Please work the problems in the white space provided and clearly box your solutions. You are allowed one $3'' \times 5''$ notecard. Enjoy! This quiz has 3pts of bonus credit.

Problem 1 (0.5 pt) Parametrize the line-segment from $P_1 = (3, 0, 7)$ to $P_2 = (10, 10, 10)$. Also, find the distance between P_1 and P_2.

Problem 2 (0.5 pt) Find an integral which represents the arclength function starting at $t = 0$ for $\vec{\gamma}(t) = \langle t^2 \sin(t), t, \frac{1}{2t+3} \rangle$. **DO NOT ATTEMPT THE INTEGRAL.**

Problem 3 (0.5 pt) Where does the helix $x = 7\cos t,\ y = 7\sin t,\ z = 3t$ intersect the $z = \pi$ plane ?

Problem 4 (0.5 pt) Suppose $A = 2$, $B = 3$ and $\vec{A} \bullet \vec{B} = 3$. Find the angle between $\vec{A}$ and $\vec{B}$.

Problem 5 (0.5 pt) Find the spherical coordinates of the point $(1, 1, \sqrt{7})$

Problem 6 (1 pt) Find the point on the plane $x + 2y + 3z = 6$ which is closest to $(3, 5, 7)$.

Problem 7 (0.5 pt) Let $P = (2, 0, 3)$, $Q = (1, -3, 0)$ and $R = (0, 0, 1)$. Find a parametrization of the plane which contains the points P, Q, R.

Problem 8 (0.5 pt) Find the Cartesian equation of the plane which contains the points P, Q, R of the previous problem.

Problem 9 (1 pt) Find the volume of the parallel-piped which has edges which line up with the vectors $\vec{A} = \langle 2, 0, 3\rangle$, $\vec{B} = \langle 1, -3, 0\rangle$ and $\vec{C} = \langle 0, 0, 1\rangle$.

Problem 10 (1 pt) Let $\vec{r}(t) = \langle 1, t^2, te^t\rangle$. Find the parametrization of the tangent line to the given curve at $(1, 1, e)$.

Problem 11 (1 pt) Consider a circle centered at $(1, 1, 3)$ which lies in a plane parallel to the xy-plane. If the circle has radius 2 then parametrize the part of the circle with $x \geq 1$. (include the domain of the parameter in your solution)

Problem 12 (0.5 pt) Find the projection of $\vec{A} = \langle 1, 2, 2\rangle$ in the $\vec{B} = \langle 1, 1, 0\rangle$-direction.

Problem 13 (1 pt) Let $\vec{A}, \vec{B}$ be constant vectors. Let $\vec{F}(t) = \cos t\,\vec{A} + \sin t\,\vec{B}$. Calculate $\int \vec{F}(t)dt$ and also calculate $d\vec{F}/dt$.

Problem 14 (2 pt) Let $\vec{G} = \cos(t)\widehat{A} + \sin(t)\widehat{B}$ where $\vec{A}, \vec{B}$ are nonzero constant vectors. If G is constant then determine the angle between $\vec{A}$ and $\vec{B}$.

Problem 15 (2 pt) Suppose $\vec{v}(t) = \langle 2t, -\sin t, \cos t\rangle$ is the velocity of a ninja hound which is at $(0, 1, 0)$ at time $t = 0$. Calculate the position $\vec{r}(t)$ and acceleration $\vec{a}$ at time t. Also, calculate the tangential and normal components of $\vec{a}$ (find a_T and a_N).

Problem 16 A surface S has parametric equations as given below:

$$x = \sinh\beta\cos t, \qquad y = \sinh\beta\sin t, \qquad z = \cosh t.$$

Find the Cartesian equation of S and identify the surface.

Problem 17 Suppose $\vec{A} \bullet \vec{B} = 0$ for all $\vec{B}$. Show $\vec{A} = 0$.

Problem 18 Find all vectors $\vec{A}$ for which $\vec{A} \bullet \widehat{z} = 3$ and $\vec{A} \times \widehat{z} = 0$. If there are many solutions then characterize them in your solution.

Problem 19 Show $\dfrac{d}{dt}[f\vec{A}] = \dfrac{df}{dt}\vec{A} + f\dfrac{d\vec{A}}{dt}$.

Problem 20 Find the parametrization of the curve of intersection of the plane $x - 2y + 3z = 1$ and the cone $\phi = \pi/6$.

Problem 21 Let $\vec{A}, \vec{B}$ be nonzero, non-colinear vectors. Let C be a curve parametrized by:

$$\vec{\gamma}(t) = \vec{r}_o + f(t)\vec{A} + g(t)\vec{B}$$

for $t \in \mathbb{R}$ where $f, g : \mathbb{R} \to \mathbb{R}$ are smooth functions. Find the torsion of C.