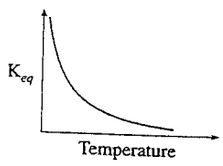
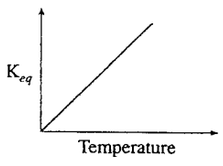
CHEMISTRY 12
Unit 2: CHEMICAL EQUILIBRIUM
LeCHATELIER'S PRINCIPLE

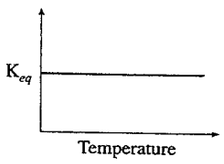
Name: _____
Date: _____
Section: _____

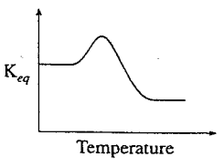
GRAPH - O - RAMA!

1. The relationship between K_{eq} and temperature for an exothermic reaction is represented by

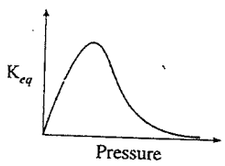
A. 

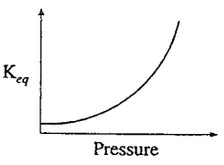
B. 

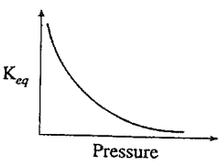
C. 

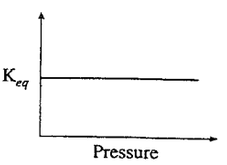
D. 

2. The relationship between K_{eq} and the pressure of a gaseous equilibrium at constant temperature can be described by

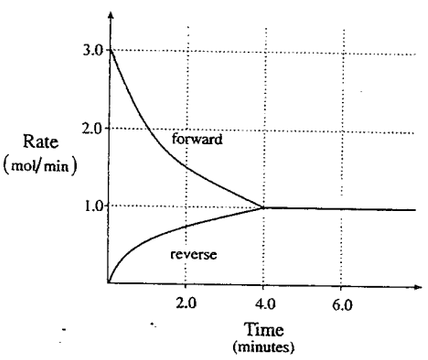
A. 

B. 

C. 

D. 

3. Consider the following graph:



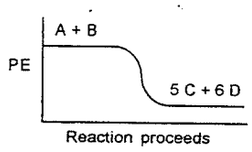
When equilibrium is reached, the rate of the forward reaction is

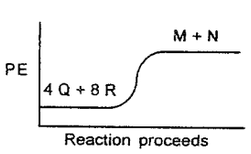
A. 0.00 mol/min
B. 0.25 mol/min
C. 1.0 mol/min
D. 3.0 mol/min

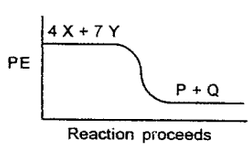
4. In each of the following, decide

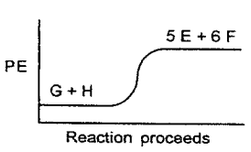
i) which side is favoured by the tendency to minimum enthalpy; that is, which side of the reaction has the lower energy.
ii) which side is favoured by the tendency to maximum entropy; that is, which side of the reaction has the more random species.
iii) whether the reaction will be
- a spontaneous reaction which goes to completion ("GOES 100%"), or
- a non–spontaneous reaction in which NO products are formed ("WON'T OCCUR"), or
- a spontaneous equilibrium reaction in which the tendency to minimum enthalpy will be balanced by an opposing tendency to maximum entropy ("EQUILIBRIUM").

Note: in parts (a) to (d) all the species are GASES

a) 

b) 

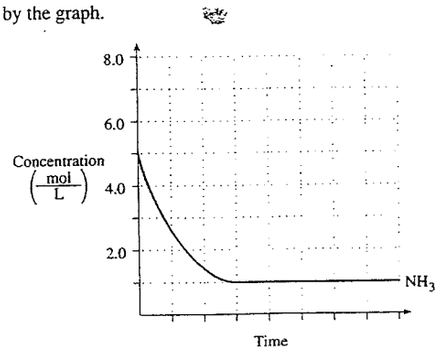
c) 

d) 

e) $H_2SO_4(l) + H_2O(l) \longrightarrow H_2SO_4(aq) + 150\ kJ$
f) $C_2H_6(g) \longrightarrow C_2H_2(g) + 2\,H_2(g)$; $\Delta H = 311$ kJ
g) $C_2H_2(g) + Ca(OH)_2(aq) \longrightarrow CaC_2(s) + 2\,H_2O(l)$; $\Delta H = 183$ kJ
h) $2\,C(s) + O_2(g) \longrightarrow 2\,CO(g)$; $\Delta H = -221$ kJ

5. Consider the following equilibrium system:

A 1.00 L container is filled with 5.0 mol NH_3 and the system proceeds to equilibrium as indicated by the graph.



$$N_{2(g)} + 3H_{2(g)} \rightleftarrows 2NH_{3(g)} + \text{energy}$$

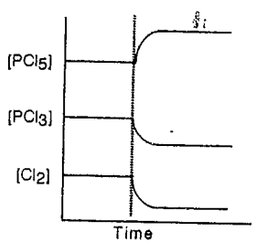
a) Draw and label the graph for N_2 and H_2. **(2 marks)**

b) Calculate the K_{eq} for $N_{2(g)} + 3H_{2(g)} \rightleftarrows 2NH_{3(g)}$. **(2 marks)**

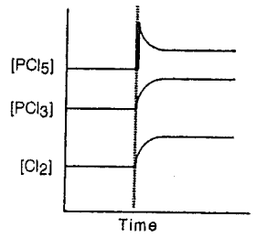
6. Interpret the following graphs in terms of the changes which must have been imposed on the equilibrium.

