

February 27, 2009

Name: _____
Last Name First Name

Perm # _____

There are a total of six pages (19 questions) on the exam. **You must show your work on the exam.** We can evaluate your exam only if you have shown work.

SCANTRON FORM:Completely fill bubbles 

1) Write your name

Completely fill answers 2) Bubble in **FORM A**3) Bubble in your **PERM** number (7 digits only, no extra numbers)**INFORMATION PAGE:** Remove the information page. No other notes or books are allowed.

INSTRUCTIONS: Turn in your Exam and Scantron form. No hats/hoods allowed. No sharing of calculators. Cell Phones, iPods, headsets, and any other electronic devices must be turned off and put away.

1. (6 pts) Given the data below, what is the rate law for the following reaction? $A + B \rightarrow C$

Experiment	[A] (M)	[B] (M)	Initial Rate (M/s)
1	0.012	0.035	0.10
2	0.024	0.070	0.80
3	0.024	0.035	0.10
4	0.012	0.070	0.80

ANSWERS are at the end of the exam

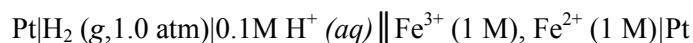
- a) Rate = $k [B]^4$
- b) Rate = $k [B]^2$
- c) Rate = $k [A]^2 [B]^2$
- d) Rate = $k [A] [B]^3$
- e) Rate = $k [B]^3$

$\text{Au}^{3+} + 3 \text{e}^- \rightarrow \text{Au (s)}$	$E^\circ \text{ (V)}$ 1.50	$\text{Cu}^{2+} + 2 \text{e}^- \rightarrow \text{Cu (s)}$	$E^\circ \text{ (V)}$ 0.34
$\text{Cl}_2 + 2 \text{e}^- \rightarrow 2 \text{Cl}^-$	1.36	$2 \text{H}^+ + 2 \text{e}^- \rightarrow \text{H}_2$	0.00
$\text{O}_2 + 4 \text{H}^+ + 2 \text{e}^- \rightarrow 2 \text{H}_2\text{O}$	1.23	$\text{Fe}^{3+} + 3 \text{e}^- \rightarrow \text{Fe (s)}$	-0.036
$\text{Fe}^{3+} + \text{e}^- \rightarrow \text{Fe}^{2+}$	0.77	$\text{Ni}^{2+} + 2 \text{e}^- \rightarrow \text{Ni (s)}$	-0.23
$\text{I}_2 + 2 \text{e}^- \rightarrow 2 \text{I}^-$	0.54	$\text{Al}^{3+} + 2 \text{e}^- \rightarrow \text{Al (s)}$	-1.66

2. (6 pts) Using the above half reactions, which of the following species can be reduced by Fe(s)?

- Al^{3+}
- Ni
- I_2
- Cu
- I^-

Questions 3 – 5: A galvanic cell is described by the following shorthand line notation



3. (6 pts) The half reaction that occurs at the cathode of this cell is written as

- $\text{H}_2(\text{g}, 1 \text{ atm}) \rightarrow 2 \text{H}^+(0.1 \text{ M}) + 2 \text{e}^-$
- $2 \text{H}^+(0.1 \text{ M}) + 2 \text{e}^- \rightarrow \text{H}_2(\text{g}, 1 \text{ atm})$
- $\text{Pt (s)} + \text{Fe}^{3+}(1 \text{ M}) \rightarrow \text{Pt}^+(\text{aq}) + \text{Fe}^{2+}(1 \text{ M})$
- $\text{Fe}^{2+}(1 \text{ M}) \rightarrow \text{Fe}^{3+}(1 \text{ M}) + \text{e}^-$
- $\text{Fe}^{3+}(1 \text{ M}) + \text{e}^- \rightarrow \text{Fe}^{2+}(1 \text{ M})$

4. (6 pts) The potential of this galvanic cell at 25 °C is

- 0.77 V
- greater than 0.77 V
- less than 0.77 V
- negative
- 0 V

5. (6 pts) When this cell is connected to an external circuit and its output is used to drive a fan motor, which of the following will occur?

- Platinum will be reduced
- Hydrogen gas will be formed
- Platinum will be oxidized
- Iron metal will plate out at the cathode
- None of the above

Questions 6 – 7: An acidified solution was electrolyzed using copper electrodes. A constant current of 1.18 A caused the anode to lose 0.584 g after 1.52×10^3 sec. Hydrogen gas was produced at the cathode.

6. (6 pts) Calculate the value of Faraday's constant from the experimental data given.
- a) $F > 96,485 \text{ C/mol}$
 - b) $F < 96,485 \text{ C/mol}$
 - c) $F = 96,485 \text{ C/mol}$
 - d) Faraday's constant cannot be determined from the data given.
7. (6 pts) Use the data given above to determine the volume of hydrogen gas produced at 23°C and 1 atm.
- a) 0.446 L
 - b) 0.223 L
 - c) 0.893 L
 - d) 22.3 L
 - e) none of the above
8. (6 pts) For the following galvanic cell, the standard free energy is $\Delta G^\circ = -89.3 \text{ kJ}$.



