

## Homework Set 4

DUE: FEB 9, 2017 (IN CLASS)

1. What is the length of the curve  $\gamma(t) = (2t, t^2, \ln t)$  for  $1 \leq t \leq e$ ? Compute the curvature  $\kappa$  of this curve  $\gamma$ .
2. Compute the moving orthonormal frame  $T, N, B$  for the space curve  $\gamma(t) = (t, e^t, t^2)$ . Determine the curvature  $\kappa$  of  $\gamma$ .
3. Suppose that in the superbowl game this weekend, the Patriots' quarterback Tom Brady wants to throw the football to a receiver standing 40 yards away. If he knows that he can throw the football with an initial speed of 30 yards per second, at what angle with the ground should he throw so that the football arrives in the receiver's hands? What is the flight time of the football? (Disregard air resistance effects, assume Tom Brady and the receiver have the same height, and use  $g = 11.25$  yards per square second)
4. An alien spaceship is flying through our galaxy following a trajectory parametrized by  $\gamma(t) = (3 \sin t, 2 - 2t, 3 \cos t)$ . Compute its tangent and normal acceleration at  $t = \pi$ .
5. Parametrize the straight line through the points  $(2, 3)$  and  $(4, -1)$  in polar coordinates, that is, as the image of a function  $r = r(\theta)$  that gives the distance  $r$  to the origin at each point  $P$  along the line such that  $\overrightarrow{OP}$  makes an angle  $\theta$  with the  $x$ -axis.