Basics of Kinematics

Full Name - Period AP/Honors : **due: 1/23**

1 Applying math to words

1. A spacecraft is traveling at $\vec{v} = \frac{38.4 \text{ km}}{\text{s}}\hat{\text{r}}$ (yes, that is a reasonable speed for a rocket). How long will it take to travel from the earth to the moon, a displacement of 384 Mm $\hat{\text{r}}$ from Earth? Ignore movement of the moon.

2. A tortoise and a hare set up a race. If the race is 5 km in length, the tortoise travels at a speed of .25 $\frac{\text{km}}{\text{hr}}$ and the hare travels at a speed of 50 $\frac{\text{km}}{\text{hr}}$, how far will the tortoise have gone when the hare wins? They travel the same path.

3. Two alcohol powered dragsters are racing along a straight path. At time 0, they are at the same point. The first has a velocity given by $\vec{v}_1 = 10\ \frac{\text{m}}{\text{s}}\hat{\text{x}} + 8\ \frac{\text{m}}{\text{s}^2}\text{t}\hat{\text{x}}$. The other has a velocity of $\vec{v}_2 = 30\ \frac{\text{m}}{\text{s}}\hat{\text{x}} + 4\ \frac{\text{m}}{\text{s}^2}\text{t}\hat{\text{x}}$. How long does the track need to be in order for the first dragster to win?

4. A cowboy's velocity at time $t = 4$ is given by $\vec{v} = 24\ \frac{\text{m}}{\text{s}}\hat{\text{x}} + 24\ \frac{\text{m}}{\text{s}}\hat{\text{y}}$. If his initial velocity is $\vec{v_i} = 12\ \frac{\text{m}}{\text{s}}\hat{\text{x}} + 8\ \frac{\text{m}}{\text{s}}\hat{\text{y}}$ what is his average acceleration vector?

5. Two motorcycles have initial positions given by $\vec{r}_{1,0} = 3\ \text{m}\hat{\text{x}} + 2\ \text{m}\hat{\text{y}}$ and $\vec{r}_{2,0} = -4\ \text{m}\hat{\text{x}} + 5\ \text{m}\hat{\text{y}}$. Their velocities are given by $\vec{v}_1 = 10\ \frac{\text{m}}{\text{s}}\hat{\text{x}} + 15\ \frac{\text{m}}{\text{s}}\hat{\text{y}}$ and $\vec{v}_2 = 13\ \frac{\text{m}}{\text{s}}\hat{\text{x}} + 12\ \frac{\text{m}}{\text{s}}\hat{\text{y}}$. Do the motorcycles collide?

2 So many wrong answers...

1. Which of these statements about velocities and speeds are definitely correct. **Select all that apply!**

   A. If two people start and end at the same point, the one with the higher speed arrives first.

   B. If two people have the same instantaneous velocity, they have the same instantaneous speed.

   C. If two people have the same instantaneous speed, they have the same instantaneous velocity.

   D. If two people have the same displacement at the same time, then they definitely had the same average velocity.

2. A ball is thrown into the air at time $t = 0$ on Earth. After a time of 2 seconds, it has a velocity of $\vec{v} = 4\ \frac{\text{m}}{\text{s}}\hat{\text{x}} + 2\ \frac{\text{m}}{\text{s}}\hat{\text{y}}$. What was the average acceleration of the ball during that 2 seconds?

   A. $\vec{a} = 2\ \frac{\text{m}}{\text{s}^2}\hat{\text{x}} + 1\ \frac{\text{m}}{\text{s}^2}\hat{\text{y}}$

   B. $\vec{a} = 10\ \frac{\text{m}}{\text{s}^2}\hat{\text{x}} + 10\ \frac{\text{m}}{\text{s}^2}\hat{\text{y}}$

   C. $\vec{a} = -10\ \frac{\text{m}}{\text{s}^2}\hat{\text{y}}$

   D. $\vec{a} = -6\ \frac{\text{m}}{\text{s}^2}\hat{\text{x}} - 4\ \frac{\text{m}}{\text{s}^2}\hat{\text{y}}$

3. Two toy cars are pushed off a table with a height h at the same time. One has a velocity of $\vec{v_1} = v_x\hat{\text{x}}$ and the other has a velocity of $\vec{v_1} = 10v_x\hat{\text{x}}$.

   (a) What is the ratio of the x components of their displacements?

   A. 1:1

   B. 1:$\sqrt{10}$

   C. 1:10

   D. 1:100

   (b) What is the ratio of the time it takes them to hit the ground?

   A. 1:1

   B. 1:$\sqrt{10}$

   C. 1:10

   D. 1:100

4. Two bowling balls are dropped from heights of h and $4h$. What is the ratio of the time it takes the first ball to hit the ground compared to the second. (Format is first:second)

   A. 4:1

   B. 2:1

   C. 1:1

   D. 1:2

   E. 1:4