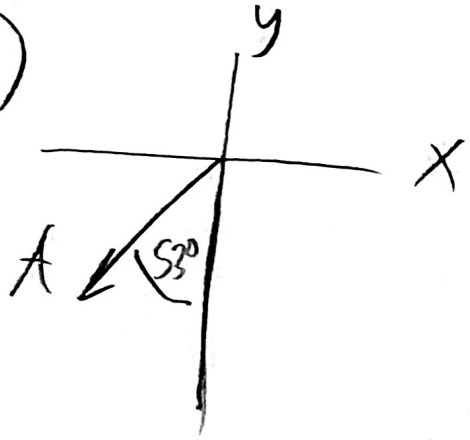
Exam 1 Solutions

1)



$|A| = 5\ m$

$\vec{A} = A_x \hat{x} + A_y \hat{y}$

$A_x = -|A| \sin\theta$

$= -5\sin(53) = -3.99 \simeq \boxed{-4}$

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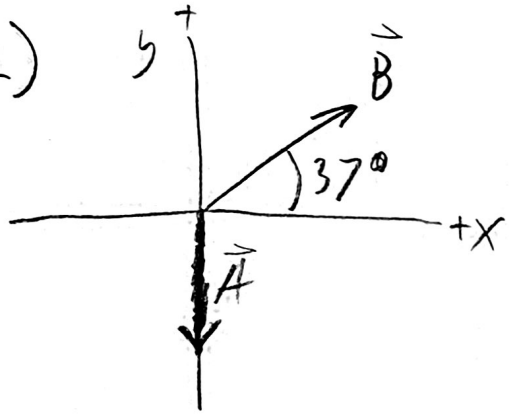
2)



$|A| = 8\ m$

$|B| = 5\ m$

$A_x = \underline{0}$

$A_y = \underline{-8}$

$B_x = 5\cos(37) = \underline{3.99}$

$B_y = 5\sin(37) = \underline{3.01}$

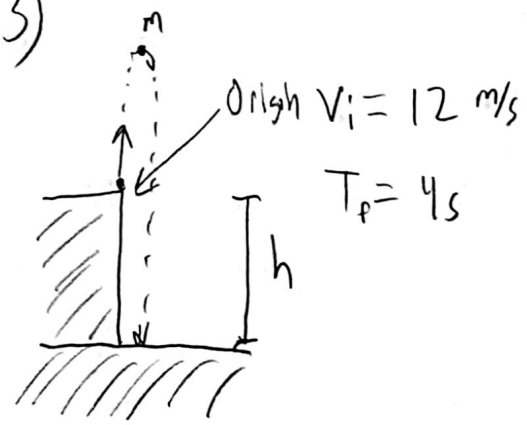
$A_x + B_x = 0 + 3.99 = \underline{3.99}$

$A_y + B_y = -8 + 3.01 = \underline{-4.99}$

$|A+B| = \sqrt{(3.99)^2 + (-4.99)^2}$

$= \boxed{6.39\ m}$

3)



$$0 = 12 - (9.8)t$$

$$t_m = \frac{12}{9.8} = 1.22\ s$$

$$y_m = 0 + 12(1.22) - \tfrac{1}{2}(9.8)(1.22)^2$$

$$= 7.35\ m$$

$$V_f = 0 - (9.8)(4 - 1.22)$$

$$V_f = -27.2$$

$$(-27.2)^2 = 0^2 - 2(9.8)(-h - 7.35)$$

$$\frac{(-27.2)^2}{-2(9.8)} = -7.35 - h$$

$$-7.35 + \frac{(-27.2)^2}{+2(9.8)} = \boxed{h = 30.4\ m}$$

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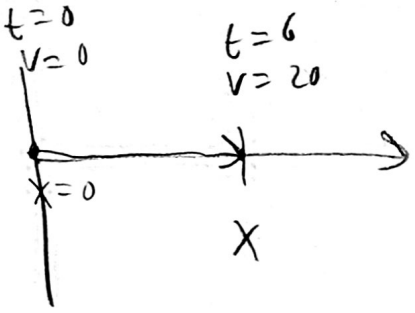
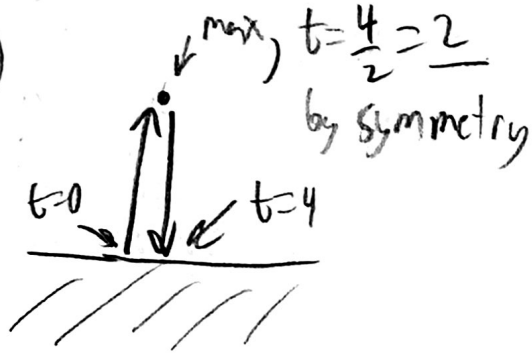
4)



$$X - 0 = \left(\frac{0+20}{2}\right)6$$

$$\boxed{X = 60}$$

5)



