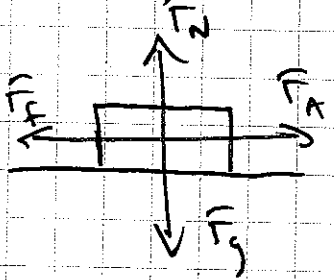
Dynamics 1

(1)



$\vec{F}_A = 50\ N$

$\vec{F}_g = mg = (8)(9.8) = 78.4\ N$

$\vec{F}_N = \vec{F}_g = 78.4\ N$

Since v is uniform, $\Sigma \vec{F} = 0$.

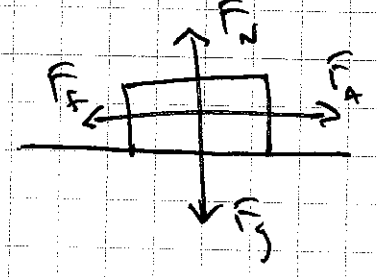
$\Sigma \vec{F} = \vec{F}_A - \vec{F}_f$

$0 = 50 - \vec{F}_f$

$\vec{F}_f = 50\ N$

$\mu = \frac{\vec{F}_f}{\vec{F}_N} = \frac{50}{78.4} = \boxed{0.64}$

(2)



$\vec{F}_A = 40\ N$

$\vec{F}_g = mg = (5)(9.8) = 49\ N$

$\vec{F}_N = \vec{F}_g = 49\ N$

$\Sigma \vec{F} = \vec{F}_A - \vec{F}_f$

$ma = \vec{F}_A + \vec{F}_f$

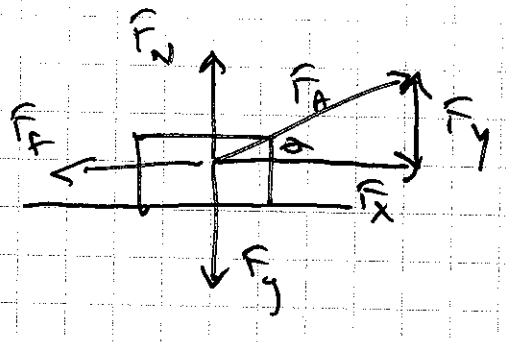
$(5)(6) = 40 + \vec{F}_f$

$30 = 40 + \vec{F}_f$

$\vec{F}_f = \boxed{-10\ N}$

$\mu = \frac{\vec{F}_f}{\vec{F}_N} = \frac{10}{49} = \boxed{0.20}$

⑧



$F_A = 43\ N$

$F_f = 27\ N$

a) Since the suitcase moves w/ constant speed, $F_x = F_f$.

$F_x = 27\ N$

$$\cos\theta = \frac{F_x}{F_A}$$

$$\theta = \cos^{-1}\left(\frac{F_x}{F_A}\right) = \cos^{-1}\left(\frac{27}{43}\right) = \boxed{51.1^\circ}$$

b) $F_A^2 = F_x^2 + F_y^2$

$43^2 = 27^2 + F_y^2$

$F_y = \sqrt{43^2 - 27^2}$

$F_y = 33.466\ N$

$F_g = mg$

$= (18)(9.8)$

$F_g = 176.4\ N$

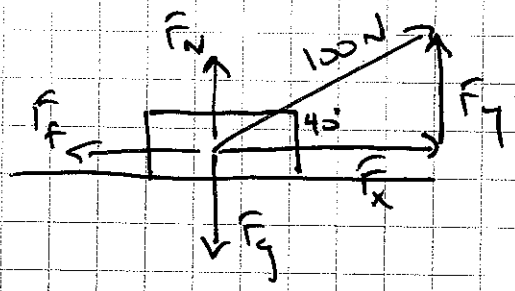
$F_N + F_y = F_g$

$F_N = F_g - F_y$

$= 176.4 - 33.466$

$F_N = \boxed{142.9\ N}$

④



$\vec{F}_N + \vec{F}_y = \vec{F}_g$

$\vec{F}_N = \vec{F}_g - \vec{F}_y$

$= mg - \vec{F}_A \sin\theta$

$= (23)(9.8) - 100 \sin 45$

$\vec{F}_N = 131.721$ N

$\Sigma \vec{F} = \vec{F}_x - \vec{F}_f$

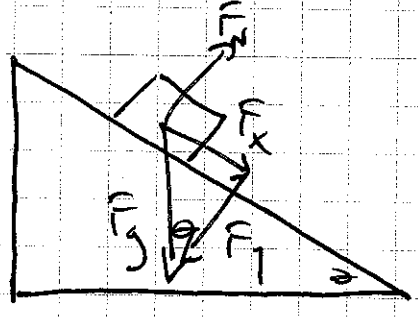
$ma = \vec{F}_A \cos\theta - \mu \cdot \vec{F}_N$

$23a = 100 \cos 45 - (0.32)(131.721)$

$23a = 31.454$

$a = \boxed{1.72 \text{ m/s}^2}$

⑤



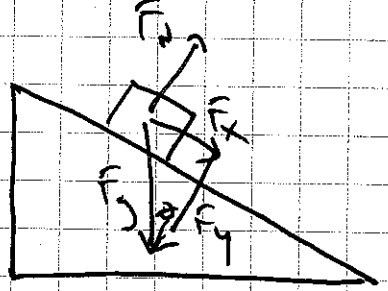
$\vec{F}_g = 215$ N (weight = $\vec{F}_g$)

$\vec{F}_x = \vec{F}_g \sin\theta$

$= 215 \sin 35$

$\vec{F}_x = \boxed{123.3 \text{ N}}$

⑥



$\Sigma \vec{F} = \vec{F}_x = \vec{F}_g \sin\theta$

$= mg \sin\theta$

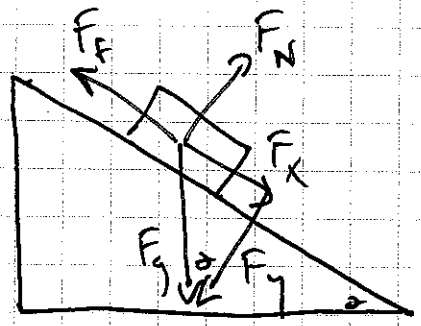
$= (6)(9.8) \sin 35$

$\Sigma \vec{F} = 24.850$ N

$a = \frac{\Sigma \vec{F}}{m} = \frac{24.85}{6}$

$a = \boxed{4.14 \text{ m/s}^2}$

(7)



$\Sigma F = 0$ (at rest)

$\Sigma F = \vec{F}_x + \vec{F}_f$

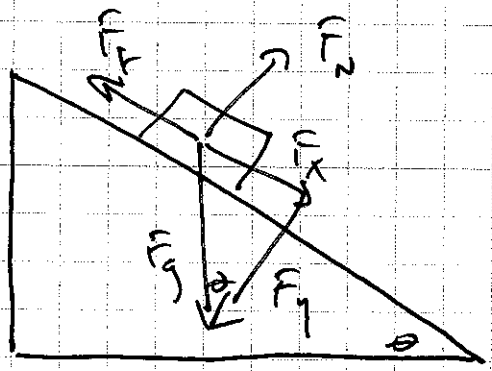
$0 = mg\sin\theta + \vec{F}_f$

$0 = (200)(9.8)\sin 45 + \vec{F}_f$

$0 = 1259.864 + \vec{F}_f$

$\vec{F}_f = \boxed{-1260\ N}$

(8)



