5.4 Videos Guide

5.4a

- Units
  - US Customary system
    - Distance is in feet (ft) (1 ft = 12 in)
    - Force is in pounds (lb)
    - Work is in ft-lb
  - SI (metric) system
    - Distance is in meters (m) (1 m = 100 cm)
    - Force is in Newtons (N) (1 N = 1 kg· 9.8 m/s^2)
    - Work is in Joules (J)
- Work = force × distance
- Hooke's Law
  - The force required to maintain a spring stretched (or compressed) x units beyond its natural length is proportional to x: $f(x) = kx$

Exercise:

- A spring has a natural length of 40 cm. If a 60-N force is required to keep the spring compressed 10 cm, how much work is done during this compression? How much work is required to compress the spring to a length of 25 cm?

Exercises:

5.4b

- If 6 J of work is needed to stretch a spring from 10 cm to 12 cm and another 10 J is needed to stretch it from 12 cm to 14 cm, what is the natural length of the spring?

5.4c

- A chain lying on the ground is 10 m long and its mass is 80 kg. How much work is required to raise one end of the chain to a height of 6 m?

- Work required to stretch/compress a spring or lift a heavy chain/cable/rope
  - $W = \int_a^b kx\,dx$
    In this expression, the force is variable (kx), and the distance is an incremental distance (dx)

Exercises:

5.4d

- A thick cable, 60 ft long and weighing 180 lb, hangs from a winch on a crane. Compute in two different ways the work done if the winch winds up 25 ft of the cable.

5.4e

- A circular swimming pool has a diameter of 24 ft, the sides are 5 ft high, and the depth of the water is 4 ft. How much work is required to pump all of the water out over the side? (Use the fact that water weighs 62.5 lb/ft^3.)

- Work required to pump fluid out of a container
  - $W = \int_a^b h(x)\, \delta A(x)\, dx$
    In this expression, δ is the density of the fluid, $A(x)$ is the surface area of the fluid, and $h(x)$ is the distance (or height) a layer of the fluid must be raised to exit the container