

IMPORTANT

USE NO. 2 PENCIL ONLY

EXAMPLE: ☐ A ☐ B ☐ C ☐ D ☐ E

ERASE COMPLETELY TO CHANGE

NAME

EQ Pro of Term 1

SUBJECT

CHEM 12 TEST

DATE

HOUR

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TEST RECORD

PART 1

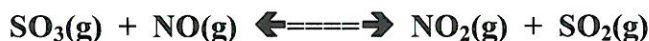
PART 2

TOTAL



Part II: Written Section – Show all steps (including ICE box when necessary) leading to the final solution. Sig Dig.'s count.

1. Consider the following equilibrium:



In an experiment, 0.100 moles of SO_3 and 0.100 moles of NO are placed in a 1.00 L container. When equilibrium is achieved, $[\text{NO}_2] = 0.0414 \text{ mol/L}$.

Calculate the K_{eq} value.

(3 marks)

I	0.100M	0.100M	0	0
C	-0.0414	-0.0414	+0.0414	+0.0414
E	0.0586	0.0586	0.0414M	0.0414

(1)

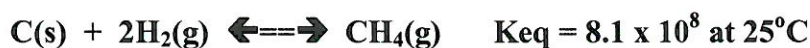
$$K_{eq} = \frac{[\text{NO}_2][\text{SO}_2]}{[\text{SO}_3][\text{NO}]}$$

(1)

$$K_{eq} = \frac{(0.0414)^2}{(0.0586)^2} = \underline{\underline{0.499}}$$

(1)

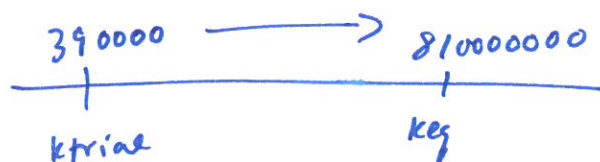
2. Consider the following equilibrium system:



A student places 4.5 mol of carbon, 3.6×10^{-3} mol of hydrogen and 5.1 mol of methane in a 1.0 L flask. The student predicts that the $[\text{CH}_4]$ increases as equilibrium is established. Do you agree? Explain your answer using appropriate calculations. (3 marks)

$$(1) \quad K_{\text{trial}} = \frac{[\text{CH}_4]}{[\text{H}_2]^2} = \frac{(5.1)}{(3.6 \times 10^{-3})^2} = 393518$$

(1)



I agree with the student. Since $K_{\text{trial}} < K_{eq}$, the SYSTEM must shift to make more product.

(1)

3. Consider the following:



$$K_{eq} = 1.00 \times 10^2$$

A 1.00 L flask is initially filled with 2.00 mol H_2 and 2.00 mol F_2 .

Calculate the $[\text{H}_2]$ at equilibrium.

(4 marks)

I	2.00M	2.00M	0
C	-x	-x	+2x
E	2.00-x	2.00-x	2x

(1)

(1) {

$$K_{eq} = \frac{[\text{HF}]^2}{[\text{H}_2][\text{F}_2]}$$

$$\sqrt{1.00 \times 10^2} = \sqrt{\frac{(2x)^2}{(2.00-x)^2}}$$

$$10 = \frac{2x}{2.00-x}$$

$$20 - 10x = 2x$$

$$20 = 12x$$

$$1.\bar{6} = x$$

(1)

$$[\text{H}_2]_{eq} = 2.00 - x$$

$$= 2.00 - 1.\bar{6}$$

$$= 0.333 \text{ M}$$

(1)

4.

A reaction mixture, $\text{CO}(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{CO}_2(\text{g}) + \text{H}_2(\text{g})$ when at equilibrium, contains 0.20mol of H_2 , 0.70mol of CO_2 , 0.20mol of CO and 0.30mol of H_2O in a 1.0L bulb. How many moles of CO_2 would have to be added to increase the amount of CO to 0.30mol? (4 marks) 3 MARKS.

(EQ) I	0.20M	0.30M	0.70M	0.20M
* (+1-stress)			+x	
* (shift)				
C	+0.10M	+0.10M	-0.10M	-0.10M
E	0.30M	0.40M	0.60+x	0.10M

(1)

$$K_{eq} = \frac{[\text{CO}_2][\text{H}_2]}{[\text{CO}][\text{H}_2\text{O}]} = \frac{(0.70)(0.20)}{(0.20)(0.30)} = 2.\bar{3}$$

(1)

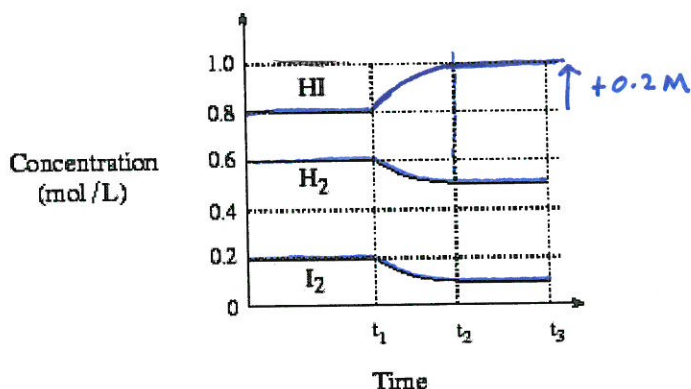
$$2.\bar{3} = \frac{(0.60+x)(0.10)}{(0.30)(0.40)}$$

$$x = 2.2 \text{ M} = [\text{CO}_2] \text{ added.}$$

(1)

$$0.28 = 0.06 + 0.10x$$

5. Consider the following graph for the reaction:



The temperature is increased at t_1 and equilibrium is re-established at t_2 .

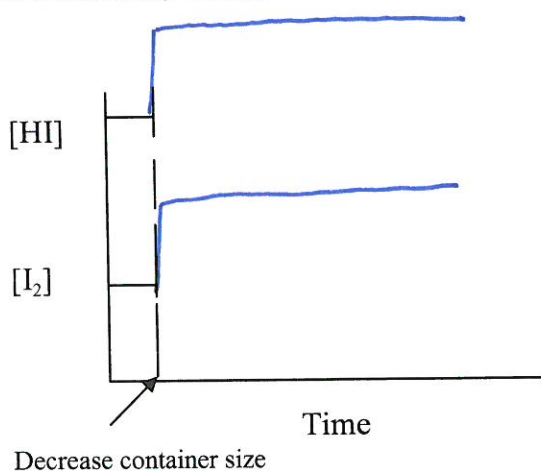
a) On the above graph, sketch the line representing the $[\text{HI}]$ between time t_1 and t_3 . (1 mark)

b) Calculate the value of K_{eq} after t_2 .

(2 marks)

$$K_{eq}(\text{after } t_2) = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]} = \frac{(1.0)^2}{(0.5)(0.1)} = 20$$

c) On the graph below, show the relative changes in concentration of HI and I_2 when the container size is decreased. (2 marks)



① All conc's inc

① No shift due to equal moles of gas.