1.1 Let $A = 2a_x + 5a_y - 3a_z$, $B = 3a_x - 4a_y$, and $C = a_x + a_y + a_z$. (a) Determine $A + 2B$. (b) Calculate $|A - 5C|$. (c) For what values of $k$ is $|kB| = 2$? (d) Find $(A \times B)/(A \cdot B)$.

1.2 For vectors $A = 2a_x + 5a_y + 4a_z$, $B = 3a_x + a_y + 5a_z$, and $C = a_x - 6a_z$, calculate:

(a) $A \cdot B$
(b) $A \times B$
(c) $A \cdot (B - C)$
(d) $A \times (B + C)$

1.3 Three field quantities are given by $P = a_x - 5a_y + 3a_z$, $Q = 3a_x + 2a_y + 4a_z$, and $R = a_x - a_y$. Determine:

(a) $P \cdot Q$
(b) $\cos \theta_{PQ}$
(c) $Q \times R$
(d) $\sin \theta_{QR}$
(e) $P \cdot (Q \times R)$
(f) $Q \cdot R \times P$
(g) $P \times (Q \times R)$
(h) $(P \times Q) \times R$

1.4 If $A = \alpha a_x + 2a_y + 10a_z$ and $B = 4\alpha a_x + 8a_y - 2\alpha a_z$, for what values of $\alpha$ are $A$ and $B$ perpendicular?

1.7 If $A = 2a_x + 3a_y - 4a_z$ and $B = -6a_x - 4a_y + a_z$, find the scalar and vector components of $A \times B$ along the direction of $C = a_x - a_y + a_z$. 
1.18 Given $A = x^2a_x - yza_y + yz^2a_z$, determine:
(a) The magnitude of $A$ at point $T(2, -1, 3)$
(b) The distance vector from $T$ to $S$ if $S$ is 5.6 units away from $T$ and in the same direction as $A$ at $T$
(c) The position vector of $S$

1.19 Let $Q = (2x - y)a_x + (4y + z)a_y + (4x - 2z)a_z$.
(a) Determine a unit vector in the direction of $Q$ at $P(1, 2, 1)$.
(b) Find the component of $Q$ at $P$ in the direction of $PT$ where $T$ is point $(5, 3, -4)$.
(c) Where is $Q$ the same as the unit vector of $a_x + 11a_y + 10a_z$?

1.20 $E$ and $F$ are vector fields given by $E = 2xa_x + ax + yza_z$ and $F = xya_x - y^2a_y + yza_z$. Determine:
(a) $|E|$ at $(1, 2, 3)$
(b) The component of $E$ along $F$ at $(1, 2, 3)$
(c) A vector perpendicular to both $E$ and $F$ at $(0, 1, -3)$ whose magnitude is unity

2.1 Convert the following points to Cartesian coordinates:
(a) $P_1(5, 120^\circ, 0)$
(b) $P_2(1, 30^\circ, -10)$
(c) $P_3(10, 3\pi/4, \pi/2)$
(d) $P_4(3, 30^\circ, 240^\circ)$

2.2 Express the following points in cylindrical and spherical coordinates:
(a) $P(1, -4, -3)$
(b) $Q(3, 0, 5)$
(c) $R(-2, 6, 0)$

2.10 (a) Express the point $(8, -15, 12)$ in spherical coordinates.
(b) Transform vector $F = 2xya_x - x^2a_y$ into cylindrical coordinates.

*2.13 Given vectors $A = 2a_x + 4a_y + 10a_z$ and $B = -5a_y + a_\phi - 3a_z$, find
(a) $A + B$ at $P(0, 2, -5)$
(b) The angle between $A$ and $B$ at $P$
(c) The scalar component of $A$ along $B$ at $P$