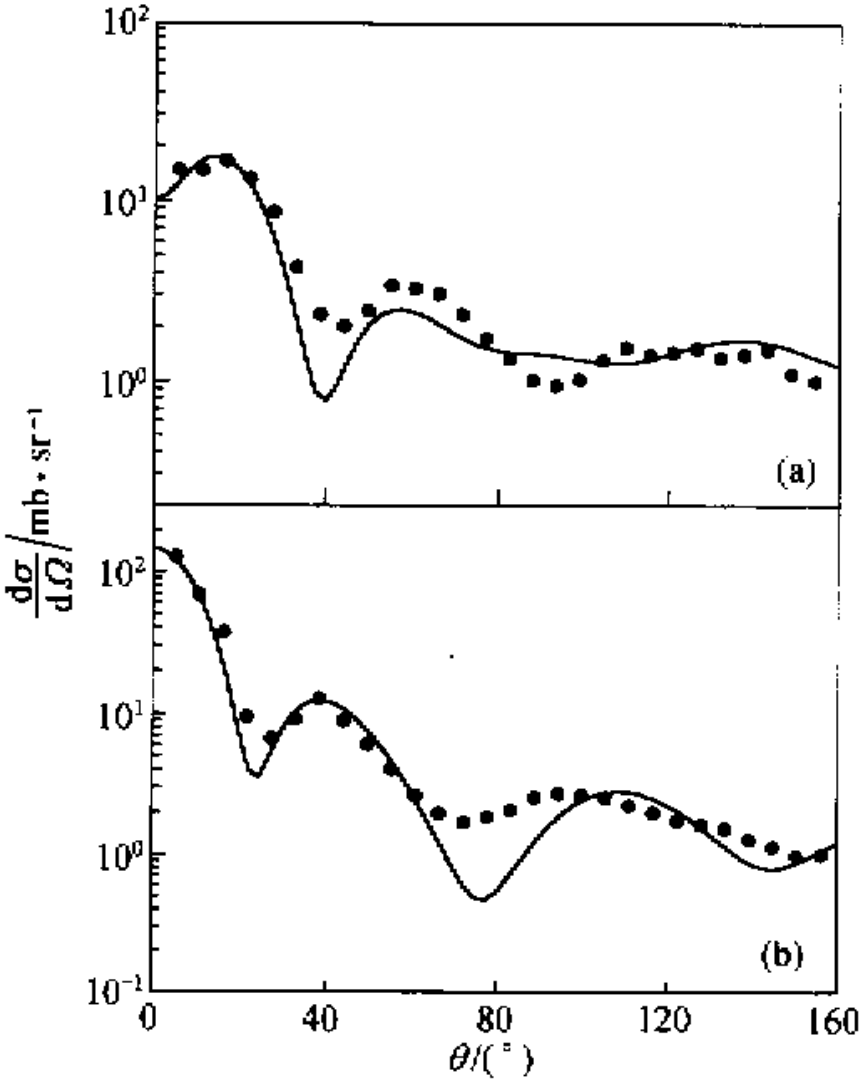
Name _____

# Exam Advanced Nuclear Physics 20/01/2020 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.*

Consider the figure below, which shows nucleon-transfer data for the $^{12}$C($d$,$p$) reaction populating two different states in the $^{13}$C product.



1. (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.

2. (3/20) Which information does this kind of reactions provide, in general, about the populated states?

3. (4/20) Explain why the data points show an oscillatory behaviour.

4. (3/20) The two populated states have spin $1/2^+$ and $1/2^-$.
   Correctly assign each state to the corresponding set of data, and explain how you can do that.

5. (3/20) Explain how, from the data, you can estimate the centre-of-mass energy at which the reaction occurred. Make the approximation that the $Q$-value be negligible with respect to the c.m. energy.

6. (4/20) Which model(s) can be used to describe the data (continuous line)? Which ingredients do you need, to make the calculations?