Contents

1 Newton's Second Law w/ Acceleration

1.1 Example

$$
\begin{aligned}
v_1 &= v \\
v_2 &= \frac{1}{2}v \\
a_1 &= a \\
a_2 &= \frac{1}{2}a \\
m_1 &= 8\,\text{kg} \\
m_2 &= 10\,\text{kg} \\
a_{m_1} &= ? \\
a_{m_2} &= ?
\end{aligned}
$$

$$
\begin{aligned}
\sum F_y^{(m_1)} &= 0 \\
N_{m_1} &= w_{m_1}
\end{aligned}
$$

$$
\begin{aligned}
\sum F_x^{(m_1)} &= -a_{m_1} \\
T_1 &= -a_{m_1}
\end{aligned}
$$

$$
\begin{aligned}
\sum F_y^{P} &= 0 \\
T_1 &= 2T_2 \\
T_2 &= \frac{1}{2}T_1
\end{aligned}
$$

$$
\begin{aligned}
\sum F_y^{(m_2)} &= -a_{m_2} \\
T_2 &= -w_{m_2} - a_{m_2}
\end{aligned}
$$

$$
\begin{aligned}
-w_{m_2} - a_{m_2} &= \frac{1}{2}T_1 \\
T_1 &= -2(w_{m_2} + a_{m_2})
\end{aligned}
$$

$$
\begin{aligned}
-2(w_{m_2} + a_{m_2}) &= -a_{m_1} \\
a_{m_1} &= 2(w_{m_2} + a_{m_2}) \\
a_{m_2} &= \frac{1}{2} a_{m_1} - w_{m_2}
\end{aligned}
$$

1.2 Example - Lab Manual 592

$$
\begin{aligned}
m_1 &= 10\,\mathrm{kg} \\
m_2 &= 5\,\mathrm{kg} \\
m_3 &= 3\,\mathrm{kg} \\
\theta &= 25^\circ \\
\phi &= 65^\circ
\end{aligned}
$$

$$
\begin{aligned}
\sum F_x^{(m_3)} &= m_3 a \\
f_{m_3} &= m_3 a + T_2 + m_3 g \sin(\theta) \\
T_2 &= \mu N_{m_3} - m_3 a - m_3 g \sin(\theta)
\end{aligned}
$$

$$
\begin{aligned}
\sum F_y^{(m_3)} &= 0 \\
N_{g,m_3} &= m_3 g \cos(\theta) \\
&= (3\,\mathrm{kg})(10\,\mathrm{m\,s^{-2}}) \cos(25^\circ) \\
N_{g,m_3} &= 27.2\,\mathrm{N}
\end{aligned}
$$

$$
\begin{aligned}
T_2 &= \mu N_{m_3} - m_3 a - m_3 g \sin(\theta) \\
T_2 &= \mu 27.2\,\mathrm{N} - (3\,\mathrm{kg})(2.35\,\mathrm{m\,s^{-2}}) - (3\,\mathrm{kg})(10\,\mathrm{m\,s^{-2}}) \sin(25^\circ)
\end{aligned}
$$

$$
\begin{aligned}
\sum F_y^{(m_1)} &= -m_1 a \\
T_1 &= m_1 g - m_1 a \\
&= (10\,\mathrm{kg})(10\,\mathrm{m\,s^{-2}}) - (10\,\mathrm{kg})(2.35\,\mathrm{m\,s^{-2}}) \\
T_1 &= 76.5\,\mathrm{N}
\end{aligned}
$$

$$
\begin{aligned}
\sum F_y^{(m_2)} &= 0 \\
N_{g,m_2} &= m_2 g \\
&= (5\,\mathrm{kg})(10\,\mathrm{m\,s^{-2}}) \\
N_{g,m_2} &= 50\,\mathrm{N}
\end{aligned}
$$

$$\begin{aligned}
\sum F_x^{(m_2)} &= -m_2 a \\
T_2 + f_{m_2} &= -m_2 a + T_1 \\
T_2 + \mu N_{m_2} &= -m_2 a + T_1
\end{aligned}$$