

68. (a) Using $m = 7.3 \times 10^7$ kg, the initial gravitational potential energy is $U = mgy = 3.9 \times 10^{11}$ J, where $h = 550$ m. Assuming this converts primarily into kinetic energy during the fall, then $K = 3.9 \times 10^{11}$ J just before impact with the ground. Using instead the mass estimate $m = 1.7 \times 10^8$ kg, we arrive at $K = 9.2 \times 10^{11}$ J.
- (b) The process of converting this kinetic energy into other forms of energy (during the impact with the ground) is assumed to take $\Delta t = 0.50$ s (and in the average sense, we take the “power” P to be wave-energy/ Δt). With 20% of the energy going into creating a seismic wave, the intensity of the body wave is estimated to be

$$I = \frac{P}{A_{\text{hemisphere}}} = \frac{(0.20)K/\Delta t}{\frac{1}{2}(4\pi r^2)} = 0.63 \text{ W/m}^2$$

using $r = 200 \times 10^3$ m and the smaller value for K from part (a). Using instead the larger estimate for K , we obtain $I = 1.5 \text{ W/m}^2$.

- (c) The surface area of a cylinder of “height” d is $2\pi rd$, so the intensity of the surface wave is

$$I = \frac{P}{A_{\text{cylinder}}} = \frac{(0.20)K/\Delta t}{(2\pi rd)} = 25 \times 10^3 \text{ W/m}^2$$

using $d = 5.0$ m, $r = 200 \times 10^3$ m and the smaller value for K from part (a). Using instead the larger estimate for K , we obtain $I = 58 \text{ kW/m}^2$.

- (d) Although several factors are involved in determining which seismic waves are most likely to be detected, we observe that on the basis of the above findings we should expect the more intense waves (the surface waves) to be more readily detected.