



**CHEMISTRY**  
**STANDARD LEVEL**  
**PAPER 3**

Friday 19 May 2006 (morning)

1 hour

Candidate session number

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**INSTRUCTIONS TO CANDIDATES**

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from two of the Options in the spaces provided. You may continue your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper using the tag provided.
- At the end of the examination, indicate the letters of the Options answered in the candidate box on your cover sheet and indicate the number of answer sheets used in the appropriate box on your cover sheet.



**Option A – Higher physical organic chemistry**

- A1.** Identify **one** analytical technique, different in each case, which can be used to obtain the following information about a molecule. [2]

Information	Analytical technique
Number of different hydrogen environments	
Types of functional group	
Molecular mass	

- A2.** The infrared spectra of propanoic acid and methyl ethanoate contain absorptions in characteristic wavenumber ranges. Using Table 18 in the Data Booklet, identify:

- (a) **two** wavenumber ranges common to both compounds. [1]

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- (b) **one** wavenumber range found only in the spectrum of one compound. [1]

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**A3.** (a) Write equations to show the mechanisms of the following reactions. In each case, show the structure of the intermediate and organic product, and use curly arrows to show the movement of electron pairs.

(i) the reaction between KOH and  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$ . [3]

(ii) the reaction between KOH and  $(\text{CH}_3)_3\text{CCl}$ . [2]

(b) Predict the rate expressions for the [2]

reaction in (a)(i):

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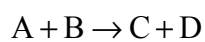
reaction in (a)(ii):

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(c) Values of average bond enthalpy appear in Table 10 of the Data Booklet. Explain, with reference to these values, whether the reaction between KOH and  $(\text{CH}_3)_3\text{CBr}$  would be slower or faster than the reaction in part (a)(ii). [1]

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**A4.** The reaction between two substances A and B

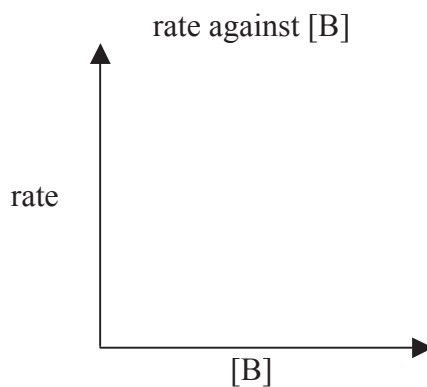
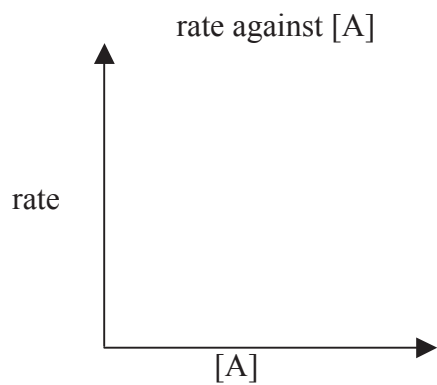
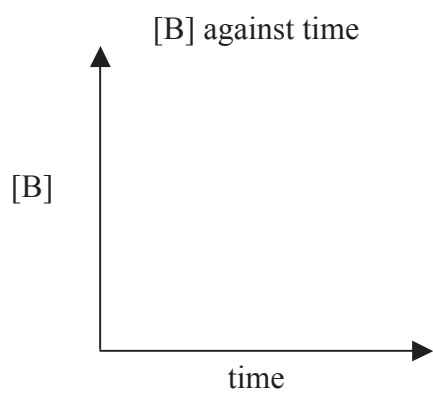
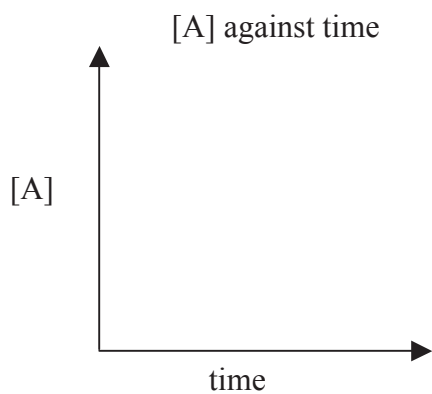


has the following rate expression:

$$\text{rate} = k [B]$$

Draw the graphical representation of:

[3]



**A5.** (a) (i) Write the equation for the reaction of ammonia with water. [1]

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(ii) Derive the expression for  $K_b$  for this reaction. [1]

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(b) Using information from Table 16 in the Data Booklet, determine the pOH of a  $0.20 \text{ mol dm}^{-3}$  solution of ammonia. [3]

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**Option B – Medicines and drugs**

**B1.** (a) Describe the likely effect of a depressant taken in: [1]

a moderate dose. ....

a high dose. ....

