

Chemistry 1220, Section 1  
Third Hour  
Practice Exam  
Dr. Lisa M. Berreau

**Instructions:**

**Do not begin until 1:30 PM. The exam must be turned in by 2:20 PM.**

⇒ The exam has 25 questions. Each question is worth 4 points for a total of 100 points. A periodic table is located on the last page.

⇒ Use only a #2 pencil to mark the answer on the ScanTron sheet. You will turn in only the ScanTron sheet and you can keep the rest of the exam. Your exam results will be emailed to you. You can check your answers with the answer key that will be posted on-line immediately after the exam on my website under Exam Scores and Statistics.

⇒ On the ScanTron sheet print your name and identification number in the areas indicated. Indicate a four character code (any combination of letters and numbers - the same code that you used for the first exam) under "version#" for the purpose of reporting final grades.

$$E^{\circ}_{\text{cell}} = E^{\circ}_{\text{red(cathode)}} - E^{\circ}_{\text{red(anode)}}$$

$$\Delta G = -nFE \quad (F = 96,500 \text{ J/V}\cdot\text{mol})$$

$$E = E^{\circ} - \frac{0.0592 \text{ V}}{n} \log Q \quad (T = 298 \text{ K})$$

$$\log K = \frac{nE^{\circ}}{0.0592} \quad (T = 298 \text{ K})$$

$$E = mc^2 \quad (c = 3.0 \times 10^8 \text{ m/s})$$

$$1 \text{ J} = 1 \frac{\text{kg}\cdot\text{m}^2}{\text{s}^2}$$

charge of 1 mol of electrons = 96,500 C = 1 Faraday

Coulombs = amperes x seconds

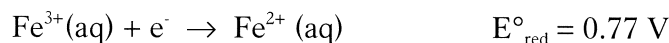
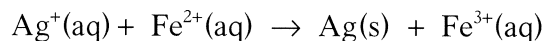
1<sup>st</sup> order reactions:

$$\ln [A]_t = -kt + \ln [A]_0$$

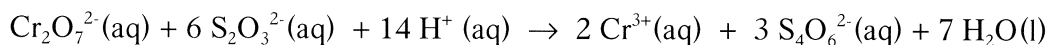
$$t_{1/2} = \frac{0.693}{k}$$

$$K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

1. Given the standard reduction potentials listed below, calculate the standard free energy change ( $\Delta G^\circ$  in kJ) for the following reaction at 25 °C.

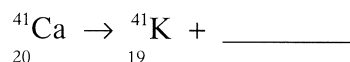


- (a) 1.0  
(b) 3.2  
(c) 2.0  
(d) 10
2. The mass of a proton is  $1.673 \times 10^{-24}$  g. The mass of a neutron is  $1.675 \times 10^{-24}$  g. The mass of the nucleus of an  $^{56}\text{Fe}$  atom is  $9.289 \times 10^{-23}$  g. What is the nuclear binding energy (in J) for  $^{56}\text{Fe}$ ?
- (a)  $7.72 \times 10^{-11}$   
(b)  $8.36 \times 10^{-9}$   
(c)  $2.57 \times 10^{-16}$   
(d)  $7.72 \times 10^{-8}$
3. One of the differences between a voltaic cell and an electrolytic cell is that in an electrolytic cell \_\_\_\_\_.
- (a) an electric current is produced by a chemical reaction  
(b) electrons flow toward the anode  
(c) oxidation occurs at the cathode  
(d) a nonspontaneous reaction is forced to occur
4. \_\_\_\_\_ is reduced in the following reaction.



- (a)  $\text{S}_4\text{O}_6^{2-}$   
(b)  $\text{Cr}_2\text{O}_7^{2-}$   
(c)  $\text{S}_2\text{O}_3^{2-}$   
(d)  $\text{Cr}^{3+}$

5. This reaction is an example of \_\_\_\_\_.



- (a) alpha decay
  - (b) positron decay
  - (c) electron capture
  - (d) gamma emission
6. What is a phosphor?
- (a) an oxide of phosphorous
  - (b) a substance that thermally reduces to phosphorus
  - (c) a substance that emits light when excited by radiation
  - (d) a bioluminescent substance
7. Which one of the following reactions is a redox reaction?
- (a)  $\text{NaOH}(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{NaCl}(\text{aq}) + \text{H}_2\text{O}$
  - (b)  $\text{Cu}(\text{s}) + \text{S}(\text{s}) \rightarrow \text{CuS}(\text{s})$
  - (c)  $\text{AgNO}_3(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{HNO}_3(\text{aq}) + \text{AgCl}(\text{s})$
  - (d)  $\text{Pb}^{2+}(\text{aq}) + 2\text{Cl}^{-}(\text{aq}) \rightarrow \text{PbCl}_2(\text{s})$
8. The electrode at which reduction occurs is called the
- (a) oxidant
  - (b) cathode
  - (c) salt bridge
  - (d) anode
9. The Haber process is used to make \_\_\_\_\_ from \_\_\_\_\_.
- (a)  $\text{HNO}_3, \text{N}_2$
  - (b)  $\text{NH}_3, \text{N}_2$
  - (c)  $\text{NO}_2, \text{O}_2$
  - (d)  $\text{NO}, \text{N}_2$

