**Math 2030, Winter 2016, Test 1**
**2 February 2016**
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1. Find the intersection of the line through $(2, 7, 1)$ and $(3, 9, 2)$ with the plane $x = y + z$. (10 pts)

2. Find the plane through $(4, 1, 2)$, $(9, 6, 5)$ and $(9, 1, 3)$. (5 pts)

3. Find the projection of $\overrightarrow{(7, 11, 5)}$ onto $\overrightarrow{(1, 2, -1)}$. Write $\overrightarrow{(7, 11, 5)}$ as the sum of a vector parallel to $\overrightarrow{(1, 2, -1)}$ and a vector perpendicular to $\overrightarrow{(1, 2, -1)}$. (10 pts)

4. Find the line of intersection of the planes $y - z + 1 = 0$ and $2x - y - 2 = 0$. (10 pts)

5. (a) Find the point of the plane $x + 3y - z - 2 = 0$ closest to $(9, 16, 0)$. (10 pts)
   (b) Find the distance from $(9, 16, 0)$ to the plane $x + 3y - z - 2 = 0$. (5 pts)
   (c) Find a point at the same distance to the plane, but on the other side of the plane. (5 pts)

6. Show that the line through $(1, -1, 0)$ and $(2, 0, 4)$ lies in the surface $z = x^2 - y^2$. (10 pts)

7. Let $\overrightarrow{r}(t) = (6t, t^2 + 2t, t^3 + 3t)$.
   (a) Compute $\overrightarrow{v}(t)$. (5 pts)
   (b) Compute $\overrightarrow{a}(t)$. (5 pts)
   (c) Decompose $\overrightarrow{a}(1)$ into normal and tangential components. (5 pts)
   (d) Compute $(ds/dt)$ when $t = 1$. (5 pts)
   (e) Compute the curvature $\kappa$ at $t = 1$. (5 pts)
   (f) Write an equation for the line tangent to the curve at $t = 1$. (5 pts)
   (g) Find the point on the curve at which $y - x$ is at a minimum. (5 pts)

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