**PHYS 232 Assignment # 4** Due: Wednesday 25/3/2020

Instructor: Professor Henry Jaqaman

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| 1a | 1b | 1c | 2a | 2b | 2c | 2d | ترتيب | Total |
| 15 | 15 | 15 | 20 | 10 | 10 | 5 | 10 | 100 |
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1. Draw the above table at the top of first page of your solutions.
2. You can submit maximum 2 pages: 1 page per problem. I will only grade the first 2 pages.
3. Submit your solutions by 10 am Wednesday via Ritaj.
4. A He+ ion (mass = 4 u), initially in its ground state, absorbs a photon moving in the positive x-direction and gets excited to the 3rd excited state (n=4).
   1. What is the energy of the photon? (15%)
   2. If the ion is initially moving in the positive y direction with a speed of 3.00 m/s, what is its velocity after it absorbs the photon? (give your answer using notation) (15%)
   3. What is the final kinetic energy *Kf*of the ion? What is the increase ΔK in its kinetic energy? Where does ΔK come from? (15%)

1. Suppose that in Rutherford’s experiment the alpha particle is moving in the positive x-direction with fixed momentum p and collides with a single stationary proton (as in the Thomson model). Assume the mass of the alpha particle = 4 times the mass of the proton. If the scattered proton has momentum p1 at an angle θ with respect to the x-axis, and the scattered alpha particle has momentum p2 at an angle φ with respect to the x-axis,
2. Show that cos φ = 5 p2 /(8 p) + 3 p/(8 p2) (20%)
3. Differentiate the above result with respect to p2 and find the maximum value of φ. Show that it is a maximum. (10%)
4. Does this result agree with what Rutherford concluded? (10%)
5. Explain why we can treat the proton and alpha particle nonrelativistically. (5%)

**+10%** for good hand-writing and clear and well-organized solutions.

**You are expected to work alone. Academic honesty is very important. Cheating will make you lose grades.**