Calculate the standard cell potential E° .

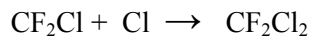
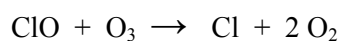
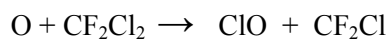
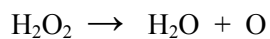
- a) +0.463 V
- b) -0.926 V
- c) -0.463V
- d) +0.926 V
- e) +0.231 V

9. (6 pts) The following two half-reactions take place in a galvanic cell. At standard conditions, what species are produced at each electrode?



- a) Ag is produced at the anode and Au^{3+} is produced at the cathode.
b) Au is produced at the cathode and Ag^{+} is produced at the anode.
c) Au is produced at the anode and Ag^{+} is produced at the cathode.
d) Ag is produced at the anode and Au is produced at the cathode.
e) Ag is produced at the cathode and Au^{3+} is produced at the anode.
10. (6 pts) For the reaction, $\text{A} \rightarrow \text{B}$, the activation energy, $E_a = 60 \text{ kJ/mol}$, and $\Delta E = 25 \text{ kJ/mol}$. What is the activation energy for the reverse reaction, $\text{B} \rightarrow \text{A}$?
- a) 85 kJ/mol
b) 60 kJ/mol
c) 35 kJ/mol
d) 25 kJ/mol
e) None of these
11. (6 pts) A particular first-order reaction, $\text{A} \rightarrow \text{Products}$, is 55.0 % complete in 70 seconds. What is the concentration $[\text{A}]$ after 80 seconds, if the initial concentration $[\text{A}]_0 = 0.10 \text{ M}$?
- a) 0.01 M
b) 0.02 M
c) 0.04 M
d) 0.05 M
e) 0.06 M

Questions 12 – 15: (3 pts each) Consider the following mechanism.



Given the mechanism above, identify each of the following substances as a catalyst, intermediate or neither.

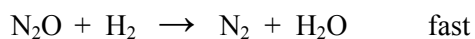
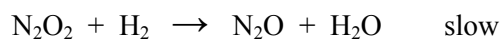
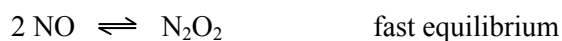
12. ClO a) catalyst b) intermediate c) neither

13. CF₂Cl a) catalyst b) intermediate c) neither

14. O₃ a) catalyst b) intermediate c) neither

15. CF₂Cl₂ a) catalyst b) intermediate c) neither

16. (6 pts) Consider the following mechanism.



What is the rate law for the mechanism given above? Eliminate all intermediates from the rate law.

a) Rate = k [N₂O₂] [H₂]

b) Rate = k $\frac{[\text{H}_2]}{[\text{NO}]^2}$

c) Rate = k [NO] [H₂]²

d) Rate = k [NO]² [H₂]²

e) Rate = k [NO]² [H₂]

More Problems



17. (6 pts) Consider the decomposition of hydrogen peroxide: $2 \text{H}_2\text{O}_2 \rightarrow \text{O}_2 + 2 \text{H}_2\text{O}$

The activation energy for the uncatalyzed reaction is 42. kJ/mol. When the reaction is catalyzed by the enzyme catalase, the activation energy is 7.0 kJ/mol. Calculate the temperature at which the uncatalyzed reaction proceeds as rapidly as the catalyzed reaction proceeds at 20 °C. Assume the frequency factor A is the same in both cases.

- a) $1.2 \times 10^3 \text{ K}$
- b) $1.8 \times 10^3 \text{ K}$
- c) $< 1000 \text{ K}$
- d) $> 2000 \text{ K}$
- e) 293 K

18. (6 pts) For which of the following transitions does the light emitted have the shortest wavelength?

- a) $n = 6$ to $n = 4$
- b) $n = 4$ to $n = 6$
- c) $n = 6$ to $n = 3$
- d) $n = 3$ to $n = 6$

19. (4 pts) If a beam of green light ($\lambda = 550 \text{ nm}$) can eject electrons from a metal surface, will red light ($\lambda = 700 \text{ nm}$) be able to eject electrons from this metal surface?

- a) Yes
- b) No

ANSWERS: 1. e 2. c 3. e 4. b 5. e 6. a 7. b 8. a 9. b 10. c 11. c 12. b
13. b 14. c 15. a 16. e 17. b 18. c 19. b

Partial Credit: 4 a (2 pts) 7 a (2 pts) 18 a (2 pts) 18 d (2 pts)