

- 1) Assume $\mathbf{A} = \mathbf{i} + 2\mathbf{j} + \mathbf{k}$, $\mathbf{B} = \mathbf{i} + \mathbf{j} + 3\mathbf{k}$, $\mathbf{C} = \mathbf{i} + 2\mathbf{j} + \mathbf{k}$. Express the vector $6\mathbf{i} + 7\mathbf{j} + 10\mathbf{k}$ as a linear combination of the vectors \mathbf{A} , \mathbf{B} , \mathbf{C} .
- 2) What is the angle between the vectors $\mathbf{i} + \mathbf{j}$ and $\mathbf{k} + \mathbf{j}$?
- 3) Find the angle between the following two planes: $2x + y + z = 1$ and $x - y - z = 2$.
- 4) Compute the vector $\mathbf{B} \times \mathbf{C}$ for the vectors from problem 1
- 5) Consider the ellipse $\mathbf{R}(t) = a \cos t\mathbf{i} + b \sin t\mathbf{j}$ for $0 \leq t \leq 2\pi$.
 - a) Compute \mathbf{T} .
 - b) Compute the curvature at the point corresponding to time t .
 - c) Find the curvature at the points $a\mathbf{i}$ and $b\mathbf{j}$.
- 6) For $t > 0$ a point is moving, in polar coordinates with $(R, \theta) = (t, e^t)$. Express the acceleration vector in terms of \mathbf{u}_r and \mathbf{u}_θ . Express in words what you see.
- 7) Consider the space curve with parametrization $\mathbf{R}(t) = 2t\mathbf{i} + \cos t\mathbf{j} + \sin t\mathbf{k}$.
 - a) Explain that this curve is a helix.
 - b) Find the pitch and decide whether the helix is lefthanded or righthanded.
 - c) Find the arclength of the curve between the points $(0, 1, 0)$ and $(\pi, 0, 1)$.
- 8) A parallelepiped is given with the following 8 vertices:
 $(0,0,0)$; $(1,1,1)$; $(3,1,1)$; $(1,2,1)$; $(4,2,2)$; $(4,3,2)$; $(2,3,2)$; $(5,4,3)$.
 Compute the volume.
- 9) There is a vector \mathbf{v} with the following properties: $\mathbf{v} \cdot (\mathbf{i} + 2\mathbf{j}) = 0$ and $\mathbf{v} \cdot (\mathbf{i} + \mathbf{k}) = 0$ and $|\mathbf{v}| = 2$. Describe all the possible \mathbf{v} vectors.