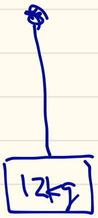
Pg. 136 #11



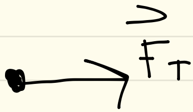
m $\rightarrow$ Force

$F = mg$

$= (12\,kg)(9.8\,m/s^2)$

$\vec{F} = 117.6\,N$

$\therefore$ This is maximum tension for string.



Assume no friction

$\therefore \quad \vec{F}_T = F_{NET}$

$= ma$

$117.6\,N = (30\,kg)\vec{a}$

$117.6\,kg\frac{m}{s^2} = (30\,kg)a$

$$\frac{117.6\,\cancel{kg}\frac{m}{s^2}}{30\,\cancel{kg}} = \vec{a}$$

$$3.92\frac{m}{s^2} = \vec{a}$$

$\Delta d = 22\,m$

$\vec{a} - 3.92\,m/s^2$

$v_i = 0\,m/s$

$\Delta t = ?$

$v_f = ?$

0

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

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

$$22\,m = \frac{1}{2}\left(3.92\frac{m}{s^2}\right)\Delta t^2$$

$$22\,m = \left(1.96\,\frac{m}{s^2}\right)\Delta t^2$$

$$\frac{22\,m}{1.96\,\frac{m}{s^2}} = \Delta t^2$$

$$11.2\,s^2 = \Delta t^2$$

$$\Delta t = \sqrt{11.2\,s^2}$$

$$\Delta t = 3.4\,s$$

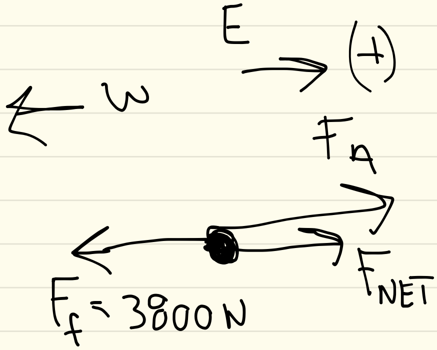
Pg 136

\# 8.

$m = 1300\,kg$

$\vec{a} = 1.6\,\frac{m}{s^2}$ [E]

$\vec{F}_f = 3800\,N$ [W]



$$F_{NET} = F_A - F_f$$

$$ma = F_A - F_f$$

$$(1300\,kg)(1.6\,m/s^2) = F_A - 3800\,N$$

$$2080\,N = F_A - 3800\,N$$

$$2080 + 3800 = F_A$$

$$F_A = 5880\,N\ \boxed{E}$$

Pg. 136 #7.

Given: $F_{NET} = 36N$

$\vec{a} = 6.0\ m/s^2$

$m_1 = ?$

$F_{NET} = m_1 a$

$m_1 = \frac{F_{NET}}{a}$

$m_1 = \frac{36\ kg\ \cancel{m/s^2}}{6\ \cancel{m/s^2}}$

$\boxed{m_1 = 6kg}$

$F_{NET} = 36N$

$\vec{a} = 2.0\ m/s^2$

$m_2 = ?$

$m_1 = 6kg$

$F_{NET} = ma$

$36N = (6 + m_2)\ 2.0\ m/s^2$

$36N = 12N + 2m_2$

$36N - 12N = 2m_2$

$24N = 2m_2$

$\therefore m_2 = 12kg.$

$F_{NET} = 36N$

$m_2 = 12kg$

$a = ?$

$F_{NET} = ma$

$a = \frac{F_{NET}}{m}$

$a = \frac{36\ \cancel{kg}\ m/s^2}{12\ \cancel{kg}}$

$a = 3\ m/s^2$

2 sig digs

$\boxed{a = 3.0\ m/s^2}$

Pg 136 # 5.

$\vec{F}_{NET} = 1.2\,N$ [Forward]

$\vec{\Delta d} = 6.6\,m$ [Forward]

$v_i = 0\,m/s$

$V_f = 3.2\,m/s$ [Forward]

$F_{NET} = ma$

$1.2\,kg\frac{m}{s^2}\,[F] = m\left(0.776\,\frac{m}{s^2}\right)[F]$

$m = \dfrac{1.2\,kg\,\cancel{\frac{m}{s^2}}\,\cancel{[F]}}{0.776\,\cancel{\frac{m}{s^2}}\,\cancel{[F]}}$

$\boxed{m = 1.5\,kg}$

$\vec{a} = \left(\dfrac{V_f^2 - v_i^2}{2\Delta d}\right)$

$V_f^2 = V_i^2 + 2a\Delta d$

$(3.2\,m/s)^2 = 2a(6.6\,m)$

$\dfrac{10.24\,\cancel{m}^2/s^2}{13.2\,\cancel{m}} = a$

$\vec{a} = 0.776\,m/s^2$ [Forward]

Newton’s Third Law of Motion

Newton’s Laws of Motion

Newton’s Third Law of Motion

- For every force, there is a reaction force equal in magnitude but opposite in direction
- When applying Newton’s Third law, the action and reaction forces will appear on separate FBDs. Since they appear on separate FBDs, they are not added together.

