

$$\begin{aligned}
 3. \quad a) \quad E[z^*] &= 2^0 \cdot (1-p) + 2^1 \cdot p \\
 &= 1(1-p) + 2p \\
 &= 1-p+2p \\
 &= 1+p
 \end{aligned}$$

$$b) E[x] = \frac{2}{2} + \frac{9}{2} = \boxed{3.5}$$

$$c) Y = x^4 \rightarrow -1^4 \cdot \left(\frac{1}{5}\right) + 0^4 \cdot \left(\frac{2}{5}\right) + 1^4 \cdot \left(\frac{2}{5}\right)$$

$$\begin{array}{l}
 y=0, P(Y) = \frac{2}{5} \\
 y=1, P(Y) = \frac{2}{5}
 \end{array}$$

$$\begin{aligned}
 d) \quad E[Y] &= E[x^4] = -1^4 \cdot \left(\frac{1}{5}\right) + 0^4 \cdot \left(\frac{2}{5}\right) + 1^4 \cdot \left(\frac{2}{5}\right) \\
 &= \frac{-1}{5} + 0 + \frac{2}{5} \\
 &= \boxed{\frac{1}{5}}
 \end{aligned}$$