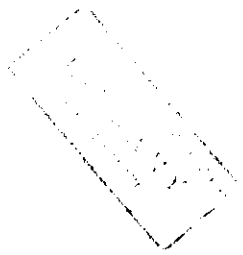
Final Exam
Chemistry 102, Prof. D. Naud
July 2, 1996 I.D. No. _____

Name_____

Signature_____

Note to Students: Some questions are straight multiple choice questions. Other multiple choice questions have the fill-in option. Fill in the correct answer ONLY when you cannot find the answer as a choice.

EXAMPLES



Straight multiple choice:

What is the chemical formula of potassium hydroxide?

A) K_2OH B) KOH C) NaOH D) RbOH

ANSWER: Circle letter B

Multiple choice with "fill-in option."

What is the pH of neutral water?

A) Two B) Three C) Ten D)_____

Answer: Because "Seven" cannot be found as a multiple choice question, write the answer "Seven" in the blank space next to choice D).

Final Exams can be reviewed in my office (Room 426) tomorrow, Wednesday, 10 to 12, and 2 to 4. Class grades will be posted

13. A 0.20 mole quantity of silver nitrate is added to a liter of 1.20 M NaCN solution. What is the concentration of silver ions at equilibrium. $K_f = 1.0 \times 10^{21}$?

$$Ag^{1+} + 2\,CN^{1-} \overset{K_f}{\rightleftharpoons} [Ag(CN)_2]^{1-}$$

A) 1.3×10^{-22} M B) 2.0×10^{-22} M C) 2.5×10^{-22} M D)_____

14. Calculate the standard entropy change for the following reaction at 298 K.

$$N_2\,(gas) + 3\,H_2\,(gas) \rightleftharpoons 2\,NH_3\,(gas)$$

$S^o(N_2) = 192$ J/(K mol)
$S^o(H_2) = 131$ J/(K mol)
$S^o(NH_3) = 193$ J/(K mol)

A) -130 J/K B) -199 J/K C) 130 J/K D)_____

15. What is the third law of thermodynamics?

A) The entropy of a solid substance is zero at 298 K.
B) The entropy of an element is zero at zero K.
C) The entropy of a perfect crystalline substance is zero at zero K.
D) The entropy of an element is zero at 298 K.
E) None of the above.

16. What is the Ksp of $Ca_3(PO_4)_2$ in terms of its molar solubility, s?

A) $6s^5$ B) $108s^5$ C) $12s^5$ D)_____

17. The pH of a solution containing equal amounts of acetic acid and sodium hydroxide is:

A) less than 7 B) more than 7 C) equal to 7 D) Can not be predicted

18. Silver nitrate is slowly added to a solution that is 0.010 M in chloride ions and 0.010 M in bromide ions. Calculate the concentration of silver ions (in moles per liter) required to initiate the precipitation of silver bromide. The Ksp's of silver bromide and silver chloride are 7.7×10^{-13} and 1.0×10^{-10} respectively.

A) 0.0090 M B) 1.5×10^{-9} C) 7.7×10^{-10} D)_____

19. Calculate the pH of a solution containing 1.0 M NH_3 and 0.70 M ammonium chloride. The pK_b of NH_3 is 4.74.

A) 9.1 B) 4.6 C) 9.4 D)_____

20. What is the Ka of phenol (C_6H_5OH) given that the pK_b of phenoxide ion ($C_6H_5O^{1-}$) is 4.11?

A) 1.3×10^{-10} B) 7.8×10^{-5} C) 4.4×10^{-8} D)_____

21. Which statement is true?

A) There are four allotropes of carbon.
B) Hydrogenation is the addition of water to compounds containing multiple bonds.
C) Water reacts with calcium carbide to give ethyne gas.
D) Cyanide ponds are used in industry to extract minute quantities of copper from ore.
E) None of the above.

22. What is the chemical formula of hematite?

A) FeS_2 B) Fe_3O_4 C) $FeCO_3$ D)_____

23 and 24. Give your answer by circling the letter after the question.

