Candidate Name	Centre Number	Candidate Number

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

WJEC CBAC

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

FOR EXAMINER'S USE ONLY		
Section	Question	Mark
A	1-7	
B	8	
	9	
	10	
	11	
TOTAL MARK		

332/01

CHEMISTRY CH2

A.M. WEDNESDAY, 6 June 2007

(1 hour 30 minutes)

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.

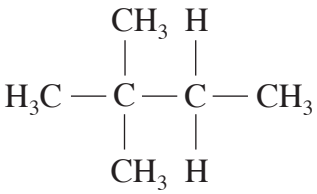
Page 12 may be used for rough work.

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. Give the systematic name for the compound with the following structure.



[1]

.....

2. *(a)* Explain what is meant by the term ***nucleophile***. [1]

.....

.....

(b) Give an example of a nucleophile. [1]

.....

3. Octane, C_8H_{18}, is used as a fuel. Write a balanced equation for its complete combustion. [1]

.....

4. For the equilibrium

$$CO(g) + 3H_2(g) \rightleftharpoons CH_4(g) + H_2O(g) \qquad \Delta H^{\ominus} = -207 \text{ kJ mol}^{-1}$$

(i) write an expression for the equilibrium constant, K_p, in terms of partial pressures, [1]

(ii) give **one** method for following the kinetics of this reaction, [1]

.....

.....

(iii) state, giving a reason, which of the forward and reverse activation energies is the larger. [1]

.....

.....

5. Define the term ***standard molar enthalpy change of formation***, $\Delta H_f^{\ominus}$. [1]

.....

.....

6. State which **one** of the following statements about the use of a catalyst in an equilibrium reaction is correct.

A A catalyst can change the value of the equilibrium constant.

B A catalyst increases the rate of the forward reaction only.

C Equilibrium is reached faster with a catalyst.

D The position of equilibrium can be changed by a catalyst. [1]

.....

7. Give an example of a **homogeneous** catalyst and the process in which it is used. [1]

.....

Section A Total [10]

SECTION B

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

8. Ammonia is manufactured by the Haber process.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H^{\ominus} = -92 \text{ kJ mol}^{-1}$$

(a) State the source of the nitrogen used in the process. [1]

.....

(b) Use Le Chatelier's principle to explain what happens to the equilibrium yield of ammonia as

(i) the temperature is increased, [2]

.....

.....

.....

(ii) the total pressure is increased. [2]

.....

.....

.....

(c) State and explain what happens to the rate of the reaction as

(i) the temperature is increased, [1]

.....

.....

.....

(ii) the total pressure is increased. [1]

.....

.....

.....

(d) The conditions often used in the Haber process are a temperature of 400°C, a pressure of 200 atmospheres and a suitable catalyst.

(i) Explain why these conditions are chosen. [3]

.....

.....

.....

.....

.....

.....

(ii) Name the catalyst used in this process. [1]

.....

(iii) Under these conditions, there is only a 15% yield of ammonia. State what happens to any unreacted nitrogen and hydrogen. [1]

.....

.....

(e) Much of the ammonia produced is used to make fertilisers.

In the manufacture of the fertiliser ammonium nitrate, nitric acid was reacted with 500 kg of ammonia according to the following equation.

$$NH_3 + HNO_3 \longrightarrow NH_4NO_3$$

(i) Calculate the number of moles of ammonia used in the reaction. [1]

.....

.....

.....

(ii) If all the ammonia used is converted to ammonium nitrate, calculate the mass of ammonium nitrate produced. [1]

.....

.....

.....

Total [14]

9. Acids can be classified as strong or weak. Nitric acid, HNO_3, is a strong acid while ethanoic acid, CH_3COOH, is a weak acid, which dissociates in water according to the following equation.

$$CH_3COOH(aq) \rightleftharpoons CH_3COO^-(aq) + H^+(aq)$$

(a) Write an expression for the acid dissociation constant, K_a, of ethanoic acid and give the unit. [2]

Unit .....

(b) Explain the meaning of the term ***strong*** as applied to an acid. [1]

.....

.....

