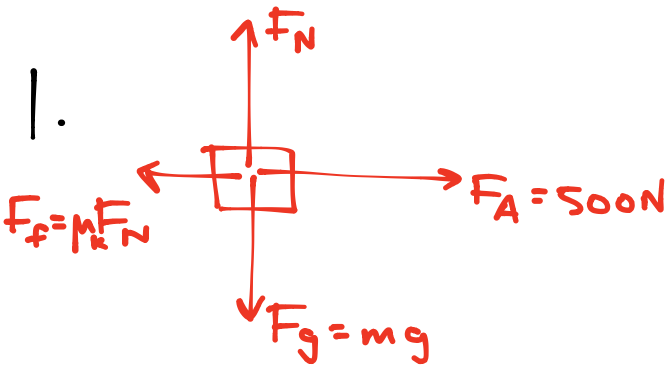
FRICTION WORKSHEET

1.



$F_N = F_g$ UP/DOWN BALANCED

$F_N = mg$

$F_{NET} = ma$

$F_A - F_f = ma$

$F_A - \mu_k F_N = ma$

$F_A - \mu_k mg = ma$

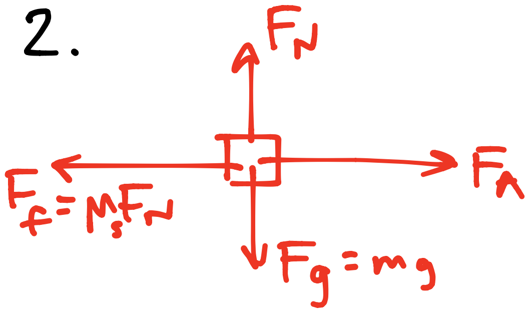
$$a = \frac{F_A - \mu_k mg}{m}$$

$$= \frac{500 - (0.40)(80.0)(9.8)}{80.0}$$

$$= 2.3\ \frac{m}{s^2}$$

Right (direction of the push)

2.



$F_N = F_g$ UP/DOWN BALANCED

$F_N = mg$

WHEN CONSIDERING THE SCENARIO WHERE AN OBJECT JUST STARTS TO MOVE, USE μ_s AND $a = 0$

$F_{NET} = ma$ ← $a = 0$ SEE NOTE

$F_A - F_f = 0$

$F_f = F_A$

$\mu_s F_N = F_A$

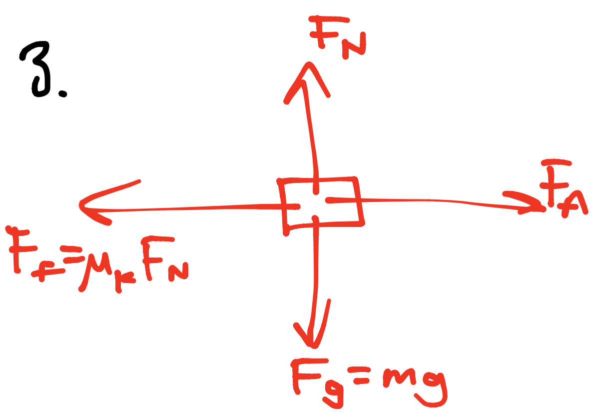
$\mu_s mg = F_A$

$\mu_s = \dfrac{F_A}{mg}$

$= \dfrac{3.25}{(0.50)(9.8)}$

$= 0.66$

3.



