9. __Given__

2 children
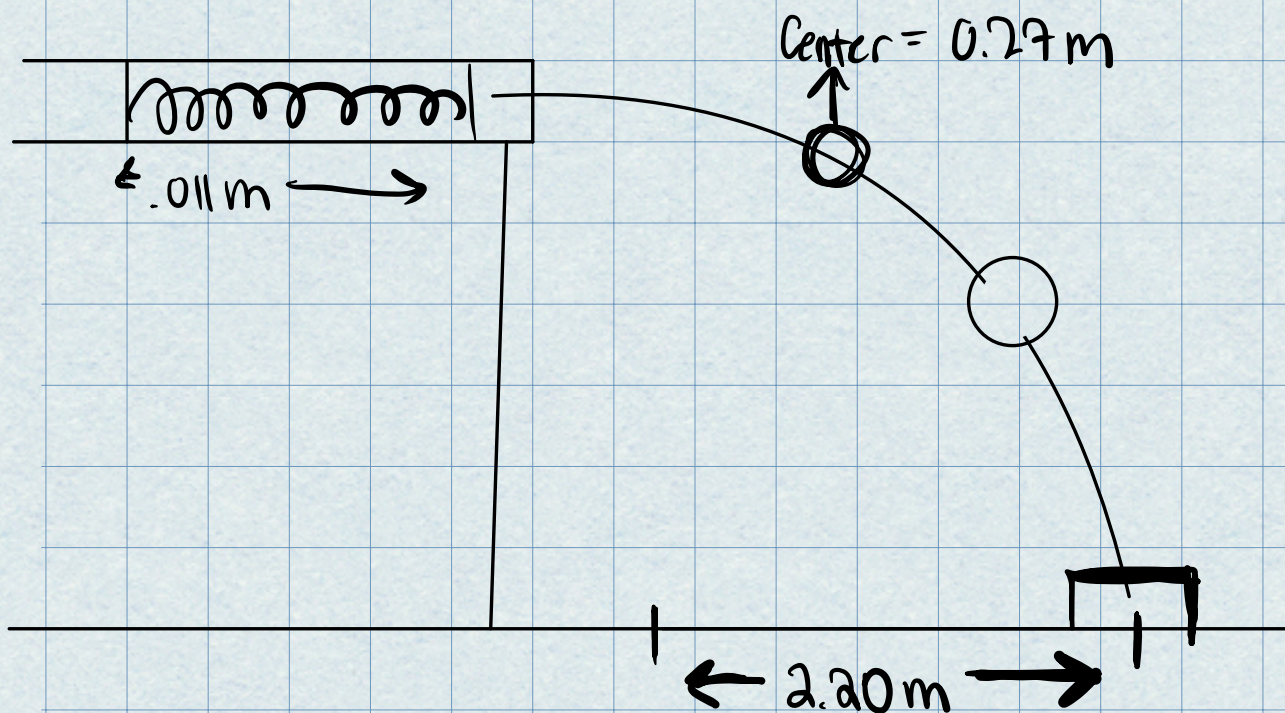
Target box = 2.2m $\longrightarrow$

spring = 1.1 cm, = .011 m

center of marble = 27 cm = 0.27m

distance = ?

g = 10 m/s^2

Center = 0.27 m

←.011m $\longrightarrow$

← 2.20 m $\longrightarrow$

Spring energy = Kinetic energy

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

$$\underline{kx^2 = mv^2}$$

$$v = \sqrt{\frac{kx^2}{m}}$$

$v_{oy} = 0$

$$\Delta x = v_{ox}t + \frac{1}{2}at^2$$

$$\Delta y = v_{oy} + \frac{1}{2}at^2$$

$$\Delta x = \frac{1}{2}at^2$$

$$t = \sqrt{\frac{2\Delta y}{a}}$$

$$\Delta x = \sqrt{\frac{kx^2}{m}} \cdot \sqrt{\frac{2\Delta y}{a}}$$

Bob: $1.93 = \Delta x = \sqrt{\frac{kx^2}{m}} \cdot \sqrt{\frac{2\Delta y}{a}}$

Rhoda: $\div 2.2 = \Delta x = \sqrt{\frac{kx^2}{m}} \cdot \sqrt{\frac{2\Delta y}{a}}$
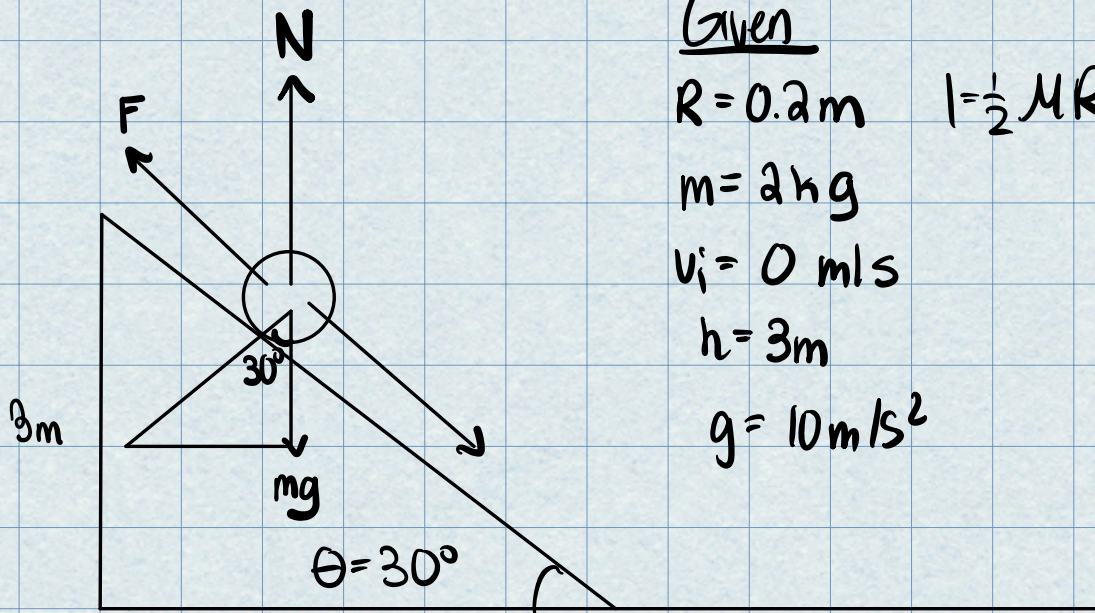
$$0.877 = \frac{1.10 \, cm}{x} = 0.877x = 1.10 \, cm$$

