Chem 201
Fall 2011

# FINAL EXAM TOPICS

The exam will consist of 40 multiple choice questions, 11-12 from exam 1, 11-12 from exam 2, 11-12 from exam 3 and 4-5 from the material covered since exam 3. The latter material corresponds to Chap. 16, sections 7-8, and Chap. 24, sections 1, 2, 6. As usual the exam will consist of 70% "C" questions, 20% "B" questions, and 10% "A" questions. I will determine what are A, B and C questions from the midterm exams by considering how many people answered the question correctly on the exam.

## "C" Questions on New Material(Homework Examples)

### Chapter 16:

- Know what a reaction mechanism is, and the difference between an elementary step and the overall reaction.
- Write rate laws for elementary reactions. [16.72c, 16.82b]
- Know what the significance of the slow or "rate-determining step" in a reaction is. [16.70]
- Be able to determine the overall reaction from a series of elementary reactions. [16.72a]
- Be able to identify reaction intermediates in a mechanism. [16.72b, 16.82c, quiz 10]
- Know what a catalyst is and how it affects a chemical reaction. [*16.76*, 16.77, 16.78]
- Be able to identify the catalyst and the catalytic intermediate in a mechanism. [*16.83*]

### Chapter 24:

- Know what alpha emission, beta emission, electron capture, positron emission are. Be able to balance nuclear reactions. [24.8, 24.12]
- Know what half-life and the decay constant are. Be able to convert back and forth between the two.
- Use the integrated rate law for first order processes to determine time info given half life and some information about the amounts of radioactive material. [21.42 ($5.27\times10^7$ hr)]
- Use the integrated rate law for first order processes to determine info about amounts of radioactive material given half life and time. [24.41, *24.103*]
- Know what fusion and fission are. Know a little bit about what's going on in a chain reaction of $^{235}U$.

## "B" Questions on New Material (Homework Examples)

### Chapter 16:

- Tell whether a given reaction mechanism is consistent with a certain rate law. [16.72c,d, *16.74*,16.82d]

### Chapter 24:

- Understand the concept behind radioisotope dating and be able to use isotopic data to determine age. [24.43, 24.44 ($2.54\times10^3$ yr), *24.47*]
- Calculate the energy changes involved in nuclear reactions from the mass defects. [*24.83* (a: beta $^{80}Kr$, e capture $^{80}Se$; b: beta mass defect = 0.002148 amu, e capture mass defect = 0.002008 amu, since energy is proportional to mass loss, the beta decay is more energetic), *24.93* ($1.69\times10^9$ kJ/mol), 24.95, 24.128]

## "A" Questions (Homework Examples)

The other topics listed under B and C questions can be converted to A questions. In general, "A" questions are those which require bringing together different concepts and where the route to solve the problem is not implicitly given. An example: 24.109 (209.987676 amu)

## Sample Questions on New Material

1. The rate law for the following reaction is rate = $k[NO_2][O_3]$

$$2\ NO_2(g) + O_3(g) \rightarrow N_2O_5(g) + O_2(g)$$

Which one of the following is a plausible mechanism for the reaction?

(a) $NO_2 + NO_2 \rightleftarrows N_2O_4$ fast
$N_2O_4 + O_3 \rightarrow N_2O_5 + O_2$ slow

(b) $2\ NO_2 + O_3 \rightarrow N_2O_5 + O_2$

(c) $NO_2 + O_3 \rightarrow NO_3 + O_2$ slow
$NO_3 + NO_2 \rightarrow N_2O_5$ fast

(d) $NO_2 + O_3 \rightarrow NO + O_4$ slow
$NO_3 + NO \rightarrow N_2O_4$ fast
$N_2O_4 + O_4 \rightarrow N_2O_5 + O_3$ fast

2. Which one of the following statements regarding catalysts is **FALSE**?

(a) A catalyst is a chemical agent that speeds up the rate of a given reaction.
(b) A catalyst may be in the same phase or a different phase than the reactants and products.
(c) A catalyst has no effect on the mechanism of a reaction.
(d) A catalyst has no effect on $\Delta G$ or K of the reaction.
(e) Effective catalysis can be achieved even when the amount of catalyst is small compared to the amount of reactants.

3. Balance the following nuclear reaction and identify the type of radioactive decay.

$$^{18}_{10}\mathrm{Ne} \rightarrow\ ^{18}_{9}\mathrm{F} + \_\_$$

(a) $^{0}_{1}\mathrm{e}$ , positron decay (b) $^{0}_{1}\mathrm{e}$ , beta decay (c) $^{4}_{2}\mathrm{He}$ , alpha decay
(d) $^{0}_{-1}\mathrm{e}$ , beta decay (e) $^{0}_{-1}\mathrm{e}$ , electron capture

4. The radioactive isotope $^{19}O$, prepared by neutron irradiation of $^{19}F$, has a half life of 29 s. What percentage of a freshly prepared sample of $^{19}O$ remains after 2.00 min?

(a) 4.5% (b) 25% (c) 5.7% (d) 18% (e) 96%

5. How much energy is released in the following nuclear reaction?

$$^{21}_{10}\text{Ne} + {}^{4}_{2}\text{He} \rightarrow {}^{1}_{0}\text{n} + {}^{24}_{12}\text{Mg}$$

Mass of $^{21}$Ne = 20.993849 amu; Mass of $^{4}$He = 4.002604 amu;
Mass of a neutron = 1.008665; Mass of $^{24}$Mg = 23.985045 amu.

(a) $9.51\times10^{7}$ kJ/mol (b) 471 kJ/mol (c) $9.22\times10^{10}$ kJ/mol
(d) $7.65\times10^{4}$ kJ/mol (e) $2.47\times10^{8}$ kJ/mol

6. The approximate date of an earthquake that occurred in a remote region before recorded history is determined by measuring the $^{14}$C activity in parts of a tree uprooted by the quake. The $^{14}$C activity is 11.2 disintegrations/min·gC in the tree. A living tree has an activity of 15.3 disintegrations/min·gC. How long ago did the earthquake occur? $t_{1/2}$ of $^{14}$C = 5730 yr.

(a) 32,100 yr (b) 1790 yr (c) 599 yr (d) 1580 yr (e) 2580 yr

Answers: 1 c, 2 c, 3 a, 4 c, 5 e, 6 e.