

## PHYSICS 232 – SAMPLE TEST # 3

### Problem 1

A rebel fighter is in hot pursuit of a starfleet cruiser. As measured by an observer on earth, the starfleet cruiser is traveling away from the earth with a speed of  $0.7c$ . The rebel fighter is traveling at a speed of  $0.9c$  relative to the earth, in the same direction as the cruiser. What is the speed of the cruiser relative to the fighter?

### Problem 2

A particle has rest mass  $3.32 \times 10^{-27}$  kg and momentum  $8.25 \times 10^{-19}$  kg.m/s.

- (a) What is the total energy (kinetic plus rest energy) of the particle?
- (b) What is the kinetic energy of the particle?
- (c) What is the ratio of the kinetic energy to the rest energy of the particle?

### Problem 3

In the Bohr model of the hydrogen atom, what is the de Broglie wavelength  $\lambda$  for the electron when it is in

- (a) the  $n = 1$  level?
- (b) the  $n = 4$  level?

In each case, compare the de Broglie wavelength to the circumference  $2\pi r$  of the orbit.

### Problem 4

**A photoelectric experiment.** While conducting a photoelectric effect experiment with light of a certain frequency, you find that a reverse potential difference of  $1.25$  V is required to reduce the current to zero. Find

- (a) the maximum kinetic energy.
- (b) the maximum speed of the emitted photoelectrons.

### Problem 5

- (a) The energy of an electron in a hydrogen atom is *negative*. What significance does this have?
- (b) How would you try to prove or disprove *Heisenberg's uncertainty principle* using a beam of electrons and an aperture?
- (c) Describe the Compton effect. Is it observable with visible light? Explain.