Problems - Chapter F
Physics 2425 - Dr. Terry Honan

■ Problem F.1

A 600 N force pushes a refrigerator 8 m along a floor. What is the work done by the force?

■ Problem F.2

Junior lifts a 20 N weight slowly (assume zero acceleration at all times) a distace of 1.5 m. What is the work done by Junior and what is the work done by gravity?

■ Problem F.3

Consider the vectors $\vec{A} = \langle -2, 5, -3 \rangle$ and $\vec{B} = \langle -1, 0, 2 \rangle$.

(a) What is the angle between the two vectors?

(b) What is the angle between $\vec{A}$ and the positive z axis?

■ Problem F.4

A 20 N block, initially at rest, is dragged 5 m along a horizontal floor by a rope. The rope has a tension of 12 N and makes an angle of 25 ° above horizontal. A friction force of 9 N acts backward.

(a) There are four forces acting: the tension, friction, the normal force and gravity. What is the work done by each force?

(b) What is the final speed of the block?

■ Problem F.5

Consider a force of $F(x) = 6\,x^2 - 20$ (in SI units). If this acts on a body that moves from $x = 2$ m to $x = 4$ m then what is the work done by the force?

■ Problem F.6

It takes a 60 N force to compress a spring 4 cm.

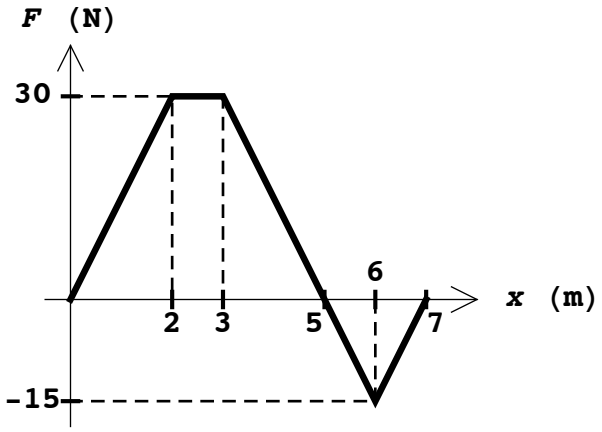
(a) What is the work done by the spring when it is compressed from 0 to $x = -4$ cm?

(b) What is the work done in compressing the spring in part (a)?

(c) What is the work done by the spring when it is compressed from the stretched position of $x = 2$ cm to $x = -4$ cm?

■ Problem F.7

A 3 kg mass intially at rest at $x = 0$ is acted upon by a single force given by the graph below. What is the speed of the mass at $x = 2$ m, $x = 5$ m and $x = 7$ m.



■ Problem F.8

A man does work W pushing a car of mass m from rest to a speed v over a distance d on a horizontal surface. A resistive force acts backward.

(a) What is the work done by the resistive force?

(b) What are the pushing force and the magnitude of the resistive force?

(c) Give the answers to parts (a) and (b) using the numbers:

$$m = 1600\,\text{kg}, v = 1.5\,\frac{\text{m}}{\text{s}}, W = 2400\,\text{J} \text{ and } d = 6\,\text{m}$$

■ Problem F.9

(a) A block of mass m slides from rest a distance D down an incline at angle θ before hitting a spring that is parallel to the incline. It compresses the spring an additional d before stopping and turning around. If the coefficient of kinetic friction is μ then what is the spring constant?

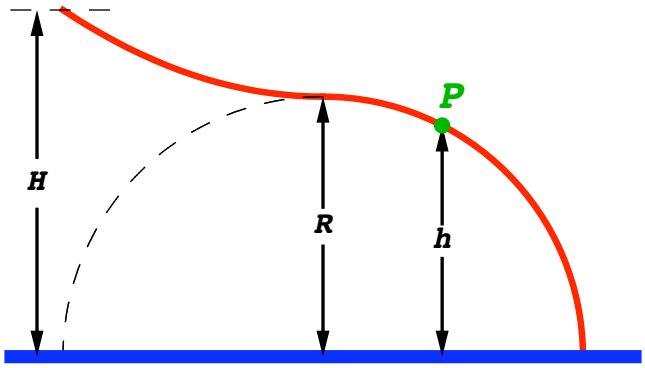
(b) Solve part (a) numerically using $m = 20$ kg, $D = 40$ cm, $d = 10$ cm, $\theta = 35°$ and $\mu = 0.20$.

■ Problem F.10

A mass swings in a vertical circle at the end of a string of length L. What is the minimum speed the mass must have at the bottom of the circle for the mass to make it over the top without the string collapsing.

Problem F.11

Consider a (frictionless) water slide for children. Ths slide is shown in red with the bottom of the slide being a quarter circle of radius R. The water line is shown in blue.



A child starts from rest at the height H above the water (the highest point on the red slide.) At some point P the child will leave the surface. What is the height h of that point P above the water.

■ Problem F.12

Consider Atwood's machine with a frictionless, light pulley. The smaller mass m_1 is on the floor while the larger mass m_2 is a height h above the floor.

(a) If it is released from rest, then what is the speed of m_2 when it hits the floor.

(b) After m_2 hits the floor m_1 is at height h. It continues upward until it eventually stops. What is the maximum height reached by m_1.

■ Problem F.13

Mass m_1 slides on a horizontal table with a coefficient of kinetic friction of μ. It is connected to a hanging mass m_2 that is initially at a height h. What is the speed of m_2 when it hts the floor?

■ Problem F.14

Given a potential energy as a function of position in two dimensions, is SI units, is :

$$U(x, y) = 4\,x^2\,y - 7\,y^2$$

(a) What is the force as a function of position?

(b) What is the force at $(-2\,\text{m}, 3\,m)$?