$F_N = F_g$ UP/DOWN BALANCED

$F_N = mg$

$F_{NET} = ma$ ← $a = 0$ CONSTANT VELOCITY

$F_A - F_f = 0$

$F_A = F_f$

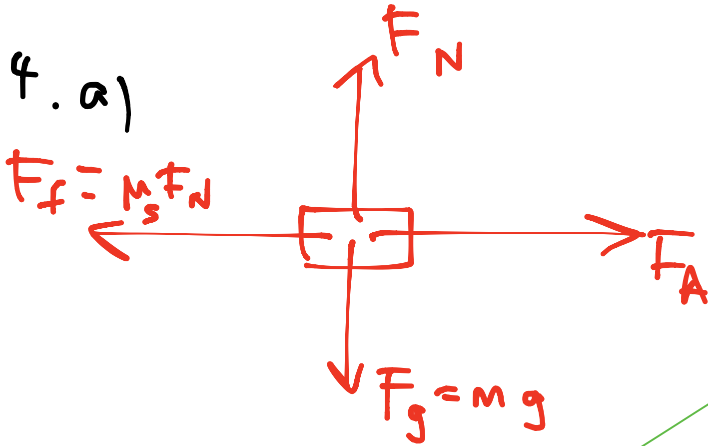
$= \mu_k F_N$

$= \mu_k mg$

$= (0.55)(150)(9.8)$

$= 810\text{ N}$

4. a)



$F_N = F_g$ UP/DOWN BALANCED

$F_N = mg$

$F_{NET} = m\cancel{a}$ → $a = 0$ SEE NOTE

WHEN CONSIDERING THE SCENARIO WHERE AN OBJECT JUST STARTS TO MOVE, USE μ_s AND $a=0$

↳ SAME AS Q2

$F_A - F_f = 0$

$F_A = F_f$

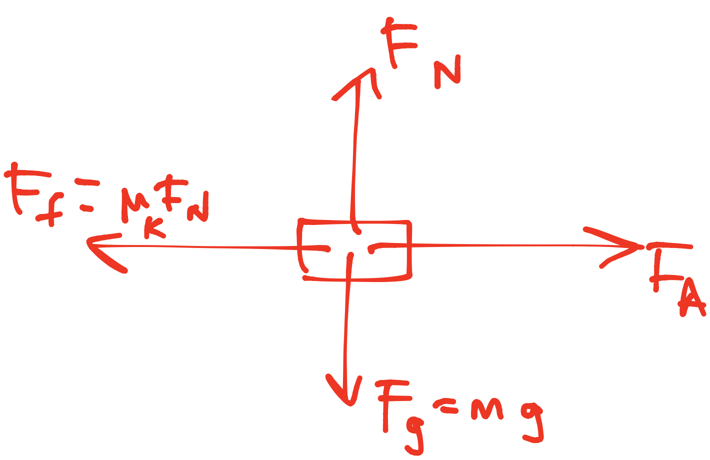
$= \mu_s F_N$

$= \mu_s mg$

$= (0.30)(5.0)(9.8)$

$= 15\,N$

b)



$F_N = F_g$ UP/DOWN BALANCED

$F_N = mg$

$F_{NET} = m\cancel{a}$ → $a = 0$ CONSTANT VELOCITY

$F_A - F_f = 0$

$F_A = F_f$

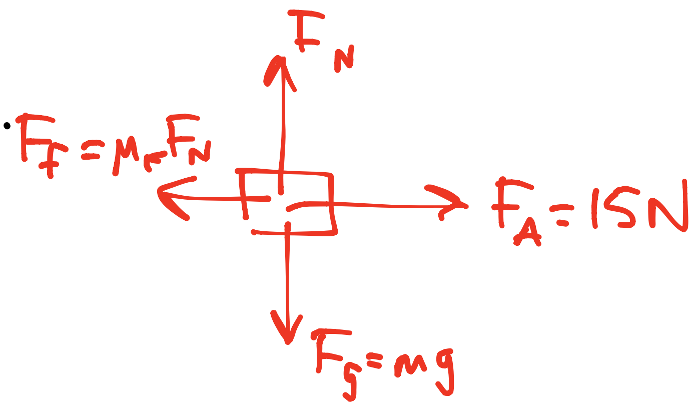
$= \mu_K F_N$

$= \mu_K mg$

$= (0.23)(5.0)(9.8)$

$= 11\,N$

5.



$F_N = F_g$ UP/DOWN BALANCED

$F_N = mg$

$F_{NET} = ma$

$F_A - F_f = ma$

$F_A - \mu_k F_N = ma$

$F_A - \mu_k mg = ma$

$F_A = ma + \mu_k mg$

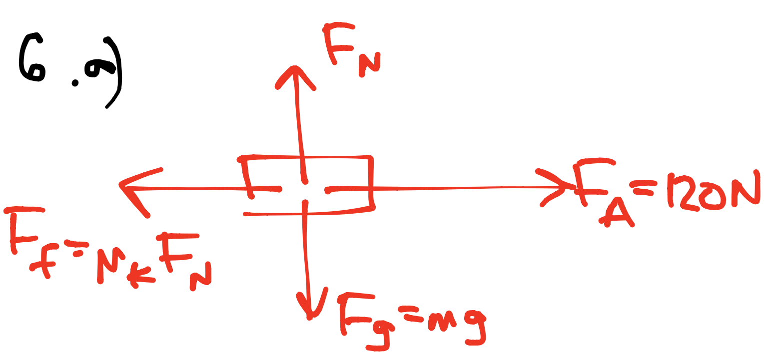
$= m(a + \mu_k g)$

$$m = \frac{F_A}{(a + \mu_k g)}$$

$$= \frac{15}{1.2 + (0.18)(9.8)}$$

$= 5.1\,kg$

6. a)



$F_N = F_g$

$F_N = mg$

UP/DOWN BALANCED

$$F_{NET} = ma$$

$$F_A - F_f = ma$$

$$F_A - \mu_k F_N = ma$$

$$F_A - \mu_k mg = ma$$

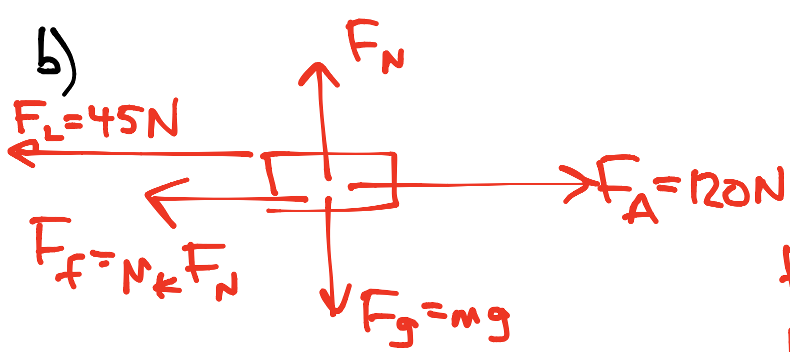
$$a = \frac{F_A - \mu_k mg}{m}$$

$$= \frac{120 - (0.45)(12.0)(9.8)}{12.0}$$

$$= 5.6 \frac{m}{s^2}$$ RIGHT

(DIRECTION OF THE PUSH)

b)



$$F_N = F_g$$

$$F_N = mg$$

UP/DOWN BALANCED

$$F_{NET} = ma$$

$$F_A - F_L - F_f = ma$$

$$F_A - F_L - \mu_k F_N = ma$$

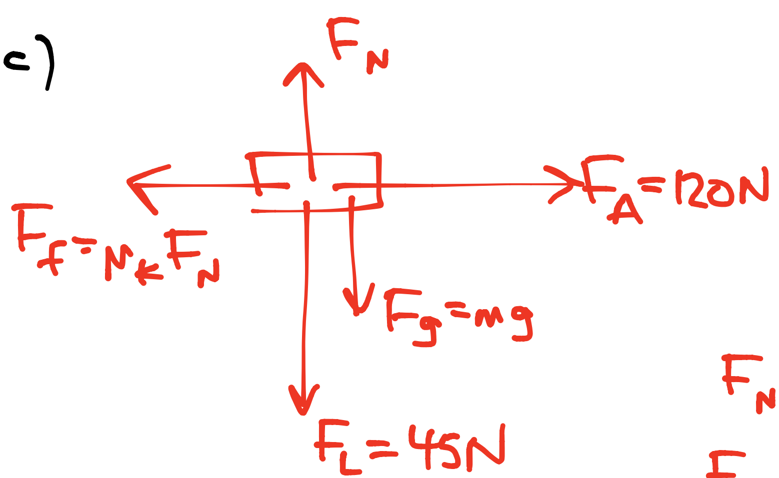
$$F_A - F_L - \mu_k mg = ma$$

$$a = \frac{F_A - F_L - \mu_k mg}{m}$$

$$= \frac{120 - 45 - (0.45)(12.0)(9.8)}{12.0}$$

$$= 1.8 \frac{m}{s^2}$$ RIGHT (DIRECTION OF MATTHEW'S PUSH)

c)



$$F_N = F_g + F_L$$ UP/DOWN BALANCED

$$F_N = mg + F_L$$

NOTICE HOW F_N IS NOT EQUAL TO mg THIS TIME!

