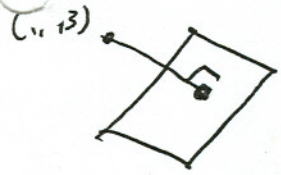
9. Find the point on $5x + y + z + 17 = 0$ which is closest to $(1, 2, 3)$.



The line through $(1,2,3)$ $\parallel$ to $5\vec{i}+\vec{j}+\vec{k}$ is

$x = 1+5t$
$y = 2+t$
$z = 3+t$

This line hits the plane when $5(1+5t)+(2+t)+(3+t)+17=0$

$27t+27=0$
$t=-1$

The point on the plane nearest $(1,2,3)$ is $(-4,1,2)$

check This point is on the plane $-20+1+2+17=0$ ✓
The vector from $(-4,1,2)$ to $(1,2,3) = +5\vec{i}+\vec{j}+\vec{k}$ which is $\perp$ to plane

10. An ant walks along the curve $\vec{r}(t) = t\cos t\,\vec{i} + t\sin t\,\vec{j} + t\,\vec{k}$, for $0 \le t$. Where does the ant touch $x^2 + y^2 + z^2 = 1$?

$t^2\cos^2 t + t^2\sin^2 t + t^2 = 1$
$2t^2 = 1$
$t^2 = \frac{1}{2}$
$t = \frac{1}{\sqrt{2}}$ (because $0 \le t$)

The point is $\left(\frac{1}{\sqrt{2}}\cos\left(\frac{1}{\sqrt{2}}\right), \frac{1}{\sqrt{2}}\sin\left(\frac{1}{\sqrt{2}}\right), \frac{1}{\sqrt{2}}\right)$