Name _____

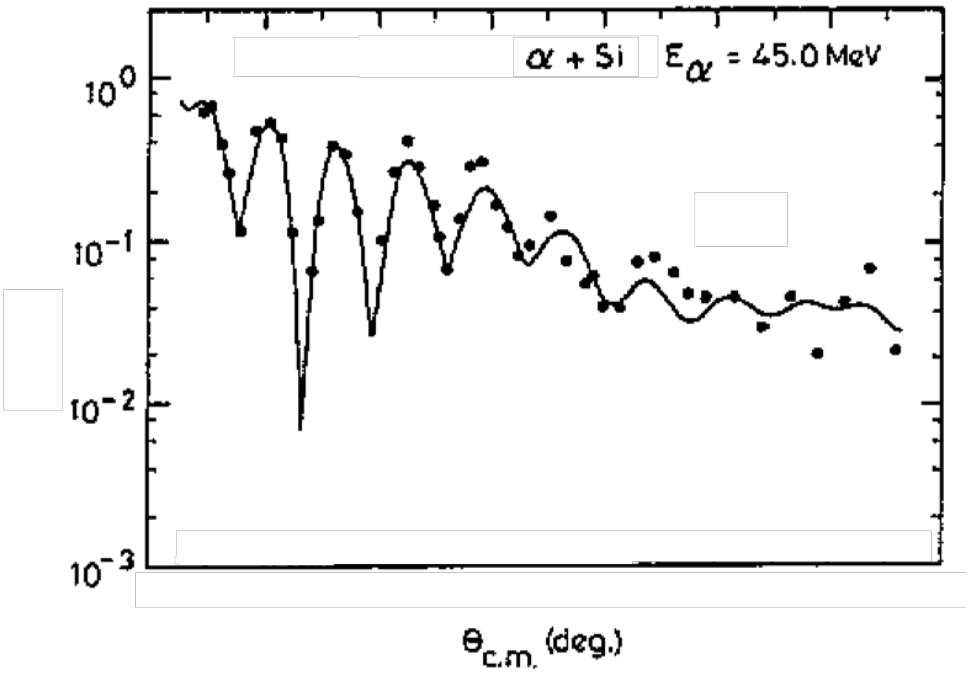
Exam Advanced Nuclear Physics 05/09/2018 09:00

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: V P Darshan et al., *Study of (α,^{3}He) and (α,t) reactions on ^{28}Si at 45 MeV*, J. Phys. G: Nucl. Part. Phys. 21 (1995) 385.
[$Z(\mathrm{Si}) = 14$; for the interaction radius use $R = 1.4\,\mathrm{fm} \times (A^{1/3}_{\mathrm{projectile}} + A^{1/3}_{\mathrm{target}})$.]

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



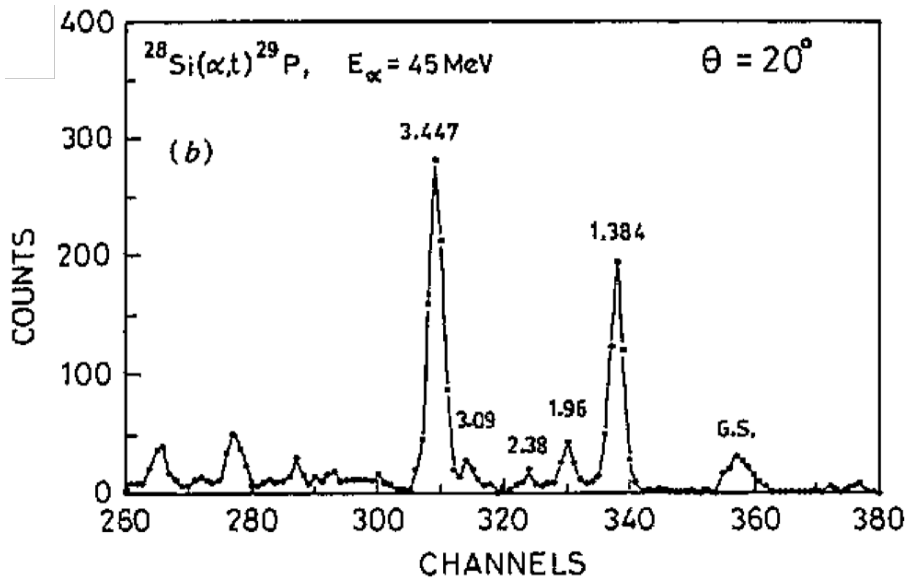
1. (4/20) Explain which kind of data are these: Which reaction mechanism? Which quantity is indicated on the y axis? How were the data obtained experimentally?

2. (3/20) Explain the behaviour of the data: the oscillations, the decrease.

3. (2.5/20) Which model(s) can be used to describe the data (continuous line)? What can we expect to learn from the model(s)?

4. (2/20) Explain how you could add the expected values of $\theta_{\text{c.m.}}$ on the abscissa. Calculate the values and add them on the axis.

Consider now the second figure here below:



5. (4.5/20) Using the given information, describe which type of reaction is observed. Why do we observe peaks? What do the numbers on top of each peak most probably represent? Why is the peak labelled 1.384 larger than the one labelled G.S.?

6. (2.5/20) The ground-state-to-ground-state Q-value of the mentioned reaction is $Q_{\mathrm{gg}} = -17.065\,\mathrm{MeV}$. What is the energy threshold of the reaction? With a beam energy of 45 MeV as indicated, up to which excitation energy can we populate states in the product nucleus?

7. (1.5/20) 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 two rightmost peaks, and the expected spin-parity of the corresponding states.