NAME:

QUIZ 2 FOR MATH 2551 F1-F4, SEPTEMBER 5, 2018

This quiz should be taken without any notes and calculators. Time: 20 minutes. Show your work, otherwise credit cannot be given.

Problem 1: The position vector of a particle is given by

$$\vec{r}(t) = \langle t^2, e^t, 1\rangle \ .$$

Find the velocity vector, the speed and the acceleration at time t. (1 point each)

$$\vec{v}(t) = \langle 2t, e^t, 0\rangle \ , \ s'(t) = |\vec{v}(t)| = \sqrt{4t^2 + e^{2t}} \ , \vec{a}(t) = \langle 2, e^t, 0\rangle$$

Problem 2: (3 points) Find the line tangent to the curve

$$\vec{r}(t) = \langle t, t^2, t\rangle$$

at the point $\vec{r}(1)$, i.e., at $t = 1$.

The line must pass through the point $(1, 1, 1)$ and has the direction $\vec{v} = \langle 1, 2, 1\rangle$ Hence the line is given by

$$\vec{x}(s) = (1, 1, 1) + s\langle 1, 2, 1\rangle$$

Problem 3: (4 points) A particle is moving along a trajectory $\vec{r}(t)$ in such a way that at time $t = 0$ it passes through the point $\vec{r}(0) = \langle 1, 0, 0\rangle$. The velocity vector at any time t is given by

$$\vec{v}(t) = \langle t, 1, 0\rangle \ .$$

Find $\vec{r}(t)$ for all t.

Integrating the velocity vector yields

$$\vec{r}(t) = \langle \frac{t^2}{2} + x_0, t + y_0, z_0\rangle$$

At the point $t = 0$ we have that $\vec{r}(0) = \langle 1, 0, 0\rangle$ and hence $x_0 = 1, y_0 = 0$ and $z_0 = 0$ and the curve is given by

$$\vec{r}(t) = \langle \frac{t^2}{2} + 1, t, 0\rangle$$

Extra credit: (1 point) A tennis ball moves horizontally towards a wall $10m$ away at a speed of $108km/h$ (Neglect air resistance). How far has the ball dropped when it hits the wall. (use $g = 10m/s^2$).

The ball takes $1/3$ of a second to hit the wall. Its vertical displacement is $-gt^2/2$ which equals $-\frac{10}{2\cdot 9}m = -\frac{5}{9}m$.