HYDROGEN ORBITALS WITH TWO ANGULAR NODES

$\{\ell = 2, |m| = 0, 1, 2$; d-orbitals, $(2\ell + 1) = 5$ components$\}$

Cartesian functions with two nodal planes:

(i)	xy	(iv)	$x^2 - y^2$	
(ii)	xz	(v)	$z^2 - y^2$	but since (v) = (iv) + (vi) set is *not* linearly independent
(iii)	yz	(vi)	$z^2 - x^2$	

Choose 5 independent components:

$xy,\ xz,\ yz,\ x^2 - y^2,\ 3z^2 - r^2$

$$3z^2 - (x^2 + y^2 + z^2) = 2z^2 - x^2 - y^2 = \text{(v)} + \text{(vi)}$$

	Cartesian	Spherical Polar	$R(r)$	$\Theta(\theta)$	$\Phi(\varphi)$	ℓ	$\|m\|$
a)	$(3z^2 - r^2)$	$r^2(3\cos^2\theta - 1)f(r)$	$r^2 f(r)$	$(3\cos^2 - 1)$	1	2	0
b)	$xzf(r)$	$r^2(\cos\theta\sin\theta\cos\varphi)f(r)$	$r^2 f(r)$	$(\cos\theta\sin\theta)$	$\cos\varphi$	2	1
c)	$yzf(r)$	$r^2(\cos\theta\sin\theta\sin\varphi)f(r)$	$r^2 f(r)$	$(\cos\theta\sin\theta)$	$\sin\varphi$	2	1
d)	$xyf(r)$	$r^2(\sin\theta\cos\varphi\sin\theta\sin\varphi)f(r)$	$r^2 f(r)$	$\sin^2\theta$	$\sin\varphi\cos\varphi$ = $\frac{1}{2}\sin 2\varphi$	2	2
e)	$(x^2 - y^2)f(r)$	$r^2(\sin^2\theta\cos^2\varphi - \sin^2\theta\sin^2\varphi)f(r)$	$r^2 f(r)$	$\sin^2\theta$	$(\cos^2\varphi - \sin^2\varphi)$ = $\frac{1}{2}\cos 2\varphi$	2	2

You should be able to associate each $\Theta_{2|m|}(\theta)$ with the relevant series

from the "Math Review" as well as $\Phi_m(\varphi)$