Question 1 (3 points): Is

\[ f(n) = 3 + n^2 \text{ in } O(n^2)? \]

Explain why or why not.

Yes. Let \( c = 2 \). Then for any \( n > 2 \), \( n^2 > 4 \). So \( 2 \cdot n^2 > 4 + n^2 > 3 + n^2 \).

Question 2 (3 points): Is

\[ f(n) = 3 \cdot n^2 \text{ in } O(n^2)? \]

Explain why or why not.

Yes. Let \( c = 3 \). Then for any \( n > 0 \), \( 3 \cdot n^2 \geq 3 \cdot n^2 \).

Question 3 (4 points): Is

\[ f(n) = (n^2)^3 \text{ in } O(n^2)? \]

Explain why or why not.

No. Suppose there is \( c > 0 \), and an \( n_0 \), such that \( c \cdot n^2 \geq (n^2)^3 = n^6 \), for \( n > n_0 \). Then \( c \geq n^4 \), for \( n > n_0 \). But clearly there is no such \( c \). For example, choose \( n = 2c \). Then \( c < n^4 = 16c^4 \) for any positive \( n \).