Chemistry 12 Practice Test Equilibrium

Total Marks____/46 *Name:_____*

Multiple Choice Section: (10 marks, 1 mark each)

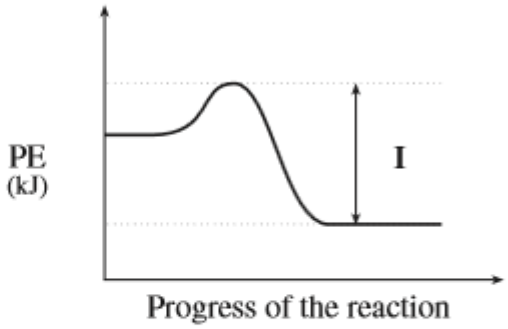
1. Consider the following reaction:

$$2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)} \qquad \Delta H = -114\,kJ$$

How could the rate of this reaction be increased?

A. Reduce the pressure.
B. Increase the volume.
C. Remove some $NO_{2(g)}$.
D. Increase the temperature.

2. Consider the following PE diagram:



Which of the following describes the energy value indicated by **I**?

A. heat of reaction
B. activation energy for the reverse reaction
C. activation energy for the forward reaction
D. potential energy of the reaction intermediate

3. Consider the following equilibrium:

$$CO_{(g)} + 2H_{2(g)} \rightleftarrows CH_3OH_{(g)} \qquad \Delta H = -91\,kJ$$

Which of the following factors will increase the yield of methanol, CH_3OH?

A. Removing CH_3OH from the system
B. Increasing the temperature
C. Increasing the volume
D. Decreasing the partial pressure of hydrogen

4. Consider the following equilibrium:

$$PCl_{3(g)} + Cl_{2(g)} \rightleftarrows PCl_{5(g)}$$

If the volume of the system is decreased, how will the reaction rates in the new equilibrium compare with the rates in the original equilibrium?

	Forward Rate	Reverse Rate
A.	increases	increases
B.	increases	decreases
C.	decreases	decreases
D.	decreases	increases

5. Consider the following equilibrium:

$$\underset{\text{colourless}}{H_{2(g)}} + \underset{\text{purple}}{I_{2(g)}} \rightleftarrows \underset{\text{colourless}}{2HI_{(g)}} \qquad \Delta H = -71.9\,kJ$$

Which of the following would allow you to conclude that the system has reached equilibrium?

A. The pressure remains constant.
B. The reaction rates become zero.
C. The colour intensity remains constant.
D. The system shifts completely to the right.

6. Consider the following equilibrium:

$$Fe_2O_{3(s)} + 3CO_{(g)} \rightleftarrows 2Fe_{(s)} + 3CO_{2(g)}$$

Identify the equilibrium constant expression.

A. $K_{eq} = \dfrac{[CO_2]^3}{[CO]^3}$

B. $K_{eq} = \dfrac{[CO_2]}{[CO]}$

C. $K_{eq} = \dfrac{[CO_2]^3[Fe]^2}{[Fe_2O_3][CO]^3}$

D. $K_{eq} = \dfrac{[Fe_2O_3][CO]^3}{[CO_2]^3[Fe]^2}$

7. Consider the following equilibrium system:

$$2NO_{(g)} + Cl_{2(g)} \rightleftarrows 2NOCl_{(g)} \qquad \Delta H = -77\,kJ$$

In which direction will the equilibrium shift and what happens to the value of K_{eq} when the temperature of the system is increased?

	Shift	K_{eq}
A.	right	increases
B.	right	decreases
C.	left	increases
D.	left	decreases

8. Consider the following equilibrium:

$$CO_{(g)} + 2H_{2(g)} \rightleftarrows CH_3OH_{(g)}$$

At equilibrium it was found that $[CO] = 0.105\,\text{mol/L}$, $[H_2] = 0.250\,\text{mol/L}$ and $[CH_3OH] = 0.00261\,\text{mol/L}$. Which of the following is the equilibrium constant value?

A. 9.94×10^{-2}
B. 0.398
C. 2.51
D. 10.0

9. Consider the following equilibrium:

$$Cu^{2+}_{(aq)} + 4Br^{-}_{(aq)} + \text{energy} \rightleftarrows CuBr_4^{2-}{}_{(aq)}$$

blue *colourless* *green*

Which of the following will cause this equilibrium to change from blue to green?