(b) Ethanol in breath can be detected using a breathalyser containing potassium dichromate(VI) crystals. Describe the colour change that occurs in a positive test and identify the species responsible for the final colour. [2]

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- B2.** (a) State the name of the class of drugs with effects similar to that of adrenaline. Outline **one** effect of these drugs on humans. [2]

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- (b) (i) Identify the stimulant responsible for addiction to smoking tobacco. [1]

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- (ii) Describe **two** short-term effects of smoking tobacco. [2]

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- (iii) Describe **two** long-term effects of smoking tobacco, other than addiction. [2]

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**B3.** (a) Outline how penicillins work as antibacterials. [1]

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(b) Compare *broad-spectrum* and *narrow-spectrum* antibiotics. [1]

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(c) Discuss the problem of overprescription of penicillins. [2]

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**B4.** (a) State **two** differences between viruses and bacteria. [2]

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(b) Suggest how acyclovir acts as an antiviral drug. [2]

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(c) Describe **two** ways in which an antiviral drug can prevent the HIV virus from interacting with human cells. [2]

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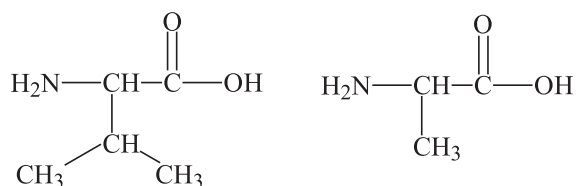
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**Option C – Human biochemistry**

- C1.** (a) (i) Deduce the structure of **one** of the dipeptides that can be formed when the two aminoacids below react together. [2]



- (ii) State the name given to this type of reaction and identify the other product of the reaction. [2]

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- (b) Describe how a mixture of aminoacids can be analysed using electrophoresis. [4]

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*(This question continues on the following page)*

*(Question C1 continued)*

- (c) (i) Explain what is meant by the primary structure of proteins. [1]

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- (ii) Explain, with reference to hydrogen bonding, why the  $\alpha$ -helix and  $\beta$ -sheet secondary structures of proteins are different. [2]

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- (iii) Identify **three** types of interactions responsible for the tertiary structure of proteins. [2]

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**C2.** (a) The formula of oleic acid is  $\text{CH}_3(\text{CH}_2)_7\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$ . Using R to represent  $\text{CH}_3(\text{CH}_2)_7\text{CH}=\text{CH}(\text{CH}_2)_7$ , show the structure of the triglyceride formed from this acid. [1]

(b) Explain why some triglycerides that are liquid at room temperature become solids when they are completely hydrogenated. [3]

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**C3.** The structures of vitamins A and C are shown in Table 22 of the Data Booklet. State, with a reason, whether each is fat soluble or water soluble. [3]

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**Option D – Environmental chemistry**

**D1.** Carbon monoxide and sulfur oxides are air pollutants. For each one

- identify a major human activity responsible for its formation.
- write an equation showing its formation.
- describe **one** harmful effect on human health.
- describe **one** method of decreasing its formation, other than by using alternatives to fossil fuel.

[8]

Carbon monoxide

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Sulfur oxides

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- D2.** (a) (i) Only a small part of the Earth’s supply of fresh water is used for domestic purposes. State the **two** main uses of fresh water. [1]

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- (ii) Identify the **two** locations that hold most of the Earth’s water. [2]

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- (b) (i) Outline how ion exchange is used to obtain fresh water from sea water. [4]

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- (ii) Discuss **one** advantage and **one** disadvantage of this method over simple distillation. [2]

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- (c) Explain what is meant by the term *biological oxygen demand (BOD)*. Compare the values of BOD for water that is pure and water that contains organic waste. [3]

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**Option E – Chemical industries**

- E1.** List **three** factors that should be taken into account before establishing a chemical industry in a particular location. [2]

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- E2. (a)** State **one** source of iron used in industry, other than iron ores. [1]

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- (b) Identify **one** ore of iron and **two** other raw materials needed to produce iron in the blast furnace. [3]

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- (c) (i) Explain why iron from the blast furnace is not as suitable as steel for making many objects. [2]

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- (ii) Outline how iron from the blast furnace is converted to steel. [1]

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**E3.** (a) Explain why aluminum resists corrosion better than iron. [3]

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(b) Explain why aluminum is more suitable than iron in aircraft manufacture. [1]

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- E4.** (a) State the most important use of petroleum, other than as a fuel. [1]

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- (b) Explain why sulfur is removed from most petroleum fractions before use. [2]

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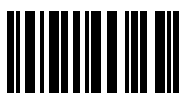
- (c) Compare hydrocracking and steam cracking by referring to the conditions and types of products obtained in each process. [4]

hydrocracking:

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steam cracking:

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**Option F – Fuels and energy**

**F1.** (a) State **two** desirable characteristics of energy sources. [2]

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(b) For each of the following energy sources, outline **one** reason why it is not widely used at present. [2]

(i) Nuclear fusion

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(ii) Tidal energy

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- F2.** (a) State the name of the process in which green plants convert solar energy into biomass. [1]

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- (b) Give the equation that represents the process in (a). Identify the necessary condition and the substance that catalyses the reaction. [2]

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- (c) Discuss **two** advantages and **two** disadvantages of the conversion of biomass into ethanol. [4]

advantages .....

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disadvantages .....

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- (d) Give the equation for the conversion of glucose to ethanol. [1]

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- F3.** A company is designing an automobile that is powered by photovoltaic cells instead of by the combustion of gasoline (petrol).

Discuss **three** advantages and **three** disadvantages of using photovoltaic cells in this case. [6]

advantages .....

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disadvantages .....

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- F4.** One reaction that occurs in a lead-acid battery involves the conversion of  $\text{PbO}_2$  into  $\text{PbSO}_4$ . Write a half-equation for this reaction.

Identify, giving a reason, whether this reaction occurs at the negative or positive electrode. [2]

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