1. Write the line $\mathbf{r}(t) = 4\mathbf{i} - 2\mathbf{k} + t(-\mathbf{i} + 3\mathbf{j} + \mathbf{k})$ in parametric and symmetric form.

Determine whether each pair of lines intersects. If so, find the point of intersection and the angle formed by the lines.

2. $\mathbf{r_1}(t) = 2\mathbf{i} - \mathbf{j} + t(\mathbf{j} - \mathbf{k})$
   $\mathbf{r_2}(t) = 3\mathbf{i} + \mathbf{j} - \mathbf{k} + t(\mathbf{i} + \mathbf{k})$

3. $\mathbf{r_1}(t) = \mathbf{i} + \mathbf{j} + \mathbf{k} + t(2\mathbf{i})$
   $\mathbf{r_2}(t) = 4\mathbf{j} - \mathbf{k} + t(-\mathbf{i} + \mathbf{j})$

4. Find the distance from the point $P(1, 1, 1)$ to the line, ℓ defined by $x = 2$, $y = t$, $z = 1 - t$

5. Find the equation of the plane orthogonal to $\langle 3, 1, -4\rangle$ and containing the point $P(3, 0, 9)$

6. A plane is given by the equation $3x + y - 2z = 4$. What vector is normal to this plane? Name any three points contained in this plane.

7. Consider the line ℓ given by $x = -2t + 1$, $y = t - 3$, $z = -t + 5$. The goal of this problem is to find a coinciding line, m where the equation for x is $x = u$.

   (a) What is the direction vector of ℓ?

   (b) What is the x component in the direction vector of m?

   (c) What is the whole direction vector of m?

   (d) Let P be the point used to specify m. What is the x coordinate of P?

   (e) Since P is on m, it is also on ℓ. Use this fact to find all three coordinates of P.

   (f) What are the parametric equations of m?

   (g) Verify your answer by finding two points that are contained in both ℓ and m.

Determine whether the following planes are identical, parallel, or intersecting. If intersecting, find the line where it intersects. (Hint: Since the line lies on both planes, it will be normal to both normal vectors. To find a point, guess one coordinate and solve for the other two.)

8. $x + y + z = 0$
   $3x + 2y + z = 3$

9. $2x + 6y - 6z = 2$
   $\dfrac{x - 1}{3} + y - z = 0$

10. $2x - y + 8z = 10$
    $-4x + 2y - 16z = 10$