

Name: _____

Directions: Show all work. No credit for answers without work. Each problem is worth 10 points. Complete 7 of the 8 problems. Your lowest scoring problem is dropped.

1. [**2 parts, 5 points each**] For each part below, determine whether the given three points lie on a straight line.

(a) $A(2, 4, 2)$, $B(3, 7, -2)$, $C(1, 3, 3)$

(b) $D(0, -5, 5)$, $E(1, -2, 4)$, $F(3, 4, 2)$

2. [**10 points**] Find a unit vector with the same direction as $7\vec{i} - \vec{j} + 3\vec{k}$.

3. [10 points] Find the angle between the vectors \vec{a} and \vec{b} , where $\vec{a} = \vec{i} - \vec{k}$ and $\vec{b} = 3\vec{i} - 2\vec{j} + \vec{k}$.

4. [10 points] Find two unit vectors orthogonal to both $\langle 2, 4, -1 \rangle$ and $\langle 3, -4, 6 \rangle$.

5. [10 points] Find the equation of the plane that passes through the point $(2, 1, -1)$ and contains the line given by $x = 3 + t$, $y = -1 + 2t$, and $z = 2 + 5t$.

6. [10 points] Find the derivative of the vector function given by $\vec{r}(t) = e^{t^2}\vec{i} - \vec{j} + \sin(5t + 2)\vec{k}$.

7. [10 points] Find the curvature of the curve given by $\vec{r}(t) = 2 \sin t \vec{i} - 6t \vec{j} + 2 \cos t \vec{k}$.

8. At time $t = 0$, a projectile is fired from the origin $(0, 0)$ with an initial speed of 200 m/s at an angle of elevation of 60° . Recall that the acceleration g due to gravity is 9.8m/s^2 .
- (a) **[7 points]** Find the position function $\vec{r}(t)$ that governs the motion of the projectile.
 - (b) **[3 points]** Find the maximum height of the projectile.