10. Which substance is serving as the reducing agent in the following reaction:



- (a)  $\text{HNO}_3$
- (b)  $\text{S}$
- (c)  $\text{NO}_2$
- (d)  $\text{Fe}_2\text{S}_3$

11. The heavier noble gases are more reactive than the lighter ones because \_\_\_\_\_.

- (a) the lighter noble gases exist as diatomic molecules
- (b) the heavier noble gases are more abundant
- (c) the heavier noble gases have low ionization energies relative to the lighter ones
- (d) the heavier noble gases have greater electron affinities

12. Which one of the following types of elements is most likely to be good reducing agents?

- (a) alkali metals
- (b) halogens
- (c) transition elements
- (d) noble gases

13. Given the following information

<u>Half-reaction</u>	<u><math>E^\circ_{\text{red}}</math> (V)</u>
$\text{Sn}^{4+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Sn}^{2+}(\text{aq})$	0.154
$\text{Fe}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Fe}(\text{s})$	-0.440
$\text{Fe}^{3+}(\text{aq}) + \text{e}^- \rightarrow \text{Fe}^{2+}(\text{s})$	0.771
$\text{Cr}^{3+}(\text{aq}) + 3\text{e}^- \rightarrow \text{Cr}(\text{s})$	-0.74

which of the following reactions will occur spontaneously as written?

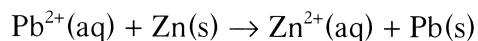
- (a)  $\text{Sn}^{2+}(\text{aq}) + \text{Fe}^{2+}(\text{aq}) \rightarrow \text{Sn}^{4+}(\text{aq}) + \text{Fe}^{3+}(\text{aq})$
- (b)  $\text{Sn}^{4+}(\text{aq}) + \text{Fe}^{2+}(\text{aq}) \rightarrow \text{Sn}^{2+}(\text{aq}) + \text{Fe}(\text{s})$
- (c)  $2\text{Cr}(\text{s}) + 3\text{Fe}^{2+}(\text{aq}) \rightarrow 3\text{Fe}(\text{s}) + 2\text{Cr}^{3+}(\text{aq})$
- (d)  $2\text{Cr}^{3+}(\text{aq}) + 3\text{Sn}^{2+}(\text{aq}) \rightarrow 3\text{Sn}^{4+}(\text{aq}) + 2\text{Cr}(\text{s})$

14. Which of the following compounds is a superoxide?

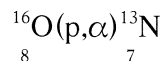
- (a)  $\text{H}_2\text{O}_2$
- (b)  $\text{RbO}_2$
- (c)  $\text{CaO}_2$
- (d)  $\text{TiO}_2$

15. The purpose of the salt bridge in an electrochemical cell is to
- (a) maintain electrical neutrality in the half-cells via migration of ions
  - (b) provide a source of ions to react at the anode and cathode
  - (c) provide a means for electrons to travel from the anode to the cathode
  - (d) provide a means for electrons to travel from the cathode to the anode
16.  $^{41}\text{Ca}$  decays by electron capture. The product of this reaction undergoes alpha decay. What is the product of this second decay reaction?
- (a) Ti
  - (b) Ca
  - (c) Ar
  - (d) Cl
17. What is required for a nuclear transmutation to occur?
- (a) very high temperature
  - (b) gamma emission
  - (c) spontaneous nuclear decay
  - (d) a particle to collide with a nucleus
18. What is the coefficient of  $\text{ClO}^-$  when the following equation is correctly balanced (basic solution)?
- $$\text{ClO}^-(\text{aq}) + \text{S}_2\text{O}_3^{2-}(\text{aq}) \rightarrow \text{Cl}^-(\text{aq}) + \text{SO}_4^{2-}(\text{aq})$$
- (a) 1
  - (b) 3
  - (c) 2
  - (d) 4
19. The oxidation state of oxygen in  $\text{O}_2\text{F}_2$  is \_\_\_\_\_.
- (a) -2
  - (b) +2
  - (c) -1
  - (d) +1
20. Which halogen can react with fluorine to form the compound  $\text{XF}_7$ ?
- (a) Br
  - (b) Cl
  - (c) I
  - (d) At

21. The value of  $E^\circ$  for the following reaction is 0.63 V. What is the value of E for this reaction (in V) when the concentration of  $Zn^{2+}$  is 1.0 M and the concentration of  $Pb^{2+}$  is  $2.0 \times 10^{-3}$  M?



- (a) 0.85  
(b) 0.52  
(c) 0.41  
(d) 0.74
22. An example of a form of pure carbon that contains only  $sp^3$  hybridized carbon atoms is \_\_\_\_\_.
- (a) graphite  
(b) buckminsterfullerene  
(c) diamond  
(d) charcoal
23. In the nuclear transmutation shown below, the emitted particle is \_\_\_\_\_.



- (a) a beta particle  
(b) a positron  
(c) an alpha particle  
(d) a proton
24.  ${}^{131}I$  has a half-life of 8.04 days. Assuming you start with a 1.53 mg sample of  ${}^{131}I$ , how many mg will remain after 13.0 days?
- (a) 0.835  
(b) 0.500  
(c) 0.440  
(d) 0.268
25. In hydrides of the Group I metals, the oxidation number of hydrogen is considered to be \_\_\_\_\_.
- (a) -2  
(b) 0  
(c) +1  
(d) -1