11. (a) For $\ell = 3$, the magnitude of the orbital angular momentum is $L = \sqrt{\ell(\ell+1)}\hbar = \sqrt{3(3+1)}\hbar = \sqrt{12}\hbar$.

(b) The magnitude of the orbital dipole moment is $\mu_{\text{orb}} = \sqrt{\ell(\ell+1)}\mu_B = \sqrt{12}\mu_B$.

(c) We use $L_z = m_\ell\hbar$ to calculate the z component of the orbital angular momentum, $\mu_z = -m_\ell\mu_B$ to calculate the z component of the orbital magnetic dipole moment, and $\cos\theta = m_\ell/\sqrt{\ell(\ell+1)}$ to calculate the angle between the orbital angular momentum vector and the z axis. For $\ell = 3$, the magnetic quantum number m_ℓ can take on the values -3, -2, -1, 0, $+1$, $+2$, $+3$. Results are tabulated below.

m_ℓ	L_z	$\mu_{\text{orb},\ z}$	θ
-3	$-3\hbar$	$+3\mu_B$	150.0°
-2	$-2\hbar$	$+2\mu_B$	125°
-1	$-\hbar$	$+\mu_B$	107°
0	0	0	90.0°
1	$+\hbar$	$-\mu_B$	73.2°
2	$2\hbar$	$-2\mu_B$	54.7°
3	$3\hbar$	$-3\mu_B$	30.0°