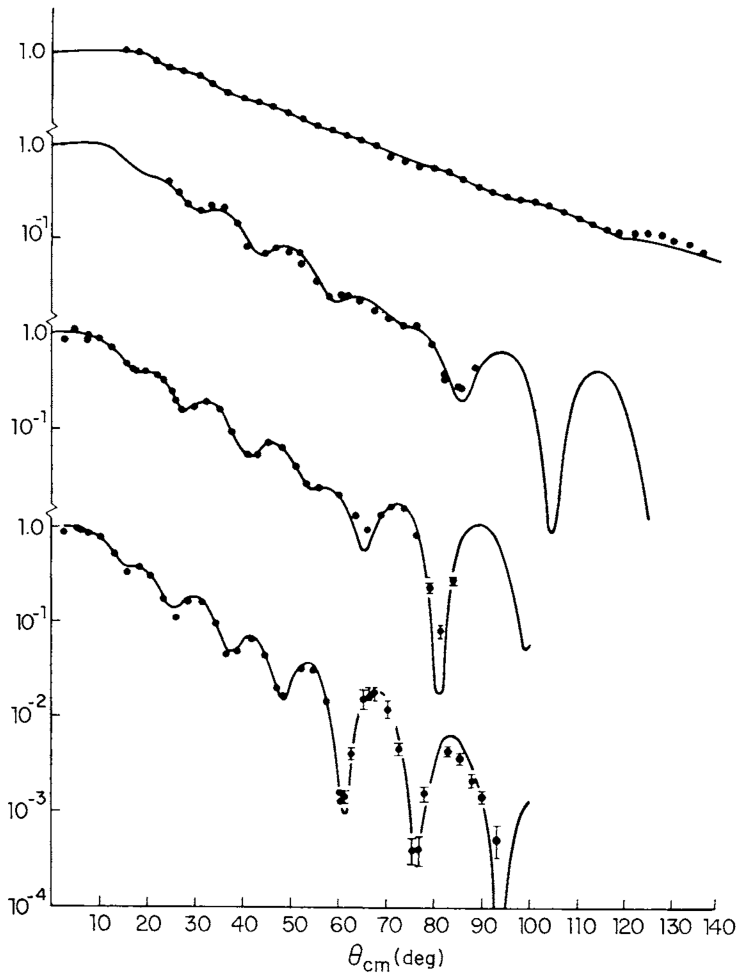
Name _____

Exam Advanced Nuclear Physics 13/01/2020 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.

Consider the figure below, which shows elastic scattering data for ^{3}He+^{58}Ni at four different energies ($Z(^{58}\mathrm{Ni}) = 28$).



1. (1/20) Indicate the quantity plotted on the *y* axis.

2. (5/20) Describe which experimental arrangement you would use to measure the reaction.
   Explain in detail how to calculate the data points shown in the figure and thus which quantities you need to measure.

3. (4/20) Explain the behaviour of the data in terms of diffraction models.

4. (3/20) The data were measured at the following laboratory energies: 22 MeV, 33 MeV, 37.7 MeV, 43.7 MeV.
   Correctly assign each energy to the corresponding set of data, and explain how you can do that without calculations.

5. (3/20) Calculate how many partial waves (at least) you expect to need to correctly describe the scattering at 22 MeV and at 43.7 MeV.
   [Use $R = 1.5\,\text{fm} \times (A_1^{1/3} + A_2^{1/3})$.]

6. (4/20) Which model(s) can be used to describe the data (continuous line)? What are their properties? What can we expect to learn from the model(s)?