Physics 161, Homework 2

Due 12:00 pm, Monday, Feb 17; No Exceptions

Lubna Rana, Sections 0201-0206

Read Chapter 3 & Ch 4, Sections 4.1 & 4.2 by Friday, Feb 14

Serway & Beichner Ch 3, P 37; Ch 4 P 5

Short Answer Questions: S1, S2, S3, S4, S5

Special Note: Please always:

1). PRINT your name and section number CLEARLY on the front page of your HW.

2). STAPLE all your pages. It is <u>your responsibility</u> to make sure that your hw gets submitted in one piece.

3). DO ALL THE PROBLEMS IN ORDER.

4). Show complete work and write logically consistent explanations for ALL PROBLEMS to receive credit.

5). Write units next to all dimensionful quantities.

Short Answer Questions

S1). The initial and final position vectors $\vec{r}_i$ and $\vec{r}_f$ relative to a lighthouse located at a point O, are $\vec{r}_i = (3.0km)\hat{\imath} + (2.0km)\hat{\jmath}$ and $\vec{r}_f = (-5.0km)\hat{\imath} + (6.0km)\hat{\jmath}$ where $\vec{i}$ and $\vec{j}$ are unit vectors pointing east and north, respectively.

a). Make a sketch indicating the initial and final positions of this ship. Also indicate the displacement $\Delta\vec{r}$ of the ship from its initial to final position.

b). Calculate $\Delta\vec{r}$. Express your final result in terms of unit vectors $\vec{i}$ and $\vec{j}$.

c). Use this result to calculate the distance between the ship's initial and final position. Is that necessarily the distance covered by the ship? Do we know the distance covered by the ship?

d). Specify the direction of the ship's displacement in terms of an angle measured from the north direction.

S2). An object is initially located at point P whose position vector $\vec{r}_i = +x_0\hat{\imath}$.

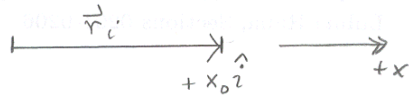

Fig S2.

a). Suppose that the object's acceleration vector is always directly propotional to the magnitudes of the object's displacement from the origin but always in a direction opposite to its position vector $\vec{r}$. Describe the particle's motion in detail using a schematic diagram of its motion and using arrows to indicate velocity and double arrows to indicate acceleration. Can you think of a function $\vec{r}(t)$ which would describe the object's position?

b). Consider again the object above which is located at at $\vec{r}_i = +x_0\hat{\imath}$ at $t = 0$. Now suppose that it travels with constant speed but moves at every instant in a direction *perpendicular* to its position at that instant. Along what kind of path does the object travel? Draw a sketch. What can you say about its acceleration?

S3). Fig. S3 shows the position of a ball at a particular instant immediately after it has been thrown horizontally out of a window. The arrow indicates the velocity $\vec{v}$ and the double arrow indicates the acceleration of the ball at this instant.

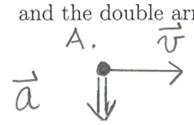

Fig S3.

a). Indicate by a labeled dot the approximate position of the B of the ball at a slightly later time (e.g., 0.1s after the ball passes the point A).

b). At B draw an arrow indicating the approximate velocity of the ball when it is at B. Clearly show how you got the result.

c). By using the information about the ball's velocity at B, indicate by a labeled dot the approximate position C of the ball 0.1s after it passes B.

d). Suppose that the ball's acceleration is everywhere the same as it is at A. Use this information to draw an arrow at C indicating its approximate velocity at that instant. Is this velocity larger than, equal to or smaller than the ball's velocity at B?

S4. A car travels with constant speed along the horizontal spiral-shaped road shown in Fig. S4. It passes first the point A, then B, and finally the point C which is the entrance to a parking lot.

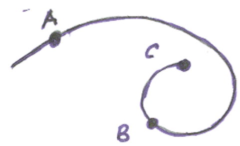

Fig S4.

a). Is the magnitude of the car's acceleration at point B equal to, larger than, or smaller than that of the car's acceleration at point A? Why?

S5. Fig S5. shows an object traveling counterclockwise around a circle at constant speed v_0.

a). Give the object's velocity in terms of unit vectors $\hat{\imath}$ and $\hat{\jmath}$ when its at points P, Q, R and T.

b). Figure out graphically the direction of the average acceleration during the time intervals (i) t_P and t_Q; (ii) t_P and t_R.

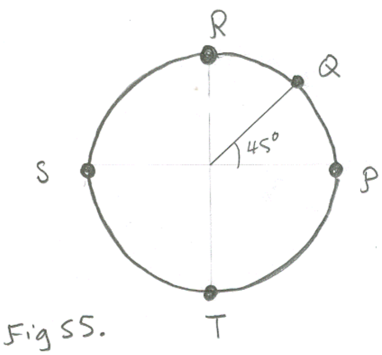

Fig S5.

c). Now, using the basic definition, calculate the average acceleration between points (i) P and Q and (ii) P and R.
Do you expect the *magnitude* of the average acceleration to be change or remain the same as the object moves around the circle from point P

d). Draw the instantaneous acceleration vector at points P, R, S and T.

e). Repeat part (d) for the case when the particle is traveling around the circle with increasing speed.

f). Repeat part (d) for the case when the particle is traveling around the circle with decreasing speed.