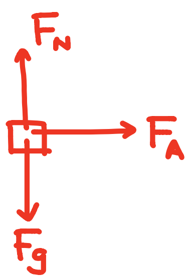
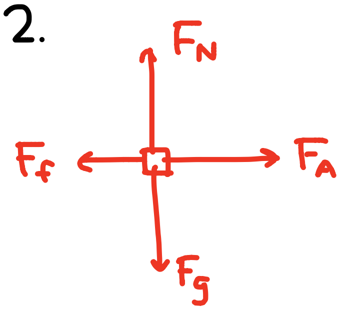
NEWTON'S SECOND LAW - SOLUTIONS

1.



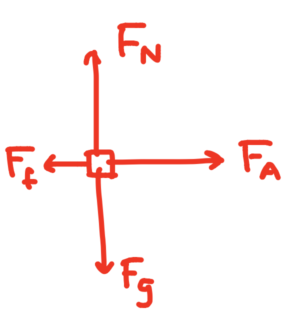
$$F_{NET} = ma$$
$$F_A = ma$$
$$= (10.)(8.5)$$
$$= 85\ N$$ RIGHT (IN THE DIRECTION OF THE ACCELERATION)

2.



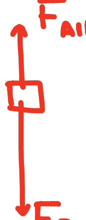
$$F_{NET} = ma$$
$$F_A - F_f = ma$$
$$a = \frac{F_A - F_f}{m}$$
$$= \frac{85 - 20.}{10.}$$
$$= 6.5\ \frac{m}{s^2}$$ RIGHT (IN THE DIRECTION OF F_A)

3.



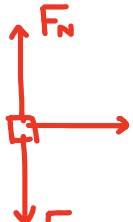
$$F_{NET} = ma$$
$$F_A - F_f = ma$$
$$F_f = F_A - ma$$
$$= 85 - (10.)(7.5)$$
$$= 10.\ N$$ LEFT (IN THE DIRECTION OPPOSITE OF F_A)

4.



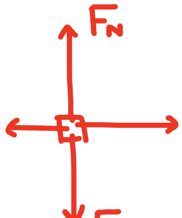
$$F_{NET} = ma$$
$$F_g - F_{AIR} = ma$$
$$mg - F_{AIR} = ma$$
$$a = \frac{mg - F_A}{m}$$
$$= \frac{(3.0)(9.8) - 6.0}{3.0}$$
$$= 7.8\ \tfrac{m}{s^2}\ \text{DOWN}$$

5. a)



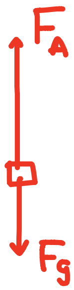
$$F_{NET} = ma$$
$$F_A = ma$$
$$a = \frac{F_A}{m}$$
$$= \frac{550}{40.0}$$
$$= 14\ \tfrac{m}{s^2}\ \text{RIGHT (IN THE DIRECTION OF } F_A\text{)}$$

b)



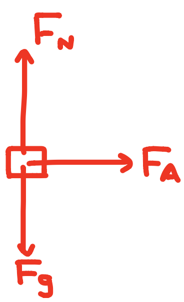
$$F_{NET} = ma$$
$$F_A - F_f = ma$$
$$a = \frac{F_A - F_f}{m}$$
$$= \frac{550 - 80.0}{40.0}$$
$$= 12\ \tfrac{m}{s^2}\ \text{RIGHT (IN THE DIRECTION OF } F_A\text{)}$$

6.



$$F_{NET} = ma$$
$$F_A - F_g = ma$$
$$F_A - mg = ma$$
$$a = \frac{F_A - mg}{m}$$
$$= \frac{5.0\times10^6 - (2.4\times10^5)(9.8)}{2.4\times10^5}$$
$$= 11\ \frac{m}{s^2}\ \text{UP}$$

7. a)



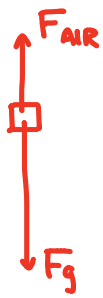
$$F_{NET} = ma$$
$$F_A = ma$$
$$m = \frac{F_A}{m}$$
$$= \frac{120}{1.5}$$
$$= 80.\ \text{kg}$$

b)
$$F_g = mg$$
$$= (80.)(9.8)$$
$$= 780\ \text{N}$$

c)

THE FORCES ARE BALANCED. BY NEWTON'S FIRST LAW, AJAY WILL CONTINUE MOVING WITH A CONSTANT VELOCITY.

8.



$$F_{NET} = ma$$

$$F_g - F_{AIR} = ma$$

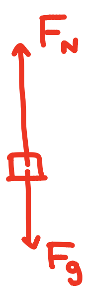
$$mg - F_{AIR} = ma$$

$$a = \frac{mg - F_{AIR}}{m}$$

$$= \frac{(0.80)(9.8) - 4.0}{0.80}$$

$$= 4.8\ \tfrac{m}{s^2}\ \text{DOWN}$$

9.



$$F_{NET} = ma$$

$$F_N - F_g = ma$$

$$F_N - mg = ma$$

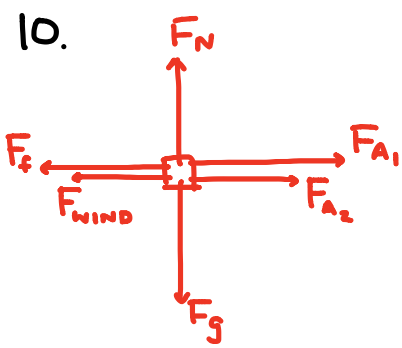
$$F_N = ma + mg$$

$$= m(a + g)$$

$$= 50.(15 + 9.8)$$

$$= 1200\ \text{N UP}$$

10.



