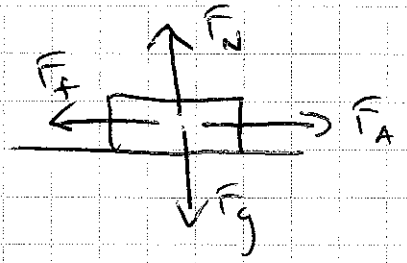
Dynamics 3

①



$F_A = 50\ N$

$\Sigma F = 0$ (uniform velocity)

$\Sigma F = F_A - F_f$

$0 = 50 - F_f$

$F_f = 50\ N$

$F_N = F_g = mg$

$= (8)(9.8)$

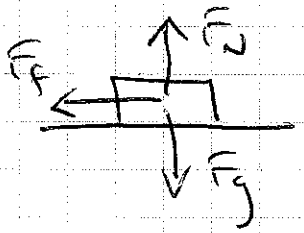
$F_N = 78.4\ N$

$F_f = \mu \cdot F_N$

$50 = \mu (78.4)$

$\mu = \boxed{0.64}$

②



$F_N = F_g = mg$

$= (2000)(9.8)$

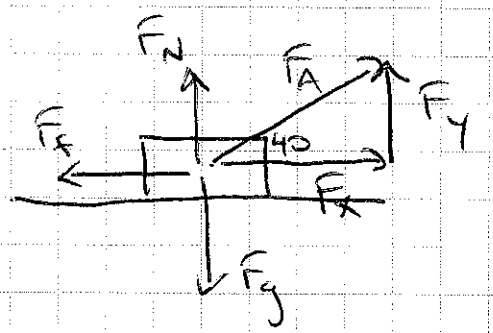
$F_N = 19\,600\ N$

$F_f = \mu \cdot F_N$

$= (1.02)(19\,600)$

$F_f = \boxed{-19\,992\ N}$ (negative b/c it is left).

③



$F_A = 100\ N$

$\cos 40 = \frac{F_x}{F_A}$ $\qquad$ $\sin 40 = \frac{F_y}{F_A}$

$F_x = F_A \cos 40$ $\qquad$ $F_y = F_A \sin 40$

$= 100 \cos 40$ $\qquad$ $= 100 \sin 40$

$F_x = 76.604\ N$ $\qquad$ $F_y = 64.279\ N$

$F_g = mg = (20)(9.8)$

$F_g = 196\ N$

$F_N + F_y = F_g$

$F_N + 64.279 = 196$

$F_N = 131.721\ N$

$F_f = \mu \cdot F_N$

$= (0.32)(131.721)$

$F_f = 42.151\ N$

$\Sigma F = F_x - F_f$

$= 76.604 - 42.151$

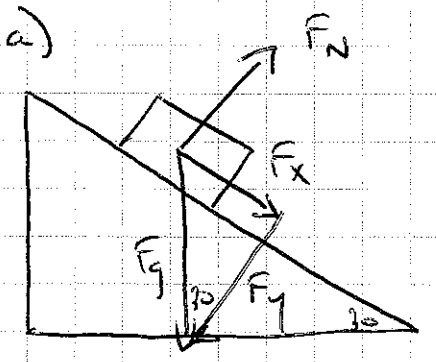
$\Sigma F = 34.453\ N$

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

$= \frac{34.453}{20}$

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

④ a)



$F_g = mg = (50)(9.8)$

$F_g = 490\ N$

$\sin 30 = \frac{F_x}{490}$

$F_x = 490 \sin 30$

$F_x = 245\ N$

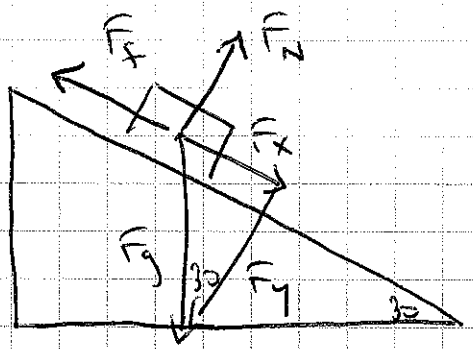
$\Sigma F = F_x$

$ma = F_x$

$50a = 245$

$a = \boxed{4.9\ m/s^2}$

b)