Some Videos

- Video 1
- Video 2 – Professor Mac
- Video 3 – NFL Collisions

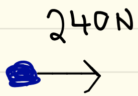
Applications of Newton's Third Law

- Action-reaction pairs of forces are applied in many situations, including:
  - a person walking
  - a rocket being launched into space
  - jet engines

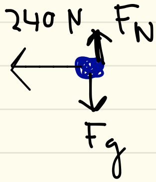
Pg. 141

#1. a)

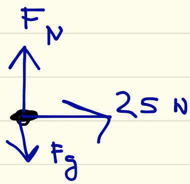
FBD of Road



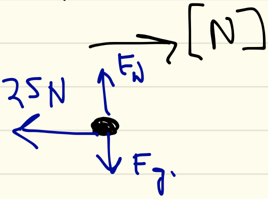
FBD of Tire



b) FBD of Desk



FBD of Person

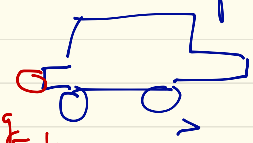


Pg 141 #6.

[E]

$m = 200g \rightarrow$

$m = 0.2kg$



ACTION

$F_A = 0.24N$ [W]

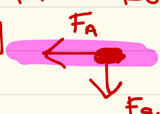
$m = 50g$

$m = 0.05$ kg.

$\vec{a}_{ball} = \dfrac{0.24 kg \frac{m}{s^2}}{0.05kg}$

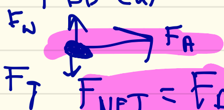
$\vec{a}_{ball} = 4.8 \frac{m}{s^2}$ [W]

FBD Ball



$\vec{a}_{car} = 1.2 \frac{m}{s^2}$ [E]

FBD Car



$F_{NET} = F_A$

$F_A = F_{NET}$

$= ma$

$= (0.2kg)(1.2 \frac{m}{s^2})$

$= 0.24 N$ [E]

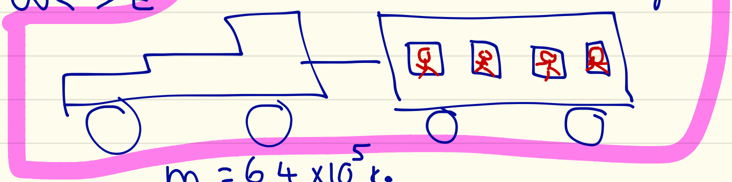
(Reaction)

Section 3.5 Using Newton's Laws

Pg. 144 # 2.

(+) W ⟷ E

$m = 5.0 \times 10^5$ kg

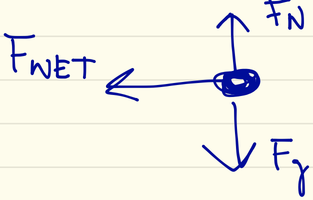


$m = 6.4 \times 10^5$ kg

$\vec{a} = 0.12\ m/s^2$ [W]

entire train
1 object
∴ 1 FBD.

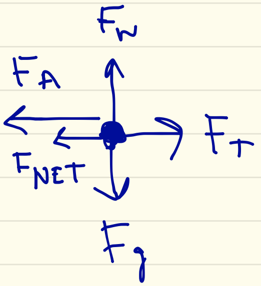
FBD



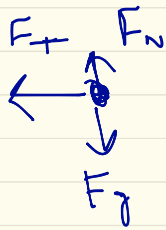
$$F_{NET} = ma$$
$$= (6.4 \times 10^5\ kg + 5.0 \times 10^5\ kg)\left(0.12 \frac{m}{s^2}\right)[W]$$
$$= (11.4 \times 10^5\ kg)(0.12\ m/s^2)[W]$$
$$= 136\,800\ N\ [W] \quad \therefore 140\,000\ N\ [W]$$

(+) W ⟷ E

b) FBD Locomotive



FBD TRAIN CAR



$$F_{NET} = F_A - F_T$$

2 Unknowns

$$F_{NET} = ma$$

$$= (6.4 \times 10^5\ \text{kg})\left(0.12\ \frac{\text{m}}{\text{s}^2}\right)[\text{W}]$$

$$F_{NET} = 76\ 800\ \text{N}\ [\text{W}]$$

$$F_T = F_{NET}$$

$$F_T = ma$$

1 unknown.

$$F_T = (5.0 \times 10^5\ \text{kg})\left(0.12\ \frac{\text{m}}{\text{s}^2}\right)[\text{W}]$$

$$F_T = 60\ 000\ \text{N}\ [\text{W}]$$

$$F_{NET} = F_A - F_T$$

$$76\ 800\ \text{N} = F_A - 60\ 000\ \text{N}$$

$$76\ 800\ \text{N} + 60\ 000\ \text{N} = F_A$$

$$136\ 800\ \text{N} = F_A$$

∴ The locomotive applies a force of 14 0000 N [W]

Pg 157 # 54