$F_N = F_y$

$= mg\cos\theta$

$= (50)(9.8)\cos 30$

$F_N = 424.352\ N$

$\Sigma F = F_x - F_f$

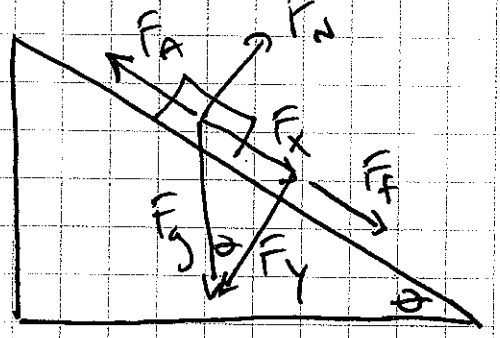
$ma = mg\sin\theta - \mu \cdot F_N$

$50a = (50)(9.8)\sin 30 - (0.15)(424.352)$

$50a = 181.347$

$a = \boxed{3.63\ m/s^2}$

(9)



$F_g = 325$ N

$F_A = 211$ N

a) $F_x = F_g \sin\theta$

$= 325 \sin 20$

$F_x = \boxed{111.157 \text{ N}}$

b) $\Sigma F = 0$ b/c the trunk has constant v.

c) $\Sigma F = F_A - F_x + \vec{F_f}$

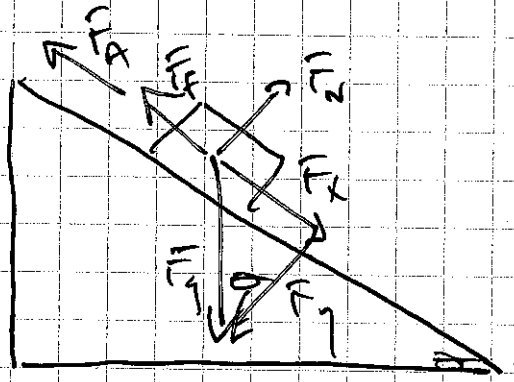
$0 = 211 - 111.157 + \vec{F_f}$

$\vec{F_f} = -99.843$ or $\boxed{100 \text{ N } [\text{DTS}]}$

d) $F_N = F_y = F_g \cos\theta = 325 \cos 20 = 305.4$ N

$\mu = \frac{F_f}{F_N} = \frac{99.843}{305.4} = \boxed{0.33}$

(10) If it was sliding down the plane, friction would point up the slope.



$$\Sigma \vec{F} = \vec{F}_A + \vec{F}_f - \vec{F}_x$$

$$0 = \vec{F}_A + 99.843 - 111.157$$

$$\vec{F}_A = \boxed{11.314 \text{ N } [\text{UTS}]}$$

(11) a) $v_i = 0$
$v_f = 0.65$ m/s
$d = 1.6$ m
$a = ?$

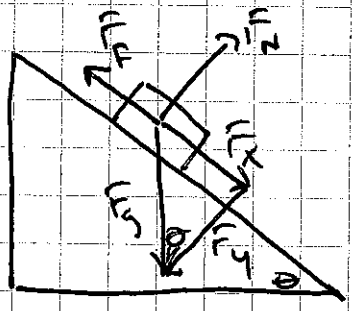
$$v_f^2 = v_i^2 + 2ad$$

$$0.65^2 = 0^2 + 2a(1.6)$$

$$0.4225 = 3.2a$$

$$a = \boxed{0.132 \text{ m/s}^2}$$

b)



$$F_N = F_y = mg\cos\theta$$

$$= (2.5)(9.8)\cos 25$$

$$F_N = 22.205 \text{ N}$$

$$\Sigma F = F_x - F_f$$

$$ma = mg\sin\theta - \mu F_N$$

$$(2.5)(0.132) = (2.5)(9.8)\sin 25 - \mu(22.205)$$

$$0.33 = 10.354 - 22.205\mu$$

$$\mu = \boxed{0.45}$$

(11) c) No. In a purely mathematical sense, mass cancels in the above calculations.

Example

$$\Sigma F = F_x - F_f$$

$$ma = mg\sin\theta - \mu \cdot mg\cos\theta$$

$$a = g\sin\theta - \mu g\cos\theta$$