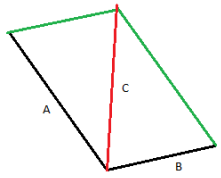
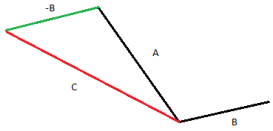
1. The maximum magnitudes of the vector sum is 7.5km, while the minimum is -0.5km.
2. When A+B



When A-B



3. A. Yes. This is because one of the components can be 0.
   B. Yes. The x and y components can cancel out some part of the magnitude, so it can be less.
4. $cos(45) = \frac{x}{5}$

   $sin(45) = \frac{y}{5}$

   $x \approx 3.535$

   $y \approx -3.536$
5. $sin(130 - 90) = \frac{x}{5}$

   $cos(130 - 90) = \frac{y}{5}$

   $x \approx -3.214$

   $y \approx 3.830$
6. Magnitude: $\sqrt{3^2 + 2^2} = \sqrt{13} \approx 3.606$

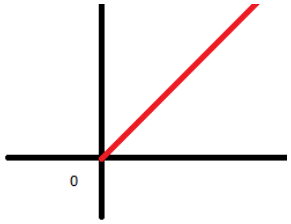
   $\theta = tan^{-1}(\frac{y}{x})$

   $\theta = 33.69\ degrees$
7. Magnitude: $\sqrt{2^2 + 2^2} = 2\sqrt{2} \approx 2.828$
   Because the 2 legs are the same, we can figure out the angle is 45 degrees. Because the positive x-axis is one quadrant to the right, that means we need to add 90 to 45, so the answer is 135 degrees.
8. Magnitude: $\sqrt{2^2} = 2$
   Because it's pointing in the negative y-axis, then we know that the angle is 90 degrees

9. Number 6 = V1
   Number 7 = V2
   Number 8 = V3
   $V_x = V_{1_x} + V_{2_x} + V_{3_x} = 3 - 2 + 0 = 1$
   $V_y = V_{1_y} + V_{2_y} + V_{3_y} = -2 + 2 - 2 = -2$
   Magnitude: $\sqrt{V_x^2 + V_y^2} = \sqrt{1^2 + (-2)^2} = \sqrt{5} \approx 2.236$
   Direction: $tan^{-1} = \frac{2}{1} \approx 63.435$degrees south from the east (assuming x+ is east and y+ north)
10. A. The child needs to measure the initial height of the gun from the ground, and needs to measure how far the dart goes once it is shot horizontally.
    B. The dart's initial velocity can be figured out by using a system of equations.
    $x = v_0 t$
    $y = -\frac{1}{2} g t^2$
11. A. The ball would land back to the girl
    B. If the train speeds up, then the ball would land behind the girl
    C. If the train slows down, the ball would land in front of the girl
    D. Assuming there is air resistance, the ball would land behind the girl. If there isn't then it would land back to the girl.
12. No. The arrow will always drop due to gravity. Therefore, you must aim a little higher in order to hit your target because you need to counteract the force of gravity while it is traveling through the air.
13. To find the height of the cliff:
    $0 = x_0 + 0 \cdot 3 + \frac{-9.8 \cdot 3^2}{2} = 44.1m$
    The cliff's height is **44.1 meters**
    To find how far from it's base:
    $x = 1.8(3) = 5.4m$
    The diver hit the water **5.4 meters** away from the cliff.
14. Rock A:
    Horizontal Velocity:

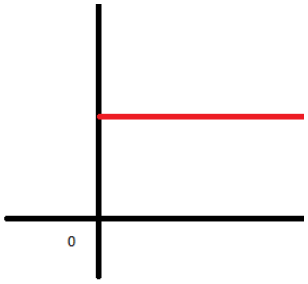
    (Positive y is velocity, x is time)

Vertical Velocity (towards the ground):

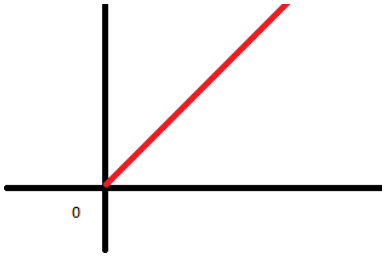


(Positive y is velocity, x is time)

Rock B:
Horizontal Velocity:



(Positive y is velocity, x is time)
Vertical Velocity (towards the ground):



(Positive y is velocity, x is time)

15. $sin(34.5) \cdot 65.2 \approx 36.93$
$cos(34.5) \cdot 65.2 \approx 53.73$
A. Step 1: Finding at what time was the peak (vertical component)
$0 \approx 36.93 + - 9.8 \cdot t$
$t \approx 3.77$
Step 2: Finding the peak
$x \approx 0 + 36.93 \cdot 3.77 + \frac{-9.8 \cdot 3.77^2}{2} \approx 69.58$
The projectile reached a maximum of ~69.58 meters
B. Total time the projectile is in the air for
$0 = 0 + 36.93 \cdot t + \frac{-9.8 \cdot t^2}{2}$
$t \approx 7.53$

The ball is in the air for 7.53 seconds

C. Total distance the projectile traveled

$x \approx 0 + 53.73 \cdot 7.53 \approx 419.65$

The projectile traveled **419.65**

D. Calculate Vertical Component After 1.5 Seconds

The vertical component will have a loss of 14.7 m/s $(1.5 \cdot 9.8)$

Original Vertical Component is $sin(34.5) \cdot 65.2 \approx 36.93$

New Vertical Component: 22.26

Calculate Horizontal Component After 1.5 Seconds

The Horizontal Component will remain constant.

Horizontal Component: $cos(34.5) \cdot 65.2 \approx 53.73$

Use the Pythagorean Theorem to find magnitude.

$\sqrt{53.73^2 + 22.26^2} \approx 58.149$

Finding the angle using $tan^{-1}(\frac{Opposite}{Adjacent})$

$tan^{-1}(\frac{22.26}{53.73}) \approx 22.50$

The Magnitude is ~58.149 m/s, the direction is ~22.26 above the horizontal

E. **At the peak, this is because no matter what, the horizontal component will always remain ~53.73, so we have to wait till the vertical component is 0, which the magnitude will be 53.73**

16. D > C = B > A

    Explanation: We know that mass has nothing to do with how far it will go, we also know that the horizontal components for all 4 are the same. Thus, we are trying to find the one with the greatest air time, and the greater the angle, the greater the air time. Therefore, the one with the largest angle will have the largest airtime, causing the D, C = B, A (D is the greatest, A is the least)

17. Example 1 = Example 2 = Example 3 = Example 4 < Example 5

    Explanation: The vertical component is what we are looking at. Since the vertical component in 1, 2, 3, 4 are the same, and 5 is twice as large as 1-4, that is how we determined the order.

18. Use the Pythagorean Theorem to find

    $\sqrt{2.3^2 + 1.2^2} \approx 2.59$

    The Magnitude Velocity is 2.59