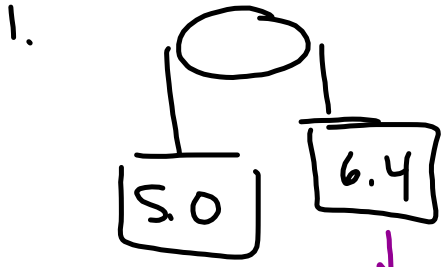
Physics 122

Exam Review Solutions

Q. 3 → $\mu_k = 0.2$

Q. 24 → Both balls → same mass.

1.

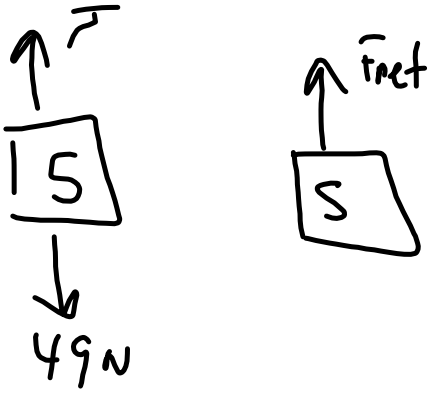


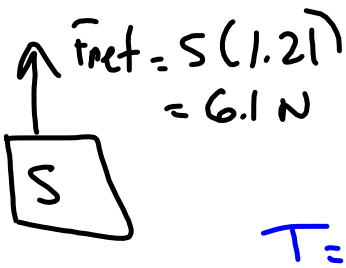
$F_{net} = 67.8 - 49$

$= 13.8\ N$

$a = \frac{F_{net}}{m} = \frac{13.8\ N}{11.4\ kg}$

$= 1.21\ m/s^2$

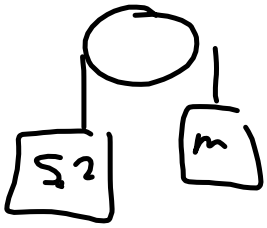




$T = 49 + 6.1$

$= 55.1\ N\uparrow$

2.



$a = 4.6\ m/s^2$

$F_{net} = F_{net}$

$(5.2+m)4.6 = 9.81(5.2-m)$

$m = 1.881\ kg$

3.

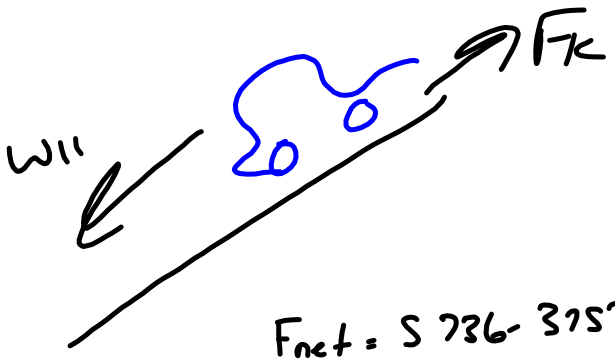
$W = 19620\ N$

$W_{11} = 5736\ N$

$W_{\perp} = 18763\ N$

$F_N = W_{\perp} = 18763\ N$

$F_K = \mu_k F_N$
$= 0.2(18763)$
$= 3753\ N$



$F_{net} = 5736 - 3753$
$= 1983\ N$

$a = \frac{1983\ N}{2000\ kg} = 1.0\ m/s^2$

$v_2^2 = v_1^2 + 2ad$
$= 0 + 2(1)(50)$

$v = 10\ m/s$

4. $W = 2943\,N$

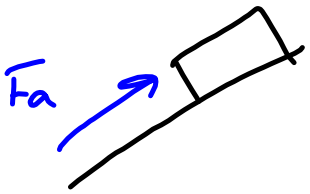
$W_{\parallel} = 1688\,N$

$W_{\perp} = 2411\,N$

$F_N = W_{\perp} = 2411\,N$

$F_S = 772\,N$

$F_K = 362\,N$



a) $F_a = 1688 - 772$

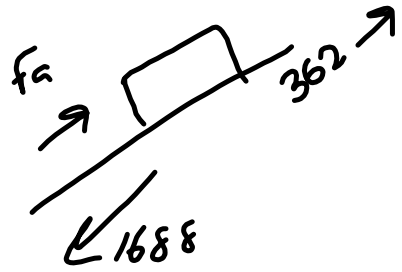
$= 916\,N$ up incline

b) $F_{net} = 300\,N$ up

$F_a = 1688 + 300 + 362$

$= 2350\,N$ up

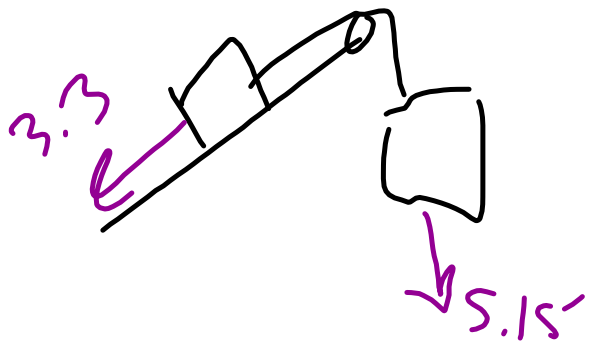
c) $F_{net} = 300\,N$ down



$1688 - F_a - 362 = 300$

$F_a = 1026\,N$ up incline.

