Honors Physics Test – Newton's Laws of Motion – 11-19-04 – Mr. Ward

Name WARD

Equations: Newton's 2nd law is **ΣF = ma**. The weight equation is **F_g = mg**

If the value in **problems 1-4** is already given, just write and box the final answer (including symbol, equals, number, units). If it needs to be calculated, write the equation, rearrange, substitute, and box the final answer (including symbol, equals, number, units).

1. (5 pts) What is the weight of a 250 000 N rocket? (F_g)

$\boxed{F_g = 2.50\times10^5 N}$

2. (5 pts) What is the mass of a 47 000 N bus? (F_g)

$F_g = mg$ $\quad m = \frac{47000N}{9.8\frac{m}{s^2}}$ $\quad \boxed{m = 4.80\times10^3 kg}$

$m = \frac{F_g}{g}$

3. (5pts) What is the mass of an 11.2 kg bike? (m)

$\boxed{m = 11.2 kg}$

4. (5 pts) What is the weight of a 0.27 kg parrot? (m)

$F_g = mg$

$= 0.27 kg (9.8\frac{m}{s^2})$ $\quad \boxed{F_g = 2.65 N}$

5. (10 pts) A force of 1.5 x 10^4 N is applied to a 7.8 x 10^6 N train on level ground. What is the acceleration of the train?

$F = 1.5\times10^4 N$ $\quad F_g = 7.8\times10^6 N$ $\quad a = \_\_ \frac{m}{s^2}$

$F_g = mg$ $\quad m = \frac{F_g}{g}$

$= \frac{7.8\times10^6 N}{9.8\frac{m}{s^2}}$

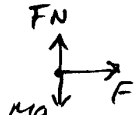
$m = 7.96\times10^5 kg$

$\Sigma \vec{F} = m\vec{a}$

$a = \frac{\Sigma F}{m}$

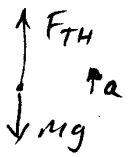
$= \frac{1.5\times10^4 N}{7.96\times10^5 kg}$

$\boxed{a = 0.0188\frac{m}{s^2}}$



6. (20 pts) A rocket with m = 1500 kg has an engine which is pushing it up with a thrust of 3 x 10^4 N. (a) Draw and label FBD. Show acceleration direction. Use ΣF = ma. (b) What is the acceleration of the rocket?

$m = 1500 kg$ $\quad F_{TH} = 3\times10^4 N$ $\quad a = \_\_ \frac{m}{s^2}$



$\Sigma \vec{F} = m\vec{a}$

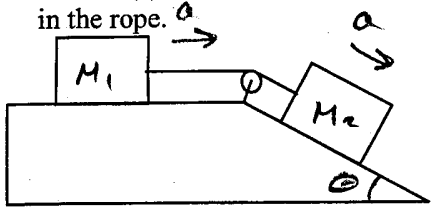
$F_{TH} - mg = ma$

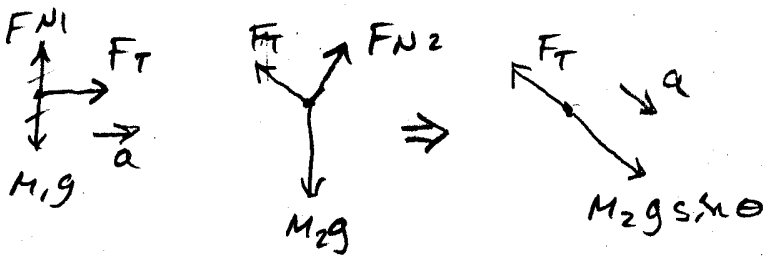
$a = \frac{F_{TH} - mg}{m}$

$= \frac{3\times10^4 N - 1500 kg(9.8\frac{m}{s^2})}{1500 kg}$

$\boxed{a = 10.2\frac{m}{s^2}, up}$

7. (25 pts) A mass, $m_1 = 6$ kg, on a level surface is attached to a mass, $m_2 = 4$ kg, on an inclined plane that is at an angle of 25°. (a) Draw FBDs and show acceleration direction. (b) Find the acceleration of the masses. (c) Find the tension in the rope.





$M_1 = 6$ kg
$M_2 = 4$ kg
$\theta = 25°$

$\Sigma \vec{F}_1 = M\vec{a}$

$F_T = M_1 a$

$\Sigma \vec{F}_2 = M_2 \vec{a}$

$-F_T + M_2 g \sin\theta = M_2 a$

add: $F_T = M_1 a$

$M_2 g \sin\theta = (M_1 + M_2) a$

$$a = \frac{M_2 g \sin\theta}{M_1 + M_2}$$

$$= \frac{4\,\text{kg}\left(9.8 \frac{\text{m}}{\text{s}^2}\right)\sin 25°}{6\,\text{kg} + 4\,\text{kg}}$$

