1. **Higher Dimensional Analysis**: Using the concepts you have learnt regarding planes in three dimensions, answer the following questions based on the information provided for a 4 dimensional space.
   Consider a plane $P_1 : \vec{n_1}.(\vec{r} - \vec{r}_0) = \vec{m}_1.(\vec{r} - \vec{r}_0) = 0$
   Consider another plane $P_2 : \vec{n}_2.(\vec{r} - \vec{r}_0) = \vec{m}_2.(\vec{r} - \vec{r}_0) = 0$
   (a) Will they intersect if they are not parallel?
   (b) What will be the condition for the two planes to be parallel?
   (c) What will be the condition for them to coincide?
   (d) When will they intersect at a single point?
   (e) When will they intersect in a line?
   (f) Are there any other forms of intersection possible, that haven't been enumerated above?
2. If three vectors $\vec{a}, \vec{b}, \vec{c} \in \mathbb{R}^3$, show that, $\vec{a} \times (\vec{b} \times \vec{c}) = (\vec{a}.\vec{c})\vec{b} - (\vec{a}.\vec{b})\vec{c}$
   Try to explain geometrically what each term means and its orthogonality or parallel nature with respect to each of the other terms.
3. We know that every vector in $\mathbb{R}^3$ can be written as a scalar combination of the vectors $\hat{i}, \hat{j}, \hat{k}$. Can every vector in $\mathbb{R}^3$ be written as a scalar combination of just $\hat{i}, \hat{j}$, i.e. for any vector $\vec{v} \in \mathbb{R}^3$, are there scalars m, n such that $\vec{v} = m\hat{i} + n\hat{j}$? Justify your answer.
4. Find the points of intersection of the line $x = 3 + 2t, y = 7 + 8t, z = 2 + t$, that is, $l(t) = (3 + 2t, 7 + 8t, 2 + t)$, with the coordinate planes.
5. Do the lines $(x, y, z) = (t + 4, 4t + 5, t2)$ and $(x, y, z) = (2s + 3, s + 1, 2s - 3)$ intersect?
6. Find the line through $(3, 1, 2)$ that intersects and is perpendicular to the line $x = -1 + t, y = -2 + t, z = -1 + t$. [HINT: If (x_0, y_0, z_0) is the point of intersection, find its coordinates.]
7. **An elementary example of computing flux of a Vector field**: Let $\vec{F}(x, y, z)$ (or) $\vec{F}(r)$ denote a vector field whose value at point $(1, 1, 1)$ on a particular plane is $2\hat{i} + 3\hat{j} - \hat{k}$. The chosen plane for analysis has two other points $(3, 2, 1)$ and $(4, 1, 2)$.
   (a) Compute the equation of the plane chosen for analysis.
   (b) Compute a unit vector (say $\hat{n}$) that is normal to the plane chosen for analysis.
   (c) Compute $\vec{F}(r).\hat{n}$ at $(1, 1, 1)$ (Later in the course, you will see that the scalar product of the form plays a crucial role in computing flux of a vector field through a given surface).
8. **Representation of a Vector Fields:** Represent the following (3D) vector fields
   (a) $\vec{F}(r) = -2\frac{\vec{r}}{|\vec{r}|}$
   (b) $\vec{F}(r) = 2\frac{\hat{j} \times \vec{r}}{|\vec{r}|^2}$

   It is recommended to represent the vector fields (without using any open-source tools) in an appropriate manner for your practice.