Exam 2

1. What is the molar mass of propanol, C_3H_7OH?

a) 46 g/mol
b) 60 g/mol
c) 74 g/mol
d) 90 g/mol

2. How many moles are in 45.0 g of Na_2CO_3?

a) 0.212 mol
b) 0.425 mol
c) 0.378 mol
d) 0.950 mol

3. How many molecules are present in 0.250 mol of H_2O_2?

a) 1.50×10^{23}
b) 3.01×10^{23}
c) 6.02×10^{23}
d) 1.20×10^{24}

4. Balance the equation:
$\_\_C_4H_{10} + \_\_O_2 \rightarrow \_\_CO_2 + \_\_H_2O$
What is the coefficient in front of O_2?

a) 6
b) 10
c) 13
d) 8

5. Which reaction type is:
$Zn(s) + CuCl_2(aq) \rightarrow ZnCl_2(aq) + Cu(s)$

a) Combination
b) Decomposition
c) Single replacement
d) Combustion

6. Which process represents reduction?

a) $Fe \rightarrow Fe^{3+} + 3e^-$
b) $Cu^{2+} + 2e^- \rightarrow Cu$
c) $2Cl^- \rightarrow Cl_2 + 2e^-$
d) $Mg \rightarrow Mg^{2+} + 2e^-$

7. Which statement is an assumption of the Ideal Gas Law?

a) Gas particles exert strong attractions on each other.
b) Gas particles move in random straight lines and have negligible volume.
c) Collisions between gas particles are inelastic.
d) Gas particles slow down as temperature increases.

8. Under which conditions do a real gas deviate the most from ideal behavior?

a) Low P and high T
b) High P and low T
c) Moderate P and moderate T
d) Standard temperature and pressure

9. The pressure of a gas is explained by:

a) The density of the gas sample
b) The mass of the gas particles
c) Collisions of particles with container walls
d) The number of valence electrons

10. What is the molarity of a solution made by dissolving 12.0 g NaOH in enough water to make 500. mL of solution?

a) 0.30 M
b) 0.48 M
c) 0.60 M
d) 1.20 M

11. What is the percent by mass of KCl in a solution containing 15.0 g KCl dissolved in 85.0 g water?

a) 12.5%
b) 15.0%
c) 17.6%
d) 20.0%

12. Which factor increases the solubility of a gas in water?

a) Increase temperature
b) Decrease pressure
c) Increase pressure
d) Stirring only

13. What is the van't Hoff factor (i) for $AlCl_3$ assuming complete dissociation?

a) 2
b) 3
c) 4
d) 5

14. A semipermeable membrane separates 0.2 M NaCl (left) and 0.2 M glucose (right). Predict the net water movement:

a) Left → Right
b) Right → Left
c) No movement
d) Moves both directions equally

15. Which statement describes an Arrhenius acid?

a) Produces OH^- in aqueous solution
b) Donates H^+ to water to form H_3O^+
c) Accepts H^+ from another species
d) Accepts an electron pair

16. In the reaction:
$NH_4^+ + H_2O \rightleftharpoons NH_3 + H_3O^+$
What is the conjugate base?

a) NH_3
b) H_3O^+
c) H_2O
d) OH^-

17. What is the pH of a 0.0050 M HNO_3 solution?

a) 1.30
b) 2.30
c) 3.30
d) 4.30

18. Which is the correct equilibrium expression for:
$HSO_4^- + OH^- \rightleftharpoons SO_4^{2-} + H_2O$

a) $K = [HSO_4^-][OH^-]/[SO_4^{2-}]$
b) $K = [SO_4^{2-}][H_2O]/[HSO_4^-][OH^-]$
c) $K = [SO_4^{2-}]/[HSO_4^-][OH^-]$
d) $K = [SO_4^{2-}]/[HSO_4^-]$

19. For the equilibrium:
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ $\Delta H = -92$ kJ
Which change shifts equilibrium to the right?

a) Add N_2
b) Increase temperature
c) Decrease pressure
d) Add catalyst only

20. A buffer is composed of:

a) A strong acid mixed with a strong base in equal amounts
b) Weak acid with its conjugate base
c) A strong acid with its conjugate base
d) A salt solution only

21. Aluminum reacts with copper(II) chloride according to the balanced equation:

$$2\ Al\ (s) + 3\ CuCl_2\ (aq) \rightarrow 2\ AlCl_3\ (aq) + 3\ Cu\ (s)$$

If 13.5 g of Al reacts with excess $CuCl_2$, how many grams of Cu will form?

$$13.5\ g\ Al \times \frac{1\ mol}{26.98\ g} \times \frac{3\ CuCl_2}{2\ Al} \times \frac{63.55\ g}{1\ mol}$$

$$= \boxed{47.7\ g\ CuCl_2}$$

5 pts

Name KEY

2.5 pt each

	A	B	C	D	E		A	B	C	D	E
1	○	●	○	○	○	11	○	●	○	○	○
2	○	●	○	○	○	12	○	○	●	○	○
3	●	○	○	○	○	13	○	○	●	○	○
4	○	○	●	○	○	14	○	●	○	○	○
5	○	○	●	○	○	15	○	●	○	○	○
6	○	●	○	○	○	16	●	○	○	○	○
7	○	●	○	○	○	17	○	●	○	○	○
8	○	●	○	○	○	18	○	○	●	○	○
9	○	○	●	○	○	19	●	○	○	○	○
10	○	○	●	○	○	20	○	●	○	○	○

22. You have 250. mL of 0.80 M NaCl solution. You dilute it with water to a total volume of 1.00 L. What is the new molarity of the solution?

$$(0.8\ M)(250\ mL) = (x)(1000\ mL)$$

$$x = \boxed{0.2\ M}$$

5 pts

23. A solution is prepared by dissolving 8.50 g NaOH in enough water to make 200. g of total solution. The solution density is 1.05 g/mL. Calculate:

a) Molarity (M)

3pts

$$\text{mol: } 8.50\text{ g} \times \frac{1\text{ mol}}{40.00\text{ g}} = 0.2125\text{ mol}$$

$$\text{L: } 200\text{ g} \times \frac{1\text{ mL}}{1.05\text{ g}} \times \frac{1\text{ L}}{1000\text{ mL}} = 0.1905\text{ L}$$

$$\frac{0.2125\text{ mol}}{0.1905\text{ L}} = \boxed{1.12\text{ M}}$$

b) Molality (m)

3pts

$$\text{mol: } 0.2125\text{ mol}$$

$$\text{k(solvent): } 200 - 8.50 = 191.50\text{ g} \times \frac{1\text{ kg}}{1000\text{ g}} = 0.1915\text{ kg}$$

$$\frac{0.2125\text{ mol}}{0.1915\text{ kg}} = \boxed{1.11\text{ m}}$$

c) Parts per million (ppm)

3pts

$$\frac{8.5}{200} \times 10^6 = \boxed{42500\text{ ppm}}$$

24. What is the pH of a 0.025 M H_3O^+ solution?

4pts

$$-\log(0.025\text{ M}) = \boxed{1.6}$$

25. A weak acid has Ka = 1.8×10^{-5}.

a) Calculate its pKa.

3pts

$$-\log(1.8 \times 10^{-5}) = \boxed{4.74}$$

b) Calculate the buffer pH range for this acid

3pts

$$4.74 \pm 1 = \boxed{3.74 - 5.74}$$