

Name _____

CHE-121

Exam 4

4/26/02

Problem	Points	Score
1	18	
2	12	
3	12	
4	16	
5	12	
6	10	
7	20	
Total	100	

1. (18 points) Potassium ion is present in food and is an essential nutrient in the human body. One of the naturally occurring isotopes of potassium, potassium-40, is radioactive. Potassium-40 has a natural abundance of 0.0117 percent and a half-life of 1.28×10^9 years. It undergoes radioactive decay in three ways: 98% by electron capture, 1% by beta emission and 1% by positron emission.

a. Why would we expect potassium-40 to be radioactive?

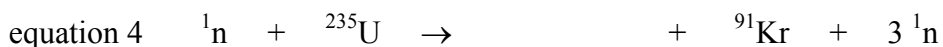
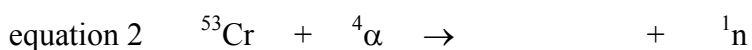
b. Write balanced nuclear equations for the three modes by which potassium-40 decays.

c. In one gram of KCl, there are 9.45×10^{17} potassium-40 ions. How long will it take for 1.00 % of these ions to undergo radioactive decay? $t_{1/2} = 0.693 / \lambda$; $\ln(N_o / N_t) = \lambda t$

d. Is it possible to stop the radioactive decay of potassium-40? Why or why not?

2. (12 points)

a. Complete and balance the following nuclear equations by supplying the missing particles.



b. Which of the equations in question 2 represents a fusion reaction? _____

c. Which of the equations in question 2 represents a fission reaction? _____

3. (12 points) Short answer.

a. What kind of reactions supply the energy generated in nuclear power plants? What is the major problem associated with nuclear power plants?

b. Exposure to radon gas is estimated to account for more than half the 360-mrem of annual exposure to ionizing radiation. It can cause lung cancer. Write the equation for the decay of ^{222}Rn and explain why it harmful to the lungs.

c. Explain the process of carbon dating.

d. Give two uses of radioisotopes. Be specific about the isotopes and their uses. (Do not use fission or fusion applications. Nuclear weapons are not useful.)

4. (16 points) Complete and balance five of the following seven equations.



5. (12 points) Answer either a or b. Use the back of the page if necessary.

a. The two sources of iron is the mineral magnetite, Fe_3O_4 and hematite, Fe_2O_3 . Industrially, it is converted to its metallic form in a blast furnace. The blast furnace contains both ores, coke, limestone and air. Describe the function of the coke, limestone and air.

Describe by means of equations how iron metal is produced in the blast furnace.

How is the iron further purified?

b. The Bayer process is used to purify aluminum. Aluminum is found in the ore bauxite as $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$. The major impurities in bauxite are SiO_2 and Fe_2O_3 .

Describe how the bauxite is converted to AlO_2^{1-} .

Describe how the SiO_2 and Fe_2O_3 are separated from the AlO_2^{1-} .

Describe how pure aluminum metal is obtained from AlO_2^{1-} .

6. (10 points) Describe in detail one of the following:

a. Global warming (include the production of carbon dioxide and its role in global warming)

b. Ozone (its role in the stratosphere, include the degradation of the ozone layer, its role in the lower atmosphere)

7. (20 points) Answer four of the five parts. You may receive bonus points if you answer all parts.

a. Describe what happens during the following three steps in metallurgy.

preparation of the ore

reduction of the ore

purification of the metal

b. What are the natural sources of the alkali metals?

Why are they never found as "free" metals?

What are two important compounds of sodium? What are they used for?

c. What are the natural sources of magnesium and calcium?

What is one use of magnesium metal?

List two compounds of the alkaline earth metals and their uses.

d. Describe two of the three allotropes of carbon.

Draw the structures of the two allotropes of oxygen.

e. What are some of the characteristics of metals? How do they differ from those of nonmetals?

Give an example of a metal and a nonmetal oxide. What are some of the physical and chemical differences?