$\cos 30 = \frac{F_y}{490}$

$F_y = 490 \cos 30$

$F_y = 424.352\ N$

$F_N = F_y = 424.352\ N$

$F_f = \mu \cdot F_N$

$= (0.15)(424.352)$

$F_f = 63.653\ N$

$\Sigma F = F_x - F_f$

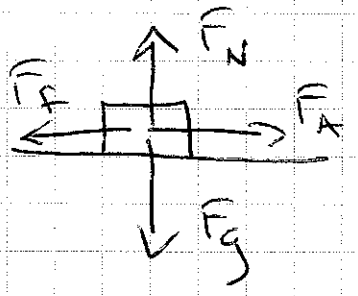
$ma = F_x - F_f$

$50a = 245 - 63.653$

$= 181.347$

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

⑤



$F_A = 50\ N$

$F_g = mg = (20)(9.8)$

$F_g = 196\ N$

$F_f = F_A = 50\ N$ $\quad F_N = F_g = 196\ N$

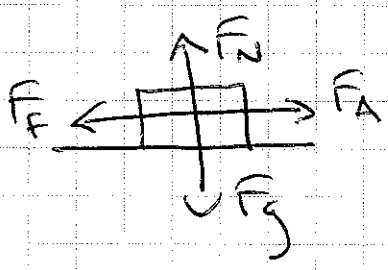
(since speed is constant)

