An-Najah National University
Faculty of Science-Department of Physics
Nuclear Physics 22462
Spring 2014
1^{st} Exam, Feb 25^{th} 2014

Name: _____

Number: _____

1. Define the following:
   (a) (2 points) Isobars
   (b) (2 points) Isotopes
   (c) (2 points) Isotones

2. The binding energy of a nucleus is given through the semi-empirical formula, which is given by the following equation:

$$B.E(Z,A) = a_v A - a_s A^{2/3} - a_c Z(Z-1)A^{-1/3} - a_{sym}\frac{(A-2Z)^2}{A}$$

   (a) (2 points) Sketch the Binding energy as a function of Z for constant A

   (b) (5 points) For N=Z system, which is larger, the proton or neutron separation energy. Show why?

3. (5 points) If, instead of the observed value of $J^\pi = 1^+$, the deuteron ground state were $J^\pi = 1^-$, what are now the possible values of orbital angular momentum L, sum of intrinsic spin S. What are the implications for nuclear force if this were true?

4. (8 points) Assuming that the following nuclei has a spherical shape; give the predicted one particle shell model spin and parity:
   A. $^{26}_{13}$Al B. $^{17}_{8}$O C. $^{42}_{20}$Ca D. $^{31}_{15}$P

5. (4 points) Use the following formulas:

$$< \mu >= [g_l(j - \frac{1}{2}) + \frac{1}{2}g_s]\mu_N,\ j = l + \tfrac{1}{2}$$
$$< \mu >= [g_l\frac{j(j+\frac{3}{2})}{(j+1)} - \frac{1}{2}\frac{1}{j+1}g_s]\mu_N,\ j = l - \tfrac{1}{2}$$

Discuss the behavior of the magnetic moment near closed shells.

Question	Points	Score
1	6	
2	7	
3	5	
4	8	
5	4	
Total:	30	

Good Luck