Part I (15 points)

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

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

Lecture 25. Friday. Oct. 31   Vector derivatives, $v$, $a$, $T$.  
Read: 17.4   Work: 1J-1ac, 4abc, 6, 9.

Lecture 26. Tues. Nov. 4   Curvature; other applications. (Practive Exam posted)  
Read: 17.5, Problem 1J-10   Work: 1J-3, 5, 10.

Lecture 27. Thurs. Nov. 6   
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  
$t = 0$)  
$r_0 = \hat{j}$, initial velocity $v_0 = -\hat{i}$, and acceleration $a = (\cos t)\hat{i} - (\sin t)\hat{j} + \hat{k}$.

Problem 2. (Thurs. 6pts: 2+2+2)  
A hockey puck of radius 1 slides along the ice at a speed $10\sqrt{2}$ in the direction of the vector  
(1,1). As it slides, it spins in a counterclockwise direction at 2 revolutions per unit time. At time  
$t = 0$, the puck's center is at the origin (0,0).

a) Find the parametric equations for the trajectory of the point P on the edge of the puck  
initially at (1,0).

b) Find the velocity $v$ of the point P.

c) What is the minimum speed of the point P, and what is the direction of the velocity at the  
corresponding time.

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: 1+1+1+1)  
Consider the helical trajectory with displacement vector  
$r(t) = \sin 4t \, \hat{i} + \cos 4t \, \hat{j} + 3t \, \hat{k}$, where  
t is time. Calculate

a) the velocity vector $V$ and the unit tangent vector $T$,

c) the speed $ds/dt$ and the arclength traced out between the points at $t = 0$ and $t = 2\pi$,

d) the curvature $\kappa$.

e) Show that the curve makes a constant angle with the vertical ($\hat{k}$) direction.