A. adding $NaBr_{(s)}$
B. adding $NaNO_{3(s)}$
C. adding a catalyst
D. decreasing the temperature

10. Consider the following equilibrium:

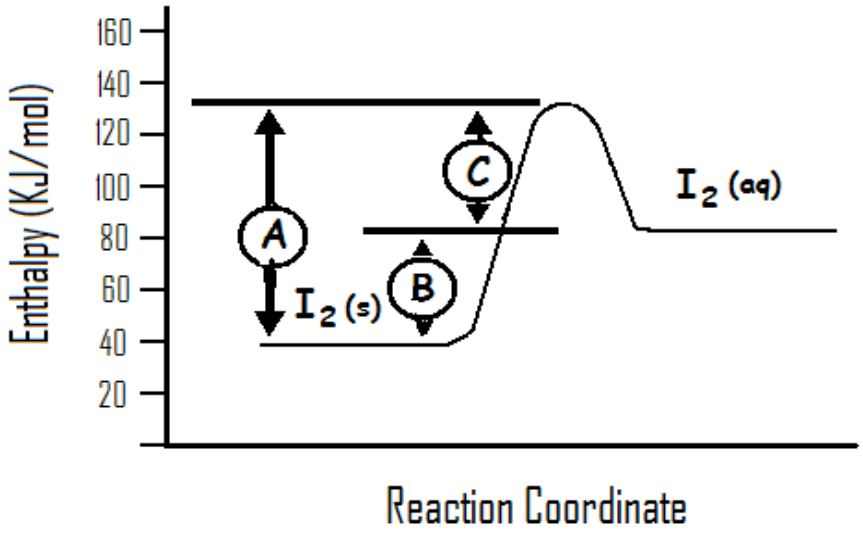
$$CO_{(g)} + H_2O_{(g)} \rightleftarrows CO_{2(g)} + H_{2(g)} \qquad K_{eq} = 5.0$$

At equilibrium, the $[CO] = 0.20\,\text{mol/L}$, $[H_2O] = 0.30\,\text{mol/L}$, and $[H_2] = 0.90\,\text{mol/L}$. Calculate the equilibrium $[CO_2]$.

A. 0.013 mol/L
B. 0.066 mol/L
C. 0.33 mol/L
D. 1.0 mol/L

Short Answer Questions: [36 marks for this section]

1. The potential energy diagram below refers to the reaction: $I_2(s) \rightleftarrows I_2(aq)$



Circle which of the following statement(s) is/are FALSE? [2 marks]

(a) 'A' is the activation energy for the reaction: $I_2(s) \rightarrow I_2(aq)$

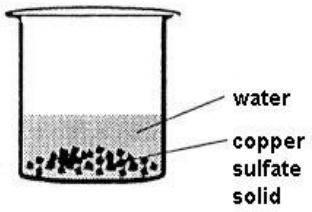
(b) ΔH for the reaction is positive and has the value 'B'

(c) At equilibrium the rate of reaction, $I_2(aq) \rightarrow I_2(s)$, is faster than that of $I_2(s) \rightarrow I_2(aq)$

(d) An increase in temperature will alter the equilibrium position and increase the solubility of I_2

2. Consider the system shown in the diagram, where a solute solution equilibrium has been established in a beaker. Briefly explain the following:

a) What is happening on a macroscopic level? [2 marks]



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b) What is happening on a microscopic level? [2 marks]

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c) State two ways by which the equilibrium could be altered. [2 marks]

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3. The following equilibrium is being investigated. [6 marks]

$CH_4(g) + H_2O(g) \rightleftarrows CO(g) + 3H_2(g)$ $\Delta H = +200$ kJ

Four identical sealed boxes are set up at 300^0C and 1.00 atmosphere each containing the equilibrium mixture. Each of the boxes is treated as described below, and time allowed for a new equilibrium to be established. Write what happens in each case as a result of changes.

	What happens to the total pressure? Write 'increase', 'decrease' or 'no change'	What happens to the partial pressure of CO? Write 'increase', 'decrease' or 'no change'	What happens to the equilibrium position? Write 'move to the right', move to the left' or 'no change'.
The system is heated above 300^0C			
More $CH_4(g)$ at 300^0C is injected into the box			
Ne (g) at 300^0C is injected into the box.			
The volume of the box is halved.			

4. Consider the following equilibrium system:

$$H_{2(g)} + Br_{2(g)} \rightleftarrows 2HBr_{(g)} \qquad K_{eq} = 14.8$$

A closed container was initially filled with equal moles of H_2 and Br_2.
When equilibrium is reached, the $[HBr]$ is $0.329\,mol/L$.

What is the equilibrium concentration of H_2 gas?

