

Printed **Last** Name: |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|

Printed **First** Name: |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|

Social Security # |_|_|_|_|_| |_|_|_|_|_| |_|_|_|_|_|

School: |_|_||Barnard |_|_||College |_|_||Engineering |_|_||General Studies

Chemistry 1404y

Exam 4

May 6, 2002

INSTRUCTIONS

Fill in your name and CUID number as indicated above.

On the bubble sheet:

- 1) On **Side 2 of the Bubble Sheet** print your first and last name in the box provided.
- 2) Then fill in the **IDENTIFICATION NO.** in the space provided and as indicated.
Your Identification No. is your SOCIAL SECURITY NUMBER.
- 3) Using a soft lead pencil, blacken the one response that best answers the question or completes the statement. There is only one correct answer to each question. Any question with more than one answer will not be counted. Your score will be the total number of correct answers; therefore, it is to your advantage to answer every question.
- 4) **There are 21 QUESTIONS. They are equally weighted.**

UNDER NO CIRCUMSTANCES are you to make any other marks... anywhere on the bubble sheet... except in the appropriate *bubbles* for marking an answer you believe to be correct.

You may write on the exam sheets themselves for the purpose of doing calculations.... but DO NOT WRITE ON THE BUBBLE SHEET.

A **FORMULA SHEET** and a **TABLE OF THE STANDARD REDUCTION POTENTIALS** are provided on **PAGE 8 and 9**. A **SCRATCH SHEET** is provided on **PAGE 10**.

Check the front blackboard for **TIME REMAINING, LAST-MINUTE CORRECTIONS** and **ADDITIONAL INFORMATION**.

You will have 75 MINUTES to complete the exam.

WHEN YOU HAVE FINISHED THE EXAM or at the end of the allowed time, deposit your **exam questions** and **bubble sheets** in the **separate** boxes provided at the front of the room.

DO NOT FORGET! Print your first and last names in the box provided (1) on the bubble sheet, and (2) on the front page of the 10 pages of this exam.

REMEMBER! It is your responsibility to ensure that your bubble sheet and exam sheets are properly identified.

1. Which one of the following statements is true?

a) In a cell, electrons flow from the lower potential half-cell to the higher potential half-cell.

- b) Electrons flow from the oxidizer to the reducer.
- c) A salt bridge is grounded and therefore permits a return current flow.
- d) Diluting the oxidizer half-cell solution will always decrease the voltage.
- e) Diluting the reducer half-cell solution will always increase the voltage.

2. $\text{MnO}_4^- + s \text{Fe}^{2+} + t \text{H}^+ \rightarrow \text{Mn}^{2+} + x \text{Fe}^{3+} + y \text{H}_2\text{O}$

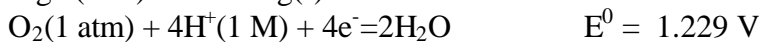
The correct values of the integers s, t, x, y are:

- a) 1111
- b) 1412
- c) 5458
- d) 5454
- e) **5854**

3. Which one of the following groups of three is arranged in order of **increasing** oxidizing strength under standard conditions? For half-cell voltages consult the table. The end product of O_2 is water.

- a) $\text{Ag}^+(1 \text{ M}), \text{O}_2(1 \text{ atm}), \text{AgCl}(s)$
- b) $\text{Ag}^+(1 \text{ M}), \text{AgCl}(s), \text{O}_2(1 \text{ atm})$
- c) $\text{AgCl}(s), \text{O}_2(1 \text{ atm}), \text{Ag}^+(1 \text{ M})$
- d) **$\text{AgCl}(s), \text{Ag}^+(1 \text{ M}), \text{O}_2(1 \text{ atm})$**
- e) $\text{O}_2(1 \text{ atm}), \text{Ag}^+(1 \text{ M}), \text{AgCl}(s)$

4. Find the voltage of a galvanic cell composed of the following two standard half-cells.



- a) -1.134
- b) 1.134
- c) 1.229
- d) -3.592
- e) **3.592**

5. A concentration cell consists of two half cells, each with a Mg electrode. $[\text{Mg}^{2+}]$ in one half-cell is 1 M and in the other $[\text{Mg}^{2+}]$ is 0.001 M. Assume room temperature. The cell voltage is

- a) 0.0257
- b) 0.0591
- c) **0.0887**
- d) 0.1182
- e) 0.1773

6. The joule, volt, watt, coulomb, kilowatt-hour, ampere are respectively units of

- a) **energy, potential, power, charge, energy, current**
- b) power, potential, energy, charge, energy, current
- c) energy, energy, power, current, power, charge
- d) energy, potential, power, charge, power, current

7. A factory produces a metric ton (2000 kg) of aluminum (atomic mass 27) each 24-hour day. What is the minimum average current that must be delivered to the factory?

- a) 41360 A
- b) 13790 A
- c) 124100 A
- d) **2.48×10^5 A**
- e) 7.44×10^5 A

8. If the factory receives 41360 A average current at a voltage of 3.5 volts and electricity costs 4 cents/kilowatt-hour, what is the daily electric bill?

- a) **\$139**
- b) \$3475
- c) \$13900
- d) \$347500

9. Which of the following five statements is true?

When a battery is being charged,

- a) it acquires negative charge because work is being done on it.
- b) the potential of the recharged cell will be equal and opposite to that of the discharged cell.
- c) **the original chemical reaction is reversed.**
- d) the anode and cathode remain the same.
- e) the cell free energy does not change.

