FORM A is EXAM IV, VERSION 1 (v1)

Name________________________________

1. DO NOT TURN THIS PAGE UNTIL DIRECTED TO DO SO.
2. These tests are machine graded; therefore, be sure to use a No. 1 or 2 pencil for marking the answer sheets.
3. Completely blacken the answer circle. If you change an answer, erase completely the previous mark.
4. You may remove you answer sheet from this booklet. If you have a pink test, test form A should be darkened (B for Blue), if it is not, notify your instructor immediately.
5. Fill in your last name, first name, and initial. Blacken the corresponding letters below.
6. Fill in your ID number. CAREFULLY, blacken the corresponding numbers below this section.
7. Fill in the Dept. Course No. and Section. The Dept. = CHEM, the Course No. = 102, and your section refers to your lab section.
8. If you what your scores posted by a portion of your ID #, mark A under the option column.
9. READ THE TEST CAREFULLY. The time limit on this test is 50 minutes.
10. Use the test for scratch paper.
11. Mark your answers in this booklet as well as on the answer sheet so you can check your score with the key after the test.
12. There are 14 questions. Each counts 7 points for 98 pts, plus 2 pts IF your name and ID are correctly bubbled in for a total of 100 points.
13. Your score will be calculated from the number of correct answers. There is no penalty for guessing.
14. Turn in your scan sheet, show your ID, and have your calculator checked. You will also turn in your test.
15. A key will be on the electronic class bulletin board at 2:15PM. This is accessed through the class homepage

IMPORTANT INFORMATION:         F = 1.8 C + 32
                                      4.184 J = 1 calorie
R = 0.0821 L • atmos/ K • mol or R = 8.314 J/K mol
q = msΔt  ΔG = ΔH -TΔS  ΔG° = -RT lnK  S_liquid_water = 4.184 J/g•°C


\[ \frac{[A]₀}{2ak} = t_{1/2} \]  \[ \frac{0.693}{ak} = t_{1/2} \]  \[ \frac{1}{ak[A]₀} = t_{1/2} \]  \[ \frac{1}{[A]} = akt + \frac{1}{[A]₀} \]

\[ \ln \left| k_1 \right| = \frac{Ea}{R} \left[ \frac{1}{T} - \frac{1}{T₁} \right] \]  \[ \ln \left| k_2 \right| = \frac{\Delta H}{R} \left[ \frac{1}{T} - \frac{1}{T₁} \right] \]  \[ \ln \left| K₁ \right| = \frac{\Delta H}{R} \left[ \frac{1}{T} - \frac{1}{T₁} \right] \]  \[ \ln \left| K₂ \right| = \frac{\Delta H}{R} \left[ \frac{1}{T} - \frac{1}{T₁} \right] \]

\[ pH = pK_a + \log \left[ \text{[conj]} \right] \]

\[ E = E° - 0.0592 \log Q \]

F = 96,500 coul/mol

1 coul = 1 amp • sec = J/V

Standard Reduction Potentials in V:

\[ \text{Zn}^2+ + 2e^- \rightarrow \text{Zn}, \quad -0.76 \]
\[ \text{Ca}^{2+} + 2e^- \rightarrow \text{Ca}, \quad -2.87 \]
\[ \text{Br}^-, 2e^- \rightarrow \text{Br}, \quad +1.06 \]
\[ \text{Ni}^{2+} + 2e^- \rightarrow \text{Ni}, \quad -0.28; \]
\[ \text{F}^-, 2e^- \rightarrow 2\text{F}^- , +2.87 \]
\[ 2\text{H}_2\text{O} + 2e^- \rightarrow \text{H}_2 + 2\text{OH}^-, -0.83 \]
\[ \text{Cu}^{2+} + 2e^- \rightarrow \text{Cu}, \quad 0.34 \text{ V} \]
\[ 4\text{H}^+ + 4\text{e}^- \rightarrow 2\text{H}_2\text{O} , +1.23 \]

102 Sample Exam 4-1    page1
1. Which statement about the following reaction is INCORRECT?

\[
\text{Zn}(s) + 2\text{HI}(aq) \rightarrow \text{ZnI}_2(aq) + \text{H}_2(g)
\]

A. The oxidation number of the Zn ion in ZnI$_2$ is 2$^\text{+}$.
B. The H in HI is the reducing agent.
C. The oxidation number of H in H$_2$ is 0.
D. Zinc is oxidized.
E. The oxidizing agent accepts a total of 2 electrons.

2. What is the maximum concentration of SO$_4^{2-}$ that can exist in a solution, which has a Ba$^{2+}$ concentration of 0.010 M? (Ksp BaSO$_4$ = 1.1 x 10$^{-10}$)

A. 1.11 e-10
B. 1.1 e-8
C. 1.1 e-12
D. 0.55 e-10
E. 2.2 e-10

3. The solubility of BaCO$_3$ is 7.9 x 10$^{-3}$ g/L. The addition of solid Na$_2$CO$_3$ to a solution saturated with excess BaCO$_3$ will cause:

A. More BaCO$_3$ to dissolve.
B. No change in the solubility of the Ba$^{2+}$ ions
C. A deposit of Na to form.
D. An increase in the Ksp of BaCO$_3$
E. The precipitation of more BaCO$_3$.

4. What is the solubility product constant (Ksp) for Ag$_2$CrO$_4$ if the solubility is 6.50 x 10$^{-5}$ moles per liter of solution?

A. 6.50 e-5
B. 1.10 e-12
C. 1.69 e-8
D. 4.22 e-9
E. 2.75 e-13

5. Given: Standard Reduction Potentials

- \( \text{Hg}_2^{2+} + 2e^- \rightarrow 2\text{Hg} \) \( E^\circ = 0.79 \text{ V} \)
- \( \text{Cd}^{2+} + 2e^- \rightarrow \text{Cd} \) \( E^\circ = -0.40 \text{ V} \)
- \( \text{Ag}^{+} + e^- \rightarrow \text{Ag} \) \( E^\circ = 0.80 \text{ V} \)
- \( \text{Ni}^{2+} + 2e^- \rightarrow \text{Ni} \) \( E^\circ = -0.25 \text{ V} \)
- \( \text{Sn}^{4+} + 2e^- \rightarrow \text{Sn}^{2+} \) \( E^\circ = 0.15 \text{ V} \)
- \( \text{Br}_2 + 2e^- \rightarrow 2\text{Br}^- \) \( E^\circ = 1.07 \text{ V} \)

Which of these is TRUE?

A. Ni$^{2+}$ is more likely to be oxidized than Cd
B. The reaction of Sn$^{4+}$ and Br$^-$ would be nonspontaneous.
C. The reaction of Ni$^{2+}$ and Ag would be spontaneous.
D. Br$_2$ is the strongest reducing agent.
E. The reaction of Hg$_2^{2+}$ and Cd$^{2+}$ would be spontaneous.
6. The equilibrium constant for the following reaction is $5.6 \times 10^{-20}$ at 25 °C. Calculate the value of $E^\circ$ for the cell utilizing this reaction:

$$2 \text{Hg(l)} + 2\text{Cl}^-(aq) + \text{Ni}^{2+}(aq) \rightarrow \text{Ni(s)} + \text{Hg}_2\text{Cl}_2(s)$$

A. -1.14 V  B. +0.57 V  C. -0.57 V  D. +1.14 V  E. -0.25 V

7. What are the products of the electrolysis of aqueous CuBr_2?
A. Cu + Br_2  B. H_2 + Br_2  C. H_2 + O_2  D. Cu + H_2  E. Cu + O_2

8. The standard reduction potential of the Ag^+ | Ag half-cell is +0.80V and the standard cell potential for the following cell is +0.84.

$$\text{Fe(s)} \mid \text{Fe}^{3+}(aq) \parallel \text{Ag}^+(aq) \mid \text{Ag(s)}$$

What is the standard reduction potential of $\text{Fe}^{3+} + 3\text{e}^- \rightarrow \text{Fe}$

A. -0.04 V  B. +0.04 V  C. +1.64 V  D. -0.12 V  E. -1.64 V

9. How many moles of Cl_2 (g) are produced by the electrolysis of molten sodium chloride, if 2.00 amps are passed through the substance for 8.00 hours? The equation for this process is:

$$2\text{NaCl} \rightarrow 2\text{Na} + \text{Cl}_2$$

A. 0.894 mol  B. 0.0149 mol  C. 0.298 mol  D. 0.596 mol  E. 0.00496 mol

10. Which statements are TRUE for the cell?

$$\text{Ni} \mid \text{Ni}^{2+}(0.20 \text{ M}) \parallel \text{Cd}^{2+}(0.50 \text{ M}) \mid \text{Cd}$$

(#1) The Ni | Ni^{2+} electrode is the cathode.
(#2) The mass of the Cd electrode will decrease.
(#3) The concentration of Cd^{2+} will decrease.
(#4) The electrons travel from the Cd electrode towards the Ni electrode.
(#5) The Ni electrode has a negative charge.

