Vectors and the equations of motion

We can use the vectors to describe the motion of the objects in multiple dimensions in a similar way as we had learned before with our 1-dimensional equations of motion.

Position:

$$\vec{r} = (x, y)$$

Displacement:

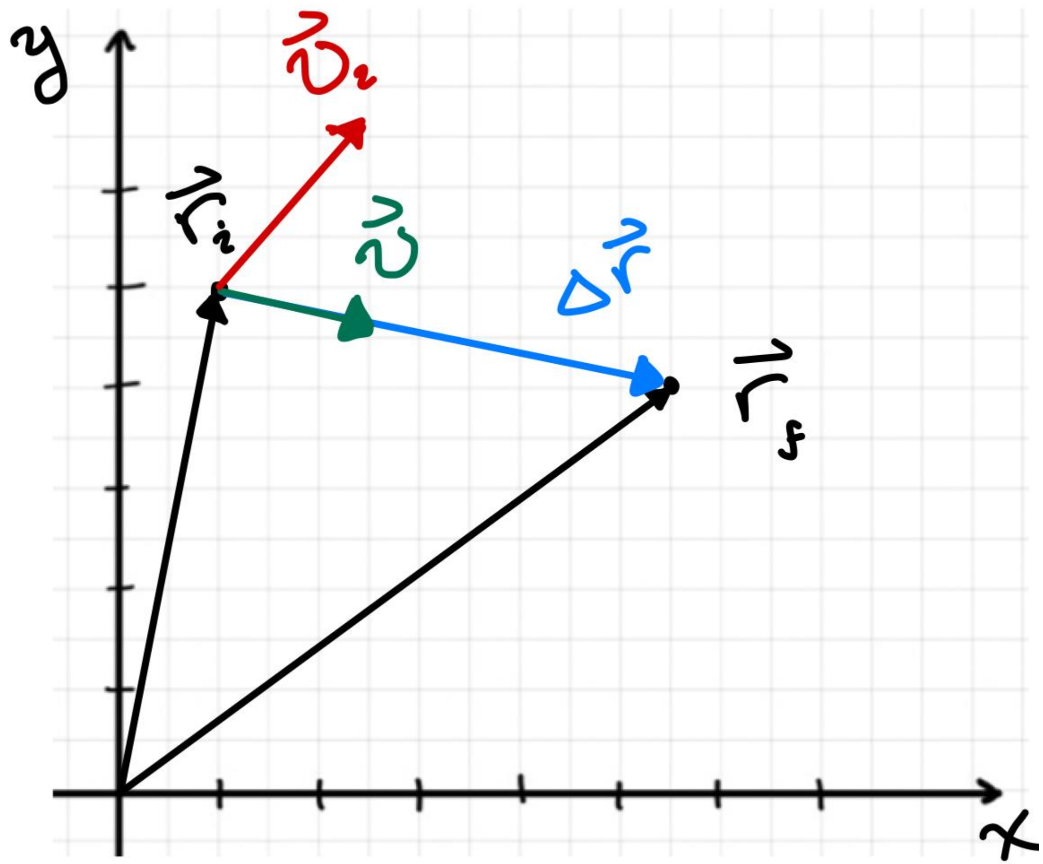
$$\Delta\vec{r} = \vec{r}_f - \vec{r}_i$$
$$= (x_f - x_i, y_f - y_i)$$

Velocity:

$$\vec{v} = \frac{\Delta\vec{r}}{t} = (v_x, v_y)$$

Acceleration:

$$\vec{a} = \frac{\Delta\vec{v}}{t} = (a_x, a_y)$$



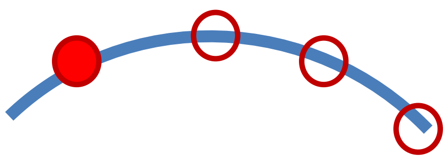
Homework

Problem 1.1

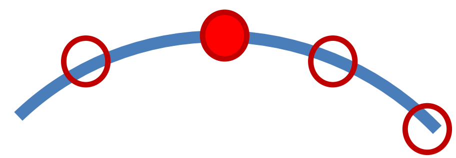
An object thrown at a certain angle follows the trajectory:

