CS5200 Homework 5 Theory
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Question 1
Calories: 300 = 60X + 60Y
Vitamin A: 36 = 12X + 6Y
Vitamin C: 90 = 6X + 30Y
Cost = 1.2X + 1.5Y Solution:
X = 2.5 cups
Y = 2.5 cups

Question 2
$P = 20x_1 + 10x_2 + 15x_3$
$3x_1 + 2x_2 + 5x_3 <= 55$
$2x_1 + x_2 + x_3 <= 26$
$x_1 + x_2 + 3x_3 <= 30$
$5x_1 + 2x_2 + 4x_3 <= 57$
$x_1, x_2, x_3 >= 0$

$P = 20x_1 + 10x_2 + 15x_3$
$55 - 3x_1 - 2x_2 - 5x_3 = s_1$
$26 - 2x_1 - x_2 - x_3 = s_2$
$30 - x_1 - x_2 - 3x_3 = s_3$
$57 - 5x_1 - 2x_2 - 4x_3 = s_4$
$x_1, x_2, x_3, s_1, s_2, s_3, s_4 >= 0$

$x_1 = 0, x_2 = 0, x_3 = 0, s_1 = 55, s_2 = 26, s_3 = 30, s_4 = 57$
$P = 0$
Non-basic set: $\{x_1, x_2, x_3\}$
Basic set: $\{s_1, s_2, s_3, s_4\}$

$P = 20x_1 + 10x_2 + 15x_3$
$55 - 3x_1 - 2x_2 - 5x_3 = s_1; x_1 = 55/3$
$26 - 2x_1 - x_2 - x_3 = s_2; x_1 = 13$
$30 - x_1 - x_2 - 3x_3 = s_3; x_1 = 30$
$57 - 5x_1 - 2x_2 - 4x_3 = s_4; x_1 = 57/5 < -tightest$

$x_1 = 11.4, x_2 = 0, x_3 = 0, s_1 = 55, s_2 = 26, s_3 = 30, s_4 = 0$
$P = 228$
Non-basic set: $\{x_2, x_3, s_4\}$
Basic set: $\{x_1, s_1, s_2, s_3\}$

$55 - 3x_1 - 2x_2 - 5x_3 = s_1; x_2 = 55/2$
$26 - 2x_1 - x_2 - x_3 = s_2; x_2 = 26 < -tightest$
$30 - x_1 - x_2 - 3x_3 = s_3; x_2 = 30$
$57 - 5x_1 - 2x_2 - 4x_3 = s_4; x_2 = 57/2$

$x_1 = 0, x_2 = 26, x_3 = 0, s_1 = 55, s_2 = 26, s_3 = 30, s_4 = 0$
$P = 260$
Non-basic set: $\{s_2, x_1, x_3\}$
Basic set: $\{x_2, s_1, s_3, s_4\}$

Question 3

Since we are given the nodes one at a time we can sort the nodes as we get them. It would only take n time to insert a node into a sorted list. Since it only takes n manipulations after that, for each new node we could find the convex hull in n^2 steps.

Question 4

Yes A is in P.
Yes A is in NP.
He should not get the million dollar reward because all he showed was that P is a subset of NP problems. In order to get the prize he would need to show that a np complete problem could be reduced to a problem in P.