Conservation of Energy

$\Delta U_{1\to 2} = W_{y_1} - W_{y_2}$ $\qquad V_g = W_y$ $\qquad$ Potential Energy

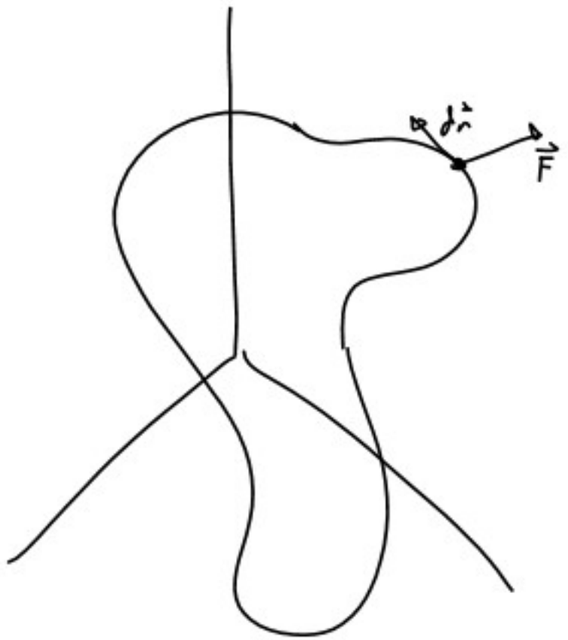
$= (V_g)_1 - (V_g)_2$

$\Delta U_{1\to 2} = \frac{GM_m}{r_2} - \frac{GM_m}{r_1}$ $\qquad V_g = \frac{-GM_m}{r} = \frac{-WR^2}{r}$

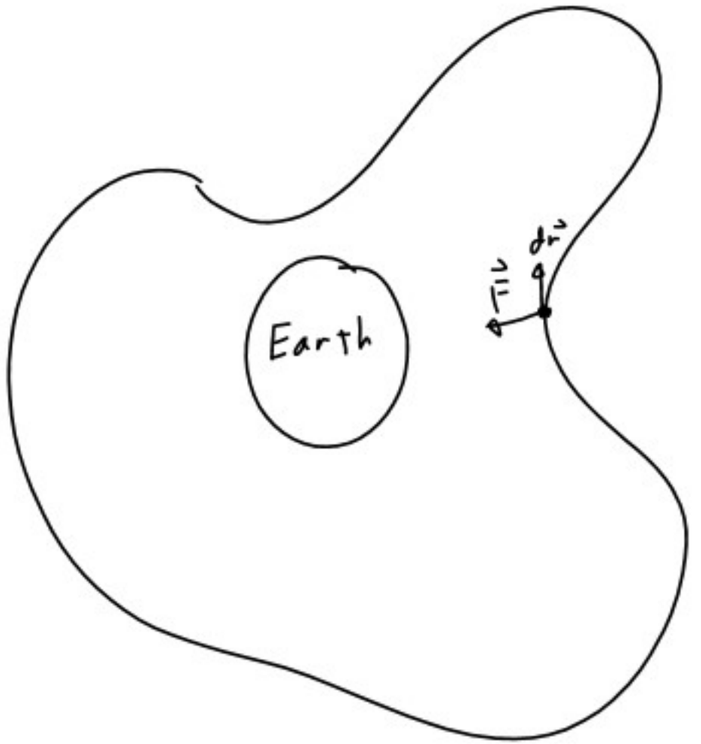
$\Delta U_{1\to 2} = \frac{1}{2}kx_1^2 - \frac{1}{2}kx_2^2$ $\qquad V_e = \frac{1}{2}Kx^2$

$= (V_e)_1 - (V_e)_2$

Conservative Forces



$$\oint F \cdot dr = 0$$



Conservation of energy

$$T_1 + V_1 = T_2 + V_2$$

A 750-g collar can slide along the horizontal rod shown. It is attached to an elastic cord with an undeformed length of 300 mm and a spring constant of 150 N/m. Knowing that the collar is released from rest at A and neglecting friction, determine the speed of the collar (a) at B, (b) at E.

