(10) I. Give the parametric equation of the line segment connecting the point \((1, 2, 3)\) and the point \((2, 5, 7)\). This is a line segment of finite length, so be sure to put the proper limits on your parameter.

(10) II. Give a coordinate equation for the plane containing the point \((1, 2, 5)\) which is perpendicular to the cross product of the vectors \(v_1 = i + j + k\) and \(v_2 = i\).
(20) III. A plane $P$ in $\mathbb{R}^3$ has equation $x - y = 0$.

A. Give a unit vector that is perpendicular to $P$.

B. Give a point that is in $P$.

C. Give the components of two non-parallel vectors which are perpendicular to the normal to $P$.

D. Give a parametrization of $P$. 
(10) IV. Here are the four corners of a parallelogram in $\mathbb{R}^3$:

$(1, 1, 1)$, $(2, 4, 3)$, $(3, 2, 4)$, and $(4, 5, 6)$.

What is its area?

(10) V. Calculate the integral:

$$\int \left( t^3 \mathbf{i} + (\sin 2t) \mathbf{j} + \left( \frac{1}{\sqrt{2t}} \right) \mathbf{k} \right) \, dt$$
VI. Give examples of:

A. A line in $\mathbb{R}^4$.

B. An equation for any cone in $\mathbb{R}^3$.

C. A negative definite quadratic form in three variables.

VII. Suppose $A = \begin{bmatrix} 6 & 4 \\ 2 & 3 \end{bmatrix}$ and $T : \mathbb{R}^2 \to \mathbb{R}^2$ is a linear transformation with the formula $T(x) = Ax$. Suppose $a = 3i + 2j$

A) What is $T^{-1}(a)$?

B) What is $T(T^{-1}(a))$?
VIII. The unit tangent vector (also called the unit velocity vector) to the path determined by the vector-valued function $f$ is the unit vector that is tangent to the path. For the path $f(t) = ti + t^2j + t^3k$,

A. give the unit tangent vector at the point where $t = 1$.

B. give the equation of the tangent line to this path at the point $f(1)$.