5.



$W = 6\,N$

$W_{\parallel} = 3.3\,N$

$W_{\perp} = 5.0\,N$

$F_N = W_{\perp} = 5.0\,N$

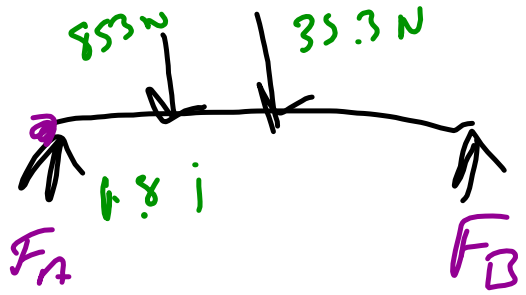
$F_K = 0.95\,N$

$F_{net} = 5.15 - 3.3 - 0.95$

$= 0.9\,N$ up

$a = \frac{0.9\,N}{1.14\,kg} = 0.8\,m/s^2$ up

6.



$\Sigma \tau_A = 0 \; [+\circlearrowleft]$

$-853(1.8) - 35.3(2.05) + 4.1 F_B = 0$ $\quad F_B = 392\,N \uparrow$

$\Sigma F_y = 0 \; [+\uparrow]$

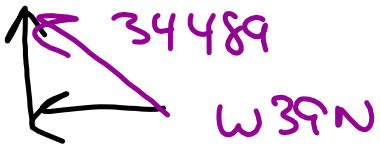
$F_a - 853 - 35.3 + 392 = 0$

$F_a = 496\,N \uparrow$

2. North $p = mv = 21\,861$ kg·m/s ↑

West $p = mv = 26\,670$ kg·m/s ←

Momentum before collision



$v = \frac{p}{m} = \frac{34489}{4275} = 8.1$ m/s W39N

E. Conservation of momentum

Before = After

Bullet + Block = Bullet + Block

$0.035(301) + 4(0) = 0.035(-12.2) + 4v$

$+2.7 = v$

Block moves 2.7 m/s in the same direction that the bullet was originally moving.

9. 900 w = 900 J/s

30 min = 1800 seconds

E = 900 J/s x 1800 seconds

E = 1 620 000 J

10. $F_1 = 32.0$ N west

$F_2 = 48.0$ N North

$F_3 = ?$

$\Sigma F_x = 0$ [+→]

$-32 + 0 + F_{3x} = 0$

$F_{3x} = +32$

$= 32$ N →

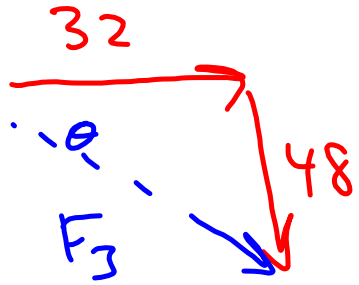
$\Sigma F_y = 0$ [+↑]

$0 + 48 + F_{3y} = 0$

$F_{3y} = -48$

$= 48$ N ↓

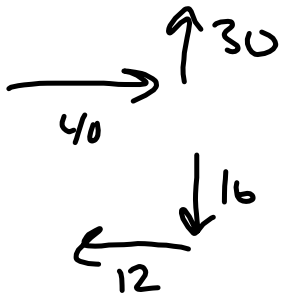
To balance



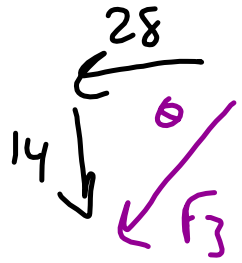
$F_3 = 58$ N E 56 S

11. $F_1 = 50\ N \quad E37N$

$F_2 = 20\ N \quad W53S$



Equilibrium



$F_3 = 31.3\ N \quad W27S$

12. a) $v_2 = v_1 + at$

$= 48 + -9.81(3.5)$

$= 13.7 \text{ m/s} \uparrow$

b) $a = g = -9.81 = 9.81 \text{ m/s}^2 \downarrow$

c) $d = v_1 t + \frac{1}{2} a t^2$

$= 48(6.5) + \frac{1}{2}(-9.81)6.5^2 = +105 \text{ m}$

above launch position.

