

Name _____

Information About This Examination

Each of the 25 multiple choice questions is worth 4 points, for a total of 100 points.

Instructions: Choose the **BEST** answer (A - E) to each of the questions below and record your answer on the separate "SCANTRON" form provided.

1. Consider the exothermic reaction:



Le Châtelier's Principle predicts that the reaction at equilibrium may easily be driven in the reverse direction by:

- A. adding more $\text{CaCO}_3 \text{ (s)}$ *another possible answer!*
 B. adding more CaO (s)
 ✓ C. increasing the temperature
 D. decreasing the temperature
 E. increasing the pressure
2. For which of the following reactions would increasing the pressure at constant temperature **NOT** change the concentrations of reactants and products?
- A. $\text{N}_2 \text{ (g)} + 3\text{H}_2 \text{ (g)} = 2\text{NH}_3 \text{ (g)}$ *SHIFT right*
 B. $\text{N}_2 \text{ (g)} + 2\text{O}_2 \text{ (g)} = 2\text{NO}_2 \text{ (g)}$ *right*
 ✓ C. $\text{N}_2 \text{ (g)} + \text{O}_2 \text{ (g)} = 2\text{NO (g)}$ *no change*
 D. $2\text{N}_2 \text{ (g)} + \text{O}_2 \text{ (g)} = 2\text{N}_2\text{O (g)}$ *right*
 E. $2\text{NO}_2 \text{ (g)} = \text{N}_2\text{O}_4 \text{ (g)}$ *right*
- ↑ pressure, equilibrium favors ↓ no. of moles of gaseous molecules*
3. A mixture of 0.100 mol SO_2 , 0.050 mol O_2 , and 0.200 mol SO_3 was introduced into a 1.000 L vessel. When equilibrium had been established, the mixture was found to contain 0.020 mol O_2 .

What is K_c for the reaction $2 \text{SO}_2 \text{ (g)} + \text{O}_2 \text{ (g)} = 2 \text{SO}_3 \text{ (g)}$?

- A. 4.8×10^{-4}
 B. 2.0×10^2
 C. 1.6×10^3
 ✓ D. 2.1×10^3
 E. 1.6×10^{-3}
- | | | | |
|---|-------|-------|------------|
| i | 0.100 | 0.050 | 0.200 |
| C | -2x | -x | +2x |
| E | 0.100 | 0.020 | 0.200 + 2x |
| | -2x | | |
- $x = 0.050 - 0.020 = 0.030$
- $[\text{SO}_2]_{\text{eq}} = 0.100 - (2)(0.030) = 0.040$
- $[\text{SO}_3]_{\text{eq}} = 0.200 + (2)(0.030) = 0.260$
- $K_c = \frac{[\text{SO}_3]_{\text{eq}}^2}{[\text{SO}_2]_{\text{eq}}^2 [\text{O}_2]_{\text{eq}}} = \frac{(0.260)^2}{(0.040)^2 (0.020)} = \underline{\underline{2112.5}}$

4. The value of K_c for the reaction below is 1.6.



What is the equilibrium concentration of CO when $[\text{CO}_2] = 0.50\text{M}$?

- ✓ A. 0.89
 B. 0.31
 C. 0.75
 D. 0.80
 E. 1.12

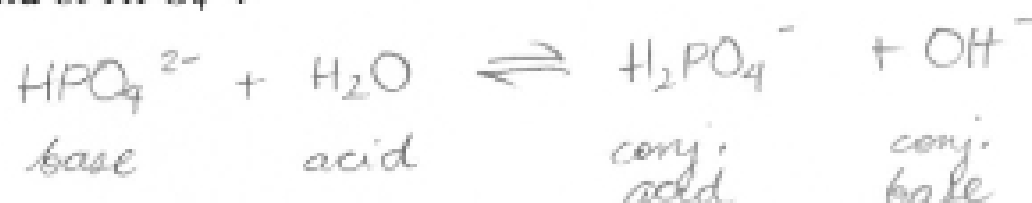
$$K_c = \frac{[\text{CO}]^2}{[\text{CO}_2]}$$

$$1.6 = \frac{[\text{CO}]^2}{0.50}$$

$$[\text{CO}] = \sqrt{(1.6)(0.50)} = 0.89$$

5. What is the conjugate acid of HPO_4^{2-} ?

- A. H_3PO_4
 B. HPO_4^{3-}
 C. HPO_3^{2-}
 ✓ D. H_2PO_4^-
 E. $\text{H}_2\text{PO}_4^{2-}$



6. Which of the following pairs of names and formulas is not correct?

- A. HNO_3 nitric acid ✓
 B. H_2SO_4 sulfuric acid ✓
 ✓ C. ClO_4^{2-} perchlorate anion X ClO_4^-
 D. $(\text{NH}_4)_3\text{PO}_4$ ammonium phosphate ✓
 E. CO_3^{2-} carbonate anion ✓

7. What volume of 0.1250M sodium hydroxide must be added to completely neutralize 25.00 mL of 0.1478M sulfuric acid?

- ✓ A. 59.12 mL
- $$2\text{NaOH} + \text{H}_2\text{SO}_4 \longrightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$$
- B. 29.56 mL
- $$\text{mol H}_2\text{SO}_4 = \left(0.1478 \frac{\text{mol}}{\text{L}}\right)(0.02500\text{L}) = 3.695 \times 10^{-3} \text{ moles}$$
- C. 14.78 mL
- D. 2.956×10^{-3} L
- E. 2.956×10^{-1} L
- $$\text{mol NaOH} = 3.695 \times 10^{-3} \left(\frac{2 \text{ mol NaOH}}{1 \text{ mol H}_2\text{SO}_4}\right) = 7.39 \times 10^{-3} \text{ moles}$$
- $$\text{Vol NaOH} = \frac{7.39 \times 10^{-3} \text{ moles}}{0.1250 \frac{\text{mol}}{\text{L}}} = \boxed{0.05912 \text{ L}}$$