Math 181 Monday, February 8 Section 6.5

WW 6.4 Good

6.5-p #2

Work: Movement against a force, through a distance

force: pounds

mass: kilograms ← "weight"

$F = ma$

↑ gravity $32\ ft/s^2$ $9.8\ m/s^2$

Ex Lift 10 lb book 5 feet up

$W = 10 \cdot 5 = 50$ ft-lbs

↑ force ↑ distance

Tue - 7.1

Thu - 7.1

Fri - 7.2 BYOD - Art

Mon - Review

Tue - Exam 1 Chaps 5 & 6

Chapter 7, 8 sections
12 Lectures
schedule 7.3-7.7 revised

Springs The force of a spring (to return to "normal") is proportional to its displacement (how much it has been stretched)

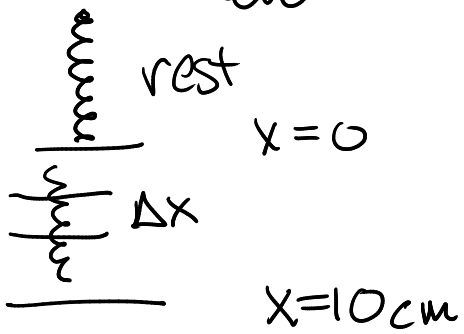
$$F(X) = kX$$

$F(X)$: displacement; k: constant

Ex A 5kg mass will stretch a spring 3cm.

$$(9.8\tfrac{m}{sec^2})(5\,kg) = F(0.03m) = k(0.03) \Rightarrow k = \frac{0.03}{(9.8)(5)}$$

How much work to stretch the spring from natural to 10 cm?

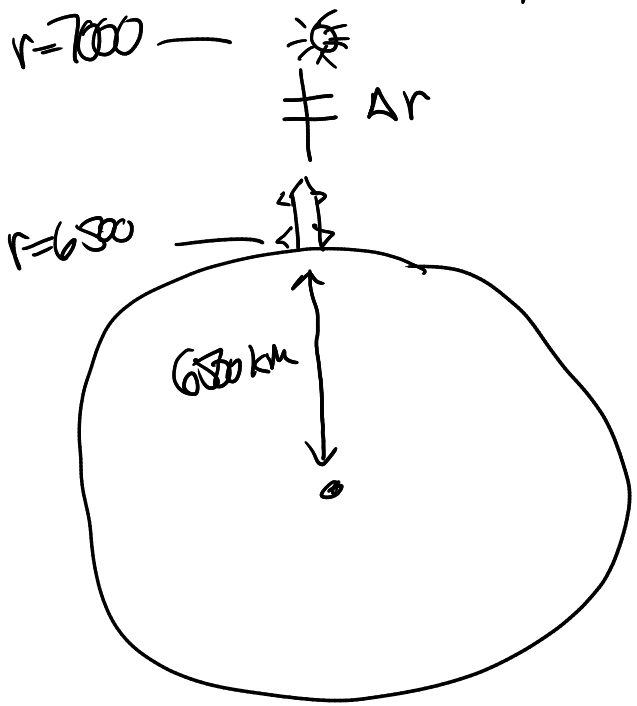


$$\Delta W = F\,\Delta x = F(x)\,\Delta x = kx\,\Delta x$$

$$W = \int dW = \int_{x=0}^{x=0.10} kx\,dx = k\frac{x^2}{2}\Big|_{x=0}^{x=0.10}$$

Ex How much work to lift a 300kg satellite to an orbit 500km high?

Force of gravity = not constant = $\frac{k}{r^2}$ where r = distance between two masses



So $9.8 \frac{m}{s^2} \cdot 300kg = \frac{k}{(6500)^2}$ (force) (force) $\Rightarrow k = 1.2422 \times 10^{17}$ kg m^3/s^2

$$F(r) = \frac{k}{r^2}$$

$$\Delta W = F(r)\,\Delta r$$

$r = 7000$ km $= 7{,}000{,}000$ m

$$W = \int dw = \int_{r=6500\text{ km}}^{r=7000000} F(r)\,dr$$

$$= \int_{6{,}500{,}000}^{7000006} \frac{k}{r^2}\,dr = \left.\frac{-k}{r}\right|_{r=6500000}^{r=7000000}$$

6,500,000 m ← Newton-meter

$= 1.3651 \times 10^9 \frac{m^2 kg}{s^2}$

Power = work/time 20 minute flight $\frac{}{20\text{ min}} = 6.82 \times 10^7$ watt $= 91{,}531$ HP