d) $v_2^2 = v_1^2 + 2ad$

$0 = 48^2 + 2(-9.81)d$

$117 \text{ m} = d$

$h_{max} = d = 117 \text{ m}$

$v_2 = v_1 + at$

$30.5 = 48 + -9.81t$

$1.8 = t$ sec

$-30.5 = 48 + (-9.81)t$

$8.6 = t$ sec

e) $v_2^2 = v_1^2 + 2ad$

$= 48^2 + 2(-9.81)(70)$

$V = 30.5 \text{ m/s}$ or -30.5

$v = 21$ m/s @ 35°

$v_x = 17.2$ m/s → $v_y = 12$ m/s ↑

↑ no change

y

$v_2^2 = v_1^2 + 2ad$

$= 12^2 + 2(-9.81)(-60)$

$v_2 = -36.3$ m/s

At ground in vertical direction

a) $v_2 = v_1 + at$ (y)

$-36.3 = 12 + (-9.81)t$

$4.9 = t$

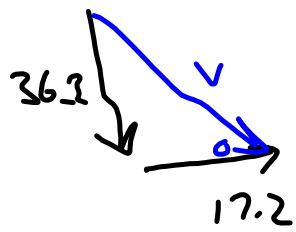
sec

b) $d = vt$ (x)

$= 17.2(4.9)$

$= 84.3$ m →

c)



$v = 40.2$ m/s

65° with the ground.

14. $T_{max} = 208\ N$ $\therefore$ $F_c = 208\ N$

$F_c = ma_c$

$208 = 0.155\ (a_c)$

$1342 = a$ m/s^2

$a = \frac{v^2}{r}$

$v^2 = ar$

$= 1342(1.65)$

$v^2 = 2214$

$v = 47\ m/s$

tangent to the circle.

15. $m = 0.284\ kg$

$v = 12.4\ m/s$

$r = 0.85\ m$

$F = \frac{mv^2}{r} = \frac{0.284(12.4)^2}{0.85}$

$= 51.4\ N$ needed

$W = mg = 2.8\ N$

a) $T = 51.4 - 2.8 = 48.6\ N$

b) $T = 51.4 + 2.8 = 54.2\ N$

c) $T = 51.4\ N$

16. $m = 0.284\ kg$

$r = 1.35\ m$

12 rev

4 sec

a) $v = \frac{2\pi(1.35)12}{4} = 25.4\ m/s$ tangent to the circle.

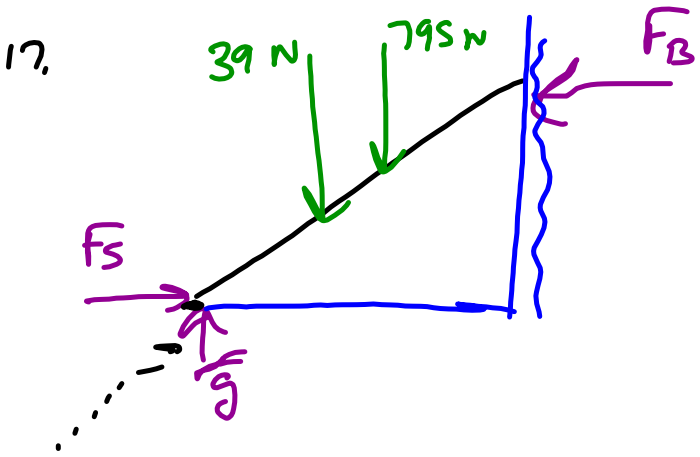
b) $a = \frac{v^2}{r} = \frac{(25.4)^2}{1.35} = 478\ m/s^2$ inward

c) $T = F_c = ma_c = 0.208(478)$

$= 99.4\ N$

inward.

17.



$\Sigma \tau_{ground} = 0$ [+5]

$\tau_{ground} = 0$ [+]

$-39(5\cos 35) - 795\left(\frac{3(5)}{4}\cos 35\right) + F_B(5\sin 35) = 0$

$F_B = 906.5$ N

$\Sigma F_x = 0$ [+→]

$F_S = 906.5$ N →

$\Sigma F_y = 0$ [+↑]