[4 marks]

5. Consider the following:

$$CO_{2(g)} + CF_{4(g)} \rightleftarrows 2COF_{2(g)} \qquad K_{eq} = 0.50$$

In a reaction container the initial concentrations are:
$[CO_2] = 0.50\,mol/L$, $[CF_4] = 0.50\,mol/L$, $[COF_2] = 0.30\,mol/L$

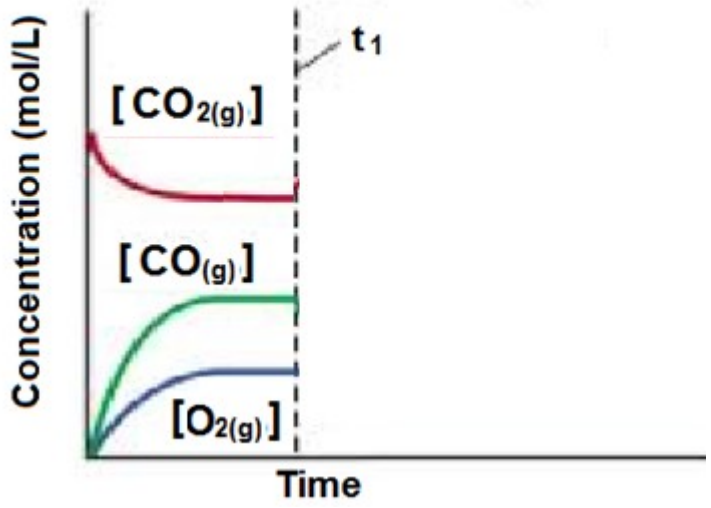
Calculate Q and state which way the reaction will shift (left toward the reactants or right toward the products or will not shift since it is at equilibrium) as a result of your calculation of Q.

[2 marks]

Reaction will_____[1 mark]

6. Refer to the diagram below then answer the questions below.

$$2\,CO_{2(g)} + Energy \rightleftharpoons 2\,CO_{(g)} + O_{2(g)}$$



a) Draw on the above diagram what you would expect would happen to the concentration of the reactants and products if the temperature of the closed system was significantly decreased at time t_1. [2 marks]

b) Describe the changes you just drew on the graph above and why they occurred. [3 marks]

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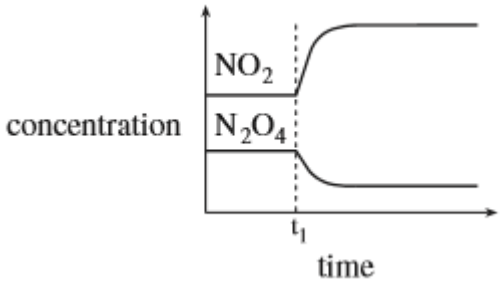
c) Using the above concentration versus time graph draw a rate versus time graph that would correspond to this concentration versus time graph, including the changes at t_1. [3 marks]

7. Consider the following equilibrium:

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

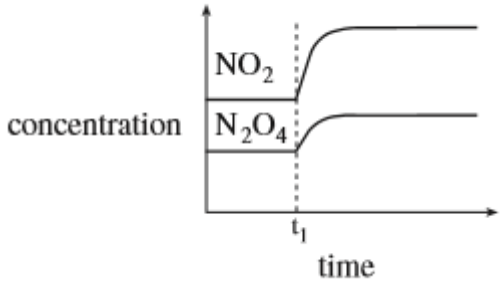
Based on the above equation explain either what environmental change occurred or what might have been added or removed from the system to generate the graphs below. Also, make sure to explain in detail why this change had the effect shown in the graph.

A.



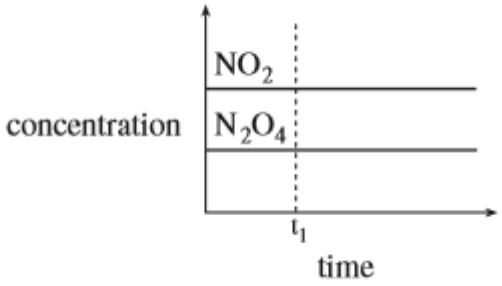
[2 marks]

B.



[2 marks]

C.



[1 mark]

For this graph something was either added or removed. What could be added or removed and result in no change.

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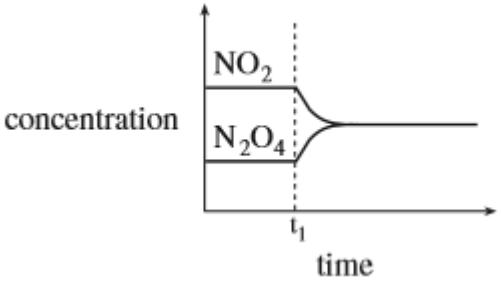
D.



[2 marks]

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