The equilibrium is: $PCl_5(g) + 92.5\ kJ \rightleftharpoons PCl_3(g) + Cl_2(g)$.

a)

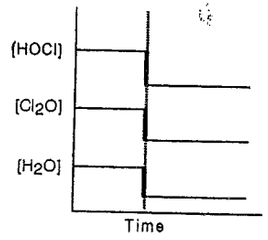


b)

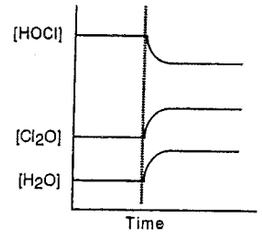


7. The equilibrium is: $H_2O(g) + Cl_2O(g) \rightleftharpoons 2\,HOCl(g) + 70\ kJ$.

a)



b)

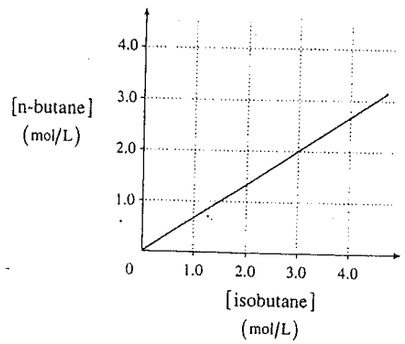


8. Consider the graph below representing the following equilibrium:

$$CH_3CH_2CH_2CH_{3(g)} \rightleftarrows CH_3CH(CH_3)_{2(g)}$$

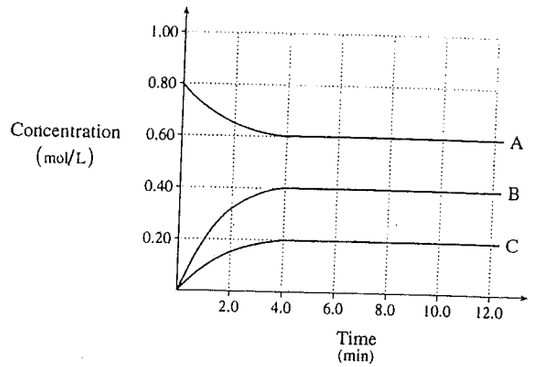
n-butane isobutane

Data for the graph was obtained from various equilibrium mixtures.



Calculate the value of K_{eq} for the equilibrium. **(2 marks)**

9. Consider the following diagram for a chemical system containing three substances represented by A, B and C:



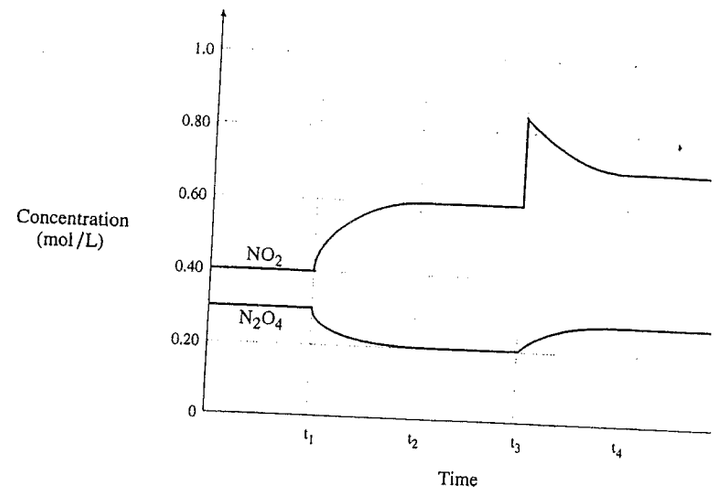
a) What feature of the graph indicates that the system reaches equilibrium? **(1 mark)**

b) Write a balanced equation for the equilibrium reaction. **(2 marks)**

c) Calculate K_{eq} at equilibrium. **(2 marks)**

10. Consider the following graph for the reaction:

$$\text{energy} + N_2O_{4(g)} \rightleftarrows 2NO_{2(g)}$$



a) What is the stress imposed at time t_1 ? **(1 mk)**

b) What is the stress imposed at time t_3 ? **(1 mk)**

c) Calculate K_{eq} for the equilibrium between t_2 and t_3. **(2 marks)**