**Instructions:** Your homework is in two parts, which you should turn in separately. Except for the division into parts A and B, this is identical to the week 4 homework in the course packet.

**Due Wednesday, October 25, in lecture.**

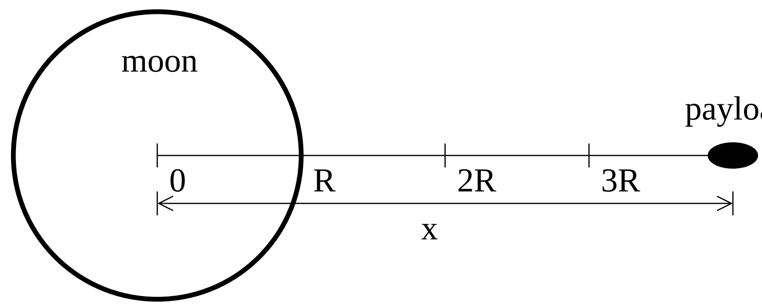
## Week 4 Homework Problems, part A

1 Stewart, section 6.4: #2, 3, 9, 12, 15, 19, 23, 29, 30

2 Stewart, section 6.5: #3, 5, 7, 9, 14, 17, 22

## Week 1 Homework Problems, part B

3 The problem of finding the work done in lifting a payload from the surface of the moon is another type of work problem. Suppose the moon has a radius of $R$ miles and the payload weighs $P$ pounds at the surface of the moon (at a distance of $R$ miles from the surface of the moon). When the payload is $x$ miles from the center of the moon ($x \geq R$), the gravitational attraction between the moon and the payload is given by the following relation:




$$\text{required force} = f(x) = \frac{R^2 P}{x^2}.$$

a) The total amount of work done raising the payload from the surface ($x = R$) to an altitude of $R$ ($x = R + R = 2R$) is

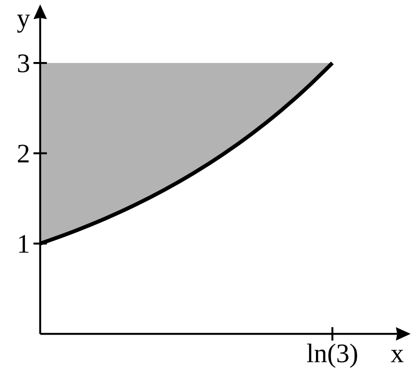
$$\text{work} = \int_a^b f(x)\,dx = \int_R^{2R} \frac{R^2 P}{x^2} dx = \underline{\hspace{3cm}} \text{ mile-pounds.}$$

b) How much work will be needed to raise the payload from the altitude $R$ above the surface (i.e., $x = 2R$) to an altitude of $2R$?

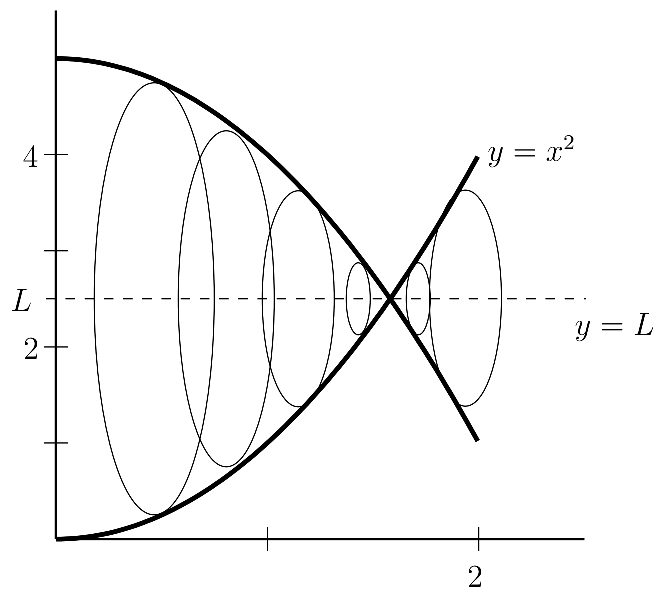
c) How much work will be needed to raise the payload from the surface to an altitude of $2R$?

4 A cable weighing 0.4 pounds per foot of length is attached to a small 80 pound robot, and then the robot is lowered into a 60 foot deep hole to retrieve a 7 pound wrench. The robot gets out of the well (carrying the wrench) by climbing up the cable with one end of the cable still attached to the robot. How much work does the robot do in climbing to the top of the well?

5 The portion of the graph of $y = e^x$ between $x = 0$ and $x = \ln 3$ is rotated around the $y$-axis to form a container. The container is filled with water. Use $n = 4$ subdivisions and midpoints to approximate the work required to pump all the water out over the side. Distance is measured in meters and the density of water is 1000 kg/m$^3$.




6




a) When the graph of $f(x) = x^2$ is rotated about the horizontal line $y = L$ for $0 \le x \le 2$, the volume obtained depends on the value $L$:

$$V(L) = \int_0^2 \pi \left(x^2 - L\right)^2 dx = \_\_\_\_\_\_\_\_$$

(Your answer should contain numbers and $L$'s.)

b) What value of $L$ minimizes the volume in part a)? $L =$ ______

c) When the graph of any function $y = f(x)$ is rotated about the horizontal line $y = L$ for $a \le x \le b$, the volume obtained depends on $L$:

$$V(L) = \int_a^b \pi \left(f(x) - L\right)^2 dx = \_\_\_\_\_\_\_\_$$

(Your answer here should contain some integrals.)

d) What value of $L$ minimizes the volume in part c)? $L =$ ______

(You should recognize the form of this answer. What is it?)