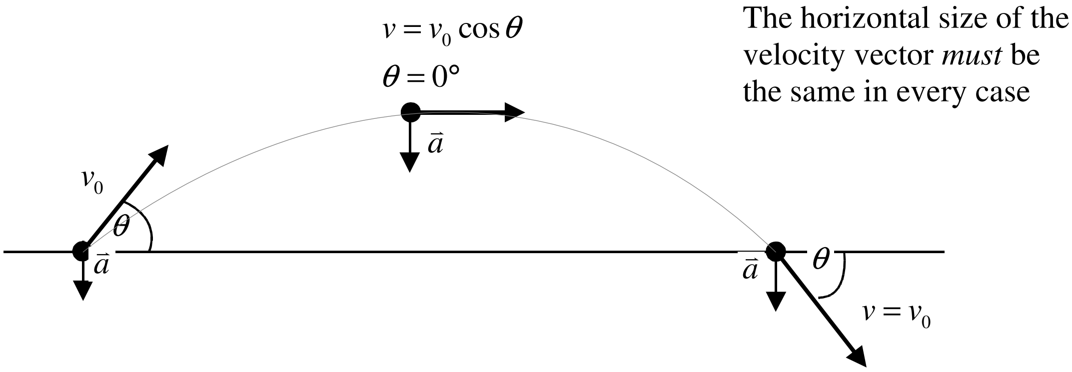
Projectile Motion Assignment 2 ***SOLUTIONS***

1.



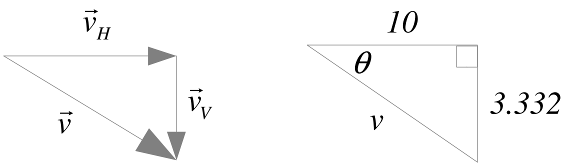
2.

(a) It is constant. The projectile moves an equal horizontal distance each equal time interval.

(b) $v_H = \dfrac{2.0}{0.20} = 10 \text{ ms}^{-1}$

$v_{0_V} = 0 \text{ ms}^{-1}$

$v_v = v_{0_V} + a_V t = 0 - 9.8 \times 0.34 = -3.332 \text{ ms}^{-1}$



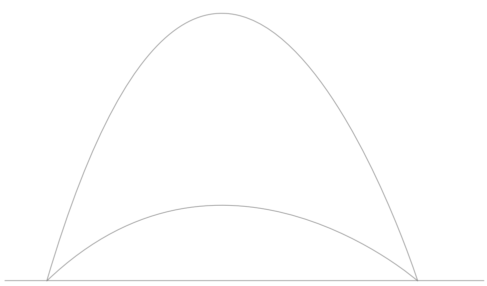
$v = \sqrt{3.332^2 + 10^2} = 10.54 \text{ ms}^{-1}$

$\theta = \tan^{-1}\left(\dfrac{3.332}{10}\right) = 18.43°$

The velocity of the projectile is 11 ms^{-1} at 18° below the horizontal.

3.

(a)



(b) One launch angle has more vertical component and less horizontal component, the other has more horizontal and less vertical. The angles are an equal magnitude away from the angle which would achieve maximum range (or they are complementary/add to 90 degrees).

4.
Air resistance provides a force on an object in the opposite direction to the object's motion and greater if the speed of the object is greater. Since the object's horizontal component will be slowed down, its range will be significantly reduced, according to $s_H = v_H t$. Since the object is launched horizontally, the time of flight will be increased because the vertical component of velocity is slowed.

5.

a)

$v_0 = 7.164\text{ms}^{-1} \quad \theta = 26.20° \quad a_V = \text{-}9.81\text{ms}^{-1}$

Distance between desks is range of projectile. To find range, we need time of flight.

$v_{0_V} = v_0 \sin\theta = 7.164 \sin 26.20° = 3.163\text{ms}^{-1}$

Find the time of flight when book is at level of desk ($s_V = 0$)

$s_V = v_{0_V} t + \frac{1}{2} a_V t^2$

$\therefore 0 = v_{0_V} t + \frac{1}{2} a_V t^2$

$\therefore t\left(v_{0_V} + \frac{1}{2} a_V t\right) = 0$

$\therefore v_{0_V} + \frac{1}{2} a_V t = 0 \text{ or } t = 0$

$$\therefore t = \frac{-v_{0_V}}{\frac{1}{2} a_V} = \frac{-3.163}{\frac{1}{2} \times (-9.8)} = 0.6455 \text{ s}$$

$s_H = v_H t$

$v_H = v_{0_H} = v_0 \cos\theta = 7.164 \cos 26.20° = 6.428\text{ms}^{-1}$

So $s_H = v_{0_H} t = 6.428 \times 0.6455 = 4.149 \text{ m}$

The desks are 4.149m apart

b)

Since the landing and launch heights are the same, the maximum height in this case occurs when t is half the time of flight, that is:

$t = \frac{1}{2} \times 0.6455 = 0.3227$

$s_V = v_{0_V} t + \frac{1}{2} a_V t^2$

$= 3.163 \times 0.3227 + \frac{1}{2}(\text{-}9.81) \times 0.3227^2$

$= 0.5104 \text{ m}$

The maximum height of the book is 0.5104 m above the desks (1.410 m above the ground)

6.

a) It has a rougher surface texture, and a greater projected area

b) It has less inertia (less mass)