CHEM 103 Final Exam

Glossary

$R = .08206$ L atm mol^{-1} K^{-1} = 8.314 J mol^{-1} K^{-1}
F = 96,485 C mol^{-1}
c = 3.00 x 10^8 m s^{-1}
1 V = 1 J/C
1 Amp = 1 C/s
e = 1.602 x 10^{-19} C

Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question.

____ 1. Which compound would not be used as an antacid for the treatment of heartburn?
a. KOH
b. $Al(OH)_3$
c. $Mg(OH)_2$
d. $NaHCO_3$
e. $CaCO_3$

____ 2. The particle used to bombard the nucleus in the reaction shown is a(an)

$$^{235}_{92}U + \_\_\_\_\_ \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3\,{}^{1}_{0}n$$

a. alpha particle.
b. positron.
c. proton.
d. neutron.
e. beta particle.

____ 3. The reaction between acetic acid (CH_3COOH)and water is written as
a. $CH_3COOH + H_2O \rightleftharpoons CH_2COOH^- + H_3O^+$
b. $CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + OH^-$
c. $CH_3COOH + H_2O \rightleftharpoons CH_3COOH_2^+ + OH^-$
d. $CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$
e. $CH_3COOH + H_2O \rightleftharpoons CH_3COOH^- + H_3O^+$

____ 4. In the anode compartment of an electrochemical cell, the electrode is being _________, and _________ are flowing in from the salt bridge.
a. oxidized; anions
b. oxidized; cations
c. oxidized; electrons
d. reduced; cations
e. reduced; anions

____ 5. For a zinc-platinum electrochemical cell, calculate the value of E_{cell} when the concentration of Pt^{2+}(aq) is 0.050 M and the concentration of Zn^{2+}(aq) is 1.1 M. E_{cell} = 1.96 V under standard conditions. Pt is the less active metal.
a. 2.04 V
b. 2.00 V
c. 1.96 V
d. 1.92 V
e. 1.88 V

____ 6. Will a precipitate form when 10.0 mL of 0.500 M NaCl is added to 10.0 mL of 0.0500 M $AgNO_3$? The K_{sp} for AgCl is 1.8×10^{-10}.
a. Yes, because $Q < K_{sp}$
b. Yes, because $Q = K_{sp}$
c. Yes, because $Q > K_{sp}$
d. No, because $Q < K_{sp}$

e. No, because $Q > K_{sp}$

____ 7. Consider a buffer solution made up of $H_2PO_4^-$ and HPO_4^{2-}. For $H_2PO_4^-$, $K_a = 6.2 \times 10^{-8}$. What mole ratio of HPO_4^{2-} to $H_2PO_4^-$ will give a pH of 7.35?

a. 0.14 to 1
b. 0.72 to 1
c. 1 to 1
d. 1.4 to 1
e. More information is needed to answer this question.

____ 8. Use the data given to calculate the value of K for the reaction at 5 C

$Ag^+(aq) + Cl^-(aq) \rightleftharpoons AgCl(s)$

	AgCl(s)	$Ag^+(aq)$	$Cl^-(aq)$
S (J K^{-1} mol^{-1})	96.2	72.68	56.4
H_f (kJ/mol)	-127.07	105.58	-167.2

a. 1.9×10^{12}
b. 3.7×10^{10}
c. 5.7×10^{9}
d. 1.3×10^{6}
e. 1.0

____ 9. Nature favors exothermic reactions because after such a reaction

a. energy previously concentrated in a few particles is now dispersed over more particles in the system.
b. energy previously concentrated in a few particles is now dispersed over more particles in the surroundings.
c. energy previously concentrated in a few particles is now dispersed over more particles in both the system and the surroundings.
d. energy previously held in many particles is now concentrated in a few, resulting in a temperature rise.
e. energy previously held in many particles is now concentrated in a few, resulting in a temperature fall.

____ 10. Which set of conditions describes a reaction that is most likely to proceed?

a. endothermic, decreasing entropy, high activation energy
b. exothermic, decreasing entropy, high activation energy
c. exothermic, increasing entropy, high activation energy
d. exothermic, increasing entropy, low activation energy
e. endothermic, decreasing entropy, low activation energy

____ 11. Which statement concerning fusion is correct?

a. Extremely high temperatures are not required.
b. A plasma of unbound nuclei and electrons must be formed.
c. Large nuclei are needed as reactants for fusion reactions.
d. Fusion reactions require large amounts of energy to sustain them.
e. Products of fusion reactions are always radioactive.

____ 12. Alpha particles are best described as

a. neutral particles that weigh approximately one atomic mass unit.
b. positive particles that are identical to the nucleus of an atom of ^4He.
c. electrons ejected at high speeds from a radioactive nucleus.
d. high-speed particles similar in size to an electron, but oppositely charged.
e. a form of electromagnetic radiation.

