P1.

$cov(Z, Z^2) = \mathbb{E}[Z^3] - \mathbb{E}[Z^2]\mathbb{E}[Z]$

$Z \sim N(0,1) \Rightarrow \mathbb{E}Z = 0$

$var[Z] = \mathbb{E}Z^2 - \mathbb{E}Z = 1 \Rightarrow \mathbb{E}Z^2 = 1$

$\mathbb{E}Z^3 = 0$ due to symmetric distribution of normal distr.

$\therefore cov(Z, Z^2) = 0 - 1 \times 0 = 0$

$\because var(Z) = 1 > 0$

$var(Z^2) = \mathbb{E}[Z^4] - \mathbb{E}[Z^2]^2 = 3 - 1^2 = 2 > 0$

$\therefore Cor(Z, Z^2) = \dfrac{Cov(Z, Z^2)}{\sigma_Z \sigma_{Z^2}} = \dfrac{0}{\sqrt{1} \cdot \sqrt{2}} = 0$

They are not independent.

$\mathbb{P}[Z > 1, Z^2 > 1] = \mathbb{P}[Z > 1]$ since $Z > 1$ implies $Z^2 > 1$

$\neq \mathbb{P}[Z > 1]\,\mathbb{P}[Z^2 > 1]$

$\therefore$ Z & Z^2 are not independent.