Practise Mid Term Exam 2

PHY2361

Exercise 1:

A spaceship moves away from Earth with speed v and fires a shuttle craft in the forward direction at a speed v relative to the spaceship. The pilot of the shuttle craft launches a probe in the forward direction at speed v relative to the shuttle craft.

a) Determine the speed of the shuttle craft relative to the Earth.
b) Determine the speed of the probe relative to the Earth.

Exercise 2:

A body quadruples its momentum when its speed doubles. What was the initial speed in units of c ?

Exercise 3:

A particle of mass m has an energy $E = 4mc^2$.

a) What is the momentum of this particle in units of mc?
b) What is the energy of this particle in a reference frame in which p = 2mc?

Problem 4 :

X-rays with an energy of 300 keV undergo Compton scattering with a target.
If the scattered X-rays are detected at 30° relative to the incident X-rays, determine

a) the Compton shift at this angle
b) the energy E' of the scattered X-ray
c) and the kinetic energy K of the recoiling electron.

The Compton wavelength of the electron is:

$$\lambda_e = \frac{h}{m_e c} = 2.43 \times 10^{-12}\ \mathrm{m}$$

The mass of the electron is:

$$m_e = 511\ \mathrm{keV}/c^2$$