Do not write on this page. Write your solutions on the paper provided. Do not simplify your answers. Do not round off numbers. Fractions, radicals, etc. are preferable to errors due to rounding.

(1) (20 pts.) Items (a) – (d) refer to the two vectors 
\begin{align*}
u &= \langle 4, 9, -2 \rangle, \\
v &= \langle 1, 2, -1 \rangle.
\end{align*}

(a) Find \( \mathbf{v} \cdot \mathbf{v} \) and \( \mathbf{u} \cdot \mathbf{v} \).
(b) Find the unit vector in the direction of \( \mathbf{v} \).
(c) Find proj\(_v\) \( \mathbf{u} \), the vector projection of \( \mathbf{u} \) onto \( \mathbf{v} \).
(d) Find orth\(_v\) \( \mathbf{u} \), the orthogonal projection of \( \mathbf{u} \) onto \( \mathbf{v} \).

(2) (20 pts.) Items (a) – (d) refer to the three points in \( \mathbb{R}^3 \):
\begin{align*}
A &= (-2, -1, 1), \\
B &= (1, 1, -1), \\
C &= (-1, 0, -1).
\end{align*}

(a) Find parametric equations for the line containing the points \( A \) and \( B \).
(b) Find the area of the triangle with vertices \( A, B, C \).
(c) Find the distance from the point \( C \) to the line passing through \( A \) and \( B \).
(d) Find an equation for the plane containing \( A, B, C \).

(3) (20 pts.) Let \( \mathcal{P} \) denote the plane defined by the equation \( 3x - 2y - 4z = 5 \). Let \( A \) be the point \( (3, -2, 6) \).

(a) Find parametric equations for the line that passes through the point \( A \) and is perpendicular to the plane \( \mathcal{P} \).
(b) Find the distance from the point \( A \) to the plane \( \mathcal{P} \).

(4) (20 pts.) You are given the acceleration function
\[ \mathbf{a}(t) = \left( 2, (t+1)^{-3}, (t+1)^{-2} \right), \]
and the initial values for velocity and position
\[ \mathbf{v}(0) = \left( 0, -\frac{1}{2}, -1 \right) \]
\[ \mathbf{r}(0) = \left( 1, \frac{1}{2}, 1 \right). \]

Find: (a) the velocity function \( \mathbf{v}(t) \), and (b) the position function \( \mathbf{r}(t) \).

(5) (20 pts.) An object moves in the \( xy \)-plane. Its position as a function of time \( t \) is given by
\[ \mathbf{r}(t) = \left( 1 + e^t, 1 - e^t \right). \]

(a) Find the velocity function \( \mathbf{v}(t) \).
(b) Set up, but do not evaluate, an integral giving the length of \( \mathcal{C} \) over the interval \( 0 \leq t \leq 2 \).
(c) Write parametric equations for the tangent line to the curve, at \( t = 0 \).
(d) At \( t = 0 \), find: the unit tangent vector \( \mathbf{T}(0) \), and the unit normal vector \( \mathbf{N}(0) \).