#1

$$\int_{\pi/4}^{\pi/3} \cos^3 x \sin^3 x \, dx$$

$$= \int_{\pi/4}^{\pi/3} \cos^2 x \sin^3 x \, (\cos x \, dx)$$

$$= \int_{\pi/4}^{\pi/3} (1-\sin^2 x) \sin^3 x \, (\cos x \, dx)$$

$$= \int_{\pi/4}^{\pi/3} (\sin^3 x - \sin^5 x)(\cos x \, dx)$$

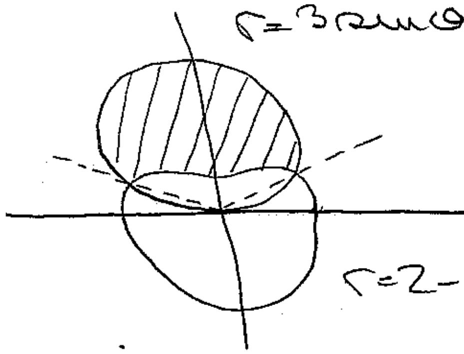
Let $u = \sin x$ $\quad$ $x = \pi/3$ $\quad u = \sin x$, $u = \sqrt{3}/2$

$du = \cos x \, dx$ $\quad$ $x = \pi/4$ $\quad u = 1/\sqrt{2}$

$$= \int_{1/\sqrt{2}}^{\sqrt{3}/2} (u^3 - u^5) \, du$$

$$= \left(\tfrac{1}{4}u^4 - \tfrac{1}{6}u^6\right) \Big|_{1/\sqrt{2}}^{\sqrt{3}/2} = 11/384$$

#2



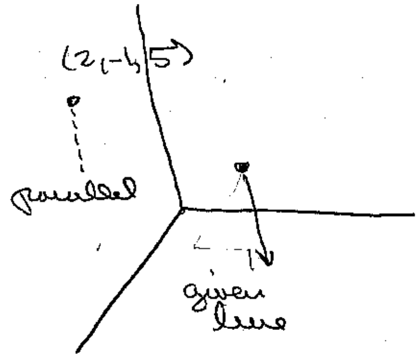

intersections

$$3\sin\theta = 2-\sin\theta$$
$$4\sin\theta = 2$$
$$\sin\theta = 1/2$$
$$\theta = \pi/6,\ 5\pi/6$$

$$\frac{1}{2}\int_{\pi/6}^{5\pi/6}(3\sin\theta)^2\,d\theta - \frac{1}{2}\int_{\pi/6}^{5\pi/6}(2-\sin\theta)^2\,d\theta$$

#3

$$x = 3t$$
$$y = 2 + t$$
$$z = 2 - t$$




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

#4

$$\begin{array}{r} (2,1,0) \\ (1,0,-1) \\ \hline \langle 1,1,1\rangle \end{array}$$

"in the plane"

direction of line of intersection

$$\langle 1,1,1\rangle \times \langle 3,-1,0\rangle$$
$$= \langle 1,3,-4\rangle$$

parallel to plane

normal $\langle 1,1,1\rangle \times \langle 1,3,-4\rangle = \langle -7,5,2\rangle$

plane

$$-7(x-2) + 5(y-1) + 2(z-0) = 0$$

#5 $\vec{r}(t) = \langle t^2-1, t^2+1, t+1 \rangle$

point $\vec{r}(0) = \langle -1, 1, 1 \rangle$

$\vec{r}\,'(t) = \langle 2t, 2t, 1 \rangle$

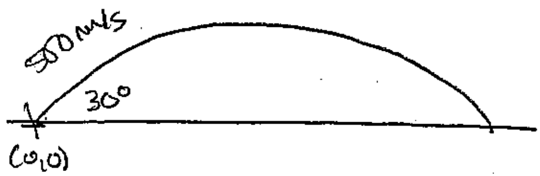
direction $\vec{r}\,'(0) = \langle 0, 0, 1 \rangle$

$x = -1$

$y = 1$

$z = 1 + t$

#6




$\vec{v}(0) = \langle 500\cos 30°, 500\sin 30° \rangle$
$= \langle 250\sqrt{3}, 250 \rangle$

$\vec{a}(t) = \langle 0, -9.8 \rangle$

$\vec{v}(t) = \langle 0, -9.8t \rangle + \vec{C}$

$\langle 250\sqrt{3}, 250 \rangle = \vec{v}(0) = \langle 0, 0 \rangle + \vec{C}$

$\vec{v}(t) = \langle 250\sqrt{3}, 250 - 9.8t \rangle$