Which reaction relates to the Mond process? **A B C D E**

Which reaction relates to the Hall process? **A B C D E**

A) $Ni + 4\,CO \longrightarrow Ni(CO)_4$

B) $FeO + CO \longrightarrow Fe + CO_2$

C) $V_2O_5 + Ca \longrightarrow 5\,CaO + 2\,V$

D) $2\,NaCl$ + electrical energy $\longrightarrow 2\,Na + Cl_2$

E) None of the above

25. Nitrogen forms compounds with hydrogen and oxygen in which the oxidation number of nitrogen varies *from ? to ?*.

A) from -5 to +3 B) from -3 to +4 C) from -3 to +3 D) from -3 to +5 E)_____

26. In steel making, the principal reducing agent in a blast furnace is:

A) hydrogen gas B) carbon monoxide C) carbon dioxide D) carbonic acid E) nitric oxide

27. Which of the following is an example of an alkaline earth metal?

A) magnesium B) lithium C) gold D) iron E) nickel

28. The formula for the most stable allotrope of sulfur (rhombic) is:

A) S_2 B) S_4 C) S_6 D) S_8 E)_____

29 Sulfuric acid is prepared from the reaction of water and one of its oxides. What is the formula of this sulfur oxide?

A) SO_2 B) S_2O_4 C) S_2O D)_____

30 Which of the following is an example of an amphoteric oxide?

A) Na_2O B) MgO C) Al_2O_3 D) SiO_2 E) None of the above

31. Which of the following compounds has an asymmetric carbon atom?

A) chloromethane B) 2-chloropropane C) 1-chloroethane

D) 3-methyloctane E) none of the above

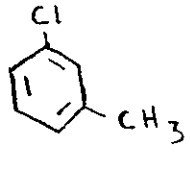
32. What is the chemical name for the following compound?

$CH_3CH_2CH(CH_3)CH_2CH(CH_3)CH_3$

A) 3,5-methylhexane B) 2,4-methylhexane

C) 2,4-methyloctane D)_____

33. What is the chemical name for the following compound?



A) meta-chloromethyltoluene B) meta-chloromethylbenzene

C) ortho-phenylchloromethane D)_____

34. The rate constant, k, is the:

A) proportionality constant in rate laws.
B) sum of the reaction coefficients.
C) product of the reaction coefficients.
D) dimensionless variable in rate laws.

35. It was experimentally determined that the following reaction is first order in X and second order in Z. Which of the following statements is NOT true?

$$X + Z \rightarrow \text{Products}$$

A) It's not possible for the above reaction to be first order in X and second order in Z.
B) Doubling the concentration of X will increase the rate of reaction by a factor of two.
C) Halving the concentration of Z will decrease the rate of reaction by a factor of one quarter.
D) The overall reaction order of the experimentally verified rate law is three.

36. How will increasing the concentrations of the reactants in the equation below affect the overall cell emf, E_{cell}? Assume product concentrations are non-zero values.

$$A^{2+}(aq) + B^{1+}(aq) \rightleftharpoons A^{1+}(aq) + B^{2+}(aq)$$

A) Nothing, because the standard cell potential, E^{o}_{cell} is a constant value.
B) Nothing, because the equilibrium constant of the above reaction is a constant value.
C) Nothing, because product concentration remains unchanged.
D) Cell emf, E_{cell}, will decrease.
E) Cell emf, E_{cell}, will increase.

37. Which of the following cell diagrams represents the standard electrode SHE?

A) $Zn \mid Zn^{2+}(aq, 1M)$
B) $Pt \mid H^{+}(aq, 1M)$
C) $Cu \mid Cu^{2+}(aq, 1M)$
D) $Au \mid H_2O \mid H^{+}(aq, 1M)$
E)_____

38. Which of the following statements is true?

A) An electrochemical cell can be constructed from zinc, zinc chloride, water and a salt bridge.
B) Electrolysis of water yields hydronium and hydroxide ions.
C) If one wants to make powerful batteries, then it's a good idea to use metals with positive standard potentials as the anode.
D) Chlorine is a good reducing agent.
E) All of the above statements are false.

39. What is the principal product when the alkene, $CH_3CH_2CH(CH_3)CH_2CH{=}CH_2$, reacts with HCl?

A) 1-chloro-4-methylheptane
B) 6-chloro-3-methylheptane
C) 2-chloro-4-methylheptane
D)_____