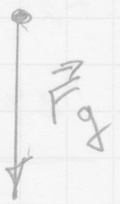
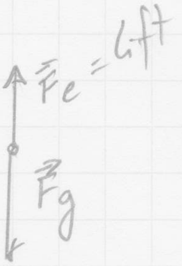
1)

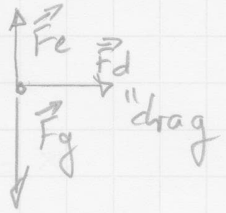
a) Without air resistance



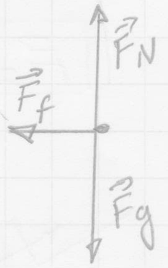

But we know ski jumpers depend on the lift from their skies...



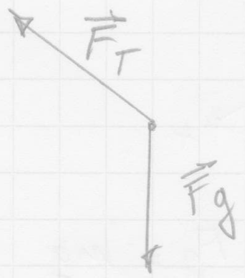

But then if we're including air resistance we need to add a drag force



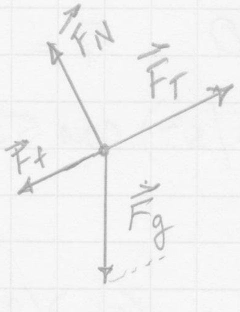

b) Forces on the skater




c) Yoyo




d)

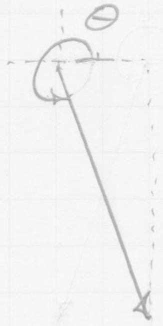


2. $F_{1x} = -3 \times 10^{-6}\,N$ $\quad F_{1y} = 3 \times 10^{-6}\,N$

$F_{2x} = 10 \times 10^{-6}\,N$ $\quad F_{2y} = -4 \times 10^{-6}\,N$

$F_{3x} = -3 \times 10^{-6}\,N$ $\quad F_{3y} = -10 \times 10^{-6}\,N$

$F_x = 4 \times 10^{-6}\,N$ $\quad F_y = -11 \times 10^{-6}\,N$




$$F = \sqrt{(4\times10^{-6}N)^2 + (-11\times10^{-6}N)^2}$$

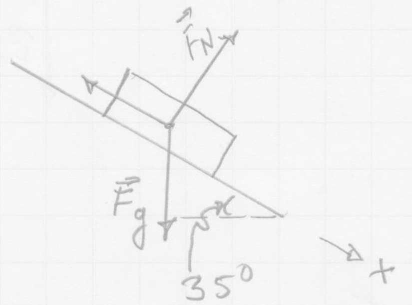
$$F = 11.7 \times 10^{-6}\,N$$

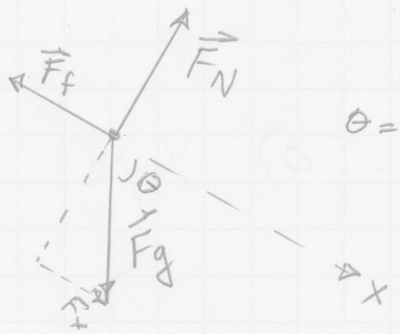
$$\alpha = \tan^{-1}\left(\frac{-11\times10^{-6}N}{4\times10^{-6}N}\right) = -70^\circ$$

$$\theta = -70^\circ + 360^\circ$$

$$\boxed{\vec{F} = (4\times10^{-6}N, -11\times10^{-6}N) \text{ or } \vec{F} = 11.7\times10^{-6}N @ 290^\circ}$$

3.




$\theta = 55^\circ$

$\mu_s = ?$ $\quad F_g = mg \quad m = 6\,kg$

$$\Sigma F_x = F_g \cos\theta - F_f = 0 \qquad F_f = mg\cos\theta$$

$$F_f = (6\,kg)(9.8\,m/s^2)\cos 55^\circ$$

$$F_f = 33.7\,N$$

$$\Sigma F_y = F_N - F_g \sin 55^\circ \qquad F_N = (6\,kg)(9.8\,m/s^2)\sin 55^\circ$$

$$F_N = 48.2\,N$$

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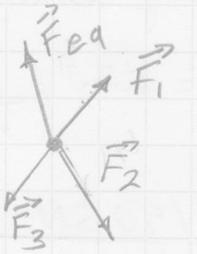
3) (cont'd)

$$F_f = \mu_s F_N$$

$$\mu_s = \frac{F_f}{F_N} = \frac{33.7N}{48.2N}$$

$$\boxed{\mu_s = 0.70}$$

4)