A. #2 & #4  B. #1 & #2  C. #1 & #4  D. #3 & #5  E. #2 & #5

11. How many electrons appear in the balanced half-reaction for:

$$\text{ClO}^- (aq) \rightarrow \text{Cl}^- (aq) \text{ in basic solution?}$$

A. 1  B. 2  C. 6  D. 4  E. 0

12. The relationship between the molar solubility in water, S, and the Ksp for the ionic solid Fe(OH)_3 is:

A. Ksp = 27S^4  B. Ksp = 3S^2  C. Ksp = 3S^4  D. Ksp = 9S^4  E. Ksp = S

13. The standard reduction potentials in V for Zn^{2+} and Cu^{2+} are -0.76 and +0.34, respectively. What is the concentration of Zn^{2+} when the following cell has the potential of 1.30 V at 25°C?

$$\text{Zn} \mid \text{Zn}^{2+}(X \text{ M}) \parallel \text{Cu}^{2+}(1.0 \text{ e-5 M}) \mid \text{Cu}$$

A. 4.4 e-87 M  B. 1.0 M  C. 4.4 e-9 M  D. 1.7 e-12 M  E. 1.0 e-5 M
14. A buffer was prepared by mixing 0.4 mol of acetic acid and 0.5 mol of sodium acetate to form an aqueous solution with 1.00 L volume. To this solution 0.4 mol of HCl was added. What is the resulting pH? (assume no change in volume.) $Ka$ for acetic acid $= 1.8 \times 10^{-5}$

A. 5.65  B. 4.74  C. 7.00  D. 3.74  E. 3.84

**Key**

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**NUCLEAR**

1. What is the element produced when Rb-81 undergoes positron emission (positron decay)?
   A. Kr  B. Sr  C. Se  D. Y  E. Br

2. If it takes 5.0 years for Co-60 to lose one-half of its radioactivity, what percentage of its original activity will remain at the end of 20 years?
   A. 25.0%  B. 12.5%  C. 0.00%  D. 6.25%  E. 37.5%

3. In the TWO successive nuclear reactions, the element $Z$ that is formed is:
   $$^{239}_{92}U \rightarrow ^{8}_{-1}B + ^{238}_{93}Y \rightarrow ^{239}_{93}Z \rightarrow ^{241}_{92}Z \rightarrow ^{239}_{94}Z$$

   the element $Z$ that is formed is
   A.  B.  C.  D.  E.

   A.  B.  C.  D.  E.

4. A gamma radiation has a mass number of _____, a charge of _____, and a mass equal to that of _____.
   A. 4, 2+, a helium nucleus  B. 0, 1-, an electron  C. 1, 1, a proton
   D. 0, 0, nothing-no mass  E. 0, 1+, a positive electron
5. Predict which one of these radioactive particles will be emitted by the decay of Li-9. (Li is atomic #3)
   A. \( ^4 \text{He} \)  B. \( ^0 \text{e} \)  C. \( ^0 \text{e} \)  D. \( _1 \text{p} \)  E. \( _0 \text{n} \)

6. The mass of a proton is \( 1.673 \times 10^{-24} \text{ g} \).
   The mass of a neutron is \( 1.675 \times 10^{-24} \text{ g} \).
   The mass of the nucleus of an Fe-56 atom is \( 9.289 \times 10^{-23} \text{ g} \).
   What is the nuclear binding energy (in J) for 1 mole of Fe-56 nuclei? (C = \( 3.00 \times 10^8 \text{ m/s} \))
   A. 4.65 e13 J  B. 1.59 e4 J  C. 1.59 e7 J  D. 9.289 e-23 J  E. 7.90 e-14 J

7. The moderator of a nuclear reactor is between and around the fuel rods. The moderator's main purpose is:
   A. to speed up the rate of the fission reaction.
   B. to slow down the neutrons given off in a fission reaction.
   C. to cool the reactor core.
   D. to start the fission of U-235.
   E. to absorb the neutrons given off in a fission reaction.

8. Answer each of the following as True or False. Then choose the response that contains the largest number of TRUE statements?
   (1) Fusion is a process that involves two or more nuclei becoming one.
   (2) Radon gas is a source of radiation that accounts for a very small part of the radiation absorbed by the human population.
   (3) The main difference between hydrogen bombs and atomic bombs is that hydrogen bombs are lighter weight.
   (4) Fission bombs are atomic bombs.
   (5) Radiation began with nuclear testing and was not present before that time.
   A. #2, #3, and #5 are true.
   B. #3 and #5 are true.
   C. #1 and #3 are true.
   D. #1 and #4 are true.
   E. all are true.
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