10. Which of the following statements is **not** true?

The advantages of a hydrogen-oxygen fuel cell are:

- a) no exhaust except water
- b) very high efficiency
- c) no wasteful release of heat
- d) hydrogen is a relatively cheap fuel
- e) **long lived, inexpensive catalysts**

11. Standard half cells $\text{Zn}^{2+}(1\text{M}) + 2\text{e}^- = \text{Zn}(\text{s})$ are coupled to each of the five half cells; $\text{Mg}/\text{Mg}^{2+}(1\text{M})$, $\text{Zn}/\text{Zn}^{2+}(0.01\text{ M})$, $\text{Ni}/\text{Ni}^{2+}(1\text{ M})$, $\text{H}_2(1\text{ atm})/\text{OH}^-(1\text{ M})$, $\text{PbO}_2(\text{s})/\text{Pb}^{2+}(1\text{M})$. As the cell is discharging, in the standard Zn half-cell, more Zn is being deposited in some cases and Zn is going into solution in other cases. Which of the following statements is true?

- a) dissolving with the first two and depositing with the last three
- b) **depositing with the first two and dissolving with the last three**
- c) depositing with $\text{Zn}/\text{Zn}^{2+}(0.01\text{ M})$ and dissolving with the other four
- d) dissolving with $\text{Zn}/\text{Zn}^{2+}(0.01\text{ M})$ and depositing with the other four
- e) dissolving in all five cases

12. A cell is composed of two standard half-cells:



Each half-cell is separately diluted with distilled water so the final volumes are ten times the original ones. What is the new voltage of the cell?

- a) 0.089 V
- b) 0.060 V**
- c) 0.030 V
- d) 0.029 V
- e) 0.000 V

13. A second order reaction $\text{A} + \text{B} \rightarrow \text{C}$ is 80% complete after 30 minutes. What fraction of the initial A will remain after one hour? $[\text{A}] = [\text{B}]$ initially.

- a) 0.111**
- b) 0.888
- c) 0.040
- d) 0.0625

14. The reaction $2\text{Ce}^{4+}(\text{aq}) + \text{Tl}^+(\text{aq}) \rightarrow 2\text{Ce}^{3+}(\text{aq}) + \text{Tl}^{3+}(\text{aq})$ is slow because.. Which answer is correct?

- a) all the ions are positive
- b) $\text{Tl}^+(\text{aq})$ is not a strong reducer
- c) $\text{Ce}^{4+}(\text{aq})$ is not a strong oxidizer.
- d) $\text{Ce}^{4+}(\text{aq})$ can only abstract one electron from a reducer**

15. The rate constant for a zero order reaction is $k = 0.052 \text{ M/s}$. How long will it take for a 0.9 M solution to react completely?

- a) 0.047 s
- b) 0.058 s
- c) 19.2 s
- d) 17.3 s**

16. Which of the following is true? The enthalpy change ΔH for a reaction..

- a) **is the enthalpy of the products minus the enthalpy of the reactants**
- b) must be negative for the reaction to occur
- c) a measure of the temperature dependence of the reaction rate
- d) the energy of activation of the backward reaction minus the energy of activation of the forward reaction

17. A reaction has an activation energy of 65 kJ/mol. If, at 37 °C an enzyme increases the rate by a factor of 10^5 , assuming the A factor remains the same, what is the new activation energy?

- a) 65 kJ
- b) 13 kJ
- c) 37.6 kJ
- d) 3.76 kJ
- e) **35.3 kJ**

18. $2\text{N}_2\text{O}(\text{g}) \rightarrow 2\text{N}_2(\text{g}) + \text{O}_2(\text{g})$ is a first order process. At a certain temperature, after one minute the pressure of N_2O has decreased to half of its initial value. What fraction of the original N_2O will remain after four minutes?

- a) 0.250
- b) 0.750
- c) 0.9375
- d) 0,125
- e) **0.0625**

19. Which of the following statements is correct? A nickel or platinum surface catalyzes a hydrogenation reaction such as $\text{H}_2\text{C}=\text{CH}_2(\text{g}) + \text{H}_2(\text{g}) \rightarrow \text{H}_3\text{C}-\text{CH}_3(\text{g})$

- a) by facilitating migration of the reacting molecules on its very smooth surface
- b) by lowering the energy of activation for the bimolecular reaction above
- c) **by forming metal atom-H bonds**
- d) by adsorbing the ethylene and altering its structure.

20. Which of the following statements about chemical chain reactions is **incorrect**?

- a) Chain initiation involves formation of a chain carrier
- b) the chain carrier is a radical which has an odd number of electrons
- c) the chain propagates by reaction of the chain carrier with a molecule which forms a new molecule and a carrier
- d) the chain terminates because the molecules have all reacted.**

21. An Egyptian papyrus has 81 % of the ^{14}C content of living plants. The half-life of ^{14}C is 5620 years. What is the age of the papyrus?

- a) 5620 yr
- b) 1708 yr**
- c) 1068 yr
- d) 4552 yr
- e) 854 yr .

CONSTANTS AND FORMULAE

$$F = 96485 \text{ C}$$

$$R = 8.314 \text{ J/(mol.K)}$$

$$E = E^0 - (RT/nF) \ln Q = E^0 - (0.0257/n) \ln Q = E^0 - (0.0591/n) \log Q \text{ at } 298 \text{ K.}$$

Q = Products/Reactants, each concentration raised to the power of its coefficient in the chemical equation.

For a first order reaction: $A \rightarrow \text{Products}$, $A_{(t)} = A_{(0)} e^{-kt}$

For a second order reaction depending on A: $A_{(t)} = A_{(0)}/\{1 + kA_{(0)}t\}$

A table of the standards reduction potentials is provided on the following page.

