LAST NAME:	FIRST NAME:	CIRCLE: Li 2:30pm Li 5:30pm Zweck 10am Zweck 1pm

1 /12	2 /12	3 /15	4 /12	5 /12	6 /12	T /75

MATH 2415 (Fall 2017) Exam I, Sep 29th

No books or notes! **NO CALCULATORS!** Show all work and give **complete explanations**. Don't spend too much time on any one problem. This 90 minute exam is worth 75 points.

(1) [12 pts] Let $\mathbf{v} = (-1, 0)$ and $\mathbf{w} = (2, 1)$.
(a) Make a labelled sketch showing the vector projection of $\mathbf{v}$ onto $\mathbf{w}$.

(b) Calculate the vector projection of $\mathbf{v}$ onto $\mathbf{w}$.

(2) [12 pts]
(a) Let L be the line through the point $\mathbf{p} = (1, 0, 3)$ that contains the vector $\mathbf{v} = (0, 1, 2)$. Let P be the plane $x + y + z = 7$. The line L and the plane P intersect in a point. Find the coordinates of this point.

(b) Let L_1 and L_2 be the lines parametrized by $\mathbf{r}_1(t) = (1, t, 0)$ and $\mathbf{r}_2(t) = (t, 2t, 3t)$, respectively. Do the lines L_1 and L_2 lie in the same plane? Explain.

(3) [15 pts] Make a labelled sketch of the traces of the surface

$$y^2 - 4x^2 - z^2 = 1$$

in the planes $x = 0$, $z = 0$, and $y = k$ for $k = 0, \pm 1, \pm 2$. Then sketch the surface.

(4) [12 pts] Let C be the parametrized curve $\mathbf{r}(t) = (3\cos 2t, 4\sin 2t, 5t)$.
(a) Show that the curve C lies on an elliptical cylinder.

(b) Find a parametrization of the tangent line to the curve C at $t = \pi/8$.

(5) [12 pts]
(a) Parametrize the curve that is given by the intersection of the surfaces $x^2 + y^2 = 4$ and $z = x^2 - 3y^2$.

(b) Let $z = f(x, y) = xe^{-y}$. Make a labelled sketch showing the contours of $f(x, y) = k$ for $k = -1$, $k = 0$ and $k = 1$.

(6) [12 pts]
(a) Let P be the point with cylindrical coordinates $(r, \theta, z) = (\sqrt{3}, \frac{\pi}{4}, -1)$. Find the spherical coordinates of P.

(b) Convert the equation $z = -\sqrt{x^2 + y^2}$ into spherical coordinates.