$$\boxed{x = 1.25 \, cm}$$

$$=$$

$$x = 0.0125 \, m$$

10.)

N

F

30°

3m

mg

θ=30°

SOH CAH TOA

h   30°   a
                  19.6N

O

a.) F = mg
     F = (2)(9.8)
     F = 19.6 N

h · cos(30) = $\frac{19.6}{h}$ · h
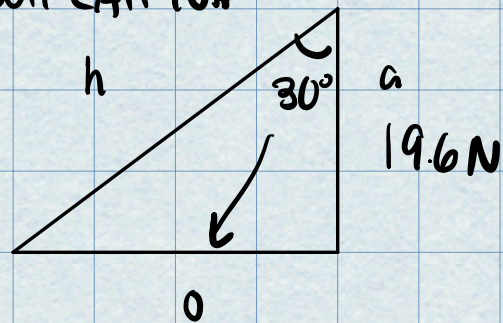
$a_{com} = \frac{3}{2} \sin\theta$

$a_{com} = \frac{3}{2} \sin(30)$

$h = \frac{19.6}{\cos(30)}$

$a_{com} = \boxed{-1.48 \text{ m/s}^2}$

h = 127 m

127 · sin(30) = $\frac{0}{127}$ · 127

$$0 = -125.55$$
$$126 \, m$$

b.) According to conservation of energy
$$KE_{final} = PE_i$$
$$KE_{trans} + KE_{rot} = mgh$$
$$\frac{1}{2}mv^2 + \frac{1}{2}Iw^2 = mgh$$
$$\frac{1}{2}mv^2 + \frac{1}{4}mv^2 = mgh$$
$$\frac{3}{4}mv^2 = mgh$$
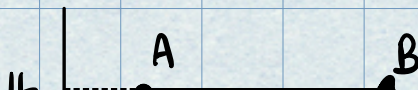
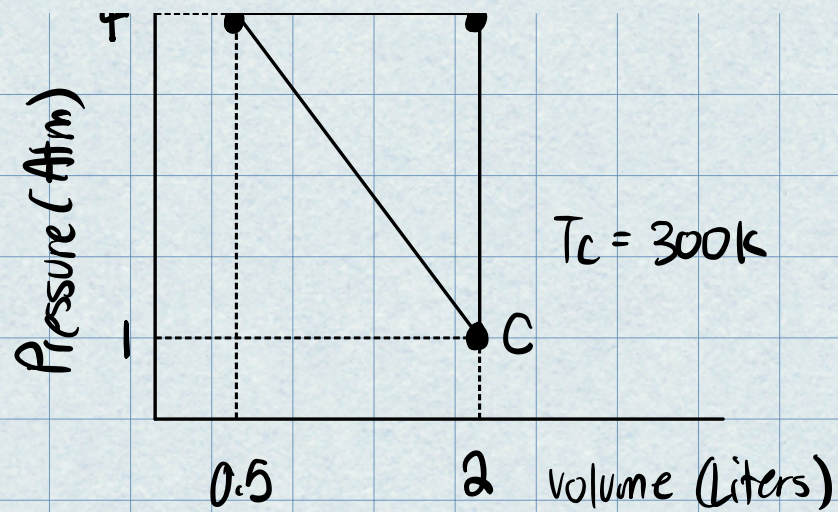$$\therefore v^2 = \frac{4}{3}gh = \frac{4}{3}(9.8 \, m/s^2)(3) = 39.2 \, m/s^2$$

$$KE_{total} = KE_{rot} + KE_{trans} = \frac{3}{4}mv^2 = \frac{3}{4}(2)(39.2 \, m/s^2)$$

$$\boxed{KE_{total} = 58.8 \, J}$$

11.)

Pressure (Atm) vs Volume (Liters)

$T_C = 300K$

Points: at V=0.5, high pressure; at V=2, high pressure (B); C at V=2, P=1

0.5   2   Volume (Liters)

a.) $T_A = T_B = T_C = 300K$

b.) $W = P \Delta U$

c.) $\Delta U = Q + W$

d.) $W - P(v_f - v_i)$

e.) $\eta = \dfrac{QQ - Q}{} = 1 - \dfrac{Q}{Q}$

12.

a.) 2.97 light years

b.) 3062 days (8.89 yrs)

c.) constant velocity of 0.3c, where
    $c = 3.00 \times 10^8$ m/s