**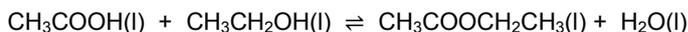1**   The equilibrium below was established by allowing 2.00 moles of ethanol and 1.00 moles of ethanoic acid to react at 25°C.  At equilibrium the mixture contained 0.845 moles of ethyl ethanoate.  Calculate $K_c$ at this temperature.

$$CH_3COOH(l) + CH_3CH_2OH(l) \rightleftharpoons CH_3COOCH_2CH_3(l) + H_2O(l)$$

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*(A2 BBoF 29)*

**2**   1.90 mol of hydrogen and 1.90 mol of iodine were allowed to reach equilibrium at 710 K.  The equilibrium mixture contained 3.00 mol of HI.

$$H_2(g) + I_2(g) \rightleftharpoons 2 HI(g)$$
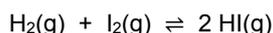
a)  Write an expression for the equilibrium constant $K_c$. ...................................................................................

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b)  Calculate the value of the equilibrium constant at 710 K. ...............................................................................

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c)  What, if anything, would be effect on the position of the equilibrium of increasing the total pressure? ................

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*(A2 BBoF 31)*

**3**   a)  What is meant by the phrase *dynamic equilibrium*? .......................................................................................

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b)  What is the difference between a *homogeneous* and a *heterogeneous* equilibrium? ..........................................

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c) State Le Châtelier's principle. ...........................................................................................................................

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d) For the equilibrium below what would be the effect on **both** the equilibrium position <u>and</u> $K_c$ of the each of the changes below, explaining your reasoning in each case.

$$2 SO_2(g) + O_2(g) \rightleftharpoons 2 SO_3(g) \qquad \Delta H = -197 \text{ kJ mol}^{-1}$$
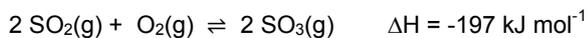
i) What effect would increasing the pressure have? .....................................................................................

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ii) What effect would increasing the amount of $O_2$ have? .............................................................................

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iii) What effect would increasing the temperature have? ...............................................................................

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**4**      $K_c$ for the equilibrium below is 7.50 at 50°C. If 50.0 g of ethanol is mixed with 50.0 g of propanoic acid, what mass of ethyl propanoate will be formed at equilibrium?

$$CH_3CH_2OH(l) + CH_3CH_2COOH(l) \rightleftharpoons CH_3CH_2COOCH_2CH_3(l) + H_2O(l)$$

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