

$$\text{quad } f(X) = aX^2 + bX + c \Rightarrow f'(X) = 2aX + b$$

$$\det \begin{array}{c|c|c} a & b & c \\ \hline 2a & b & 0 \\ \hline 0 & 2a & b \end{array} = a \underline{4ac - b^2}$$

$$\text{cube } f(X) = 4X^3 - g_2X - g_3 \Rightarrow f'(X) = 12X^2 - g_2$$

$$-\frac{1}{64} \det \begin{array}{c|c|c|c|c} 4 & 0 & -g_2 & -g_3 & 0 \\ \hline 0 & 4 & 0 & -g_2 & -g_3 \\ \hline 12 & 0 & -g_2 & 0 & 0 \\ \hline 0 & 12 & 0 & -g_2 & 0 \\ \hline 0 & 0 & 12 & 0 & -g_2 \end{array} = g_2^3 - 27g_3^2$$