Chapter C7: Potential Energy

Physics I

College of the Atlantic

C7.1: The Electromagnetic Interaction

We aren't going to cover this section.

C7.2: The Gravitational Interaction

The main equation:

$$V(r) = -G\frac{m_1 m_2}{r} \,. \tag{1}$$

- This looks weird. Sketch the function and remember that all that matters is potential energy differences. Then it won't seem so bad.
- G is the universal gravitational constant: $G = 6.67 \times 10^{-11} \frac{\mathrm{Jm}}{\mathrm{kg}^2}$.

C7.3: Gravitation Near the Earth

The punchline of this section is Figure C7.3 on p. 123. This figure shows us that Eq. (1) is well approximated by $V(z) = mgz$ near the earth's surface.

C7.4: The Potential Energy of a Spring

- The main equation is:

$$V(r) = \frac{1}{2}k_s(r - r_0)^2 \,. \tag{2}$$

- This is often written in the simpler form:

$$V(r) = \frac{1}{2}k_s x^2 \,, \tag{3}$$

where it is understood that the spring has zero potential energy when it is relaxed—i.e. neither compressed or stretched.

- This equation is an approximation. For most springs it is an extremely good approximation, as long as the string is not stretched or compressed too much.
- This equation is also used for any interaction whose potential energy function has a quadratic (parabola-like) minimum. This is the point of Fig. (C7.5).

C7.6: Significant Digits

Don't get carried away with digits.

Examples

1. The radius of the moon is 1740 km and its mass is 7.4×10^{22} kg. A 5 kg piece of cheese is dropped from a spaceship floating 50 km above the moon's surface. What is the cheese's speed right before it hits the moon?

2. A spring has a length of 8 cm when unstretched. It is then pushed in 3 cm (so that it is 5 cm long) and used to shoot a 12 g marble. What is the speed of the marble immediately after it is launched? The spring has a spring constant of 450 J/m^2.