Directions:

1. Each student is responsible for following directions. Read this page carefully.

2. Write your name and other requested information on this page and on the separate answer sheet.

3. CODE your name on the answer sheet using an ordinary (#2) pencil.

4. CODE your correct 10-digit identification number (PUID) on the answer sheet. THIS IS VERY IMPORTANT!

5. CODE your lab section number on the answer sheet. Please use all four digits, 0101, 0102, 0201, etc. This is also very important!

6. Put all calculations on the examination pages. DO NOT PUT ANY EXTRA MARKS ON THE COMPUTER ANSWER SHEET!

7. This exam consists of 20 multiple-choice questions worth 6.25 points each. Choose the one best or correct answer for each question and write it both on your exam paper and on the computer answer sheet. The computer answer sheet is the only one that will be graded!

8. This exam consists of 6 pages plus a Periodic Table. Please check to be sure that you have them all!

END OF EXAM

1) Please make sure that you have entered 20 answers on your scan sheet.

2) Make sure that you have entered your name, ID number, and lab section number (4 digits).

3) You MUST turn the scan sheet in to your TA before leaving the exam!
D 1. What is the mass percent of sodium hydroxide (NaOH) in a solution that is made by dissolving 8.00 g NaOH in 50.0 g H₂O?

[Molar masses: Na = 22.99, O = 16.00, and H = 1.008 g mol⁻¹]

(a) 16
(b) 0.138
(c) 0.160
(d) 13.8
(e) 7.20

B 2. 8.00 g of NaOH was used to make a 500.0 mL solution. What is the solution’s pH?

[Molar masses: Na = 22.99, O = 16.00, and H = 1.008 g mol⁻¹]

(a) 0.699
(b) 13.6
(c) 1.80
(d) 12.2
(e) None of the above

A 3. What is the pOH of the solution in Question (2)?

(a) 0.398
(b) 13.3
(c) 1.80
(d) 12.2
(e) None of the above

E 4. The solution in Question (2) is:

(a) Neutral
(b) Acidic
(c) Alkaline
(d) Basic
(e) (c) & (d)

A 5. A 34.0% sulfuric acid (H₂SO₄) solution has a density of 1.25 g/mL. How many grams of H₂SO₄ are contained in 1.00 L of this solution?

(a) 425 g
(b) 42.5 g
(c) 0.425 g
(d) 1250 g
(e) 100 g
B  6. What is the molarity of a solution made by dissolving 2.00 g of potassium chlorate (KClO₃) in enough water to make 150. mL of solution?
   [Molar masses: K = 39.10, Cl = 35.45, O = 16.00]
   (a) 0.0133 M
   (b) 0.109 M
   (c) 13.3 M
   (d) 13.3 x 10⁻³ M
   (e) 1.09 M

C  7. What effect does dissolving solute particles have on the freezing and boiling points of the solvent?
   (a) No change
   (b) Freezing and boiling points are lowered
   (c) Freezing point is lowered/ boiling point increases
   (d) Freezing point increases/ boiling point is lowered
   (e) Freezing and boiling points are increased

C  8. Concentrations of very dilute solutions often are reported in units of parts per million or parts per billion. For aqueous solutions, 1 ppm is equal to:
   (a) 1 g/L
   (b) 1 mg/mL
   (c) 1 mg/L
   (d) 1 μg/L
   (e) Depends on the density of the solution

C  9. Concentrations of very dilute solutions often are reported in units of parts per million or parts per billion. For aqueous solutions, 1 ppb is equal to:
   (a) 1 g/L
   (b) 1 mg/mL
   (c) 1 μg/L
   (d) 1 μg/mL
   (e) Depends on the density of the solution
For Questions 10-14, consider the following reaction and its energy diagram:

\[ 2\text{HI}(g) \rightarrow \text{H}_2(g) + \text{I}_2(g) \]

![Energy Diagram]

\( \bullet = \text{H} \)

\( \bullet = \text{I} \)

E 10. The reaction is:
(a) endothermic
(b) cannot tell
(c) absorbs heat
(d) absorbs light
(e) exothermic

C 11. The structure shown in {} and marked with \( \dagger \) as a superscript represents:
(a) reactants
(b) products
(c) transition state
(d) catalyst
(e) energy required for collision to occur

C 12. The energy difference between reactants and products is represented by:
(a) D
(b) B
(c) C
(d) B + C + D
(e) Cannot be determined from the provided diagram.
D 13. The rate of the reaction is proportional to:

(a) \([H_2][I_2]\)
(b) \([I_2]\)
(c) \([H_2]\)
(d) \([HI]^n\)
(e) \([H_2][I_2][HI]^2\)

B 14. The dependence on \([HI]^y\) would be determined experimentally. If doubling the concentration of HI increases the rate of reaction by a factor of four \((4x)\), then \(y\) equals

(a) 1
(b) 2
(c) 4
(d) 0
(e) Need more info

B 15. What effect does adding a catalyst have on the activation energy \((E_a)\)?

(a) Increases \(E_a\)
(b) Decreases \(E_a\)
(c) Depends on whether the reaction is endothermic or exothermic
(d) No change
(e) Depends on the temperature of the reaction

For Questions 16 and 17, consider the sequence of reactions given here.

\[
\begin{align*}
O_3 & \xrightarrow{hv} O_2 + O^* \\
O_3 + Cl^* & \rightarrow O_2 + ClO^* \\
O^* + ClO^* & \rightarrow O_2 + Cl^*
\end{align*}
\]

C 16. The net reaction is:

(a) \(ClO^* + O_3 \rightarrow 2O_2 + Cl\)
(b) \(ClO^* + O_3 \rightarrow 2O_2 + Cl^*\)
(c) \(2O_3 \rightarrow 3O_2\)
(d) \(2ClO^* \rightarrow O_2 + Cl\)
(e) \(Cl^* + O_3 \rightarrow O_2 + ClO^*\)
B 17. Cl' in the sequence of reactions listed on the previous page is best described as a:

(a) reactant
(b) catalyst
(c) product
(d) solvent
(e) intermediate

For Questions 18 and 19, consider the fact that when $\text{S}_2\text{Cl}_2(g)$ reacts with $\text{Cl}_2(g)$, an equilibrium is established with the product $\text{SCl}_2(g)$, with an equilibrium constant of $K = 4$, according to the following equilibrium reaction:

$$\text{S}_2\text{Cl}_2(g) + \text{Cl}_2(g) \rightleftharpoons \text{SCl}_2(g) \quad K = 4$$

B 18. Suppose you start with the following concentrations:

$$[\text{S}_2\text{Cl}_2] = 0.10 \text{ M}$$
$$[\text{Cl}_2] = 0.10 \text{ M}$$
$$[\text{SCl}_2] = 0.30 \text{ M}$$

Which of the following statements is true? (Remember to balance the equation!)

(a) The reaction is at equilibrium.
(b) There is too much product.
(c) There is too much reactants.
(d) More $\text{SCl}_2$ needs to be made to reach equilibrium.
(e) The temperature will decrease.

E 19. Having started with the concentrations listed in question 18, what will happen to the concentration of $\text{Cl}_2$?

(a) It will decrease.
(b) It will not change.
(c) It will go up and then come down to reach equilibrium.
(d) It will go down rapidly and come up afterwards slowly until the reaction is at equilibrium.
(e) It will increase.

D 20. Arnold Beckman is an American scientist who:

(a) developed the practical synthesis of ammonia.
(b) commercialized the use of pH paper.
(c) applied La Chatelier's principle to the manufacturing of sulfuric acid.
(d) made the first commercial pH meter.
(e) studied hydrogen fuel cells.

THE END!