1a) \[ \text{length of } AB = \sqrt{(1-0)^2 + (-2-0)^2 + (3-0)^2} = \sqrt{14} \]
Midpoint of \( AB \) = \( \left( \frac{1-0}{2}, \frac{-2-0}{2}, \frac{3-0}{2} \right) = \left( \frac{1}{2}, -1, \frac{3}{2} \right) \)

b) \[ \text{length of } AB = \sqrt{(5-3)^2 + (4-0)^2 + (2-4)^2} = \sqrt{56} = 2\sqrt{14} \]
Midpoint of \( AB \) = \( \left( \frac{5+3}{2}, \frac{4+0}{2}, \frac{2-4}{2} \right) = (4, 2, -1) \)

2a) \( A \ (4,0,0) \); \( B \ (4,5,0) \); \( C \ (0,5,0) \); \( D \ (4,0,3) \);
\( E \ (0,0,3) \); \( F \ (0,5,3) \)

b) \[ |\overrightarrow{OE}| = \sqrt{(4-0)^2 + (5-0)^2 + (3-0)^2} = \sqrt{50} = 5\sqrt{2} \]

3a) \[ x^2 + y^2 + z^2 = 25 \]
b) \[ (x-1)^2 + (y-2)^2 + (z-3)^2 = 25 \]

4a) \( (3,5,-2) + 2(1,2,3) = (5, 9, 4) \)
b) \( (3,8,1) \cdot (4,-1,4) = 3(4) + 8(-1) + 1(4) = 8 \)

5a) 2 vectors are \( \perp \) (orthogonal) if dot product = 0
b) 2 vectors are \( \parallel \) if vectors are scalar multiples of each other \( t=1 \), \( t=2 \)

c) \( x = 2 + 6t, y = 5 + 7t, z = 1 + 8t \)

d) lines \& vectors are \( \parallel \) if direction vectors are equal

e) \( \perp \) if dot product = 0

7) Find intersection by plugging parametric equations into sphere equation:
\[ (-6+4s)^2 + (0+s)^2 + (3-5s)^2 = 9 \] solving
7 cont'd \((-6+4s)^2 + (0+s)^2 + (3-s)^2 = 9\)
\[36 - 48s + 16s^2 + s^2 + 9 - 6s + s^2 = 9\]
\[18s^2 - 54s + 36 = 0\]
\[18(s^2 - 3s + 2) = 0\]
\[18(s - 2)(s - 1) = 0\]
\[s = 1, 2\]

The pts of \(\cap\) are:
@ \(s=1\)
\[(-6 + 1(4), 0 + 1(1), 3 + 1(-1)) = (-2, 1, 2)\]
@ \(s=2\)
\[(-6 + 2(4), 0 + 2(1), 3 + 2(-1)) = (2, 2, 1)\]

6e cont'd the 2 lines are \(\perp\) because their dot product \(6(4) + 7(0) + 8(-3) = 24 + 0 - 24 = 0\)