7 The following reversible reaction is used in industry to make methanol, CH_3OH:

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g) \quad \Delta H = -91 \text{ kJ mol}^{-1}$$

(a) Which change would affect both the value of the equilibrium constant, K_c, and the proportion of methanol present in an equilibrium mixture of the three gases?

(1)

- ☒ **A** adding a catalyst
- ☒ **B** changing the temperature
- ☒ **C** increasing the concentration of carbon monoxide
- ☒ **D** increasing the pressure

(b) The expression for the equilibrium constant, K_c, for this reaction is

$$K_c = \frac{[CH_3OH(g)]}{[CO(g)][H_2(g)]^2}$$

0.200 mol of CO(g) and 0.400 mol of $H_2(g)$ are mixed in a sealed container of volume 1.2 dm^3 at a temperature of 500 K and a pressure of 100 atmospheres and allowed to reach equilibrium.

The equilibrium mixture is found to contain 0.086 mol of $CH_3OH(g)$.

(i) Calculate K_c for this reaction. Give your answer to an appropriate number of significant figures and state the units.

(5)

(ii) The equilibrium mixture of CO(g), H_2(g) and CH_3OH(g) is heated in the same sealed container to a temperature higher than 500 K. Since the gas volume remains the same, the increased temperature results in an increase in pressure.

Explain why it is difficult to predict the effect on the yield of CH_3OH.

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(Total for Question 7 = 9 marks)