(c) Write the **ionic** equation for the neutralisation of acid with alkali, showing state symbols. [1]

.....

(d) In a neutralisation experiment, $50{\cdot}0\,cm^3$ of aqueous sodium hydroxide solution of concentration $0{\cdot}500\,mol\,dm^{-3}$ were added to $50{\cdot}0\,cm^3$ of aqueous nitric acid solution of concentration $0{\cdot}500\,mol\,dm^{-3}$ in a calorimeter. The initial temperature of the solutions was 18·0 °C and the temperature rose to 21·4 °C.
Assuming that the specific heat capacity of all the solutions is $4{\cdot}18\,J\,g^{-1}K^{-1}$ and that $1\,cm^3$ of solution has a mass of 1 g, calculate

(i) the number of moles of acid used, [1]

.....

.....

(ii) the heat evolved in the experiment, in joules, [2]

.....

.....

.....

(iii) the enthalpy change of neutralisation for this reaction, in kilojoules per mole. [2]

.....

.....

.....

(e) State why the enthalpy change of neutralisation using hydrochloric acid is the same as that of nitric acid, yet the enthalpy change of neutralisation using ethanoic acid is different. [1]

.....

.....

(f) (i) State Hess's Law. [1]

.....

.....

(ii) Explain why Hess's Law follows from the principle of conservation of energy. [1]

.....

.....

.....

(g) Use the standard enthalpy change of formation values, $\Delta H_f^{\ominus}$, given in the table below to calculate the standard enthalpy change, $\Delta H^{\ominus}$, for the following reaction.

$$2N_2(g) + 2H_2O(g) + 5O_2(g) \longrightarrow 4HNO_3(l)$$ [2]

Species	$\Delta H_f^{\ominus}$ / kJ mol^{-1}
$N_2(g)$	0
$H_2O(g)$	– 242
$O_2(g)$	0
$HNO_3(l)$	– 176

.....

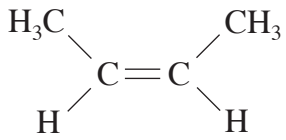
.....

.....

Total [14]

Turn over.

10. *(a)* A mixture of alkenes with formula C_4H_8 was obtained from the cracking of fuel oil. One of the alkenes present, **X**, had the following structure.



(i) Explain what is meant by the term ***cracking***. [1]

.....

.....

(ii) Draw the structures for **two other** isomers of C_4H_8. [2]

Isomer 1 Isomer 2

(iii) Name the compound that forms when **X** reacts with bromine and classify the reaction type. [2]

Name of compound .....

Reaction type .....

