Physics 1P

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Dynamics Chapter Problems 47-54 + 63-66
Kinetic + Static Friction

(47) $\mu_K = 0.10$ $m = 8.0\ Kg$ $F_F = ?$

First, find normal force by using Newton's 2nd Law

$\vec{F} = m \cdot g = 8.0\ Kg \cdot 9.8 \frac{m}{s^2} = 78.4\ N$

$\vec{F}_F = \mu_K \cdot F_N = 0.10 \times 78.4\ N = \boxed{7.84\ N}$

(48) $F_F = 46\ N$, $\mu_K = 0.30$, weight?

$\vec{F}_F = \mu_K * F_N$, so $F_N = \frac{F_F}{\mu_K} = \frac{46 \frac{Kg\,m}{s^2}}{0.30} = \boxed{153.3\ N}$

(49) $\vec{F}_F = 360\ N$, mass $= 95\ Kg$, $\mu_K = ?$

Use $F = ma$ to find $F_N = 95\ Kg \cdot 9.8 \frac{m}{s^2} = 931\ N$

$\vec{F}_F = \mu_K \cdot \vec{F}_N$, so $\mu_K = \frac{\vec{F}_F}{\vec{F}_N} = \frac{360\ N}{931\ N} = \boxed{0.387}$

(50) $F_F = 126\ N$, $\mu_K = 0.20$, mass?

First, Find $\vec{F}_N$. $\vec{F}_F = \mu_K \cdot \vec{F}_N$, so $\vec{F}_N = \frac{\vec{F}_F}{\mu_K} = \frac{126 \frac{Kg\,m}{s^2}}{0.20} = 630\ N$

Use 2nd Law to find mass

$m = \frac{\vec{F}_N}{\vec{a}} = \frac{630 \frac{Kg\,m}{s^2}}{9.8 \frac{m}{s^2}} = \boxed{64.3\ Kg}$

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(51) $\vec{F}_F = 12\,N$; $\mu_K = 0.60$, weight?

$\vec{F}_F = \mu_K \cdot F_N$, so $F_N = \text{weight} = \dfrac{\vec{F}_F}{\mu_K} = \dfrac{12\,N}{0.60} = 20\,N$

(52) $\mu_K = 0.15$, $m = 16\,Kg$, $F_F = ?$

$\vec{F}_N = 16\,Kg \cdot 9.8\,\frac{m}{s^2} = 156.8\,N$

$\vec{F}_F = \mu_K \cdot \vec{F}_N = 0.15 \times 156.8\,N = 23.52\,N$

(53) $\vec{F}_F = 3.5\,N$, $m = 4\,Kg$, $\mu_K = ?$

$\vec{F}_F = \mu_K \cdot \vec{F}_N$, so $\mu_K = \dfrac{\vec{F}_F}{\vec{F}_N} = \dfrac{3.5\,N}{39.2\,N} = 0.09$

$\vec{F}_N = m \cdot \vec{g} = 4\,Kg \cdot 9.8\,\frac{m}{s^2} = 39.2\,N$

(54) $\vec{F}_F = 100\,N$, $\mu_K = 0.24$, mass $= ?$

$\vec{F}_F = \mu_K \cdot \vec{F}_N$, so $\vec{F}_N = \dfrac{\vec{F}_F}{\mu_K} = \dfrac{100\,\frac{Kg\,m}{s^2}}{0.24} = 416.7\,N$

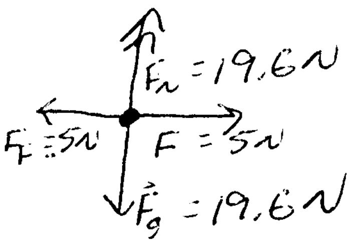
$\vec{F}_N = m\vec{g}$, so $m = \dfrac{\vec{F}_N}{\vec{g}} = \dfrac{416.7\,\frac{Kg\,m}{s^2}}{9.8\,\frac{m}{s^2}} = 47.5\,Kg$

(63) stationary 2.0 kg object

$\mu_s = 0.80 \quad \mu_K = 0.65 \qquad F_N = m \cdot g = 2.0\,kg \cdot 9.8\frac{m}{s^2}$

$= 19.6\,N$

a)



Oops, not to scale

b) ~~$F_{F_s} \le \mu_s \cdot \vec{F}_N = 0.80 \times 19.6N = 15.7N$~~

b) F_{frict} is equal and opposite to Force.

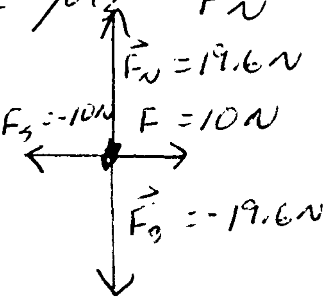
so $\vec{F}_{F_s} = 5\,N$

c) $\vec{a} = 0\frac{m}{s^2}$ because object is in static equilibrium.

(64) object will start moving when:

$F_{F_s} \le \mu_s \cdot F_N = 0.80 \cdot 19.6\,N = 15.7\,N$

a) FBD



↑ Forces must exceed this to start ~~mo~~ accelerating

b) ~~$F_{F_s} \le 0.80 \times 19.6N = 15.7N$~~

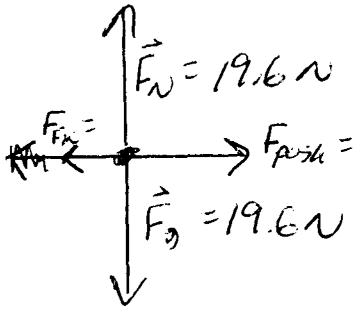
F_{frict} is equal + opposite to Force,

so $F_F = 10\,N$

c) The object is in static equilibrium, so

$\vec{a} = 0\frac{m}{s^2}$

(65) a) FBD



This exceeds 15.7 N, so object will start moving ~~at~~ with kinetic friction. $\mu_K = 0.65$

$\vec{F}_{FK} = \mu_K \cdot \vec{F}_N$

b) $\vec{F}_{FK} = 0.65 \times 19.6N = 12.7N$

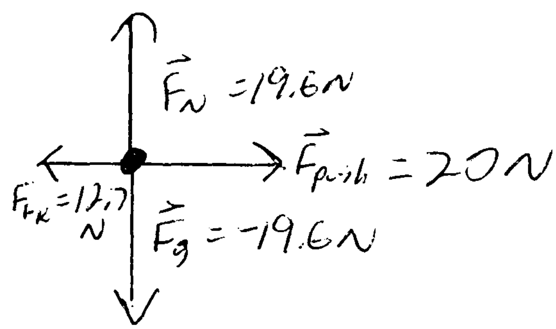
c) $\vec{F}_{Net} = 16N - 12.7N = 3.3N$, so

$\vec{a} = \frac{\vec{F}_{net}}{m} = \frac{3.3 \frac{kg\,m}{s^2}}{2.0 kg} = 1.65 \frac{m}{s^2}$

(66) Force of 20N exceeds 15.7 N; so object will accelerate and move with $\vec{F}_{FK} = \mu_K \cdot \vec{F}_N$

$\vec{F}_{FK} = 0.65 \times 19.6N = 12.7N$

a)



b) $F_{FK} = 0.65 \times 19.6N = 12.7N$

c) $\vec{F}_{net} = 20N - 12.7N = 7.3N$; so

$\vec{a} = \frac{\vec{F}_{net}}{m} = \frac{7.3 \frac{kg\,m}{s^2}}{2.0 kg} = 3.65 \frac{m}{s^2}$