____ 13. The K_{sp} expression for silver phosphate, Ag_3PO_4 is

a. $[Ag^+][PO_4^{3-}]$.

b. $[Ag^+][PO_4^{3-}]^3$.

c. $[Ag^+]^3[PO_4^{3-}]$.

d. $3[Ag^+][PO_4^{3-}]$.

e. $3[Ag^+]^3[PO_4^{3-}]$.

____ 14. The relationship between Gibbs free energy and E $_{cell}$ is G =

a. $-\dfrac{0.0592}{n}$ log K

b. $\dfrac{0.0592}{n}$ log K

c. -nFE $_{cell}$.

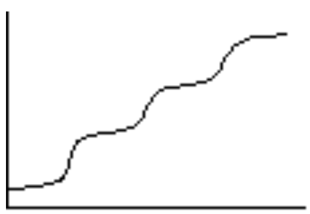
d. nFE $_{cell}$.

e. -RT ln K.

____ 15. The value of the ionization constant for a weak acid HA is 4.2×10^{-7}. What is the pH of a 0.35 M solution of this acid?

a. 6.83
b. 6.38
c. 3.42
d. 3.19
e. 2.96

____ 16. Which acid-base titration would yield a titration curve of the general form shown?



a. H_2CO_3 titrated with NaOH
b. NaOH titrated with H_3PO_4
c. Na_3PO_4 titrated with HCl
d. H_2SO_4 titrated with NaOH
e. H_3PO_4 titrated with NaOH

____ 17. The value of E $_{cell}$ for an aluminum-nickel electrochemical cell is +1.41 V at 25 C. Calculate the value of G for this cell under standard conditions.

a. -816 kJ
b. -680 kJ
c. -272 kJ
d. +403 kJ
e. +680 kJ

____ 18. Gamma radiation is best described as

a. neutral particles that weigh approximately one atomic mass unit.
b. positive particles that are identical to the nucleus of an atom of ^{4}He.
c. electrons ejected at high speeds from a radioactive nucleus.
d. a form of electromagnetic radiation.
e. high-speed particles similar in size to an electron, but oppositely charged.

____ 19. Ammonia is a weak base and perchloric acid is a strong acid. Which statement is true of a solution of ammonium perchlorate?
a. It is strongly acidic.
b. It is weakly acidic.
c. It is neutral.
d. It is weakly basic.
e. We cannot predict its acid-base properties without more information.

____ 20. A buffer solution is 0.500 M in ascorbic acid and 0.500 M in sodium ascorbate. Its pH is 4.10. After addition of 10 mL of 1 M NaOH to 1.00 L of this buffer, the most likely value of the pH is
a. 4.08.
b. 4.10.
c. 4.12.
d. 5.95.
e. 10.15.

Exhibit 17-1
A 50.00 mL sample of 0.0950 M acetic acid ($K_a = 1.8 \times 10^{-5}$) is being titrated with 0.106 M NaOH.

____ 21. Refer to Exhibit 17-1. What is the pH at the equivalence point of the titration?
a. 5.28
b. 7.00
c. 8.72
d. 9.26
e. Need more information to answer

____ 22. One of the reactants used to produce nitrogen for automobile air bags is _________.
a. ammonia
b. ammonium nitrate
c. liquid air
d. nitric acid
e. sodium azide

____ 23. Beta particles are best described as _________, ejected at high speeds from a radioactive nucleus.
a. protons
b. particles similar in size to an electron, but oppositely charged
c. electrons
d. neutral particles weighing approximately one atomic mass unit
e. positive particles identical to the nucleus of an atom of ^{4}He

____ 24. In the reaction shown, the radiation produced is a(an)

$$^{51}_{22}Ti \rightarrow ^{51}_{23}V + \_\_\_\_\_\_\_\_\_\_\_\_\_\_.$$

a. alpha particle.
b. positron.
c. beta particle.
d. neutron.
e. gamma ray.

____ 25. ^{90}Sr is an isotope produced from atmospheric testing of nuclear bombs. If nuclear testing was stopped in 1960, what percentage of radioactivity due to ^{90}Sr remained in 2000? The half-life of ^{90}Sr is 28.5 years.
a. 62.2 %
b. 37.8 %
c. 12.3 %
d. 0.85 %
e. virtually 0 %

____ 26. The half-life of radon-222 is 2.8 days. A homeowner used a radon test-kit to sample the air in his home, but forgot to send it for processing for 30 days. If the level of radon was actually 100 counts, what value would be reported by the test lab?
a. 94 counts

b. 17 counts
c. 9.3 counts
d. 1.5 counts
e. 0.060 counts

____ 27. All of the following are uses of radioactivity except
a. radiation therapy.
b. irradiation of food by microwaves.
c. tracers in medical procedures.
d. production of electricity.
e. dating of archaeological remains.

____ 28. In the reaction shown below, _________ is the oxidizing agent and _________ the reducing agent.
$$Zn(s) + H_2SO_4(aq) \rightarrow H_2(g) + ZnSO_4(aq)$$
a. Zn^{2+}; H_2
b. Zn; H^+
c. H_2; Zn^{2+}
d. H^+; Zn^{2+}
e. H^+; Zn

____ 29. A certain reaction has H_{rxn} = +177.8 kJ, and S_{rxn} = +160.5 J/K. Above what temperature does it become product-favored ?
a. 384 C
b. 630 C
c. 835 C
d. 1108 C
e. 1381 C

____ 30. Which has the highest entropy?
a. $H_2O(g)$ at 150 C
b. $H_2O(g)$ at 100 C
c. $H_2O(l)$ at 100 C
d. $H_2O(l)$ at 4 C (the temperature of maximum density)
e. $H_2O(s)$ at -50 C

Problem

31. A 100 MW power plant uses the following nuclear reaction to generate heat, thereby producing steam that drive a turbine to generate electricity:

$$^{235}_{92}U + ^{1}_{1}n \rightarrow ^{140}_{53}I + ^{94}_{38}Sr + 2\ ^{1}_{1}n$$

If the efficiency of the plant is 27% (27% of energy produced by reaction is converted into electricity), how many grams of $^{235}_{92}U$ must be consumed in a 24 hour period to operate the 100 MW plant?

1 W = 1 J/s
$^{1}_{1}n$ = 1.00867 g/mol
$^{94}_{38}Sr$ = 93.91536 g/mol
$^{140}_{53}I$ = 139.93121 g/mol
$^{235}_{92}U$ = 235.0439 g/mol

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32. From the following information, determine the solubility product, K_{sp}, of $AgBr(s)$.

$$AgBr(s) + e^- \rightarrow Ag(s) + Br^-(aq) \qquad E^o = 0.071\ V$$
$$Ag^+(aq) + e^- \rightarrow Ag(s) \qquad E^o = 0.799\ V$$

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Answer Section

MULTIPLE CHOICE

1.	ANS: A	OBJ: 16.10 Practical Acid-Base Chemistry
2.	ANS: D	OBJ: 20.5 Artificial Transmutations
3.	ANS: D	OBJ: 16.2 Carboxylic Acids and Amines
4.	ANS: A	OBJ: 19.3 Electrochemical Cells
5.	ANS: D	OBJ: 19.7 Effect of Concentration on Cell Potential
6.	ANS: C	OBJ: 17.6 Precipitation: Will it Occur?
7.	ANS: D	OBJ: 17.1 Buffer Solutions
8.	ANS: B	OBJ: 18.7 Gibbs Free Energy Changes and Equilibrium Constants
9.	ANS: C	OBJ: 18.2 Chemical Reactions and Dispersal of Energy
10.	ANS: D	OBJ: 18.11 Thermodynamic and Kinetic Stability
11.	ANS: B	OBJ: 20.7 Nuclear Fusion
12.	ANS: B	OBJ: 20.1 The Nature of Radioactivity
13.	ANS: C	OBJ: 17.4 Solubility Equilibria and the Solubility Product Constant, K
14.	ANS: C	OBJ: 19.6 E° and Gibbs Free Energy
15.	ANS: C	OBJ: 16.7 Problem Solving Using K
16.	ANS: E	OBJ: 17.2 Acid-base Titrations
17.	ANS: A	OBJ: 19.6 E° and Gibbs Free Energy
18.	ANS: D	OBJ: 20.1 The Nature of Radioactivity
19.	ANS: B	OBJ: 16.8 Acid-Base Reactions of Salts
20.	ANS: C	OBJ: 17.1 Buffer Solutions
21.	ANS: C	OBJ: 17.2 Acid-base Titrations
22.	ANS: E	OBJ: 21.6 A Periodic Perspective: The Main Group Elements
23.	ANS: C	OBJ: 20.1 The Nature of Radioactivity
24.	ANS: C	OBJ: 20.2 Nuclear Reactions
25.	ANS: B	OBJ: 20.4 Rates of Disintegration Reactions
26.	ANS: E	OBJ: 20.4 Rates of Disintegration Reactions
27.	ANS: B	OBJ: 20.9 Applications of Radioactivity
28.	ANS: E	OBJ: 19.1 Redox Reactions
29.	ANS: C	OBJ: 18.6 Gibbs Free Energy
30.	ANS: A	OBJ: 18.3 Measuring Dispersal of Energy: Entropy

PROBLEM

31. ANS:
xxxxxx

32. ANS:

AgBr(s) + e- → Ag(s) + Br-(aq) Eo = 0.071 V
Ag(s) → Ag+(aq) + e- Eo = -0.799 V

AgBr(s) → Ag+(aq) + Br-(aq) Eo =-0.728 V

Ksp = 4.87 x 10-13