

**Question #81584, Physics / Other**

1. Protons in an accelerator at the Fermi National Laboratory near Chicago are accelerated to a total energy that is 400 times their rest energy.

(a) What is the speed of these protons? (Round your answers to six decimal places.)

$$E = 400 \times mc^2 = \gamma mc^2$$

(b) What is their kinetic energy?

$$(m_p = 938.3 \text{ MeV}/c^2)$$

**Solution**

a)

$$400 = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$v = 0.999997c.$$

b)

$$K = (400 - 1)(938.3) = 374400 \text{ MeV} = 374.4 \text{ GeV}.$$

2. When light of wavelength 210nm falls on a gold surface, electrons having a maximum kinetic energy of 0.81 eV are emitted. Find values for the following.

(a) the work function of gold

(b) the cutoff wavelength

**Solution**

a) Energy of a single photon in light of wavelength 210nm:

$$E = hf = h \frac{c}{\lambda} = \frac{1241.5}{210} = 5.91 \text{ eV}$$

The work function of gold:

$$5.91 - 0.81 = 5.10 \text{ eV}.$$

b)

$$\lambda_{cutoff} = \frac{1241.5}{5.10} = 243 \text{ nm}$$

Answer provided by <https://www.AssignmentExpert.com>