$\vec{F}_1 = 0.5N @ 50°$

$\vec{F}_2 = 1 N @ 310°$

$\vec{F}_3 = ?$

$\vec{F}_{eq} = 0.8N @ 110°$

$$\vec{F}_1 + \vec{F}_2 + \vec{F}_3 = \vec{F}_R = -\vec{F}_{eq}$$

$$\vec{F}_3 = -\vec{F}_{eq} - \vec{F}_1 - \vec{F}_2$$

$F_{1x} = (0.5N)\cos 50° = 0.32N$ $\quad$ $F_{1y} = (0.5N)\sin 50° = 0.38N$

$F_{2x} = (1N)\cos 310° = 0.64 N$ $\quad$ $F_{2y} = (1N)\sin 310° = -0.77N$

$F_{eqx} = (0.8N)\cos 110° = -0.27 N$ $\quad$ $F_{eqy} = (0.8N)\sin 110° = 0.75N$

$$F_{3x} = 0.27N - 0.64N - 3.2N = -0.69N$$

$$F_{3y} = -0.75N - 0.38N + 0.77N = -0.36N$$

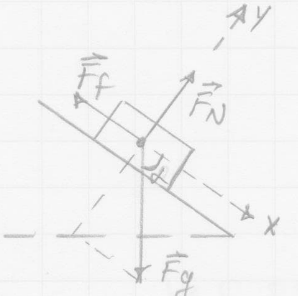
$$F_3 = \sqrt{F_x^2 + F_y^2} = \sqrt{(-0.69N)^2 + (-0.36N)^2} = 0.78N$$

$$\alpha = \tan^{-1}\left(\frac{-0.36N}{-0.69N}\right) = 27.55°$$

$\theta = \alpha + 180°$ $\quad$ $\theta = 208°$

$$\boxed{\vec{F}_3 = 0.78N @ 208°}$$

5.




Equilibrium implies that the net force is zero; constant velocity.

$m = 15\,kg$ $\quad \vec{F}_N = 90.5\,N$

$F_f = ?$ $\quad F_g = mg \quad g = 9.8\,m/s^2$

$$\Sigma F_y = F_N - F_{gy} = F_N - F_g \sin\alpha = 0$$

$$F_N = F_g \sin\alpha = mg \sin\alpha$$

$$\sin\alpha = \frac{F_N}{mg} \qquad \alpha = \sin^{-1}\left(\frac{F_N}{mg}\right)$$

$$\alpha = \sin^{-1}\left(\frac{90.5N}{(15kg)(9.8m/s^2)}\right) = 38^\circ$$

$$\Sigma F_x = F_g \cos\alpha - F_f = 0$$

$$F_f = F_g \cos\alpha = mg \cos\alpha$$

$$F_f = (15kg)(9.8m/s^2)\cos 38^\circ$$

$$\boxed{F_f = 116\,N}$$

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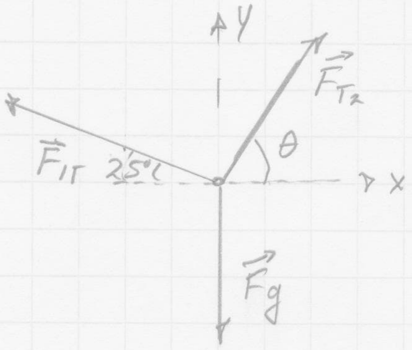
6.)




Equilibrium: $\Sigma F_x = 0$

$\Sigma F_y = 0$

$m = 75\,kg$

$g = 9.8\,m/s^2$

$F_{T1} = 500N$

$\theta = ?$

$$\Sigma F_x = F_{T2}\cos\theta - F_{1T}\cos 25° = 0$$

$$F_{T2}\cos\theta = F_{1T}\cos 25°$$

$$\Sigma y = F_{1T}\sin 25° + F_{2T}\sin\theta - mg = 0$$

$$F_{2T}\sin\theta = mg - F_{1T}\sin 25°$$

Dividing the two equations eliminates $F_{2T}$.

$$\frac{\cancel{F_{2T}}\sin\theta}{\cancel{F_{2T}}\cos\theta} = \frac{mg - F_{1T}\sin 25°}{F_{1T}\cos 25°}$$

$$\tan\theta = \frac{mg - F_{1T}\sin 25°}{F_{1T}\cos 25°}$$

$$\theta = \tan^{-1}\left(\frac{mg - F_{1T}\sin 25°}{F_{1T}\cos 25°}\right)$$

$$\theta = \tan^{-1}\left(\frac{(75kg)(9.8m/s^2) - (500N)\sin 25°}{(500N)\cos 25°}\right)$$

$$\boxed{\theta = 49.1°}$$