Practice Question Set For A-Level
**Subject : Chemistry**
**Paper-2 Topic: Rate Equations**

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**Name of the Student**:_____
**Max. Marks : 23 Marks** **Time : 23 Minutes**

Q1.

(a) Compound **A**, $HCOOCH_2CH_2CH_3$, is an ester. Name this ester and write an equation for its reaction with aqueous sodium hydroxide.

*Name* _____

*Equation* _____

**(2)**

(b) The initial rate of reaction between ester **A** and aqueous sodium hydroxide was measured in a series of experiments at a constant temperature. The data obtained are shown below.

| Experiment | Initial concentration of NaOH / mol $dm^{-3}$ | Initial concentration of **A** / mol $dm^{-3}$ | Initial rate / mol $dm^{-3}$ $s^{-1}$ |
|---|---|---|---|
| 1 | 0.040 | 0.030 | $4.0 \times 10^{-4}$ |
| 2 | 0.040 | 0.045 | $6.0 \times 10^{-4}$ |
| 3 | 0.060 | 0.045 | $9.0 \times 10^{-4}$ |
| 4 | 0.120 | 0.060 | to be calculated |

Use the data in the table to deduce the order of reaction with respect to **A** and the order of reaction with respect to NaOH. Hence calculate the initial rate of reaction in Experiment 4.

*Order with respect to **A*** _____

*Order with respect to NaOH* _____

*Initial rate in Experiment 4* _____

_____

**(3)**

(c) In a further experiment at a different temperature, the initial rate of reaction was found to be $9.0 \times 10^{-3}$ mol $dm^{-3}$ $s^{-1}$ when the initial concentration of **A** was 0.020 mol $dm^{-3}$ and the initial concentration of NaOH was 2.00 mol $dm^{-3}$.
Under these new conditions with the much higher concentration of sodium hydroxide, the reaction is first order with respect to **A** and appears to be zero order with respect to sodium hydroxide.

(i) Write a rate equation for the reaction under these new conditions.

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(ii) Calculate a value for the rate constant under these new conditions and state its units.

*Calculation* _____

_____

_____

Units _____

(iii) Suggest why the order of reaction with respect to sodium hydroxide appears to be zero under these new conditions.

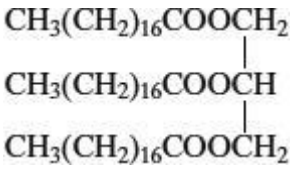
_____

_____

_____

**(6)**

(d) A naturally-occurring triester, shown below, was heated under reflux with an excess of aqueous sodium hydroxide and the mixture produced was then distilled. One of the products distilled off and the other was left in the distillation flask.



(i) Draw the structure of the product distilled off and give its name.

*Structure*

*Name* _____

(ii) Give the formula of the product left in the distillation flask and give a use for it.

*Formula* _____

*Use* _____

**(4)**

**(Total 15 marks)**

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Q2.

(a) The following table shows the results of three experiments carried out at the same temperature to investigate the rate of the reaction between compounds **P** and **Q**.

| | Experiment 1 | Experiment 2 | Experiment 3 |
|---|---|---|---|
| Initial concentration of **P**/mol $dm^{-3}$ | 0.50 | 0.25 | 0.25 |
| Initial concentration of **Q**/mol $dm^{-3}$ | 0.36 | 0.36 | 0.72 |
| Initial rate/mol $dm^{-3}$ $s^{-1}$ | $7.6 \times 10^{-3}$ | $1.9 \times 10^{-3}$ | $3.8 \times 10^{-3}$ |

Use the data in the table to deduce the order with respect to **P** and the order with respect to **Q**.

*Order with respect to **P*** _____

*Order with respect to **Q*** _____

**(2)**

(b) In a reaction between **R** and **S**, the order of reaction with respect to **R** is one, the order of reaction with respect to **S** is two and the rate constant at temperature $T_1$ has a value of $4.2 \times 10^{-4}$ $mol^{-2}$ $dm^6$ $s^{-1}$.

(i) Write a rate equation for the reaction. Calculate a value for the initial rate of reaction when the initial concentration of **R** is 0.16 mol $dm^{-3}$ and that of **S** is 0.84 mol $dm^{-3}$.

*Rate equation* _____

*Calculation* _____

(ii) In a second experiment performed at a different temperature, $T_2$, the initial rate of reaction is $8.1 \times 10^{-5}$ mol $dm^{-3}s^{-1}$ when the initial concentration of **R** is 0.76 mol $dm^{-3}$ and that of **S** is 0.98 mol $dm^{-3}$. Calculate the value of the rate constant at temperature $T_2$.

_____

_____

_____

(iii) Deduce which of $T_1$ and $T_2$ is the higher temperature.

_____

**(6)**

**(Total 8 marks)**

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