$0 = V_i - 9.8(2)$

$V_i = 19.6 \text{ m/s}$

$y = 0 + (19.6)(2) - \frac{1}{2}(9.8)(2)^2$

$\boxed{y = 19.6 \text{ m}}$

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6)

Truck: $a=0$, $V=12$ m/s

Car: $a=3$, $V=0$, $t=0$, $x=0$

$x_t = 0 + (12)T + 0$

$x_c = 0 + 0 + \frac{1}{2}(3)T^2$

$x_t = x_c = x$, $T=?$

$12T = \frac{1}{2}3T^2$

$T = 8$

$\boxed{x = 12(8) = 96}$

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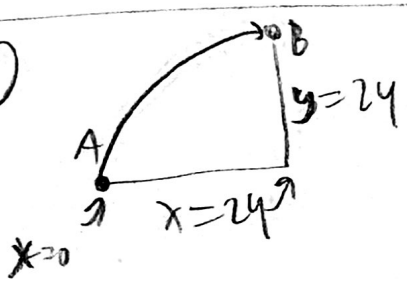
7)



$t = 12$

$\boxed{V = \frac{x}{t} = \frac{24}{12} = 2 \text{ m/s}}$

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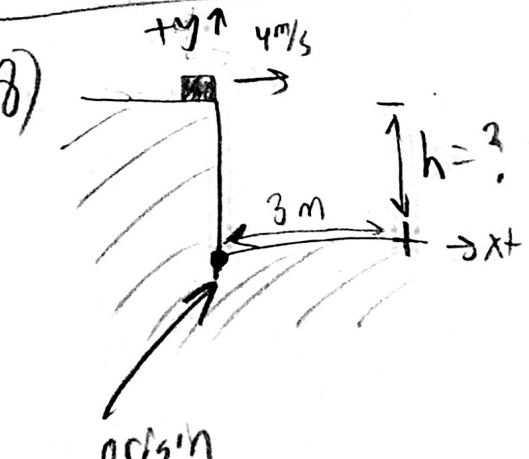
8)



x:

$3 = 0 + (4)T + 0$

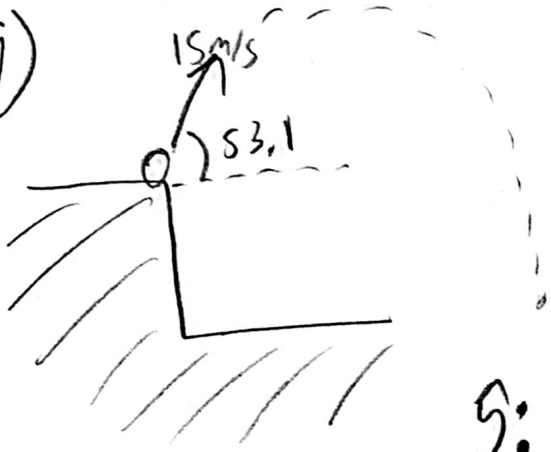
$T = \frac{3}{4}$

y:

$0 = h + 0 - \frac{1}{2}(9.8)\left(\frac{3}{4}\right)^2$

$\boxed{h = 2.756 \text{ m}}$

9)



$V_x = 15\cos(53.1) = +9.006\ m/s$

$V_y = 15\sin(53.1) = 11.995\ m/s$

S: $0 = 11.995 - (9.8)T$

$T = \frac{11.995}{9.8} = 1.22s$

$3s - 1.22s = 1.78s$

$V_{yf} = 0 - (9.8)(1.78) = -17.4\ m/s$

→ $|V| = \sqrt{(9.006)^2 + (17.4)^2}$

$|V| = 19.6\ m/s$

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10) Vertical & horizontal components of motion are independent of each other. Therefore the blocks will strike the ground at the same time.

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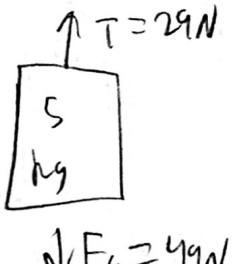
11)



$F = 5(9.8) = 49\ N$

$29 - 49 = -20 \rightarrow \frac{-20N}{5kg} = \boxed{-4\ m/s^2}$

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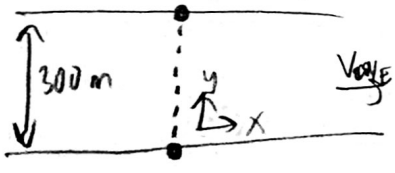
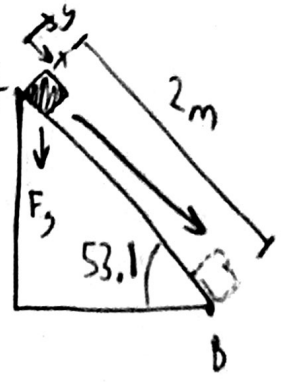
12)



