

Work and Energy I

1. A block of mass m , initially at rest, is dropped from a height h onto a massless spring whose force constant is k . Find the maximum distance y that the spring will be compressed (see Fig.1)
2. Compute the work required to stretch a spring a distance x from its unstretched length (an equilibrium position), if the force required increases in direct proportion to the amount of elongation (according to Hook's Law). $[W = \frac{1}{2} k x^2]$
3. A small mass m is pulled to the top of a frictionless half-cylinder (of radius R) by a cord passing over the top of the cylinder (Fig.2). If the mass moves at a constant speed, show that $F = mg \sin \theta$. Find the work done in moving the mass at constant speed from the bottom to the top of the half-cylinder.
4. A pump raises water from a well of depth 20 m at a rate of 10 kg/s and discharges it at 6 m/s. What is the power of the motor? $[2100 \text{ W}]$
5. A jet airplane engine develops a thrust of 15000 N. When the plane is flying at 300 m/s, what horsepower is developed (1 hp = 746 W)? $[4.5 \times 10^6 \text{ W} = 6030 \text{ hp}]$

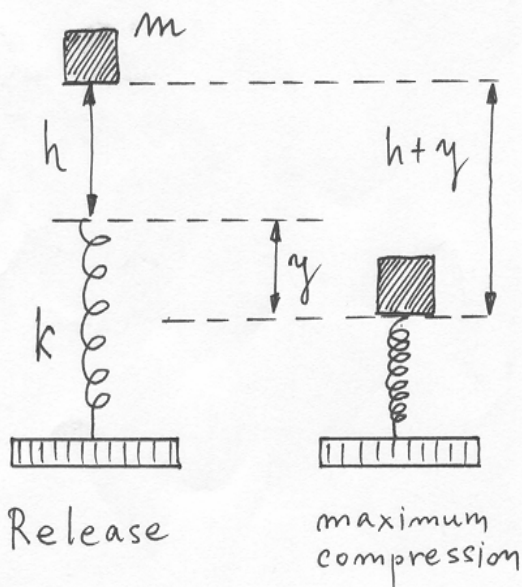


Fig. 1.

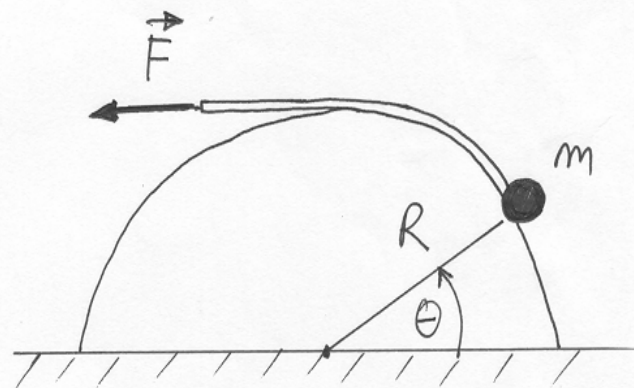


Fig. 2.