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Score: 22/20, well done!

PHYS 135 A - Exam 2

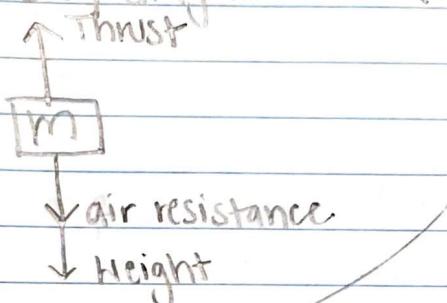
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2 Chapter 4: Dynamics, Force & Newton's...

1)

$5.00 \times 10^5 \text{ kg}$ ↑ rocket
 $1.25 \times 10^7 \text{ N}$ ↑ thrusters
 $4.5 \times 10^6 \text{ N}$ ↓ air resis.

(a) Free body diagram



(b) rocket's acceleration?

$$F_{\text{net}} = ma$$

$$F = T - f - mg$$

$$ma = T - f - mg$$

↓ accel.

→ 9.8 m/s^2

$$\rightarrow (5 \times 10^5 \text{ kg}) a = 1.25 \times 10^7 \text{ N} - 4.5 \times 10^6 \text{ N} - (5 \times 10^5 \text{ kg})(9.8 \text{ m/s}^2)$$

$$\text{Solve for } a: \frac{(1.25 \times 10^7 \text{ N}) - (4.5 \times 10^6 \text{ N}) - (4.9 \times 10^6 \text{ N})}{(5 \times 10^5 \text{ kg})}$$

$$a = 6.20 \text{ m/s}^2$$

2) 70 kg pushes → w/ mass 90 kg

exerts 700N on 2nd player. Force 2nd exerts on 1st?

$$F_1 = F_2$$

$$m_1 = 70 \text{ kg}$$

So, if player 1 exerts

$$m_1 a_1 = m_2 a_2$$

$$m_2 = 90 \text{ kg}$$

a force on player 2,

$$F_1 = 700 \text{ N}$$

then player 2 must

exert a force of =

magnitude & opposite

direction back on player 1.

$$F_2 = -700 \text{ N}$$

- 3) Sled decelerated 200 m/s^2 air resistance = 1000 N
 mass = 2000 kg what add. f required for dec?

$$F = (\text{deacceleration})(\text{mass})$$

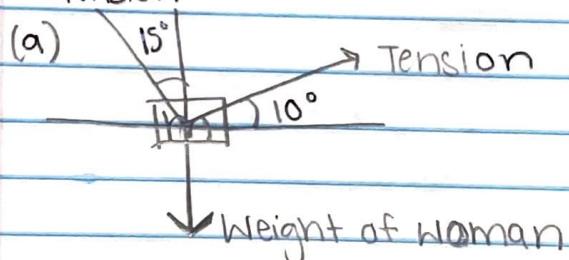
$$F = (200 \text{ m/s}^2)(2000 \text{ kg})$$

$$F = 400,000 \text{ N}$$

An added force of
 $400,000 \text{ N}$
 $\hookrightarrow 4.0 \times 10^5 \text{ N}$

- 4) 76 kg person. Pulled

Tension



- (c) F_{net}, y

$$F_{\text{net}} = m a_y$$

$$F_{\text{net}} = 0$$

$$F_{\text{net},y} = T_2 \sin \theta_2 + T_1 \cos \theta_1 - W$$

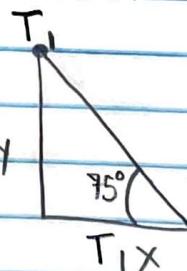
- (b) F_{net}, x

$$F_{\text{net}} = m a_x$$

$$F_{\text{net}} = 0$$

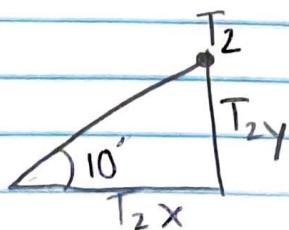
$$F_{\text{net},x} = T_2 \cos \theta_2 - T_1 \sin \theta_1$$

- (d) $F_{\text{net}} = 0$



$$\cos 75^\circ = \frac{a}{h}$$

$$\sin 75^\circ = \frac{o}{h}$$



$$\cos 10^\circ = \frac{a}{h}$$

$$\sin 10^\circ = \frac{o}{h}$$

$$T_1 = (76 \text{ kg})(9.8 \text{ m/s}^2)$$

$$\cos 15^\circ + \left(\frac{\sin 15^\circ}{\cos 10^\circ} \right) \sin 10^\circ$$

$$= 736.3 \text{ N}$$

$$T_2 = (736.3 \text{ N}) \left(\frac{\sin 15^\circ}{\sin 10^\circ} \right)$$

$$= 193.5 \text{ N}$$

Well done

Chapter 5: Friction, Drag, & Elasticity

1) 120 kg wooden crate

$$\text{Static} = 0.5$$

$$\text{Kinetic} = 0.3$$

(a) max force horiz. w/moving?

