Name _____

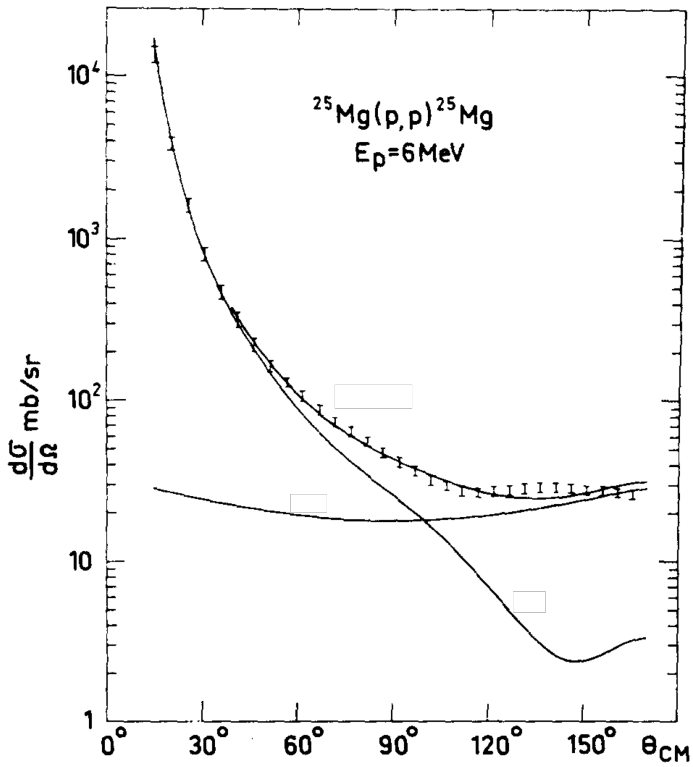
Exam Advanced Nuclear Physics 15/01/2018 14:00

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. Please use the attached sheets for your answers; any additional sheet will be discarded.
The questions serve as a leading trace for the oral examination, during which other aspects and details may be explored.

The questions concern the article: A. Gallmann et al., *Analysis of the Reactions ^{25}Mg(p,p)^{25}Mg and ^{24}Mg(d,p)^{25}Mg at 5 and 6 MeV*, Phys. Rev. 88 (1966) 654.
[Data for (bonus) calculations: $Z(\mathrm{Mg}) = 12$; for the interaction radius use $R = 1.4\,\mathrm{fm} \times A_{\mathrm{target}}^{1/3}$.]

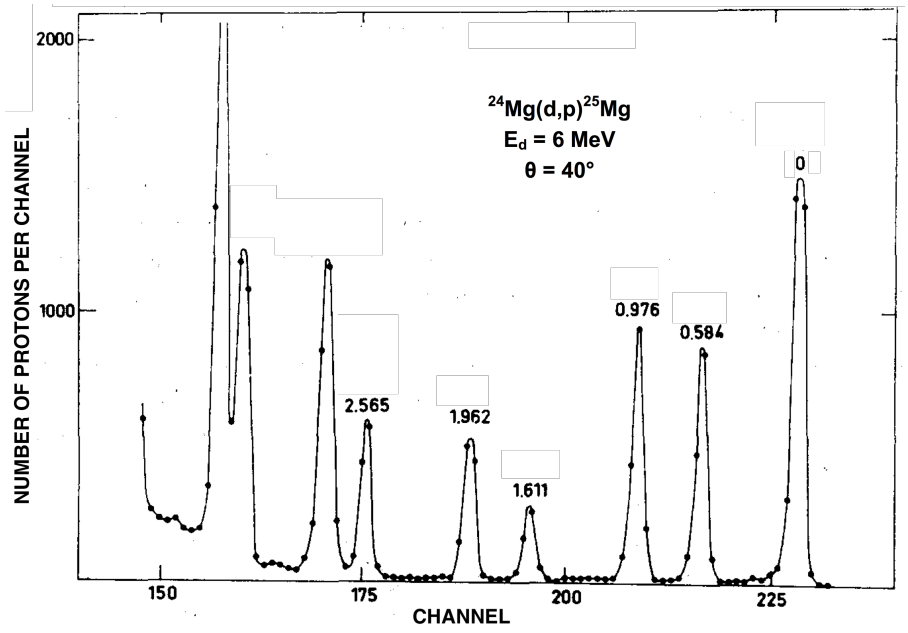
Consider the figure below, where the data points are from the measurement and the continuous lines are from model calculations.



1. (3.5/20) Explain which kind of data are these and how they were obtained experimentally.

2. (4/20) Explain which reaction mechanisms are accounted for by the two calculations, and why the two curves have that angular dependence.

Consider now the second figure here below:



3. (1/20) Explain which kind of data are these and how they were obtained experimentally.

4. (3/20) Why do we observe peaks? What do the numbers on top of each peak most probably represent?

5. (5.5/20) Comment on the reaction mechanism that produces those peaks. Which information about the nuclei involved can we learn from this reaction? Which are the experimental observables that we use to deduce such information?

6. (3/20) Use the predicted sequence of shell model orbitals, given in the figure below, to deduce the expected transferred angular momentum l for the population of the three rightmost peaks, and the expected spin-parity of the corresponding states.
   (Bonus: 1/20, only if the rest of this question is answered correctly) Deduce quantitatively the expected angle of the first maximum of the corresponding angular distributions.