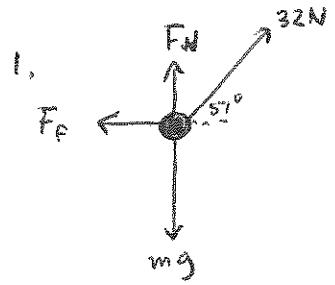
Dynamics: Now with Numbers!

1.



$\hat{y}: \sum \vec{F}_y = 0$

$F_N + 32\sin 51° = mg$

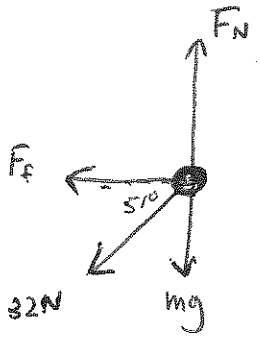
$F_N = 14.33152923$

$\hat{x}: \sum \vec{F}_x = m\vec{a}$

$32\cos\theta - F_f = m\vec{a}$

$32\cos\theta - 0.66(F_N) = m\vec{a}$

$\vec{a} = 2.7\ m/s^2$ right



$\hat{y}: \sum \vec{F}_y = 0$

$F_N = mg + 32\sin 51°$

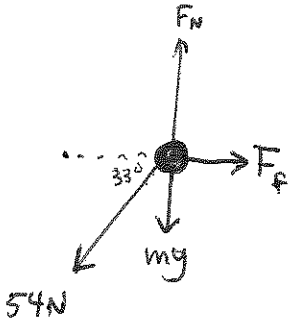
$F_N = 64.06867077N$

$\hat{x}: \sum \vec{F}_x = m\vec{a}_x$

$32\cos 51° + F_f = m\vec{a}_x$

$32\cos 51° + 0.66(F_N) = m\vec{a}$

$\vec{a} = 16\ m/s^2$ left.



$\hat{y}: \sum \vec{F}_y = 0$

$F_N = mg + 54N\sin 33°$

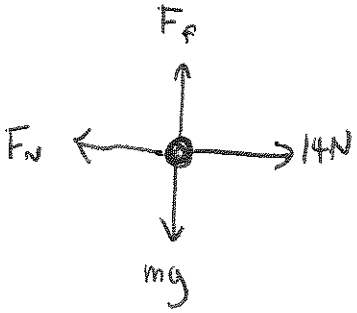
$F_N = 68.61050789N$

$\hat{x}: \sum \vec{F}_x = m\vec{a}$

$54\cos 33° - F_f = m\vec{a}$ (I made left +)

$54\cos 33° - \mu F_N = m\vec{a}$

$\vec{a} = 3.1\ m/s^2$ left.



$\hat{x}: \sum \vec{F}_x = 0$

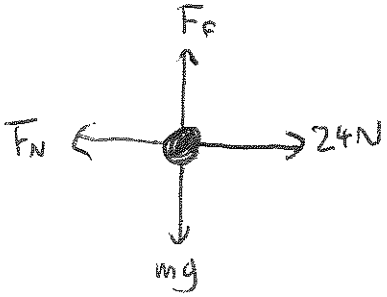
$F_N = 14N$

$\hat{y}: \sum \vec{F}_y = m\vec{a}$

$mg - F_f = m\vec{a}$

$1.2kg(9.8\ N/kg) - \mu F_N = m\vec{a}$

$\vec{a} = 1.1\ m/s^2$ down



$\hat{x}\ \sum \vec{F}_x = 0$

$F_N = 24N$

$\hat{y}: \sum \vec{F}_y = m\vec{a}$

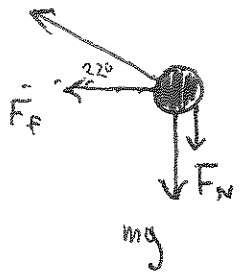
$mg - F_f = m\vec{a}$

$\vec{a} = -5.2\ m/s^2$

$\vec{a} = 0\ m/s^2$

* $\Rightarrow F_f > mg$

Remember F_f is $\leq \mu F_N$ so here it will stop motion



$\hat{y}$: $\sum \vec{F}_y = 0$

$F_N + mg = 16N \sin 22°$

$F_N = 0.603705494$

$\hat{x}$: $\sum \vec{F}_x = ma$

$F_f + 16N \cos 22° = 0.55kg\ \vec{a}$

$\vec{a} = 27 m/s^2$ left

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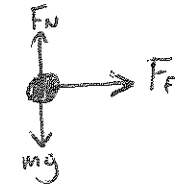
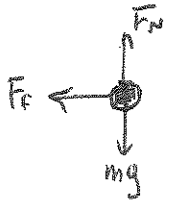
2. A.



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

$F_f = 250kg(0.919 m/s^2) =$ 230N right (static)

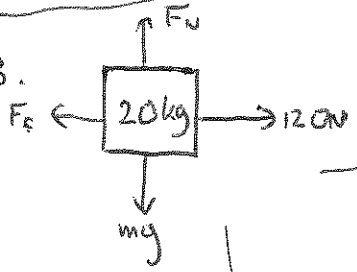
B.



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

$F_f = 250kg(2.30 m/s^2) = 575 \approx$ 580N left (static)

3.



a. $\sum F_y = 0$

$F_N = mg$

$F_N = 196N$

$F_f = \mu F_N$

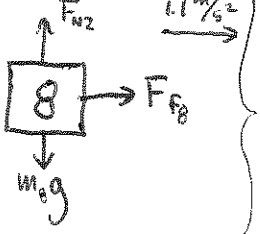
$F_f = 0.50\ (196N)$

$\vec{F}_f =$ 98N left on 12kg from ground

b. $\sum \vec{F}_x = m\vec{a}$

$120N - F_f = 20kg\ (\vec{a})$

$\frac{120N - 98N}{20kg} = \vec{a} = 1.1 m/s^2$ right



$\sum \vec{F}_x = m\vec{a}$

$F_{f8} = m_8 \vec{a}$

$F_{f8} = 8kg(1.1 m/s^2)$

$\vec{F}_{f8} =$ 8.8N right on 8kg from 12kg

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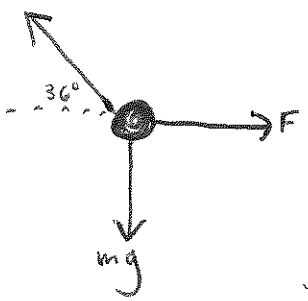
4. A.



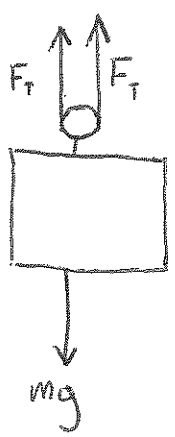
$\hat{y}$: $\sum \vec{F}_y = 0$

$F_T \sin 36° = mg$

$F_T = \frac{0.222kg(9.8 N/kg)}{\sin 36°}$

$F_T = 3.7N$

B.



$$\sum \vec{F} = 0$$

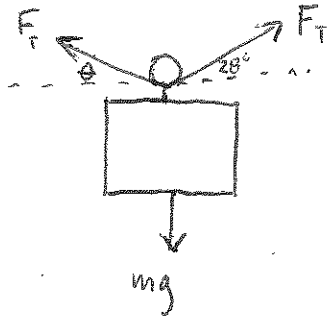
$$F_T + F_T = mg$$

$$2F_T = mg$$

$$F_T = \frac{mg}{2}$$

$$\boxed{F_T = 390N}$$

C.



$$\sum \vec{F}_x = 0$$

$$F_T \sin\theta = F_T \sin 28°$$

$$\sin\theta = \sin 28°$$

$$\theta = \sin^{-1}(\sin 28°)$$

$$\theta = 28°$$

$$\sum \vec{F}_y = 0$$

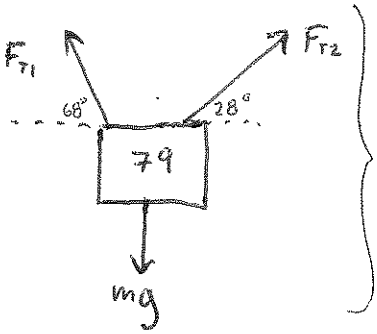
$$F_T \sin 28° + F_T \sin 28° = mg$$

$$2F_T \sin 28° = mg$$

$$F_T = \frac{mg}{2\sin 28°}$$

$$\boxed{F_T = 820N}$$

D.



$$\sum \vec{F}_x = 0$$

$$F_{T1}\cos 68° = F_{T2}\cos 28°$$

$$F_{T1} = \frac{F_{T2}\cos 28°}{\cos 68°}$$

$$\sum \vec{F}_y = 0$$

$$F_{T1}\sin 68° + F_{T2}\sin 28° = mg$$

$$\left[\frac{F_{T2}\cos 28°}{\cos 68°}\right]\sin 68° + F_{T2}\sin 28° = mg$$

$$F_{T2} = \frac{mg}{\left[\frac{\cos 28°\sin 68°}{\cos 68°} + \sin 28°\right]}$$