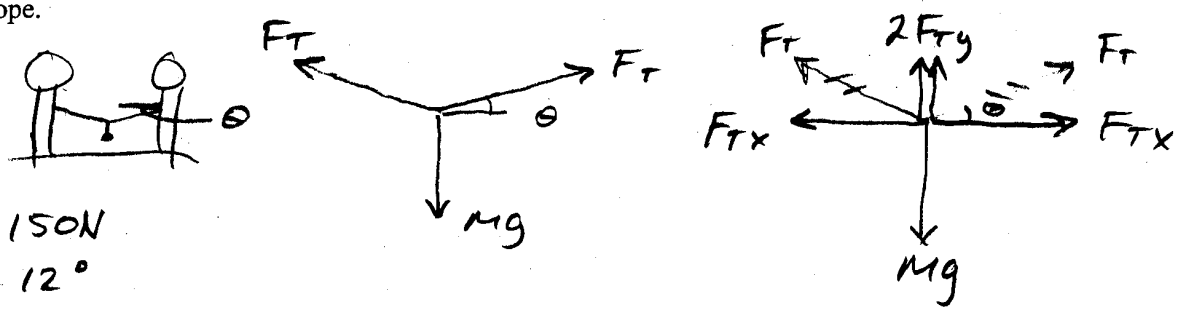
b) $\boxed{\vec{a} = 1.66 \frac{\text{m}}{\text{s}^2}, \text{ downhill}}$

$F_T = M_1 a$

$= 6\,\text{kg}\left(1.66 \frac{\text{m}}{\text{s}^2}\right)$

c) $\boxed{F_T = 9.96\,\text{N}}$

8. (25 pts) A rope is stretched between two trees. A 150 N weight is hung on the rope. The rope sags such that each end of the rope make a 12° angle with the horizontal. (a) Draw and label a good FBD. (b) Calculate the tension in the rope.



$F_g = 150N$

$\theta = 12°$

$$\Sigma \vec{F}_y = M\vec{a}_y$$

$$2F_{Ty} - Mg = M\vec{a}_y^{\,0}$$

$$2F_T \sin\theta - Mg = 0$$

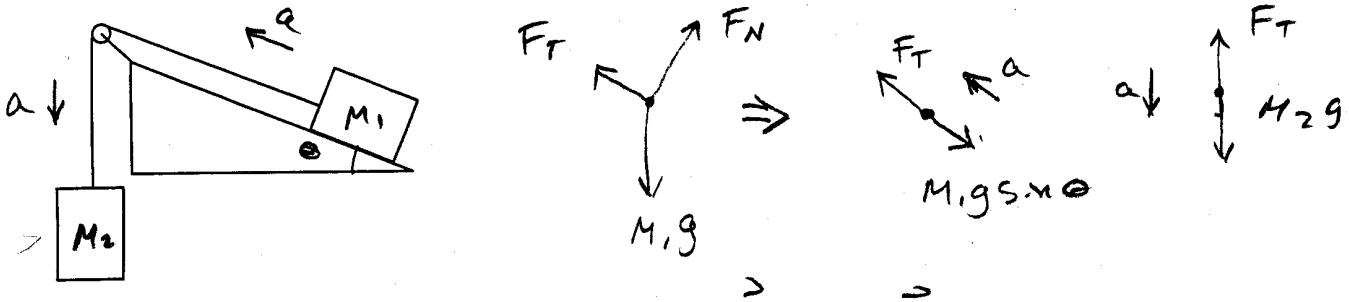
$$F_{Ty} = F_T \sin\theta$$

$$F_T = \frac{Mg}{2\sin\theta}$$

$$= \frac{150N}{2\sin 12°}$$

b) $\boxed{F_T = 361N}$

EC. (10 pts – If you want to do this problem, get paper from me.) A mass, $m_1 = 15$ kg, is on a 20° frictionless hill. Another mass, $m_2 = 6.5$ kg, is hanging off the pulley. (a) Find the acceleration of the masses, including direction. (b) What mass would m_1 have to be so the masses would not accelerate?



$\Sigma \vec{F}_1 = M_1\vec{a}$ $\qquad$ $\Sigma \vec{F}_2 = M_2\vec{a}$

$F_T - M_1 g \sin\theta = M_1 a$ $\qquad$ $-F_T + M_2 g = M_2 a$

$-F_T + M_2 g = M_2 a$ $\qquad$ ← add

$M_2 g - M_1 g \sin\theta = M_1 a + M_2 a$

$(M_2 - M_1 \sin\theta) g = (M_1 + M_2) a$

$$a = \frac{(M_2 - M_1 \sin\theta) g}{M_1 + M_2}$$

$$= \frac{(6.5\,kg - 15\,kg \sin 20^\circ)\, 9.8\,\frac{m}{s^2}}{15\,kg + 6.5\,kg}$$

a) $\boxed{a = 0.624\,\frac{m}{s^2}}$

$M_2 - M_1 \sin\theta = 0$

$$M_1 = \frac{M_2}{\sin\theta}$$

$$= \frac{6.5\,kg}{\sin 20^\circ}$$

b) $\boxed{M_1 = 19.0\,kg}$