DAA – Assignment 1

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Prove or disprove the following using sound mathematical techniques. Briefly explain each step of your working.

1. $7n-2=O(n)$

$f(n) \leq g\ (n)\ \forall\ n \geq k$

$f(n) = 7n - 2$
$g(n) = n$
$c = 7$
$7n = 2\ \leq 7n$

$if\ n = 1$
$7(1) - 2 \leq 7(1)$
$5 \leq 7\ \forall\ n \geq 1$

$if\ n = 2$
$7(2) - 2 \leq 7(2)$
$12\ \leq 14\ \forall\ n \geq 1$

2. $7n-2=\Theta(n)$

$C_1\, g(n) \leq f(n) \leq C_2\, g(n)\ \forall\ n \geq k$
$f(n) = 7n - 2$
$g(n) = n$
$C^1 = 5$
$C_2 = 7$
$5n \leq 7n - 2 \leq 7n\ \forall\ n \geq k$

$if\ n = 1$
$5(1) \leq 7(1) - 2 \leq 7(1)\ \forall\ n \geq 1$
$5 \leq 5 \leq 7\ \forall\ n \geq 1$

$if\ n = 2$
$5(2) \leq 7(2) - 2 \leq 7(2)\ \forall\ n \geq 1$
$10 \leq 12 \leq 14\ \forall\ n \geq 1$

3. $7n-2=\Theta(n^2)$

$C_1\, g(n) \leq f(n) \leq C_2\, g(n)\ \forall\ n \geq k$

$f(n) = 7n - 2$

$g(n) = n^2$

$C^1 = 5$

$C_2 = 7$

$if\ n = 1$

$5n^2 \leq 7n - 2 \leq 7n^2$

$5(1)^2 \leq 7(1) - 2 \leq 7(1)^2$

$5 \leq 5 \leq 7$

$if\ n = 2$

$5n^2 \leq 7n - 2 \leq 7n^2$

$5(2)^2 \leq 7(2) - 2 \leq 7(2)^2$

$20 \leq 12 \leq 28$

4. $3n^3+20n^2+5=O(n^6)$

$f(n) = 3n^3 + 20n^2 + 5$
$g(n) = n^6 n^2$
$f(n) \leq g(n)\ \forall\ n \geq k$
$3n^3 + 20n^2 + 5 \leq n^6\ \forall\ n \geq k$

$if\ n = 1$
$3(1)^3 + 20(1)^2 + 5$
$3(1)^3 + 20(1)^2 + 5 \leq 28(1)^6\ \forall\ n \geq 1$
$28 \leq 28\ \forall\ n \geq 1$

$if\ n = 2$
$3(2)^3 + 20(2)^2 + 5$
$3(2)^3 + 20(2)^2 + 5 \leq 28(2)^6\ \forall\ n \geq 1$
$109 \leq 1792\ \forall\ n \geq 1$