Disclaimer: This is intended as a guide for a 1 hour review of the Exam 1 material. The exam may not look like this review!!

1. Write formulas for each of the following (no justification required):
   (a) $\text{proj}_v \mathbf{F}$
   (b) The angle between two vectors $\mathbf{v}$ and $\mathbf{w}$
   (c) The distance from a point $Q$ and a plane with point $P$ and normal vector $\mathbf{n}$.
   (d) The torque from a force $\mathbf{F}$ applied to point $Q$ that tends to revolve about a point $P$.
   (e) The spherical to rectangular formulas (i.e. $x=\ldots, y=\ldots, z=\ldots$, in terms of $\rho, \theta, \phi$).
   (f) A vector in the plane that makes an angle $\frac{\pi}{7}$ with the $x$-axis and has magnitude 5.
   (g) The volume of the parallelepiped whose corners are made up of $\mathbf{u}, \mathbf{v}$, and $\mathbf{w}$.

2. (a) Find an equation for the plane passing through $A = (1, 2, -3), B = (-1, 5, 1)$ and $C = (0, 3, 2)$.
   (b) Find the distance from $Q = (0, 0, 0)$ to the plane in (a). [No simplification required].

3. Consider the points $P = (1, 2, -1)$ and $Q = (0, -5, 2)$.
   (a) Find parametric equations for the line going through $P$ and $Q$.
   (b) Find symmetric equations for the line.
   (c) Find a different set of parametric equations that graphs the same line (different from your answer in (a)).

4. Give quick (rough) sketches of the following in 3-space.
   (a) $y = 2$
   (b) $4x + 3y - 2z = 12$
   (c) $y = z^2$
   (d) $z = x^2 + y^2$
   (e) $x^2 + z^2 = -4 + y^2$

5. (a) Convert the cylindrical point $(r, \theta, z) = (2, \pi/3, -2)$ to BOTH rectangular and spherical coordinates.
   (b) Convert the spherical equation $\rho = 2\cos(\phi)$ to a rectangular equation (i.e., $(x, y, z)$).
6. Sketch the vector-valued function \( \mathbf{r}(t) = 2 \cos t \mathbf{i} + t \mathbf{j} + 2 \cos t \mathbf{k} \) from \( t = [0, 4\pi] \).

7. Give two vector-valued functions whose graph is \( y = x^2 \) in the plane \( z = 3 \) with \( 0 \leq x \leq 1 \).

8. Let \( \mathbf{r}(t) \) be such that

\[
\mathbf{v}(1) = \begin{pmatrix} -1 \\ 2 \\ -2 \end{pmatrix}
\]

and

\[
\mathbf{a}(1) = \begin{pmatrix} 3 \\ 0 \\ 3 \end{pmatrix}
\]

Find \( \mathbf{T}(1), \mathbf{a}_T(1), \mathbf{a}_N(1), \mathbf{N}(1), \) and \( K(1) \).

*Hint: I only want these for \( t = 1 !!! \)*

9. (a) Draw a graph of a vector-valued function with \( a_N(t) = 0 \) and \( a_T(t) > 0 \) for all \( t \).

(b) Suppose \( a_T(t) = 0 \) for all \( t \). What can be said about the speed of \( \mathbf{r}(t) \)?

(c) Give the formula for the arclength of \( \mathbf{r}(t) \) from \( a \leq t \leq b \).

10. Suppose that

\[
\mathbf{r}(0) = \mathbf{j} + \mathbf{k}
\]

and

\[
\mathbf{v}(t) = \begin{pmatrix} -\cos t \\ -\sin t \\ 0 \end{pmatrix}
\]

Find \( \mathbf{r}(t) \) for all \( t \).

---

**Good Luck!!!**