1. Do Fall 2014 Exam I

2. Let \((x, y, z) = r(t)\) be a constant speed curve. Show that the acceleration vector of the curve is always perpendicular to the velocity vector.

3. 14.2.7 (also do limit of same function as \((x, y) \to (0, 0)\))

4. (From Fall 2010, Exam 1) The Parallelogram Law states that, for any vectors \(u\) and \(v\),

\[
|u + v|^2 + |u - v|^2 = 2|u|^2 + 2|v|^2.
\]

(a) Give a geometrical interpretation of the Parallelogram Law.
(b) Prove the Parallelogram Law using vector algebra. [Hint: Use \(|u + v|^2 = (u + v) \cdot (u + v)\) together with the distributive law for the dot product.]

5. Set up but do not evaluate an integral to calculate the length of the parametrized curve

\[
r(t) = (t^2, e^{3t}, \cos(4t)), \quad 0 \leq t \leq \pi.
\]

That is, find numbers \(a\) and \(b\) and a function \(F\) so that the length of the curve is given by

\[
\int_a^b F(t) \, dt.
\]

6. 14.1.38
7. 14.1.41
8. 14.1.61
9. 14.2: 11, 14, 31, 41