Physics 2110
Autumn 1998
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EXAM 1

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Name:_____ Social Security #:_____

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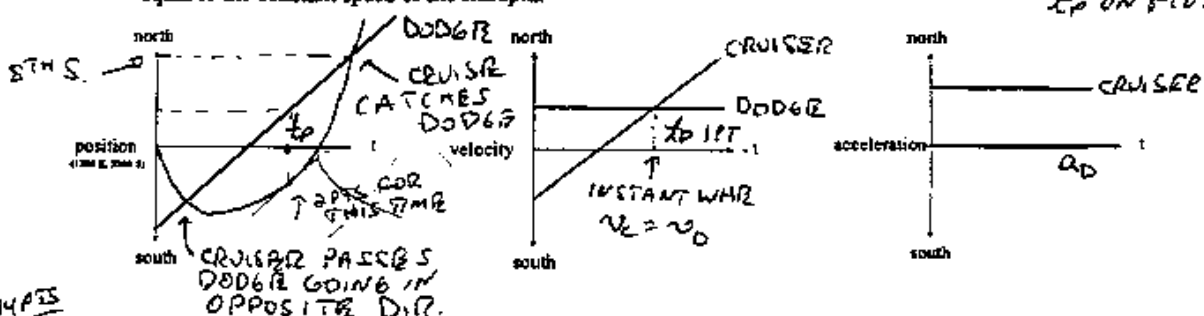
A. 15 PTS The situation is this: A police officer in his patrol cruiser is proceeding south along 1300 East at a constant speed somewhat under the speed limit. The following events all occur at the same instant which you will take to be $t_0 = 0$: (a) the officer sees two blocks ahead of him a Dodge Intrepid approaching in the opposite lane at a speed of 30 mph above the speed limit; (b) the cruiser is just crossing the intersection at 1300 East and 3300 South; and (c) the officer gives chase to the speeding Intrepid with uniform acceleration first slowing down, instantly stopping, and turning around, and taking off after the Intrepid. Take the intersection of 1300 East and 3300 South as the origin of a one dimensional coordinate system with south pointing negatively, and north as positive. Finally, assume the cruiser catches up to the Intrepid at 1300 East and 800 South.

1. 12 PTS Graph the motions of the cruiser and Intrepid on the graphs provided. 2 PTS EACH CORRECT PLOT
2. 3 PTS In words describe the significance of all points, if any, where the positive vs. time plots, the velocity vs time plots, and the acceleration vs. time plots of the motions intersect.
(12 PTS EACH)
position
3. 3 PTS Indicate with a mark on the positive vs. time plots where (or when) the velocity of the cruiser is equal to the constant speed of the Intrepid. MARKED AS t_0 ON PLOTS
position



B. 14 PTS The following are a pair of position (vectors) along the path of motion for an object traveling in two dimensions: $\vec{r}_1 = (3.00\text{ m})\hat{i} + (-4.00\text{ m})\hat{j}$; $\vec{r}_2$ has a magnitude of 10.0 m and makes an angle of 60.0° up from the +x axis.

$r_{2x} = r_2 \cos 60° = 6.00\text{ m}$
$r_{2y} = r_2 \sin 60° = 8.66\text{ m}$

$\vec{r}_2 = (6.00\text{ m})\hat{i} + (8.66\text{ m})\hat{j}$

1. 4 PTS What is the displacement vector $\Delta\vec{r}$ between the two positions? You may express your answer either as a magnitude and direction or in unit vector form.

$\Delta\vec{r} = \vec{r}_2 - \vec{r}_1 = (x_2 - x_1)\hat{i} + (y_2 - y_1)\hat{j} = (2.00\text{ m})\hat{i} + (12.5\text{ m})\hat{j}$

$\Delta r = \sqrt{(\Delta x)^2 + (\Delta y)^2} = 12.9\text{ m}$

$\theta = \tan^{-1}\frac{\Delta y}{\Delta x} = 81.1°$

2. 4 PTS The time elapsed in going from the first position to the second position was 2.00 s. What is the average velocity during this period of time?

$\vec{v}_{av} = \frac{\Delta\vec{r}}{\Delta t} = \left(\frac{\Delta x}{\Delta t}\right)\hat{i} + \left(\frac{\Delta y}{\Delta t}\right)\hat{j}$

$= (1.00\text{ m/s})\hat{i} + (6.35\text{ m/s})\hat{j}$

$v_{av} = 6.43\text{ m/s}$
$\theta = 81.1°$

3. 6 PTS On the diagram, draw $\vec{r}_1$, $\vec{r}_2$ and $\vec{v}_{av}$.
2 PTS EACH VECTOR