Chapter 35 Problem 28 [†]

Given
$m = 1.0\ g = 1.0 \times 10^{-3}\ kg$
$k = 80\ N/m$

Solution
Find the separation between the energy levels for a harmonic oscillator, which is a mass on a spring.

The angular frequency of the mass on a spring oscillator is given by the formula

$$\omega = \sqrt{\frac{k}{m}} = \sqrt{\frac{80\ N/m}{1.0 \times 10^{-3}\ kg}} = 283\ rad/s$$

The frequency of this oscillator is

$$f = \frac{\omega}{2\pi} = \frac{283\ rad/s}{2\pi} = 45.0\ Hz$$

The allowed energy levels of a harmonic oscillator are

$$E_n = hf(n + \tfrac{1}{2})$$

Therefore, the difference between adjacent energy levels is

$$\Delta E = hf$$

Therefore, the energy difference is

$$\Delta E = (6.63 \times 10^{-34}\ J \cdot s)(45.0\ Hz) = 2.98 \times 10^{-32}\ J$$

This quantization is so small it is not measurable.

[†]Problem from Essential University Physics, Wolfson