

Name of the Student: _____

Max. Marks : 21 Marks

Time : 21 Minutes

Q1.

This question is about fuels.

- (a) Crude oil is separated into fractions by fractional distillation.

State the meaning of the term 'fraction' in this context.

(1)

- (b) Petrol for cars contains branched and cyclic alkanes produced by catalytic cracking.

Identify the catalyst used in this process.

(1)

- (c) 3-Ethyl-4-methylhexane is a branched alkane in petrol.

Draw the skeletal formula of this alkane.

(1)

- (d) Give the equation for the complete combustion of 3-ethyl-4-methylhexane.
Use the molecular formula for 3-ethyl-4-methylhexane in your equation.

(2)

- (e) Carbon dioxide is a product from the combustion of petrol in cars. Carbon dioxide acts as a greenhouse gas when it absorbs infrared radiation.

Give **one** reason why carbon dioxide absorbs infrared radiation.

(1)

- (f) Nitrogen monoxide (NO) is formed when petrol is burned in cars.

State **one** environmental problem that NO causes.

State what is used to remove NO from the exhaust gases formed in petrol-fuelled cars.

Environmental problem _____

Removal of NO _____

(2)

- (g) Petrol sold in the UK contains 10% bioethanol. Bioethanol is ethanol made from crops by fermentation and is considered to be carbon-neutral.

State what is meant by the term 'carbon-neutral'.

(1)

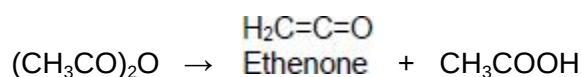
(Total 9 marks)

Q2.

This question is about ethanoic anhydride.

In the gas phase, ethanoic anhydride $(\text{CH}_3\text{CO})_2\text{O}$ decomposes to form ethenone.

The equation is

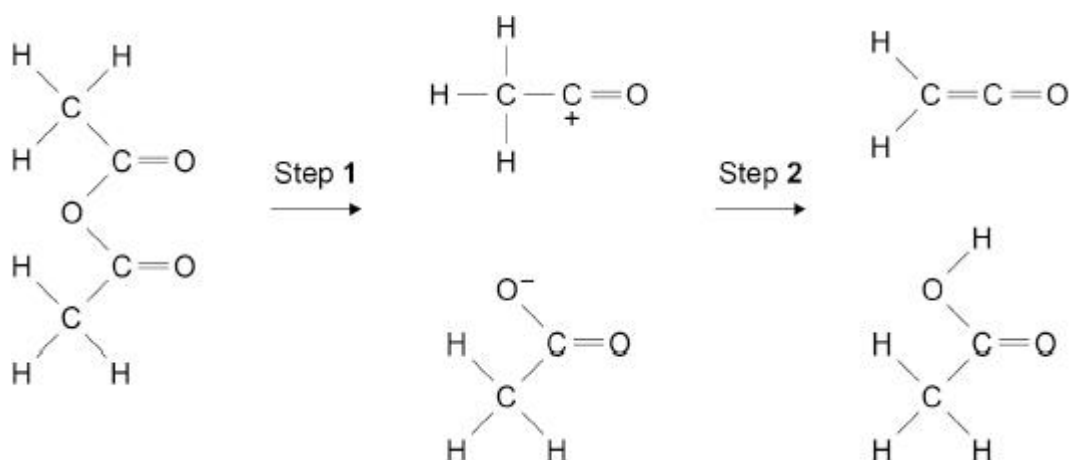


- (a) Ethenone is the simplest member of the ketene homologous series. Ketenes all contain one $\text{C}=\text{C}$ double bond and one $\text{C}=\text{O}$ double bond.

Deduce the general formula for the ketene homologous series.

(1)

- (b) The figure below shows an incomplete suggested mechanism for the decomposition of ethanoic anhydride.



Complete the mechanism in the figure above by adding three curly arrows and any relevant lone pairs of electrons.

(3)

- (c) For a chemical reaction the relationship between the rate constant, k , and the temperature, T , is shown by the Arrhenius equation.

$$k = Ae^{\frac{-E_a}{RT}}$$

For the decomposition of gaseous ethanoic anhydride

the activation energy, $E_a = 34.5 \text{ kJ mol}^{-1}$

the Arrhenius constant, $A = 1.00 \times 10^{12} \text{ s}^{-1}$

At temperature T_1 the rate constant, $k = 2.48 \times 10^8 \text{ s}^{-1}$

Calculate T_1

The gas constant, $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$

T_1 _____ K (3)

- (d) Sketch the Maxwell–Boltzmann distribution of molecular energies for gaseous ethanoic anhydride at temperature T_1 and at a higher temperature T_2

Include a label for each axis, and mark on the appropriate axis a typical position for the activation energy.

Explain why the rate of reaction is faster at T_2



Explanation

(5)
(Total 12 marks)