Math 252

Work   Name:_____

$$\boxed{\text{Show all relevant work!}}$$

Work, as defined by physicists, is the product of a force acting over a distance (in the direction of the force). Since force and weight are equivalent quantities, in standard units work is measured in foot-pounds. Lifting a 5 pound object three feet, produces 15 foot-pounds of work against gravity. Carrying the same 5 pound object 3 feet does no work since the weight of the object is measured vertically (due to gravity) and the distance it is transported is horizontal. We will be concerned with the work done on a complex system where either the force or the distances acted on are not constant.

The metric unit for work is the joule or a newton-meter. Since we are typically given mass in metric measurements rather than weight, we have to apply Newton's second law, $F = ma$ to a given mass to compute its weight (in newtons). Lifting a 4kg block 2 meters generates $4 \times 9.81 \times 2 = 78.48$ joules of work.

1. Compute the work done by a pump to empty the swimming pool illustrated below. Assume that the weight density of water is 62.4 lb/ft^3 and that the pump hose floats at the level of the water at all times.

30 ft

10 ft

16 ft
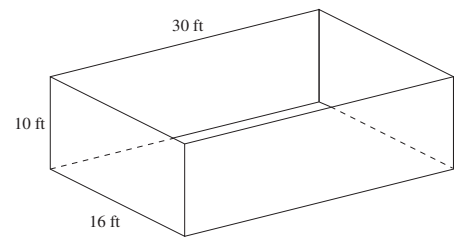
2. Find the answer to (1) if the pump hose lies at the bottom of the pool.

3. Suppose a fuel tank is in the shape of a sphere of radius 10 feet. If the weight density of fuel oil is 42 lb/ft^3, find the work done by gravity in emptying the full tank.

10
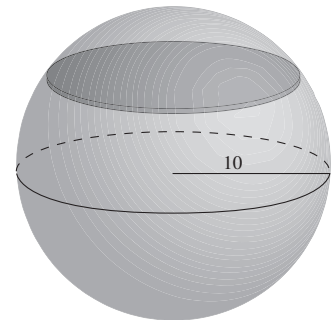
4. Suppose a fuel tank is in the shape of a cylinder resting on its side. Assume the tank has radius 5 feet, length 18 feet , and is buried 6 feet below the surface. If the weight density of fuel oil is 42lb/ft^3, find the work done by a pump in emptying the tank. Assume the pump hose rests on the surface of the fuel.

6 ft

5 ft

18 ft
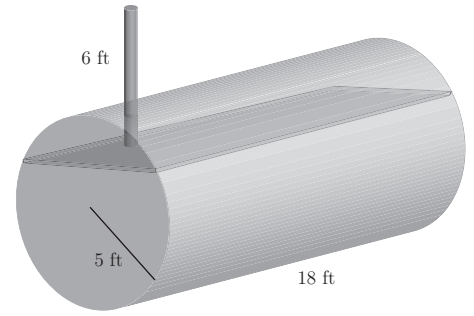
5. Repeat (4) if the pump is pumping all of the oil from the bottom of the tank.

6. Compute the work done by a pump to empty a swimming pool like the one shown below (with a shallow end and a deep end). Assume that the weight density of water is 62.4 lb/ft^3 and that the pump hose floats at the level of the water at all times.

30 ft

10 ft

3 ft

16 ft