrams where appropriate, should include consideration of the effect of temperature change on the following:

- activation energy;
- energy distributions;
- frequency of collisions.

[4]

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- (b) The reaction



is thought to proceed by the collision of two HI molecules:



- (i) State the equation which relates enthalpy change of a reaction (ΔH^\ominus) to the activation energy of the forward reaction (E_f) and the activation energy of the reverse reaction (E_b). [1]

.....

- (ii) Complete the following table, which lists some properties of the above reaction, by inserting each of the three values given in its appropriate box. [2]

Values: $+59 \text{ kJ mol}^{-1}$, $+175 \text{ kJ mol}^{-1}$, $+185 \text{ kJ mol}^{-1}$

<i>Quantity</i>	<i>Value / kJ mol⁻¹</i>
activation energy, E_f , of forward reaction	
activation energy, E_b , of reverse reaction	
enthalpy change of reaction, ΔH^\ominus	+10
activation energy, E_f , of forward reaction in the presence of platinum metal catalyst	

- (c) Platinum metal acts as a **heterogeneous catalyst** for the reaction in (b). Explain the meaning of each of the terms **heterogeneous** and **catalyst**:

heterogeneous;

..... [1]

catalyst.

..... [1]

- (d) Platinum can also act as a heterogeneous catalyst for the hydrogenation of ethene. Write a balanced equation to show the hydrogenation of ethene. [1]

.....

- (e) Describe the structure of and bonding in ethene. [3]

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.....
.....

Total [13]

Turn over.

10. Propanoic acid, $\text{C}_2\text{H}_5\text{COOH}$, is used as a preservative in both animal feed and human food products. In dilute aqueous solution it is a weak acid, dissociating according to the equation



- (a) (i) Write an expression for the acid dissociation constant, K_a , of propanoic acid and give the units for K_a . [2]

$$K_a =$$

Units

- (ii) Explain the terms *weak* and *dilute* as applied to acid solutions. [2]

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- (b) Give one chemical test which could be used to confirm the presence of a carboxylic acid group, $-\text{COOH}$, in propanoic acid. Your answer should include all reagents and observations. [2]

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- (c) Propanoic acid can be prepared by the oxidation of the primary alcohol, propan-1-ol, $\text{C}_2\text{H}_5\text{CH}_2\text{OH}$. State an oxidising agent and reaction conditions which could be used to carry out this preparation. [2]

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- (d) The oxidation of propan-1-ol can, under different conditions, produce another product, compound **P**, which also contains three carbon atoms per molecule and has the composition 62.0% carbon, 27.6% oxygen and 10.4% hydrogen by mass. Determine the molecular formula of compound **P**. [2]
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-
-

- (e) A sample of propanoic acid was dissolved in water and titrated against aqueous sodium hydroxide solution of concentration $0.125 \text{ mol dm}^{-3}$.



The sample of propanoic acid required 45.0 cm^3 of the sodium hydroxide solution for complete reaction.

- (i) Calculate the number of moles of sodium hydroxide used in the titration. [1]
-
-
- (ii) State the number of moles of propanoic acid present in the sample. [1]
-
- (iii) Calculate the mass of propanoic acid in the sample. [1]
-
-
- (f) Giving a reason, state whether the pH of propanoic acid solution will be higher or lower than the pH of pure water. [1]
-
-

Total [14]

11. The following table shows the standard enthalpies of formation, ΔH_f^\ominus for the series of gaseous straight-chain alkanes of general formula C_nH_{2n+2} .

<i>Alkane</i>	<i>Number of C atoms</i>	$\Delta H_f^\ominus / \text{kJ mol}^{-1}$
ethane	2	-84
propane	3	-105
butane	4	-126
pentane	5	-147
hexane	6	-168
heptane	7	

- (a) (i) Complete the above table by using the values given to predict the ΔH_f^\ominus value for heptane. [1]

- (ii) Give a reason why ΔH_f^\ominus changes by a fixed amount for each step in ascending the alkane series. [1]

.....

- (iii) I Using the appropriate ΔH_f^\ominus values from the table, and given that $\Delta H_f^\ominus C_2H_4(g) = + 52 \text{ kJ mol}^{-1}$, calculate the enthalpy change, ΔH^\ominus , for the reaction [2]



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- II Giving your reasons, predict the enthalpy change for the reaction [2]



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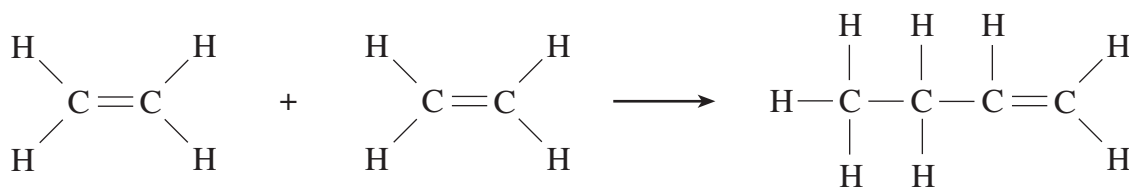
(iv) Name the industrial process in which the two reactions in (a)(iii) might occur.

[1]

(b) The following table gives some average bond enthalpy values.

Bond	Average Bond Enthalpy / kJ mol ⁻¹
C — C	347
C = C	612
C — H	413

(i) Use the table to calculate the enthalpy change, ΔH^\ominus , for the possible gaseous reaction



[2]

(ii) Ethene molecules can react to form the polymer poly(ethene), $\text{-(CH}_2\text{-CH}_2\text{)}_n\text{-}$.

I Classify the type of polymerisation reaction involved.

[1]

II Given that the polymerisation of ethene involves the replacement of each $\text{C} = \text{C}$ by two $\text{C} - \text{C}$ bonds, state giving your reasons, whether the polymerisation of ethene to form polythene will be exothermic or endothermic.

[2]

- (iii) State the conditions of temperature and pressure used in the industrial polymerisation of ethene to form low density poly(ethene). [1]

Temperature Pressure

- (iv) The industrial polymerisation requires the presence of a *free radical initiator*.

I Explain the term *free radical*. [1]

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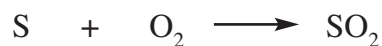
II Name a free radical initiator used in the industrial polymerisation. [1]

.....

Total [15]

12. One of the main contributors to acid rain pollution is sulphur dioxide gas, SO_2 .

(a) This gas is formed when sulphur burns in oxygen or air.



Give **one** process which makes a major contribution to the formation of atmospheric sulphur dioxide, SO_2 , from sulphur. [1]

.....

(b) The sulphur dioxide can then react with oxygen.



(i) Write an expression for the equilibrium constant in terms of pressure, K_p , for this reaction. [1]

(ii) Giving your reasons, state whether the equilibrium amount of $\text{SO}_2(\text{g})$ will increase, decrease or stay the same

I on raising the temperature, [2]

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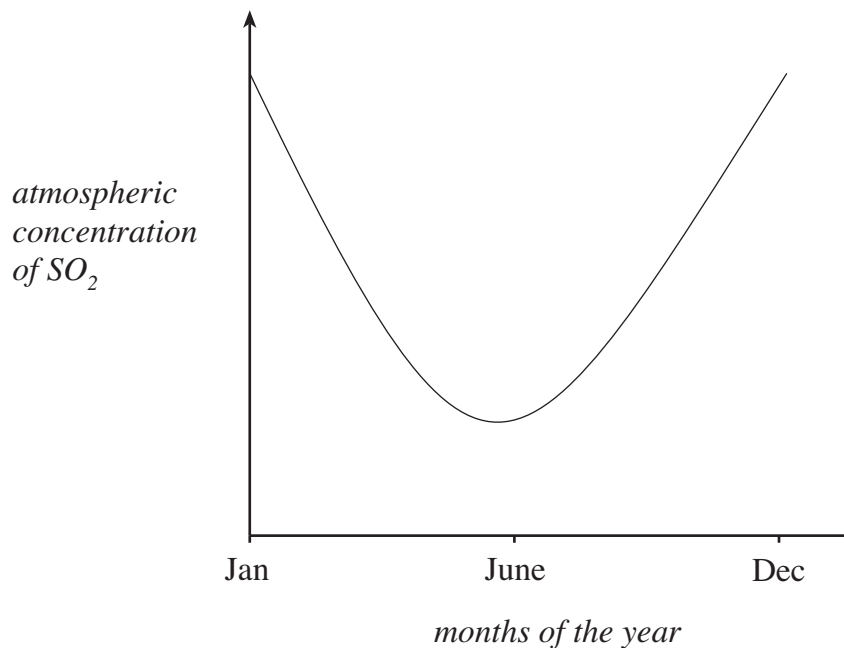
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II on increasing the pressure at constant temperature. [2]

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.....

- (c) During a typical year in the northern hemisphere, the concentration of SO_2 in the atmosphere varies as follows.



- (i) Give one reason why the level of atmospheric SO_2 is greater in winter than in summer. [1]

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- (ii) Sulphur oxides, SO_2 and SO_3 , are removed from the atmosphere by dissolving in rainwater. Why is this rain acidic? [1]

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- (d) State **two** problems which are caused by acid rain. [2]

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(e) An important industrial process uses the same reactions as (a) and (b).

(i) Name the process. [1]

.....

(ii) State the chemical manufactured by the process. [1]

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(iii) Outline the conditions used in the industrial process to carry out the reaction given in (b). [2]

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Total [14]

Section B Total [56]

Rough Work

A series of horizontal dotted lines for rough work.