

Assignment 1A

Due Thursday, May 11

Physics U603

Summer 1 2006

1. Hecht, Ch. 2: 14, 17, 22, 42; Ch. 3: 26
2. Ocean waves: The expression for the speed of (long wavelength) waves on a water surface given in the class notes is valid in deep water. In general, however, the wave speed

$$c = \sqrt{\frac{g\lambda}{2\pi} \tanh\left(\frac{2\pi d}{\lambda}\right)}$$

depends on the depth d of the water, as well as the wavelength λ and the acceleration g of gravity.

- (a) Show that this reduces to the expression given in class for deep water (or short wavelength) such that $d \gg \lambda$.
- (b) Show that the speed is approximately $c = \sqrt{gd}$ in the limit of shallow water (or long wavelength), $\lambda \gg d$.
- (c) Tsunamis, produced by large earthquakes or meteor impacts, qualify as “shallow water” waves even in the deepest parts of the ocean. Consider a tsunami with a 50 km wavelength and amplitude 3 m travelling in water with a depth of 4 km. Determine the speed and period of the wave.
- (d) The tsunami encounters increasingly shallow water as it approaches a coastline. When the water depth is 30 m, determine the speed, wavelength, and amplitude of the wave. (Use conservation of energy. What is the period under these circumstances?)