

CARST : MARST Course : Nuclear Physics Module : 2007

Class Test : Detection of Radiation, Nuclear Reactions, Accelerators

Instructions: Answer all questions.

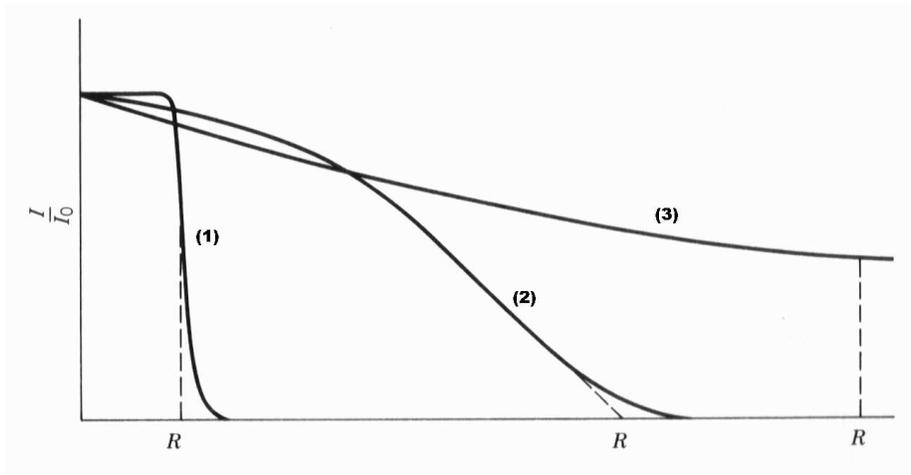
Time:

$1\frac{1}{2}$ hour = 90 minutes

Total Marks:

60 marks (60 marks = 100%)

- The figure below depicts passage of alpha particles, electrons and photons through matter.
 - Identify which of the curves relates to which type of particle. (6)
 - Give two formulae which describe the curves, and indicate which of the two formulae is applicable to which curve. (6)
 - Explain the difference between the curves for the alpha particles and electrons, referring to the energy-loss formula and the different properties of these two particles. (8)
 - Comment on how the behaviour of an energetic neutron would compare to the particles mentioned above. (4)



Total for Question 1 [24]

- It is desired to study the first excited state of ^{16}O , which is at an energy of 6.049 MeV by using the (α, n) reaction on a target of ^{13}C .
 - Write down the reaction in the form $a + X \longrightarrow Y + b$, assign the words projectile, target, ejectile and residue correctly to each term. (4)
 - Calculate the Q value of the reaction separately for the ground and the excited states. (7)
 - What is the minimum energy of incident alpha particles which will populate the excited state? (6)
 - In what direction will the neutron travel? (2)

- (e) If it is desired to detect the neutrons at 90° to the incident beam, what is the minimum alpha particle energy that can result in the excited state being populated ? (5)

Total for Question 2 [24]

3. (a) Describe the operation of a Van de Graff electrostatic high voltage generator. Include a labelled sketch. (6)
- (b) Calculate the minimum radius of an air insulated high voltage terminal if it is desired to achieve a maximum voltage of 1.5MV. (Assume the breakdown electric field of air is 3×10^6 V/m.) (4)
- (c) How can one increase the maximum voltage of the device without increasing the size of the terminal ?. (2)

Total for Question 3 [12]

Total

[60]