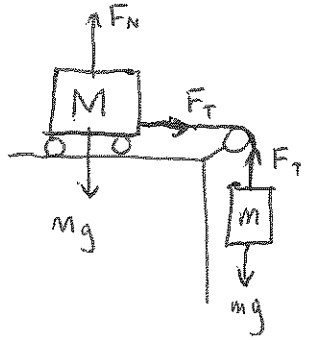
$$F_{T2} = 291.6179382N$$

$$F_{T1} = \frac{291.61\ldots \cos 28°}{\cos 68°}$$

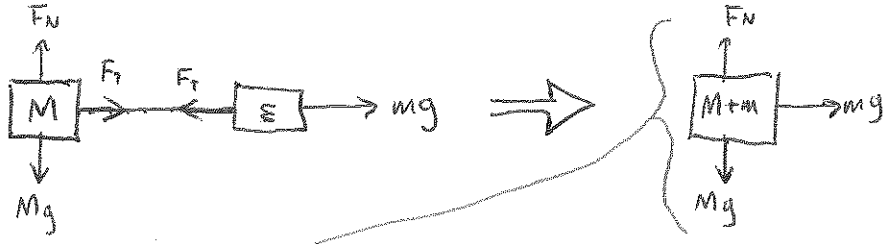
$$\boxed{F_{T1} = 690N}$$

$$\boxed{F_{T2} = 290N}$$

5. A



"straighten the system"



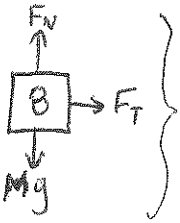
system: $\sum \vec{F} = m\vec{a}$

$mg = (M+m)a$

$\vec{a} = \frac{0.25kg\,(9.8\,N/kg)}{8.25kg} = 0.29696969\ldots$

$\vec{a} = 0.30\,m/s^2$ down for hanging mass

8kg:

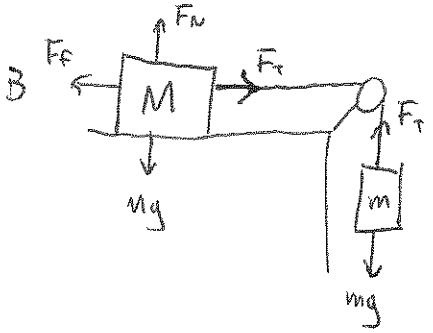


$\sum \vec{F} = ma$

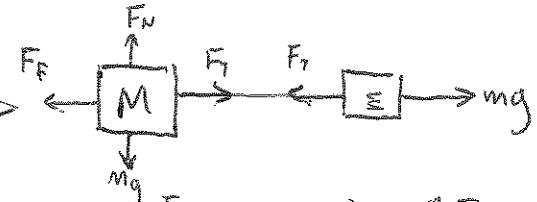
$F_T = 8kg(0.29696\ldots\,m/s^2)$

$F_T = 2.4N$

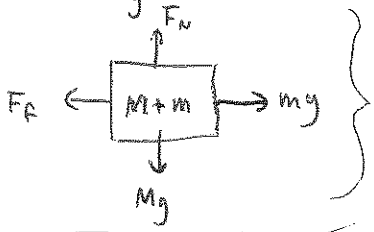
B



straighten



system:



$\sum F_y = 0$

$F_N = Mg$

$\sum \vec{F}_x = m\vec{a}$

$mg - F_f = (M+m)\vec{a}$

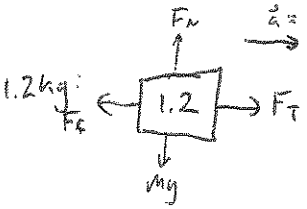
$mg - \mu Mg = (M+m)\vec{a}$

$\vec{a} = \frac{0.850kg(9.8N/kg) - 0.44(1.2kg)(9.8\,N/kg)}{2.05kg}$

$\vec{a} = 1.539317073\,m/s^2$

$\vec{a} = 1.5\,m/s^2$ down for hanging mass

1.2kg:



$\sum \vec{F}_x = m\vec{a}$

$F_T - F_f = ma$

$F_T = ma + F_f$

$F_T = 1.2(1.53\ldots) + 0.44(1.2)(9.8)$

$F_T = 7.0N$