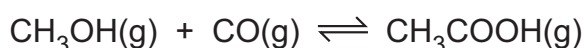


5 Ethanoic acid is manufactured in the reaction between methanol and carbon monoxide.

An equilibrium mixture is produced.



(a) State **two** characteristics of an equilibrium.

1

2

[2]

(b) Both a high yield of ethanoic acid and a high rate of reaction are needed.

The reaction is carried out at 300 °C.

The forward reaction is exothermic.

(i) State the disadvantage of using a temperature:

- below 300 °C

.....

- above 300 °C.

.....

[2]

(ii) Complete Table 5.1 using **only** the words **increases**, **decreases** or **no change**.

Table 5.1

	effect on the equilibrium concentration of CH ₃ COOH(g)	effect on the rate of the forward reaction
catalyst is added		increases
pressure is increased		

[3]

(iii) Suggest which element from the list is a suitable catalyst for the reaction.

Give a reason for your answer.

aluminium carbon cobalt magnesium sodium

catalyst

reason

[2]

(c) Ethanoic acid is a member of the carboxylic acid homologous series.

(i) Name the carboxylic acid that contains only one carbon atom.

..... [1]

(ii) State the molecular formula of a carboxylic acid that contains four carbon atoms.

..... [1]

(ii) Propyl butanoate is an ester.

Name the carboxylic acid and alcohol that react to produce propyl butanoate.

carboxylic acid

alcohol

[2]

(e) An organic compound has the following composition by mass:

C, 58.82%; H, 9.80%; O, 31.38%.

Calculate the empirical formula of the compound.

empirical formula = [3]

[Total: 18]