

# Solutions to Problems in Goldstein, *Classical Mechanics*, Second Edition

Homer Reid

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## Chapter 1

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### Problem 1.1

A nucleus, originally at rest, decays radioactively by emitting an electron of momentum  $1.73 \text{ MeV}/c$ , and at right angles to the direction of the electron a neutrino with momentum  $1.00 \text{ MeV}/c$ . (The  $\text{MeV}$  (million electron volt) is a unit of energy, used in modern physics, equal to  $1.60 \times 10^{-6} \text{ erg}$ . Correspondingly,  $\text{MeV}/c$  is a unit of linear momentum equal to  $5.34 \times 10^{-17} \text{ gm-cm/sec.}$ ) In what direction does the nucleus recoil? What is its momentum in  $\text{MeV}/c$ ? If the mass of the residual nucleus is  $3.90 \times 10^{-27} \text{ gm}$ , what is its kinetic energy, in electron volts?

Place the nucleus at the origin, and suppose the electron is emitted in the positive  $y$  direction, and the neutrino in the positive  $x$  direction. Then the resultant of the electron and neutrino momenta has magnitude

$$|\mathbf{p}_{e+\nu}| = \sqrt{(1.73)^2 + 1^2} = 2 \text{ MeV}/c,$$

and its direction makes an angle

$$\theta = \tan^{-1} \frac{1.73}{1} = 60^\circ$$

with the  $x$  axis. The nucleus must acquire a momentum of equal magnitude and directed in the opposite direction. The kinetic energy of the nucleus is

$$T = \frac{p^2}{2m} = \frac{4 \text{ MeV}^2 c^{-2}}{2 \cdot 3.9 \cdot 10^{-27} \text{ gm}} \cdot \frac{1.78 \cdot 10^{-27} \text{ gm}}{1 \text{ MeV } c^{-2}} = 9.1 \text{ ev}$$

This is much smaller than the nucleus rest energy of several hundred  $\text{GeV}$ , so the non-relativistic approximation is justified.

# Goldstein Classical Mechanics Solutions Manual

**Ian Pickup**



## Goldstein Classical Mechanics Solutions Manual:

\_\_\_\_\_, 2019-01-16 This book deals with the interplay between fundamental physics and philosophy of physics from the one hand and metaphysics and philosophy from the other hand It is divided into three independent parts philosophical general and mathematical Part I deals with foundations and philosophy of quantum mechanics philosophy of time philosophy of consciousness and free will foundations of mathematics as well as a brief introduction to metaphysics Part II is a general excursion in the world of fundamental physics particles fields strings black holes the universe quantum gravity mathematics and history of physics Part III is a detailed rigorous introduction to the three main areas of fundamental physics classical mechanics thermodynamics and statistical mechanics quantum mechanics

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Signal Processing Scattering and Operator Theory and Numerical Methods volume 3      **Physics in Canada** ,1972

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