$$f = \mu N \rightarrow f = \mu mg$$

$$f_{\text{static}} = (0.5)(120 \text{ kg})(9.8 \text{ m/s}^2)$$

$$f_{\text{static}} = 588 \text{ N} / f_s \leq 588 \text{ N}$$

$$(b) f_{\text{kinetic}} = (0.3)(120 \text{ kg})(9.8 \text{ m/s}^2)$$

$$f_{\text{kinetic}} = 352.8 \text{ N}$$

$$F_{\text{net}} = ma$$

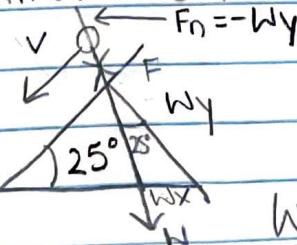
$$\text{Acceleration} = \frac{f_{\text{static}} - f_{\text{kinetic}}}{m}$$

$$a = \frac{588 \text{ N} - 352.8 \text{ N}}{120 \text{ kg}}$$

$$a = 1.96 \text{ m/s}^2$$

2) incline 25° $a = ?$

$$\text{Kinetic} = 0.1$$



$$f_s \leq \mu_s F_N$$

$$f_k = \mu_k F_N$$

$$\sin 25^\circ = \frac{W_x}{W} \rightarrow W \sin 25^\circ$$

$$\cos 25^\circ = \frac{W_y}{W} \rightarrow W_y = -W \cos 25^\circ$$

$$W_x - F_k = \text{max}$$

$$a = (9.81)(\sin(25^\circ) - 0.1(\cos(25^\circ)))$$

$$a = 3.25 \text{ m/s}^2$$

3) 40m/s top speed magnitude = ?
 0.75 m² area
 1.225 kg m⁻³ den. of air
 0.75 = C

$$F_D = \frac{1}{2} C_p A V^2$$

$$= \frac{1}{2} (0.75) (1.225 \text{ kg m}^{-3}) (0.75 \text{ m}^2) (40 \text{ m s}^{-2})$$

$$\boxed{F_D = 551.25 \text{ N}}$$

4) 2300 kg mass $\frac{F}{A} = Y(\Delta x / L)$
 10 m long wooden beam
 radius = 4 cm \rightarrow 40 mm \rightarrow 0.04 m 10 (7 m / -3 mm)
 decreases by 3 mm \rightarrow 0.003 m

$$\frac{F/A}{\Delta L/L} = Y \rightarrow Y = \frac{22563 \text{ N} / 5 \times 10^{-3} \text{ m}^2}{0.003 \text{ m} / 10 \text{ m}} = 22563 \text{ N/m}^2$$

$$\boxed{Y = 1.5 \times 10^{10} \text{ N/m}^2}$$

4 Chapter 6: Uniform Circular Motion.

1) pitch 144 km/hr
 0.5 m radius

$$V = r\omega$$

40 m/s
 $\frac{m}{m} \downarrow$
 $\frac{1}{sec}$

$$\frac{40 \text{ m/s}}{0.5} = \frac{0.5 \omega}{0.5}$$

$$80 \text{ rad/sec} = \omega$$

2) 0.9 km radius
 120 km/hr

$$V = \frac{120 \text{ km}}{1 \text{ hr}} \left(\frac{1000 \text{ m}}{1 \text{ km}} \right) \left(\frac{1 \text{ hr}}{3600 \text{ s}} \right)$$

$$V = 33.3 \text{ m/s}$$

$$0.9 \text{ km} \rightarrow 900 \text{ meters}$$

$$\tan^{-1} = \frac{(33.3 \text{ m/s})^2}{900 \times 9.8}$$

$$\theta = 7.17^\circ$$

3) 2 race cars

(a) Which path... friction and centripetal force?

- Path 2 because the friction of path 2 allows for the vehicle to take the curve at significantly higher speeds.

(b) Path 1 = 400m Path 2 = 800m

coefficient of friction = 1.0

$$F_c = \frac{mv^2}{r} = m\alpha g$$

$$\frac{v^2}{rg} \rightarrow v = \sqrt{rg} \text{ (meters)}$$

$$\text{Path 1} = v = \sqrt{1(9.81 \text{ m/s}^2)} (400 \text{ m})$$

$$v = 62.6 \text{ m/s}$$

$$\text{Path 2} = v = \sqrt{1(9.81 \text{ m/s}^2)} (800 \text{ m})$$

$$v = 98.6 \text{ m/s}$$

4)

(a) $4.5 \times 10^{12} \text{ m}$ apart

$1.4 \times 10^{22} \text{ kg}$ mass of Pluto

$$F_G = Gm_1m_2 \rightarrow G = \frac{6.673 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2 (1.4 \times 10^{22} \text{ kg})}{(4.5 \times 10^{12} \text{ m})^2}$$

$$\text{Acc. due to G. Neptune} = 4.6 \times 10^{-14} \text{ m/s}^2$$

$$(b) G = \frac{(6.673 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2)(8.62 \times 10^{25} \text{ kg})}{(2.5 \times 10^{12} \text{ m})^2}$$

$$G = 9.2 \times 10^{-10} \text{ m/s}^2 \text{ (Neptune & Uranus)}$$

$$\frac{9.2 \times 10^{-10} \text{ m/s}^2}{4.6 \times 10^{-14} \text{ m/s}^2} = 2.0 \times 10^4$$

acceleration due to gravity at Neptune to Uranus compared with Pluto.

(+2) Bonus, well done