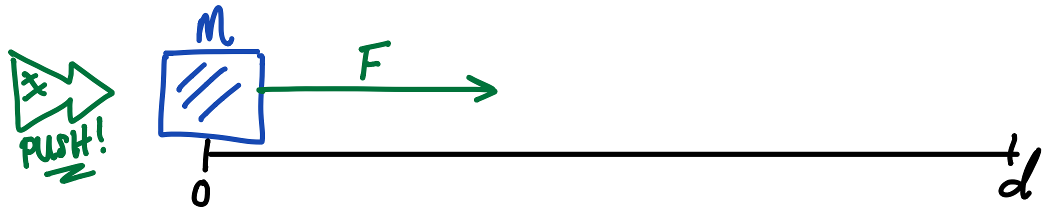
Ch 6.4 WORK: An Application of Integration

Part 1: The BASICS of Work.

A constant Force:



Defn 1: [Work by Constant Force]

! Units:

Defn 2: [Gravitational Force]

Ex 1: Calculate the WORK done in the following situations:

A A force of 2 Newtons moves a 5kg box 12 meters.

B A 2kg book falls to the ground from a height of 2 meters.

QUESTION: WHAT IF FORCE IS NOT CONSTANT?

ANSWER: WE NEED CALCULUS! (INTEGRALS).

WORK

PART 2: THE SPRING PROBLEM

DEFN 3: [HOOKE'S LAW].

Ex 1 A force of 8 lbs is required to hold a spring stretched 2 inches from its natural length.
How much work is done in stretching its natural length to 4 inches beyond its natural length.

sol.

Ex 2. Suppose that 4 J or work is needed to stretch a spring from its natural length of 10 cm to a length of 12 cm.

A How much work is needed to stretch the spring from 12 cm to 15 cm?

Sol:

B How far beyond its natural length will a force of 20 Newtons keep the spring stretched.

Sol:

PART 3: THE CABLE PROBLEM

* WE CAN APPLY SIMILAR TECHNIQUES TO ANOTHER APPLICATION!

Ex 3. A cable with density 2 lb/ft is used to lift 100 lb bundle of shingles from the base of a building to the roof. Treating the shingles as a concentrated point mass, determine the work needed to hoist the shingles up to the roof that is 20 feet tall.

A What is the weight of a slice of the cable with length Δy?

Sol:

B Compute the work done to lift the cable by itself to the roof?

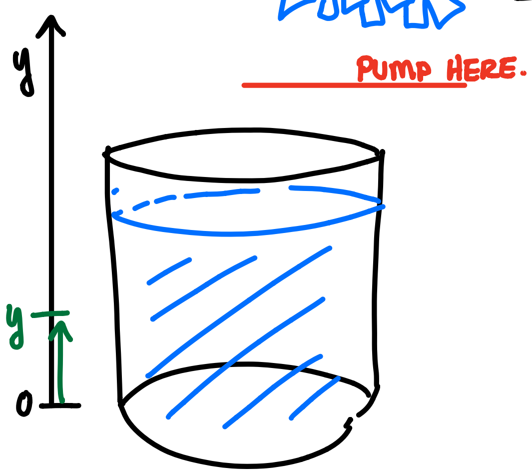
Sol:

C Compute the work done in lifting the shingles to the top of the roof, and add this to the answer from part B.

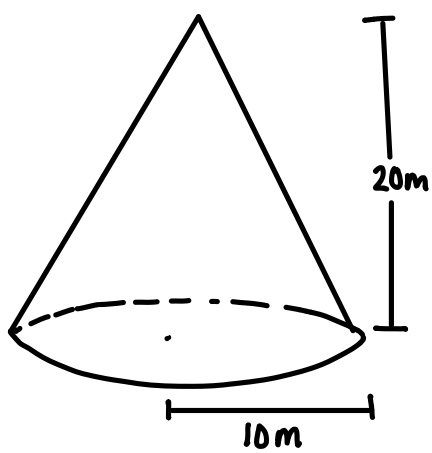
Sol:

PART 4: THE TANK PROBLEM.

* WE CAN COMPUTE WORK NECESSARY TO PUMP FLUIDS FROM A TANK!



Ex 4: A tank if full of water. Set up an integral that represents the work required to pump the water to a height of 2 meters above the top of the tank. The tank is shaped as pictured.



Sol: