① a) $5n^3 + 2n^2 + 3n = O(n^3)$

$5n^3 + 2n^2 + 3n \leq 5n^3 + 2n^3 + 3n^3$

$5n^3 + 2n^2 + 3n \leq 10n^3$

$c = 10$

$5 + 2 + 3 \leq 10$

$\boxed{10 \leq 10}$ $n_0 = 1$

$n \geq n_0$

b) $\sqrt{7n^2 + 2n - 8} = \Theta(n)$

$c_1 \cdot n \leq \sqrt{7n^2 + 2n - 8} \leq c_2 \cdot n$

let $n_0 = 1$

$c_1 \leq \sqrt{1} \leq c_2$

$c_1 \leq 1 \leq c_2$

$\boxed{\begin{array}{l} n_0 = 1 \\ c_1 = \emptyset \\ c_2 = 2 \end{array}}$

c) $d(n) = O(f(n))$ $\quad$ $e(n) = O(g(n))$

$\downarrow$ $\quad$ $\downarrow$

for $n \geq n_0$ $d(n) \leq c \cdot f(n)$ $\quad$ for $n \geq m_0$ $e(n) \leq k \cdot g(n)$

$e(n) \cdot d(n) \leq k \cdot c \cdot f(n) \cdot g(n)$

$\hookrightarrow d(n)e(n) \leq O(f(n)g(n))$

② def example 1 (1st) has run time $\Theta(n^2)$

def example 2 (1st) has run time $\Theta(n)$

def example 3 (1st) has run time $\Theta(n^2)$

def example 4 (n) has run time $\Theta(n \log n)$