GEO 2303W
January 29, 2008
Due: February 6, 2008

PROBLEM SET #1

(1) Why is the atomic weight of uranium given as 238.03 when the heaviest naturally occurring isotope of uranium is ^{238}U (The others are ^{235}U and ^{234}U)?

(2) Specify the values for Z, N, and A for the following nuclides:
$^{40}_{19}K$, $^{51}_{23}V$, $^{130}_{54}Xe$, $^{222}_{86}Rn$, $^{238}_{92}U$

(3) Calculate the atomic weight of element carbon (C), and element uranium (U).
The isotope abundance: ^{12}C, 98.90%; ^{13}C (13.00335 amu), 1.10%; ^{238}U (238.05078 amu), 99.28%; ^{235}U (235.04392 amu), 0.7200%, assuming ^{14}C and ^{234}U are negligible.

(4) Calculate the binding energies per nucleon for:
$^{12}_{6}C$
$^{16}_{8}O$ (15.99491 amu)
$^{28}_{14}Si$ (27.97693 amu)
$^{56}_{26}Fe$ (55.93494 amu)
$^{232}_{90}Th$ (232.03807 amu)

(5) In class we calculated the binding energy per nucleon of ^{4}He to be 7.07 MeV/nucleon. Calculate the following differences in binding energy per nucleon for the following pairs.
^{1}H to ^{4}He
^{4}He to ^{12}C
^{12}C to ^{28}Si
How do differences in binding energy per nucleon change from the lower mass to the mass of Si?

(6) Do the following measurements have a good precision but a poor accuracy, or a good accuracy but a poor precision? Why?

(a) You have weighed a beaker 6 times and got the following data: 40.2250g, 40.2245g, 40.2242g, 40.2253g, 40.2258g, and 40.2249g. However, you realized you had forgotten to tare the balance before your measurement.

(b) One group of students are asked to measure the length of a piece of paper by using a centimeter long ruler and report their data as: 11.5cm, 9.0cm, 12.0cm, 10.0cm, 7.0cm, 13.0cm, 8.0cm, 11.0cm, and 8.5cm. And you know the length of the paper is 10.0 cm.

(c) You have made 8 times measurements of the calcium concentration in an unknown solution, corrected to a calcite standard. The data are: 10.01%, 10.02%, 10.03%, 10.00%, 9.99%, 10.00%, 9.98%, 10.01%. Unfortunately, you were informed that due to temperature variation, the calcium concentration of the standard has a 5% offset.

(7) You have just measured a Sr standard 8 times. The $^{87}Sr/^{86}Sr$ values are given below. What is the mean and standard deviation?

0.710249	0.710265	0.710236	0.710245
0.710255	0.710238	0.710241	0.710253

Assuming the count rate was 3.0×10^7 ions/sec for ^{87}Sr during one run, and the sample was run for two hours. What are the counting statistics of ^{87}Sr for this run? Is most of the error coming from counting statistics or other sources of errors in this measurement?