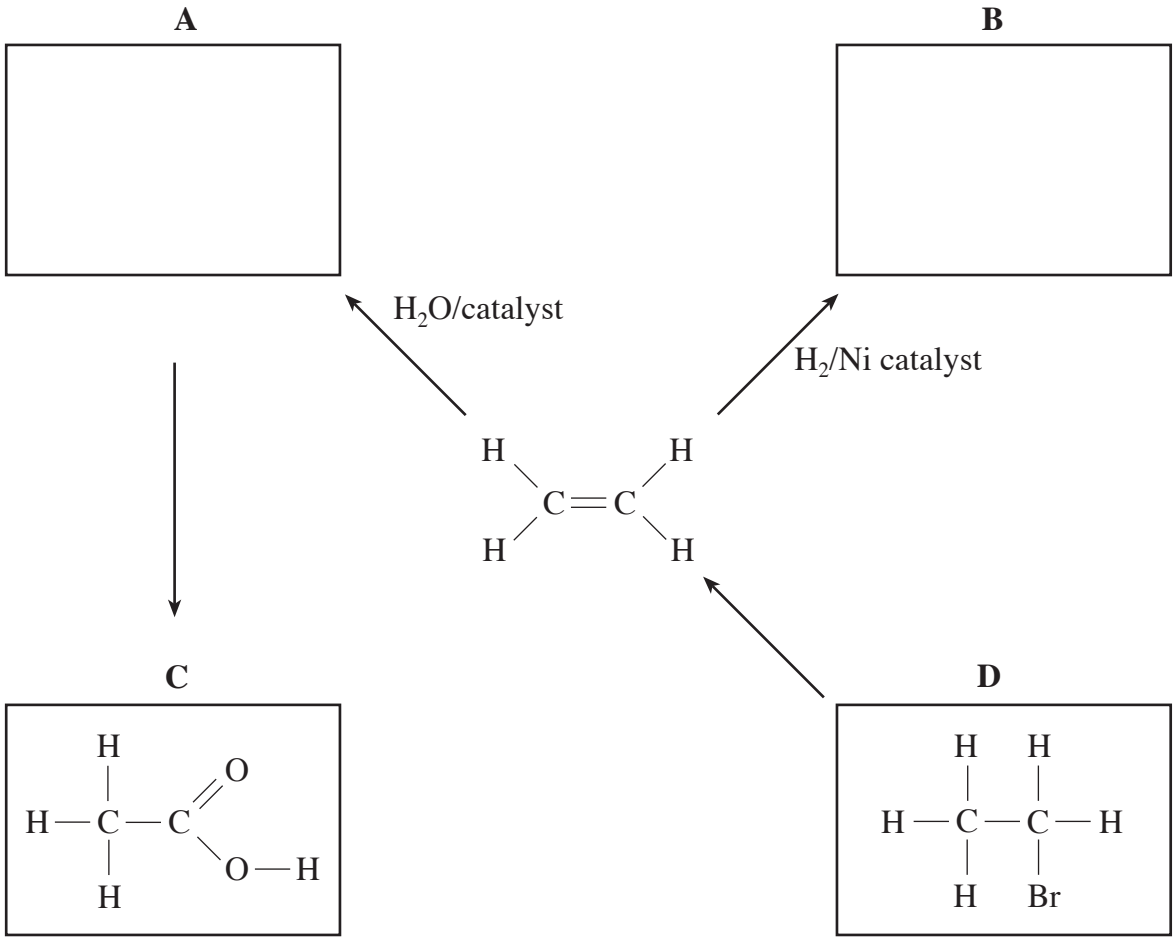
(b) The simplest alkene is ethene, C_2H_4. Explain why C_2H_4 has a lower boiling temperature than C_4H_8. [2]

.....

.....

.....

(c) Ethene can be used to produce many useful compounds. Study the reaction scheme shown below and then answer the following questions.



(i) Draw the structure of compounds **A** and **B** in the appropriate boxes. [2]

(ii) Name the reagents and condition(s) necessary to convert compound **A** to compound **C**. [2]

.....

.....

(iii) Classify the type of reaction taking place when ethene is formed from compound **D**. [1]

.....

(d) Ethene can be polymerised to give the polymer, poly(ethene). Substituted alkenes can also be polymerised to give useful polymers.

Give the names of **two** important polymers of substituted alkenes. [2]

..... and .....

Total [14]

11. *(a)* Petroleum (crude oil) is one of the major raw materials of the organic chemical industry. It is a mixture of compounds, mainly from the homologous series of alkanes. Some of these alkanes are structural isomers of one another. Alkanes are saturated hydrocarbons whose chemistry is restricted to combustion and substitution reactions.

Explain, using **alkanes** as examples, the following terms:

(i) homologous series; [3]

.....

.....

.....

.....

(ii) structural isomers; [3]

.....

.....

.....

(iii) substitution reaction. [2]

.....

.....

.....

(b) The mean temperature of the Earth is fixed by a steady-state balance between the energy received from the Sun and an equal quantity of heat energy radiated back into space. One mechanism for regulating the Earth's temperature is the greenhouse effect. However, there is concern that build-up of certain gases is causing an enhanced greenhouse effect.

Describe the role of carbon dioxide as a greenhouse gas. Your answer should include the following:

- why there is a build-up of carbon dioxide in the atmosphere;
- how carbon dioxide acts as a greenhouse gas;
- problems caused as a consequence of an enhanced greenhouse effect;
- steps necessary to reduce the build-up of carbon dioxide in the atmosphere. [6]

.....

.....

.....

.....

.....

.....

.....

.....

.....

Total [14]

Section B Total [56]

Rough Work