$$F_{NET} = ma$$

$$F_{A_1} + F_{A_2} - F_f - F_{WIND} = ma$$

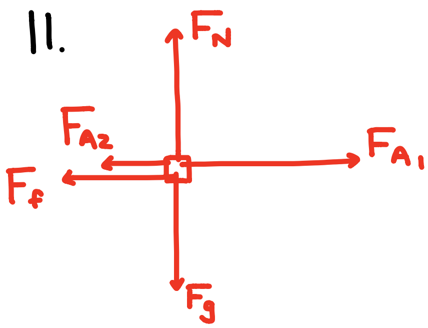
$$a = \frac{F_{A_1} + F_{A_2} - F_f - F_{WIND}}{m}$$

$$= \frac{175 + 125 - 140 - 120}{75}$$

$$= 0.53\ \tfrac{m}{s^2}\ \text{RIGHT}$$

(IN THE DIRECTION OF F_{A_1} & F_{A_2})

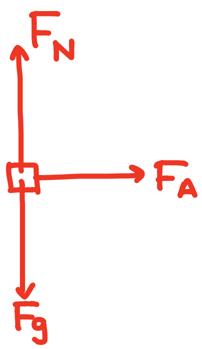
11.



$$F_{NET} = ma$$
$$F_{A1} - F_{A2} - F_f = ma$$
$$F_f = F_{A1} - F_{A2} - ma$$
$$= 1500. - 300. - (450)(0.30)$$
$$= 1070\text{ N}$$

= 1070 N LEFT (IN THE DIRECTION OPPOSITE OF F_{A1})

12.



$$F_{NET} = ma$$
$$F_A = ma$$
$$a = \frac{F_A}{m}$$
$$= \frac{500.}{55}$$
$$= 9.\overline{09}\ \frac{m}{s^2}$$

KINEMATICS

GIVEN:

$d = 40.\text{ m}$

$v_i = 0$

$a = 9.\overline{09}\ \frac{m}{s^2}$

$t = ?$

$$d = v_i t + \frac{1}{2}at^2 \quad (v_i = 0)$$
$$d = \frac{1}{2}at^2$$
$$t = \sqrt{\frac{2d}{a}}$$
$$= \sqrt{\frac{2(40.)}{9.\overline{09}}}$$
$$= 3.0\text{ s}$$

13. KINEMATICS

GIVEN:

$v_i = 20.\ \frac{m}{s}$

$v_f = 0$

$d = 50.\ m$

$a = ?$

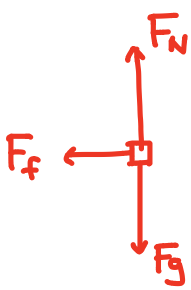
$$v_f^2 = v_i^2 + 2ad$$

$$0 = v_i^2 + 2ad$$

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

$$= -\frac{(20.)^2}{2(50.)}$$

$$= -4.0\ \frac{m}{s^2}$$



$$F_{NET} = ma$$

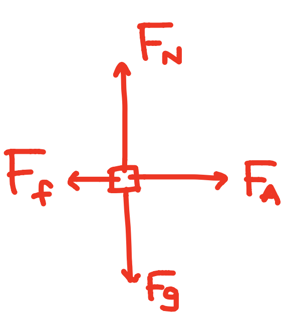
$$-F_f = ma$$

$$F_f = -ma$$

$$= -(2300)(-4.0)$$

$= 9200\ N$ LEFT (IN THE DIRECTION OPPOSITE OF THE INITIAL VELOCITY)

14. AS THE BOOK IS BEING PUSHED



$$F_{NET} = ma$$

$$F_A - F_f = ma$$

$$a = \frac{F_A - F_f}{m}$$

$$= \frac{15 - F_f}{m}$$

KINEMATICS

GIVEN:

$v_i = 0$

$t = 5.0\,s$

$a = \frac{15 - F_f}{m}$

$v_f = ?$

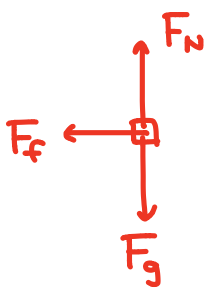
$v_f = \cancel{v_i}^{\,0} + at$

$v_f = at$

$= \left(\frac{15 - F_f}{m}\right) t$

$= \left(\frac{15 - F_f}{m}\right)(5.0)$

AFTER HEATHER STOPS PUSHING



$F_{NET} = ma$

$-F_f = ma$

$a = -\frac{F_f}{m}$

KINEMATICS

GIVEN:

$v_i = \left(\frac{15 - F_f}{m}\right)(5.0)$

$v_f = 0$

$a = -\frac{F_f}{m}$

$t = 3.0\,s$

$\cancel{v_f}^{\,0} = v_i + at$

$0 = v_i + at$

$= \left(\frac{15 - F_f}{m}\right)(5.0) + \left(-\frac{F_f}{m}\right)(3.0)$

$= \frac{75 - 5.0F_f}{m} - \frac{3.0F_f}{m}$

$= 75 - 8.0F_f$

$F_f = \frac{75}{8.0}$

$= 9.4$ N LEFT (IN THE DIRECTION OPPOSITE OF F_A)