On each step of its trajectory, draw the direction of the acceleration vector:

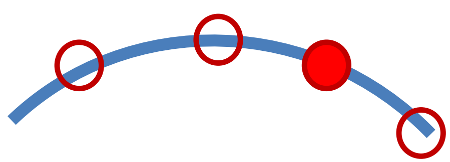
a)



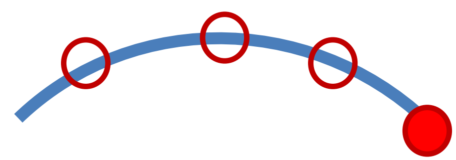
b)



c)



d)



Homework

Problem 1.2

When we learned about the acceleration due to gravity, we saw that the acceleration is constant throughout the trajectory of an object. Also, we learned that it always points down. The magnitude of this acceleration was found to be

$$a = 9.81\ {}^{m}/_{s^2}$$

With these considerations in mind, how would we need to write the components of the acceleration due to gravity?

$$\vec{a} = (\qquad , \qquad)$$

Problem 1.3

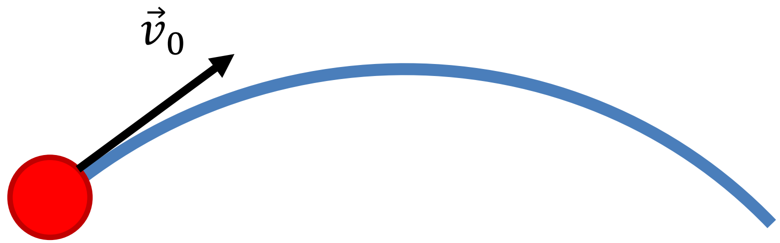
Do the components of the vector corresponding to the acceleration due to gravity that you wrote in Problem 1.2 agree with the acceleration vectors that you drew in Problem 1.1? Why or why not?

Homework

Problem 1.4

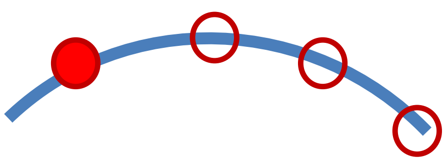
Now it is time to put some numbers on our Physics. At the instant after the object was thrown, corresponding to $t = 0s$, its velocity was $\vec{v}_0 = (5\,{}^{m}/_{s}\,, 2\,{}^{m}/_{s})$

$t = 0s$



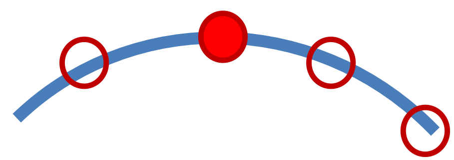
Use the equations at the beginning of the handout to find the velocity vector at each of the following times:

$t = 0s$



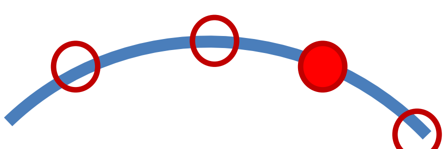
$\vec{v}_0 = (5\,{}^{m}/_{s}\,, 2\,{}^{m}/_{s})$

$t = 1s$



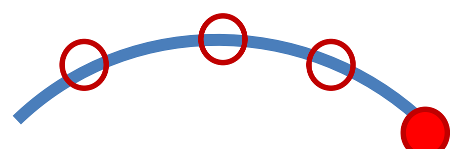
$\vec{v}_1 = (\qquad , \qquad)$

$t = 2s$



$\vec{v}_2 = (\qquad , \qquad)$

$t = 3s$



$\vec{v}_3 = (\qquad , \qquad)$