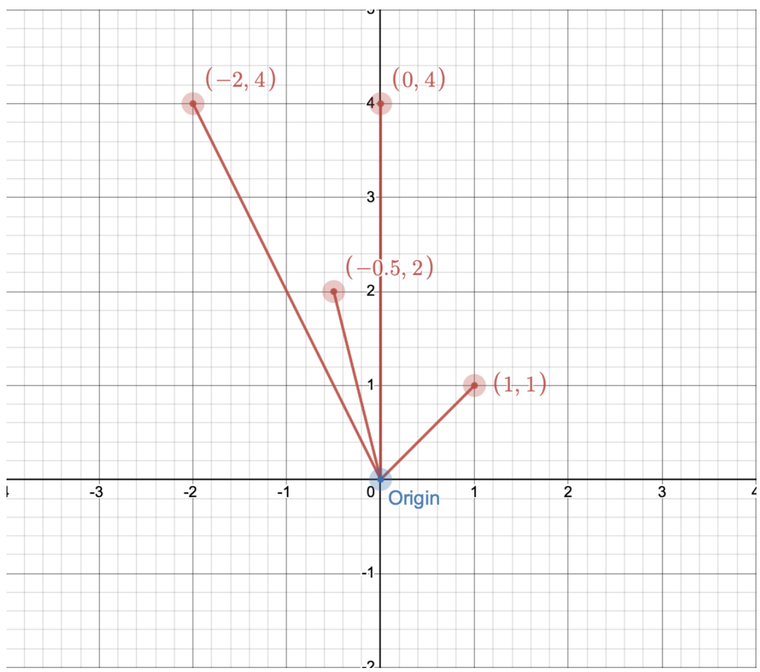
Grade 7/8 Math Circles
Week of 16$^{\text{th}}$ October
Newton's Second Law Solutions

Exercise Solutions

1. By plotting the points on the Cartesian plane, and connecting them to the origin, we get



2. From left to right, we have that the first vector is $(1,1)$, the second, $(-1,2)$, and finally, $(3,-1)$
3. Going in order we have
   (a) $(3,4)+(4,4)=(7,7)$
   (b) $(2,2)-(1,2)=(1,0)$
   (c) $(((2,1)+(7,3))-(1,6)=(8,-2)$
   (d) $\left(\frac{1}{2},\frac{3}{4}\right)+\left(\frac{1}{2},\frac{1}{4}\right)=(1,1)$
4. Starting from the left we have, 4, 49, 5, $\approx 2.82842712475...$, 4, 2, 4
5. From the left, we have 5, $\sqrt{8}$, $\sqrt{17}$
6. Starting from the top left, we have $F_{net}=5$ and $a=1$, $F_{net}=\sqrt{10}$ and $a=\sqrt{10}/5$, $F_{net}=2$ and $a=2/5$, finally, $F_{net}=0$ and $a=0$

Problem set Solutions

1. The cost of a theatre ticket wouldn't make sense, since we do not care about direction. The current of a river would aptly be described by a vector, how strong it is would be how long the vector is, and the direction of the current would be the direction of the vector. Likewise with the flight path, we denote the direction of the flight path to be the vector's direction, and the speed of the airplane as the length of the vector. The population of the world is simply a number, no need for a vector.

2. From left to right we have

$$(2,2)+(2,2)=(4,4) \qquad ((1,1)+(2,2))-(1,1)=(2,2)$$
$$(3,7)+(7,3)=(10,10) \qquad (2,2)-(5,-1)=(-3,3)$$

3. from left to right we have; 5, 13, $\sqrt{8}$, $\sqrt{2}$, and 2

4. (a) The resultant vector is a vector due east, depicting a speed of 450
   (b) The resultant vector is a vector due North East, $(550, 150)$ depicting a speed of $\sqrt{550^2+150^2} = \sqrt{325000} \approx 570.08$

5. (a) The net force acting on the box is $15N$
   (b) Since we have that $F = ma$, and we know that $F = 15$ and $m = 10kg$, we have that $a = F/m = 15/10 = 1.5$. Since the net force is in the positive direction, it'll be moving towards the right.

6. Since we have that $m = 6.0kg$ and $a = 4.0m/s^2$, we know that $F = ma = 6kg \cdot 4.0m/s^2 = 24N$

7. Since we have that $a = 3.0m/s^2$ and $F = 6.0N$, we know that $F = ma \implies m = F/a = (6.0N)/(3.0m/s^2) = 2kg$

8. Since we know that the rock is in your hand, and by newton's third law, since it requires $147N$ to hold it at rest, that means the rock exerts a force of $147N$ on your hand. Since gravity accelerates objects at a rate of $9.81m/s^2$, we have that the mass of the rock is $m = F/a = (147N)/(9.81m/s^2) \approx 14.985kg$

9. First, we'll add up all the forces acting on the box. We have that $\vec{F_{tot}} = (-1,4)+(4,-3)+(-3,-1) = (0,0)$. Thus, since the net force is 0, we also have that the magnitude of the force of 0!