$F_f = \mu \cdot F_N$

$50 = \mu(196)$

$\mu = \boxed{0.26}$

⑥



$F_g = mg = (15)(9.8)$

$F_g = 147\ N$

$F_N = F_g = 147\ N$

$F_f = \mu \cdot F_N$

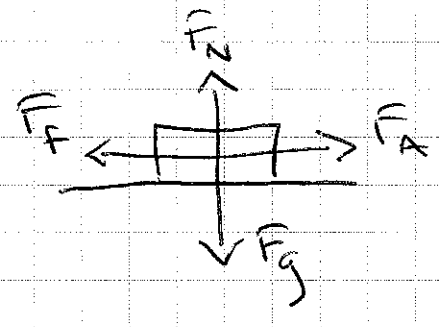
$= (0.3)(147)$

$F_f = 44.1\ N$

In order to move with a constant velocity, F_A must equal F_f. Thus,

$F_A = \boxed{44.1\ N}$

⑦



$F_g = mg = (2)(9.8)$

$F_g = 19.6\ N$

$F_N = F_g = 19.6\ N$

$F_f = \mu \cdot F_N$

$= (0.12)(19.6)$

$F_f = 2.352\ N$

$\Sigma F = F_A - F_f$

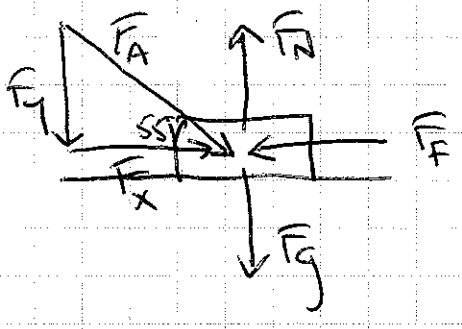
$ma = F_A - F_f$

$(2)a = 4 - 2.352$

$2a = 1.648$

$a = \boxed{0.82\ m/s^2}$

⑧



$F_g = mg = (0)(9.8)$

$F_g = 0$

$F_A = 100\ N$

$\cos 55 = \frac{F_x}{100}$

$F_x = 100 \cos 55 = 57.358\ N$

$\sin 55 = \frac{F_y}{100}$

$F_y = 100 \sin 55 = 81.915\ N$

$F_N = F_y + F_g$

$= 81.915 + 0 = 81.915\ N$

a) Since v is uniform,

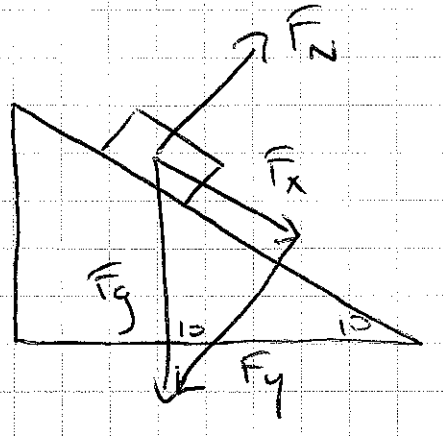
$F_f = F_A$

$F_f = \boxed{-57.4\ N}$

b) $\mu = \frac{F_f}{F_N} = \frac{57.358}{81.915}$

$\mu = \boxed{0.70}$

(9) a)



$F_g = mg = (10)(9.8)$

$F_g = 98\ N$

$\sin 10 = \frac{F_x}{98}$

$F_x = 98 \sin 10 = 17.018\ N$

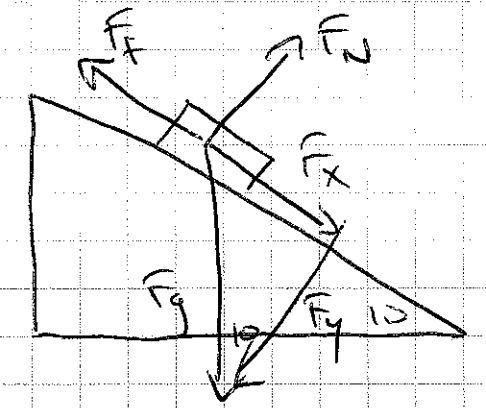
$\Sigma F = F_x$

$ma = F_x$

$10a = 17.018$

$a = \boxed{1.70\ m/s^2}$

b)



$\cos 10 = \frac{F_y}{98}$

$F_y = 98 \cos 10 = 96.511\ N$

$F_N = F_y = 96.511\ N$

$F_f = \mu \cdot F_N$

$= (0.10)(96.511)$

$F_f = 9.651\ N$

$\Sigma F = F_x - F_f$

$= 17.018 - 9.651$

$\Sigma F = 7.367\ N$

$a = \frac{\Sigma F}{m} = \frac{7.367}{10} = 0.737\ m/s^2$

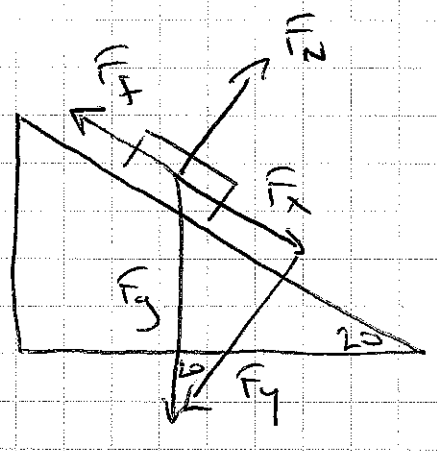
$d = v_i t + \frac{1}{2} a t^2$

$20 = (0)t + \frac{1}{2}(0.737)t^2$

$20 = 0.3685\ t^2$

$t = \boxed{7.37\ s}$

(10) a)



$F_g = mg$

$\sin 20 = \frac{F_x}{mg}$ $\quad \cos 20 = \frac{F_y}{mg}$

$F_x = mg \sin 20$ $\quad F_y = mg \cos 20$

$F_N = F_y = mg \cos 20$

$F_f = \mu \cdot F_N$

$F_f = \mu \cdot mg \cos 20$

$\sum F = F_x - F_f$

$ma = mg \sin 20 - \mu mg \cos 20$

$a = g \sin 20 - \mu g \cos 20$

$= (9.8) \sin 20 - (0.1)(9.8) \cos 20$

$a = \boxed{2.431 \text{ m/s}^2}$

b) $v_i = 0$
$t = 8 \text{ s}$
$v_f = ?$

$v_f = v_i + at$

$= 0 + (2.431)(8)$

$v_f = \boxed{19.4 \text{ m/s}}$