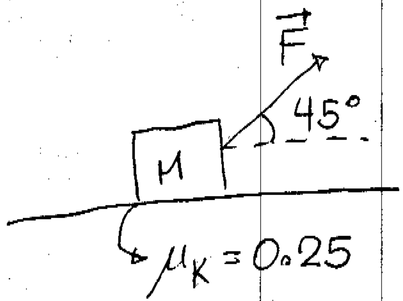
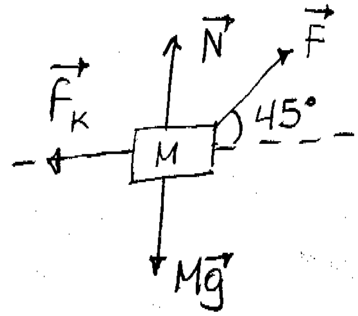
Problem 1:





$\Delta t = 10 s$

$M = 100 kg$

$F = 800 N$

a) $N - Mg + F \sin 45° = 0$

$N = Mg - F\frac{\sqrt{2}}{2}$

$\boxed{N = 414 N}$ (10)

b) $\boxed{F_K = \mu_K N = 104 N}$ (5)

c) $\boxed{F \cos 45° - F_K = F_{Net} = 462 N}$ (10)

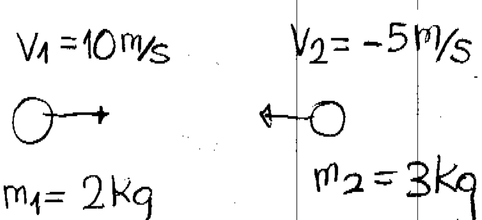
d). $F_{Net} = Ma$, $a = \frac{F_{Net}}{M} = 4.62 m/s^2$

$\Delta X = V_{0x}\Delta t + \frac{1}{2} a \Delta t^2$ ($V_{0x} \to 0$ (from rest))

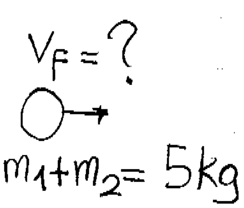
$\Delta X = \frac{1}{2} a \Delta t^2 = \boxed{231 m}$ (10)

Problem 3:

Initially



After



a) $P_i = P_1 + P_2$ (5)

$= m_1 V_1 + m_2 V_2 = 5 \ kg \ m/s$

b) $K_i = K_1 + K_2$

$= \frac{1}{2} m_1 V_1^2 + \frac{1}{2} m_2 V_2^2$ (10)

$= 137.5 \ J$

c) $P_i = P_f$

$P_f = (m_1 + m_2) V_f$

$= 5 kg \ m/s$

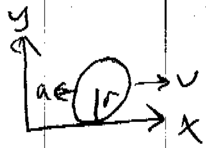
$V_f = \frac{5 \ kg \ m/s}{5 \ kg}$

$\boxed{V_f = 1 \ m/s}$ (10)

d) $K_f = \frac{1}{2}(m_1 + m_2) V_f^2$ (10)

$= 2.5 J$

Problem 2)



$r = 0.5\,m$
$m = 2.0\,kg$
$x = 100\,m$

a) $I = \frac{1}{2} m r^2 = \frac{1}{2}(2\,kg)(0.5\,m)^2 = \frac{1}{4}\,kg\,m^2$

b) $x = vt$
$100\,m = v(20\,s)$
$v = 5\,m/s$
$v = r\omega \qquad \omega = \frac{5\,m/s}{0.5\,m} = 10\,\frac{rad}{s}$

c) $P_{angular} = I\omega = \left(\frac{1}{4}\,kg\,m^2\right)\left(10\,\frac{rad}{s}\right) = \frac{10}{4}\,kg\,\frac{m}{s}\cdot m$

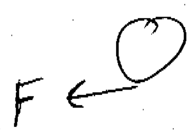
d) This torque has to stop both angular + linear motion.

<u>Angular</u>

$v_f^2 = v_i^2 + 2ax$
$0 = (5\,m/s)^2 + 2a\,100\,m$
$a = \frac{-25}{200} = -\frac{1}{8}\,m/s^2 \qquad \alpha = \frac{a}{r} = \frac{-\frac{1}{8}\,m/s^2}{0.5\,m} = -\frac{1}{4}\,\frac{rad}{s^2}$

$\tau = I\alpha = \left(\frac{1}{4}\,\frac{rad}{s^2}\right)\left(\frac{1}{4}\,kg\,m^2\right) = \frac{1}{16}\,kg\,\frac{m}{s^2}\cdot m = \frac{1}{16}\,N\cdot m$

<u>Linear</u>



$F = ma = (2\,kg)\left(-\frac{1}{8}\,m/s^2\right) = -\frac{1}{4}\,kg\,\frac{m}{s^2}$
$\tau = rF = (0.5\,m)\left(\frac{1}{4}\,kg\,\frac{m}{s^2}\right) = \frac{1}{8}\,kg\,\frac{m}{s^2}\,m$

$\tau_{total} = \tau_{angular} + \tau_{linear} = \left(\frac{1}{16} + \frac{1}{8}\right)N\cdot m = \frac{3}{16}\,N\cdot m$