Only care about y-direction

$V_y = \frac{300\ m}{50s} = \boxed{6\ m/s}$

13) 

$m = 2kg$

$F_g = (2)(9.8) = 19.6N$

$= (19.6)\sin(53.1)\hat{x} \rightarrow F_{gx} = 15.673N$

$+(19.6)\cos(53.1)\hat{y}$

$= ma \Rightarrow a_x = 7.8\ m/s$

$\rightarrow \quad V^2 = 0 + 2(7.8)(2-0)$

$V^2 = 31.346$

$\boxed{V = 5.6}$

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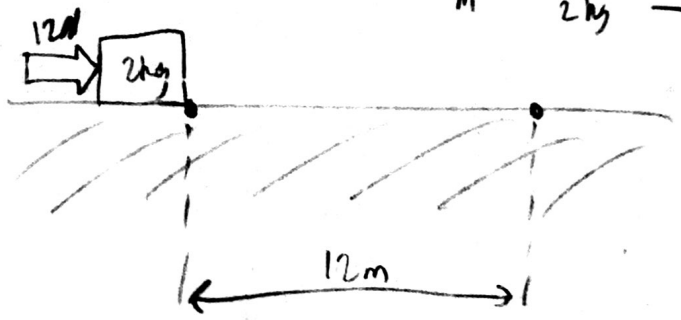
14) $F = ma \rightarrow a = \frac{F}{m} = \frac{12N}{2kg} = 6\ m/s^2$



$12m = 0 + 0 + \frac{1}{2}6T^2$

$4 = T^2$

$\boxed{T = 2s}$

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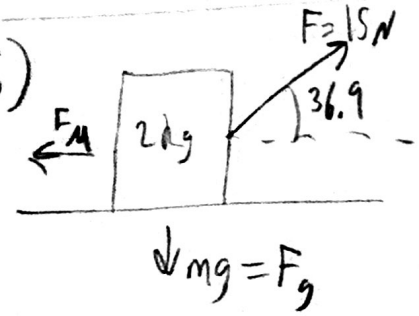
15) 

$F = 15N$

$= 15\cos(36.9)\hat{x} \rightarrow F_x = 11.995N$

$+15\sin(36.9)\hat{y} \rightarrow F_y = 9.006N$

$F_N = -F_g - F_y$

$= +19.6 - 9.006 = 10.594N$

$F_g = (2)(9.8) = -19.6N$

$F_M = \mu F_N = 4.237N$

$F_x - F_M = 11.995 - 4.237 = 7.758N \rightarrow \frac{7.758N}{2kg} = \boxed{3.879\ m/s^2 = a_x}$

16)

$F_g = mg \rightarrow$ Moon:

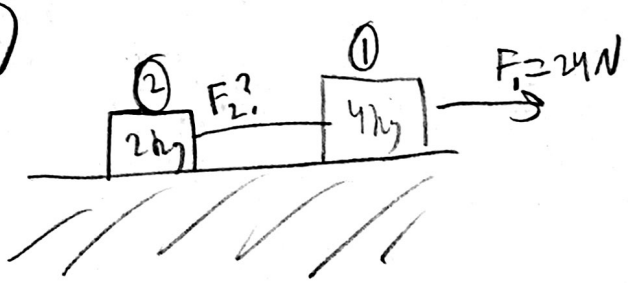
$2 = m(1.6)$

$m = 1.25\ kg$

Earth:

$m = 1.25\ kg \rightarrow F_g = (1.25)(9.8) = \boxed{12.25\ N}$

17)



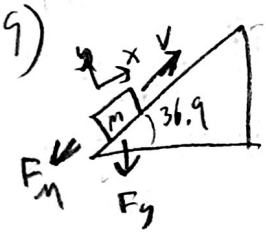
$24N = (2kg + 4kg)\,a$

$24N = 6kg \cdot a \Rightarrow 4\ m/s^2$

$\boxed{F_2 = 2kg \cdot 4\ m/s^2 = 8\ N}$

18) Scales do not directly measure weight, they measure the Normal force that opposes weight. At equilibrium (i.e. no vertical motion) the net force is 0. the weight & Normal forces are equal. In the case of the elevator slowing down while rising, the net acceleration (and force) is pointed down, & therefore the Normal force must be less than the weight.

19)



$F_g = -m[9.8\sin(36.9)]\hat{x} - m[9.8\cos(36.9)]\hat{y}$

$9.8\cos(36.9) = 7.837\ m/s^2$

$a_x = -9.8\sin(36.9) = -5.884\ m/s^2$

$F_N = -F_{gy} = +m(7.837\ m/s^2)\hat{y}$

$F_{fr} = \mu F_N = (0.3)\,m(7.837) = m(-2.35)$ ← a_m

$a_x + a_m \Rightarrow \boxed{-8.235\ m/s^2}$

20) g is a constant $\boxed{-9.8\ m/s^2}$