

ANSWERS: 1. a)  $P(0, 1, 2), R(4, 2, 3)$ ; b)  $5, \theta = 61.2^\circ$ ; c)  $\frac{5}{\sqrt{6}} \langle 1, 2, -1 \rangle = \langle \frac{5\sqrt{6}}{6}, \frac{5\sqrt{6}}{3}, \frac{-5\sqrt{6}}{6} \rangle$ ;  
 d)  $\frac{5}{\sqrt{18}}$ ; e)  $\frac{5}{18} \langle 4, 1, 1 \rangle = \langle \frac{10}{9}, \frac{5}{18}, \frac{5}{18} \rangle$ ; f)  $\langle \frac{-1}{9}, \frac{31}{18}, \frac{-23}{18} \rangle$ ; g)  $\langle \frac{-1}{9}, \frac{31}{18}, \frac{-23}{18} \rangle \cdot \langle 4, 1, 1 \rangle = 0$ ;  
 h)  $\langle 3, -5, -7 \rangle, \frac{\sqrt{83}}{2}$ ; i)  $x = 0 + 4t, y = 1 + 1t, z = 2 + 1t$ ; j)  $3x - 5y - 7z = -19$ ; k)  $\frac{9}{\sqrt{18}}$ ; l)  $\frac{19}{\sqrt{83}}$ .

2. a) vector; b) vector; c) no sense; d) no sense; e) vector; f) scalar; g) no sense; h) no sense.

3.  $\vec{a} \cdot (\vec{b} - \text{proj}_{\vec{a}} \vec{b})$  (we want to show that the dot product is zero)  
 $= \vec{a} \cdot \left( \vec{b} - \left( \vec{b} \cdot \frac{\vec{a}}{|\vec{a}|} \right) \frac{\vec{a}}{|\vec{a}|} \right)$  (definition of  $\text{proj}_{\vec{a}} \vec{b}$ )  
 $= \vec{a} \cdot \vec{b} - \vec{a} \cdot \left[ \left( \vec{b} \cdot \frac{\vec{a}}{|\vec{a}|} \right) \frac{\vec{a}}{|\vec{a}|} \right]$  (dot product distributes)  
 $= \vec{a} \cdot \vec{b} - \left[ \left( \frac{\vec{b} \cdot \vec{a}}{|\vec{a}|^2} \right) (\vec{a} \cdot \vec{a}) \right]$   $\{ \vec{a} \cdot s(\vec{b}) = s(\vec{a} \cdot \vec{b}) \}$  property of dot product  
 $= \vec{a} \cdot \vec{b} - \vec{b} \cdot \vec{a}$  ( $\vec{a} \cdot \vec{a} = |\vec{a}|^2$ )  
 $= 0$  (dot product commutes)