

Please PRINT your name \_\_\_\_\_

**No calculators, cell phones, computers, notes, etc.**

Circle your answer. Make your work correct, complete and coherent.

The quiz is worth 5 points. The solutions will be posted on my website later today.

**Quiz 17, November 4, 2019**

An object starts at the origin with velocity  $4\vec{i} + 8\vec{j}$ . The acceleration of the object at time  $t$  is  $\vec{r}''(t) = 2e^t\vec{i} + 16e^{2t}\vec{j}$ . What is the  $x$ -coordinate of the object when the  $y$ -coordinate is 12?

**ANSWER:**

Integrate to learn that  $\vec{r}'(t) = 2e^t\vec{i} + 8e^{2t}\vec{j} + \vec{c}_1$ . Plug in  $t = 0$  to learn

$$4\vec{i} + 8\vec{j} = \vec{r}'(0) = 2\vec{i} + 8\vec{j} + \vec{c}_1.$$

So,  $\vec{c}_1 = 2\vec{i}$ ,

$$\vec{r}'(t) = (2e^t + 2)\vec{i} + 8e^{2t}\vec{j}.$$

Integrate again to learn

$$\vec{r}(t) = (2e^t + 2t)\vec{i} + 4e^{2t}\vec{j} + \vec{c}_2.$$

Plug in  $t = 0$  to learn

$$0 = \vec{r}(0) = 2\vec{i} + 4\vec{j} + \vec{c}_2.$$

So,  $\vec{c}_2 = -2\vec{i} - 4\vec{j}$  and

$$\vec{r}(t) = (2e^t + 2t - 2)\vec{i} + (4e^{2t} - 4)\vec{j}.$$

The  $y$ -coordinate of the object is 12 when  $4e^{2t} - 4 = 12$ ; thus,  $4e^{2t} = 16$ ;

$$e^{2t} = 4$$

$$2t = \ln 4$$

$$t = (\ln 4)/2 = (2\ln 2)/2 = \ln 2.$$

The  $x$ -coordinate of the object is  $2e^{\ln 2} + 2\ln 2 - 2 = 4 + \ln 4 - 2 = \boxed{2 + \ln 4}$  when the  $y$ -coordinate of the object is 12.