Combining Kinematics + Dynamics

You need to know everything about acceleration + displacement:

$a = \frac{\Delta V}{\Delta t}$ $(\Delta V = V_2 - V_1)$

$V_{ave} = \frac{\Delta d}{\Delta t}$ $\left(V_{ave} = \frac{V_1 + V_2}{2}\right)$

} constant acceleration

Maybe Useful Equations

① $\Delta d = V_1 t + \frac{1}{2} a t^2$

② $\Delta d = V_2 t - \frac{1}{2} a t^2$

③ $V_2^2 = V_1^2 + 2a\Delta d$

You also need to know about forces:

Weight: $F_g = mg$

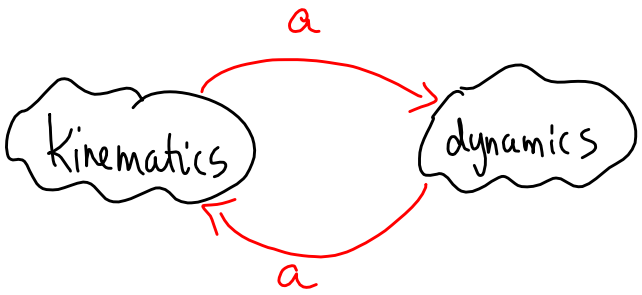
friction: $F_f = \mu F_N$ ← FBD

Newton's Laws

① Law of Inertia

② $\vec{F}_{net} = m\vec{a}$ (FBD)

③ ?



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$m = 9.1 \times 10^{-31}\ kg$

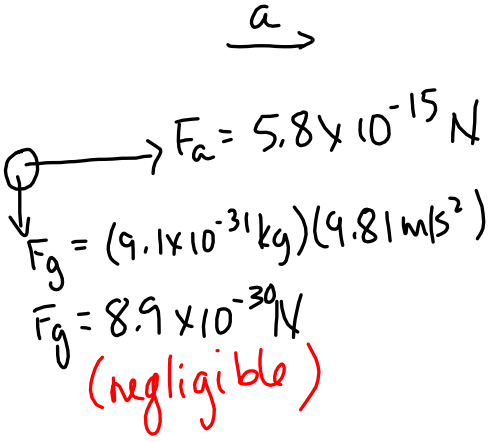
$F_a = 5.8 \times 10^{-15}\ N$

$v_1 = 0$

$\Delta d = 3.5\ mm$

$v_2 = ?$

Draw a FBD:



Find the acceleration:

$$\vec{F}_{net} = m\vec{a}$$

$$F_a = ma$$

$$a = \frac{F_a}{m}$$

$$a = \frac{5.8 \times 10^{-15}\ N}{9.1 \times 10^{-31}\ kg}$$

$N = kg \cdot m/s^2$

$$a = 6.4 \times 10^{15}\ m/s^2$$

Now find v_2:

$$v_2^2 = \cancel{v_1^2}^{\,0} + 2a\Delta d$$

$$v_2^2 = 2(6.4 \times 10^{15}\ m/s^2)(3.5 \times 10^{-3}\ m)$$

$$v_2^2 = 4.4615 \times 10^{13}\ m^2/s^2$$

$$v_2 = 6.7 \times 10^{6}\ m/s$$

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$\vec{F}_a = 9.50\,N\,[S]$

$m = 20.0\,kg$

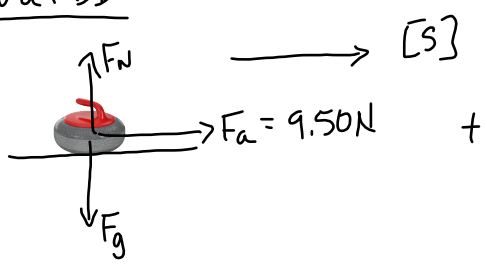
$V_1 = 0$

$\Delta t = 1.86\,s$

a) $\vec{a} = ?$

b) $\vec{V}_2 = ?$

Draw a FBD:



Find acceleration:

$\vec{F}_{net} = m\vec{a}$

$F_a = ma$

$a = \frac{F_a}{m}$

$a = \frac{9.50\,N}{20.0\,kg}$

$a = 0.475\,m/s^2$

$\vec{a} = 0.475\,m/s^2\,[S]$

b) find V_2:

$\vec{a} = \frac{\Delta\vec{V}}{\Delta t}$

$\vec{a} = \frac{\vec{V}_2 - \vec{V}_1}{\Delta t}$

$\vec{V}_2 = \vec{V}_1 + \vec{a}\Delta t$ ($\vec{V}_1 = 0$)

$\vec{V}_2 = (0.475\,m/s^2\,[S])(1.86\,s)$

$\vec{V}_2 = 0.884\,m/s\,[S]$

TO DO

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FBD for car braking: