Name ________________________________

Exam Advanced Nuclear Physics 14/01/2019 14:00

Question: Nuclear Reactions

These questions will be evaluated on 20 points. You require a minimum of 7/20 points on this part to pass the course. The points will be rescaled to a weight of 6 towards your final grade for the course.
You are not allowed any book or notes.
You may use a calculator and the given list of formulas for this part of the examination.
Write your answers in the boxes; the rest of the space (back side of the sheets) will not be evaluated.

Consider the reaction: ^{7}Li+^{120}Sn, measured at a beam energy (in the laboratory) of 25 MeV (for example, as in V.A.B. Zagatto et al., J. Phys. G: Nucl. Part. Phys. 43 (2016) 055103).
[$Z(\mathrm{Li}) = 3$, $Z(\mathrm{Sn}) = 50$; for the calculations use $r_0 = 1.6\,\mathrm{fm}$.]

1. (2/20) Briefly describe an experimental setup that could be used to measure the elastic-scattering angular distribution. Add a sketch if useful.

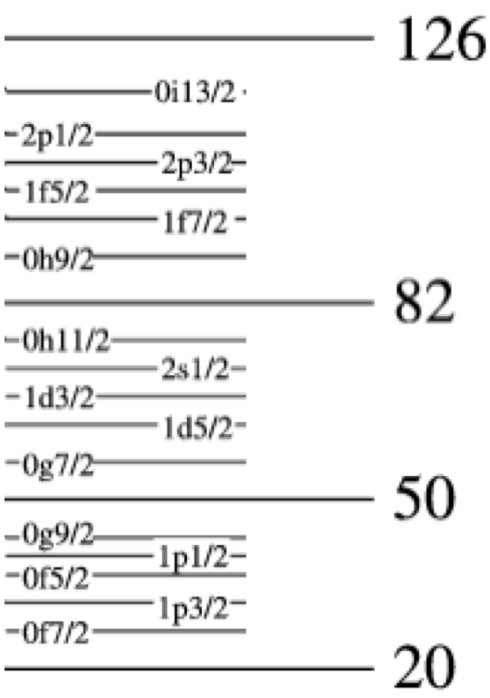
2. (6/20) Use the frame here below to plot the expected elastic-scattering angular distribution relative to the Rutherford cross section:
   - Describe and justify the expected shape of the distribution.
   - Add the axis units and values, consistently with the plotted shape (justify your answer quantitatively).

3. (4/20) Use a suitable model (explain why) and calculate the expected total reaction cross section.

Consider now the reaction: ^{120}Sn(d,p) at a deuteron energy of 17 MeV (as in M.J. Bechara and O. Dietzsch, Phys. Rev. C 12 (1975) 90).
The reaction populates (among others) the following states:

E^* (^{121}Sn) (keV)	J^π
0.0	$3/2^+$
6.3	$11/2^-$
60	$1/2^+$
941	$7/2^-$

4. (4/20) Describe, using the shell-model orbital sequence here below, which are the expected main configurations of the populated states (which particles occupy which orbitals).
   What can you deduce about the structure of the ground state of ^{120}Sn?



5. (4/20) For each populated state deduce the expected transferred angular momentum l.
   Deduce quantitatively the expected angle of the first maximum of the corresponding angular distributions [use $r_0 = 1.6\,\mathrm{fm}$; $Q_{gg} = +3.946\,\mathrm{MeV}$).