$T = \frac{1}{2}mv^2$

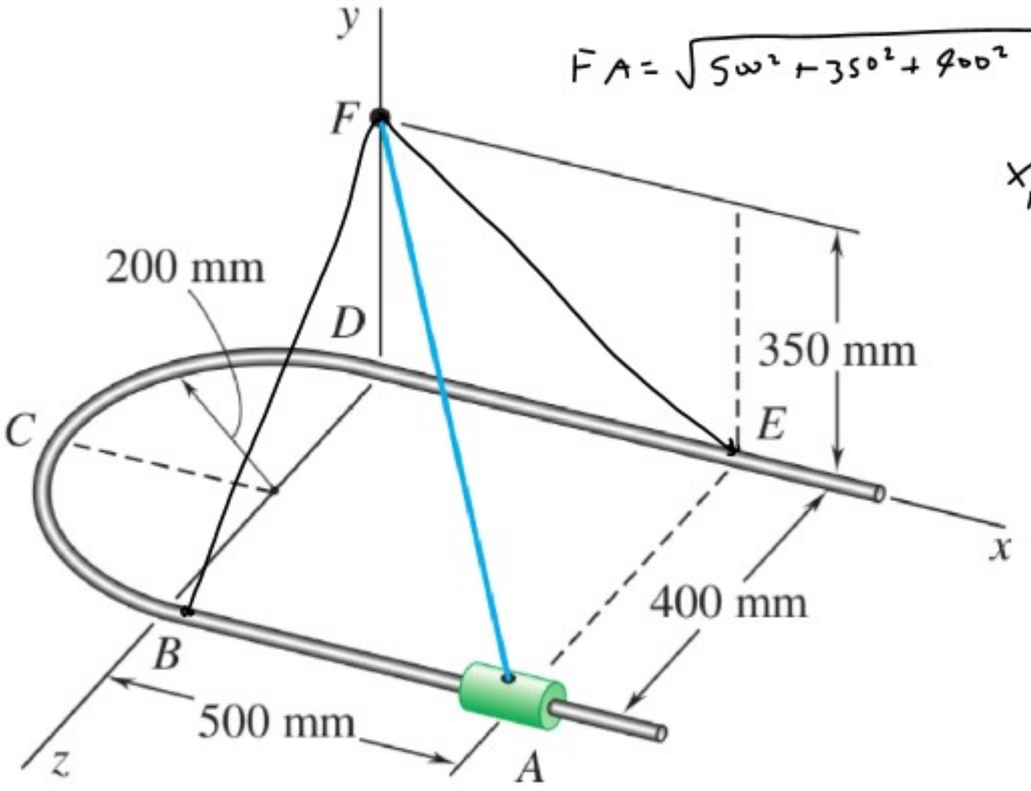
$T_A + V_A = T_B + V_B$

$T_A = 0$

$V_A = \frac{1}{2}kx^2$

$= \frac{1}{2}150(0.93)^2 = 13.85$

$V_B = \frac{1}{2}150(0.7)^2 = 3$



$\vec{F}_A = 500i - 350j + 400k$ mm

$F_A = \sqrt{500^2 + 350^2 + 400^2} = 730$ mm

$x_A = 730 - 300 = 430$ mm
$= 0.43$ m

$\vec{F}_B = -350j + 400k$ mm

$F_B = \sqrt{300^2 + 400^2} = 500$ mm

$x_B = 500 - 300 = 200$ mm
$= 0.2$ m

$\vec{F}_E = 500i - 350j$ mm

$F_E = \sqrt{500^2 + 350^2}$
$= 610$ mm $= 0.61$ m

$x_E = 0.31$ m

$V_A = T_B + V_B$

$13.35 = T_B + 3$

$10.35 = T_B$

$T_B = \frac{1}{2} m V_B^2$

$10.35 = \frac{1}{2} 0.75 \, V_B^2$

$\frac{2(10.35)}{0.75} = V_B^2 = 7.23$

$V_B = 2.69 \text{ m/s}$

$T_A + V_A = T_E + V_E$

$V_A = T_E + V_E$

$13.35 = T_E + 7.2$

$13.35 - 7.2 = T_E$

$6.64 = T_E$

$V_E = \frac{1}{2} k x_E^2$

$= \frac{1}{2} 150 (0.31)^2$

$= 7.2$

$T_E = \frac{1}{2} m V_E^2$

$6.64 = \frac{1}{2} 0.75 \, V_E^2$

$\frac{2(6.64)}{0.75} = 17.7 = V_E^2$

$V_E = 4.2 \text{ m/s}$

A 2-lb collar C may slide without friction along a horizontal rod. It is attached to three springs, each of constant 30 lb/ft and 2-in. undeformed length. Knowing that the collar is released from rest in the position shown, determine the maximum speed it will reach in the ensuing motion.

$T_1 + V_1 = T_{max} + V_{min}$

$V_{1A} + V_{1B} = T_{max} + V_{2B}$

$V_{1A} = T_{max} + V_{2B}$

$V_{1A} - V_{2B} = T_{max}$

$0.637 - 0.0715 = 0.565 = T_{max}$

$V_{1A} = \frac{1}{2} kx^2 = \frac{1}{2} 30 \left(\frac{2.47}{12}\right)^2 = 0.64$

$x = \sqrt{2^2 + 9^2} - 2 = 2.47 \text{ in}$

$V_{2B} = \frac{1}{2} kx^2 = \frac{1}{2} 30 \left(\frac{0.83}{12}\right)^2 = 0.0715$

$x = \sqrt{2^2 + 2^2} - 2 = 0.83 \text{ in}$