$F_g = 39 + 795$

$= 834$ N

$\mu = \frac{F_S}{F_N}$

$= \frac{906.5}{834}$

$\mu_s = 1.08$

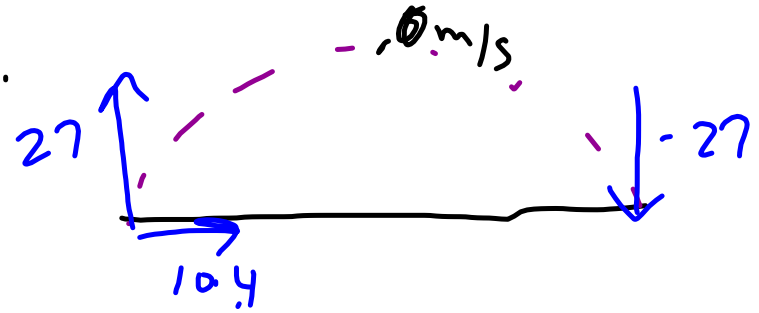
18

$v_2 = v_1 + at$

$-25.8 = 25.8 + (-9.81)t$

$5.3 \text{ sec} = t$

19.



a) $v_2^2 = v_1^2 + 2ad$

$0 = 27^2 + 2(-9.81)d$

$37.1 = d$

$h_{max} = d = 37.1\ m$

b) $v_2 = v_1 + at$

$-27 = 27 + -9.81(t)$

$5.5 = t$

sec

c) $d = vt = 10.4\ m/s\,(5.5)$

$= 57.2\ m \rightarrow$

20. $t = \frac{d}{v} = \frac{12.5}{76.5} = 0.18 \text{ sec}$

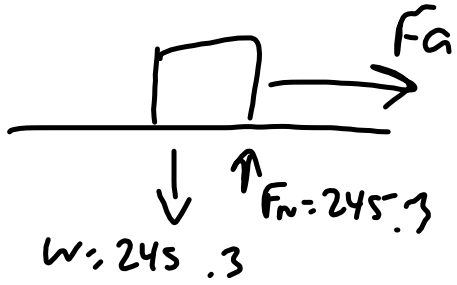
$d = \frac{1}{2} a t^2$

$= \frac{1}{2}(-9.81)(0.18)^2$

$= -0.16$

Fell 0.16m

21.



$F_S = 0.3(245.3) = 73.6$ N

$F_K = 0.1(245.3) = 24.5$ N

a) $F_a > 73.6$ N →

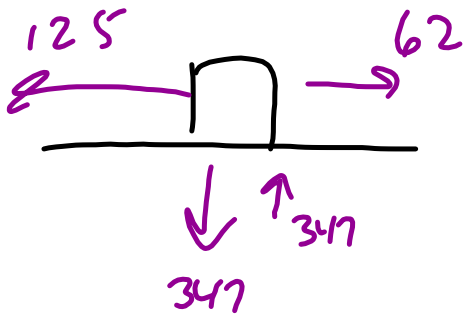
b) $F_a = 24.5$ N →

c) $F_{net} = ma$

$-25(2.2)$

$= 55$ N

$F_a = 55 + 24.5 = 79.5$ N →

22. 

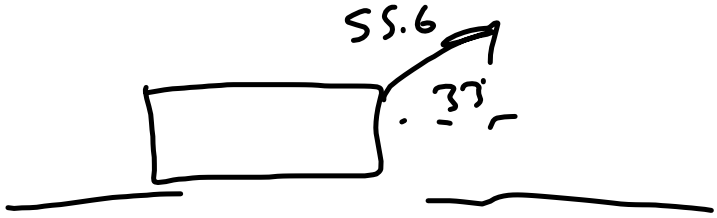
$F_S = 0.2(347) = 69.4\ N$

$F_K = 0.12(347) = 41.6\ N$

$125 < 62 + 69$

This object does not move.

23.



$F_y = 55.6 \sin 33 = 30.3$ N↓

$W = 883$ N

$F_N = 883 - 30.3 = 852.9$ N↑

Conservation of momentum.

24. Horizontal

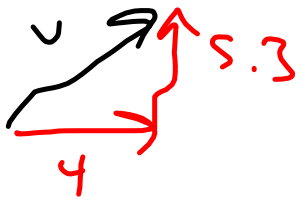
$1.5 + 0 = 0.9 + 0.15v$

$4\ m/s = v$

Vertical

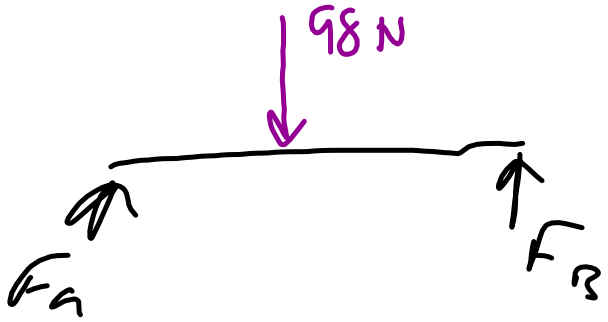
$0 + 0 = -0.8 + 0.15v$

$5.3 = v$



$V = 6.6\ m/s$ 53 ccw from the original direction.

25.



$F_A = 49\,N \uparrow$ $F_B = 49\,N \uparrow$