

Exam I – Chapters 12 & 22

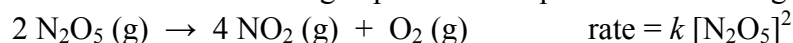
Please show all work for full credit and be mindful of your significant figures!

Please refer to the back of your periodic table for important equations.

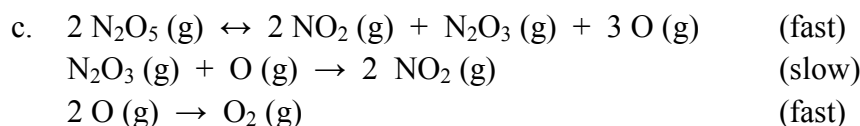
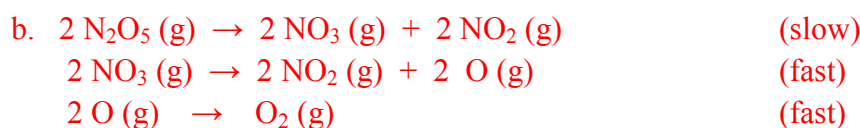
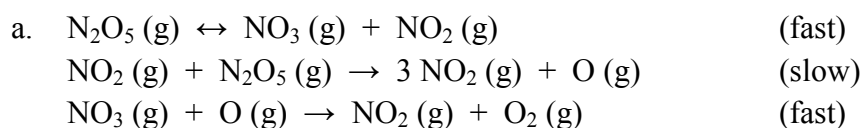
1. (pts) A chemistry student discovered a new radioisotope and collected some data on it. The student started with 35.68 g of the sample at 8:00 AM on Monday and returned to lab on Tuesday at 9:00 AM and found the mass of the radioisotope to be 25.07 g. What is the half-life of the student's radioisotope?

49.1 hrs

2. (pts) The reaction and rate law for the gas-phase decomposition of dinitrogen pentoxide are



Which of the following are valid mechanisms for the reaction? (*please circle either a, b, or c*)



3. (pts) Calculate the average rate of a reaction if at 15.0 seconds the reactant concentration is 2.50 M but after 43.5 seconds the concentration is 1.25 M. (*Hint: recall the original definition of rate.*)

0.0439 M/s

4. (pts) Please answer true or false regarding atom stability and decay? (*circle one*)

T / F a. ALL atoms with an odd number of protons and an odd number of neutrons are unstable.

T / F b. In general, atoms with an atomic number greater than Bi are unstable and undergo alpha decay.

T / F c. All elements on the periodic table have at least one stable isotope.

T / F d. Elements with an even atomic number usually have a larger number of stable isotopes than elements with an odd atomic number.

5. (pts) Nuclear fission is when the nucleus splits into two lighter nuclei and neutrons.
6. (pts) What type of radiation increases the atomic number of the parent nuclide?
 a. alpha b. beta c. gamma d. positron
7. (pts) What particle is argon-40 bombarded with to produce a neutron and potassium-40?
 a. ${}^0_1\text{e}$ b. ${}^0_{-1}\text{e}$ c. ${}^1_0\text{n}$ d. ${}^1_1\text{H}$
8. (pts) How many half-lives have passed when 75% of a sample decomposes?
 a. 1 b. 2 c. 3 e. not enough information given
9. (pts) Show the unstable nuclide ${}^{210}\text{Pb}$ undergo a decay series of β , β , α to a stable isotope.
- a.
- b.
- c.

Stable end isotope is ${}^{206}\text{Pb}$.

10. (pts) For the simple decomposition reaction



The rate law is $\text{rate} = k[\text{AB}]^2$.

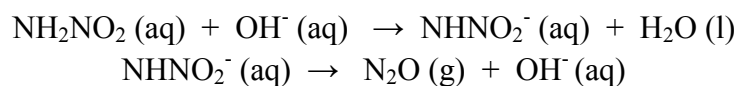
- a. If the rate is $3.45 \times 10^{-3} \text{ M/s}$ when the concentration of the reactant is 0.75 M, what is the rate when then concentration of the reactant is 1.25 M?
rate = $9.58 \times 10^{-3} \text{ M/s}$
- b. How many seconds will it take for the same reaction to go from a concentration of 2.25 M to a concentration of 0.50 M?
254 s

11. (pts) A particular first order reaction has a rate constant of $2.35 \times 10^{-2} \text{ s}^{-1}$ at $25.0 \text{ }^\circ\text{C}$. What is the value of the rate constant, k , at $65.0 \text{ }^\circ\text{C}$ if the activation energy is 55.5 kJ/mol ?

0.333 s^{-1}

Extra Credit: (5 pts)

Consider the following mechanism for the decomposition of nitramide (NH_2NO_2) in aqueous solution:



(1 pt) What is the catalyst in this reaction? _____

(1 pt) What is the intermediate in this reaction? _____

(1 pt) Write the overall reaction: _____

(2 pts) How will the rate of the overall reaction be affected if aqueous HCl is added to the solution?