$$F_{NET} = ma$$

$$F_A - F_f = ma$$

$$F_A - \mu_k F_N = ma$$

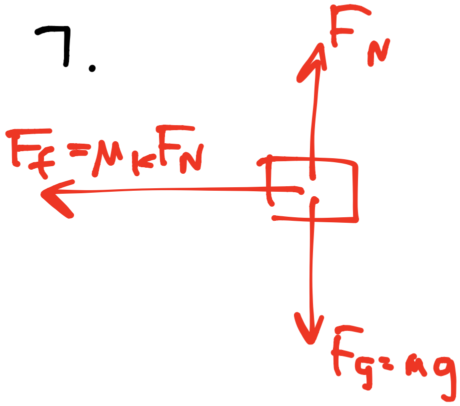
$$F_A - \mu_k(mg + F_L) = ma$$

$$a = \frac{F_A - \mu_k(mg + F_L)}{m}$$

$$= \frac{120 - (0.45)[(12.0)(9.8) + 45]}{12.0}$$

$= 3.9\ \frac{m}{s^2}$ RIGHT (DIRECTION OF MATTHEW'S PUSH)

7.



$$F_N = F_g$$

$$F_N = mg$$

UP/DOWN BALANCED

$$F_{NET} = ma$$
$$-F_f = ma$$
$$-\mu_k F_N = ma$$
$$-\mu_k mg = ma$$
$$a = \frac{-\mu_k \cancel{m} g}{\cancel{m}}$$
$$= -\mu_k g$$
$$= -(0.80)(9.8)$$
$$= -7.84 \frac{m}{s^2}$$

NOTICE HOW $\vec{a}$ DID NOT DEPEND ON MASS (m CANCELLED OUT)

KINEMATICS

$$a = -7.84 \frac{m}{s^2}$$
$$v_i = 80 \frac{km}{h} = 22.\bar{2} \frac{m}{s}$$
$$v_f = 0$$
$$t = ?$$

$$v_f = 0$$
$$v_f = v_i + at$$
$$0 = v_i + at$$
$$t = -\frac{v_i}{a}$$
$$= -\frac{22.\bar{2}}{-7.84}$$
$$= 2.8\ s$$

8. KINEMATICS to FIND a:

$d = 60\ m$

$v_i = 15\ \frac{m}{s}$

$t = 4.5\ s$

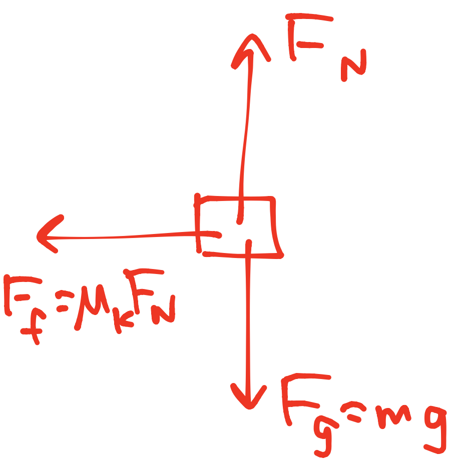
$a = ?$

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

$$a = \frac{2(d - v_i t)}{t^2}$$

$$= \frac{2\left[60 - (15)(4.5)\right]}{(4.5)^2}$$

$$= -0.7407\ \frac{m}{s^2}$$



$F_N = F_g$ UP/DOWN BALANCED

$F_N = mg$

$$F_{NET} = ma$$

$$-F_f = ma$$

$$-\mu_k F_N = ma$$

$$-\mu_k mg = ma$$

$$\mu_k = -\frac{ma}{mg}$$

$$= -\frac{a}{g}$$

$$= -\frac{(-0.7407)}{9.8}$$

$$= 0.076$$