

18.02A Problem Set 2 – Fall 2006 due Thursday Nov.16/06, 12:45 in 2-106

Although this problem set is not due until the week after Exam 1, you should do it before the exam by way of exam preparation. The second part, Problem Set 6B, will be issued at the exam, and will also be due on thursday, Nov.16.

Part I (15 points)

(You need not hand in the exercises in parentheses, which are just for more practice.)

Lecture 24. Thurs. Nov. 2 Parametric equations of lines and curves.

Read: 18.4, 17.1, 17.2 to middle p.593 Work: 1E-3bc,4; 1I-2b, 3ad, 5 (4,6)

Lecture 25. Friday. Nov. 3 Vector derivatives, \mathbf{v} , \mathbf{a} , \mathbf{T} .

Read: 17.4 Work: 1J-1ac, 4abc, 6, 9.

Lecture 26. Tues. Nov. 7 Curvature; other applications. (Practive Exam given out)

Read: 17.5, Problem 1J-10 Work: 1J-3, 5, 10.

Lecture 27. Thurs. Nov. 9

Exam 1, covering lectures 20-26, 1:05-1:55pm **Walker 3rd Floor** (enter on river side)

Part II (20 points)

Problem 1. (Thurs. 4pts: 1+1+1+1)

a) Find the position vector of the trajectory of circular motion in the plane around the origin starting at $(-1, 0)$ going clockwise at unit speed.

b) Find the position vector of the trajectory of circular motion in the plane around the origin starting at $(10, 0)$ going counterclockwise at speed 60.

c) Repeat part b) if the speed is now 60 rpm (with t measured in minutes).

d) Find the position and velocity vectors of the trajectory with initial position (at time $t = 0$) $\mathbf{r}_0 = \hat{\mathbf{j}}$, initial velocity $\mathbf{v}_0 = -\hat{\mathbf{i}}$, and acceleration $\mathbf{a} = (\cos t)\hat{\mathbf{i}} - (\sin t)\hat{\mathbf{j}} + \hat{\mathbf{k}}$.

Problem 2. (Thurs. 6pts: 2+2+2)

a) A jet takes off from $(1, 1, 0)$ at time $t = 0$ and moves with constant speed $\mathbf{v} = (-5, 0, 1)$. In a flight simulator, the trajectory of the jet is displayed in the yz -plane as it would appear to an observer at the point $(1, 0, 0)$. Find the formula (in the form $y = y(t), z = z(t)$) for the trajectory on the screen.

b) By considering the velocity vector of the point on the screen, show that the motion in part (a) is in a straight line. What happens as $t \rightarrow \infty$?

c) Draw a picture of several trajectories as they would appear on the screen if all of them are parallel to the same vector in 3-space.

Problem 3. (Friday. 6 pts: 3+3)

Do question 15 on p.592 of the text, but compute both a) the position, and b) the speed of the point P.

Problem 4. (Tues. 4pts)

Find unit tangent and normal vectors to the parabola $(x, y) = (at^2, 2at)$ where a is a constant.