

Birzeit University-Department of Physics  
 Quantum Mechanics I Phys232  
 Spring 2021  
 First Exam, April 12<sup>th</sup> 2021

1. (20 points) Two identical elementary particles, K meson for example, are approaching each other at a speed of  $0.90c$  with respect to an observer at rest. The rest mass of the K meson is  $497.7 \text{ MeV}/c^2$ .
  - (a) Compute the energy of each of the K mesons with respect to the observer at rest.
  - (b) Compute the momentum of each of the K mesons with respect to the observer at rest.
  - (c) Compute the energy of one of the K mesons with respect to the other.
2. (20 points) An elementary particle is traveling with a velocity of  $0.993c$  and total energy of  $2.340 \text{ GeV}$  with respect to an observer at rest. What is the mass (in  $\text{GeV}/c^2$ ) of the particle, can you identify the particle. You can use the internet of this purpose.
3. (30 points) An astronaut travel to the star Sirius A from earth, located  $8.6$  light years (light year is a unit of distance not unit of time) away. According to the astronaut, the total time of the round trip is  $4$  years.
  - (a) What was the speed of the spaceship? Assume constant velocity for the entire trip.
  - (b) How much time has passed to an observer on earth during the  $4$  years trip? .
  - (c) If the spaceship is  $1000 \text{ m}$  long in its rest frame, how long is the spaceship during the trip as measured from earth?
4. (15 points) In compton effect, if we replace the electron with an object that has a mass as a multiple integer of the electron mass, plot the change in photon wave length as a function of the object mass.
5. (15 points) The work-function of zinc is  $4.24 \text{ eV}$ . Will green light produces a photoelectric effect with zinc? Give a detailed justification of your answer.

Question:	1	2	3	4	5	Total
Points:	20	20	30	15	15	100
Score:						

Good Luck