INSTRUCTIONS

1. DO NOT OPEN THIS EXAM UNTIL INSTRUCTED TO BY YOUR ROOM LEADER. All exam pages must remain stapled. Do not separate or remove any pages. You will have 60 minutes to complete this exam.

2. This exam has 9 pages, including the cover sheet, and 15 questions. There are 12 workout questions (partial credit is possible) and 3 short answer questions (no partial credit). For every question on this exam you must (a) show your work, (b) box your final answer and (c) write your final answer on your Answer Page.
Questions 1-4: A nutritionist working for NASA must meet certain minimum nutritional requirements and yet keep the weight of the food at a minimum.

He is now considering a combination of two foods which are packaged in tubes. Each tube of Food A contains 4 units of protein, 2 units of carbohydrates and 2 units of fat. A tube of Food A weighs 2 pounds. Each tube of Food B contains 3 units of protein, 6 units of carbohydrates and 1 units of fat. A tube of Food B weighs 3 pounds.

The minimum nutritional requirements are 54 units of protein, 36 units of carbohydrates and 20 units of fat. Let \( x \) be the number of tubes of Food A and let \( y \) be the number of tubes of Food B.

1. Write the objective equation for this problem.

2. Write the inequalities associated with this problem.
3. Graph your inequalities on the grid below.

![Graph Grid]

4. Use the vertices of the feasible set and the objective equation to find the number of tubes of Food A and Food B that will meet the minimum nutritional requirements and minimize weight.
Questions 5-8: An investor has $12,000 to invest in three types of stocks, low-risk, medium-risk and high-risk.

She invests according to three principles. The amount invested in low-risk stocks will be at most $2000 more than the amount invested in medium risk stocks. At least $4000 will be invested in low-risk and medium-risk stocks combined. No more than $10,000 will be invested in medium-risk and high-risk stocks combined.

The expected yield for these investments are 6% for low-risk stocks, 7% for medium-risk stocks and 8% for high-risk stocks. The investor wishes to maximize the yield on the investments. Let $x$ be the amount to be invested in low-risk stocks and $y$ be the amount to be invested in medium-risk stocks.

5. Write the objective equation for this problem.

6. Write the inequalities associated with this problem.
7. Graph your inequalities on the grid below.

8. Use the vertices of the feasible set and the objective equation to find the amount of money that the investor invest in each type of stock to maximize yield.
Questions 9-12: A coffee supplier has warehouses in Seattle and San Jose. The coffee supplier receives orders from coffee retailers in Salt Lake City and Reno.

The retailer in Salt Lake City needs 600 pounds of coffee and the retailer in Reno needs 550 pounds of coffee. The Seattle warehouse has 1100 pounds available and the warehouse in San Jose has 700 pounds available.

The shipping costs are as follows: $2.50 per pound from Seattle to Salt Lake City; $3.00 per pound from Seattle to Reno; $4.00 per pound from San Jose to Salt Lake City; $2.00 per pound from San Jose to Reno.

Let \((x, y)\) correspond to \(x\) pounds of coffee shipped from Seattle to Salt Lake City and \(y\) pounds of coffee shipped from Seattle to Reno. The coffee supplier wishes to find the \((x, y)\) that minimizes the company’s the shipping costs.

9. Write the objective equation for this problem.

10. Write the inequalities associated with this problem.
11. Graph your inequalities on the grid below.

![Graph Grid]

12. Use the vertices of the feasible set and the objective equation to find the values of $x$ and $y$ which will minimize the shipping costs.
13. Of the 171 students who took a math exam, 90 correctly answered Question 1, 95 correctly answered Question 2 and 46 answered both questions correctly. How many students answered Question 2 correctly but not Question 1?

14. Use unions, intersections and/or complements of sets $R$, $S$ and $T$ to write an expression for the Venn diagram below.
15. Let $S$ and $T$ be subsets of the universal set $U$. Suppose $n(U) = 25$, $n(S) = 11$, $n(T) = 12$ and $n(S \cup T) = 16$. Find $n(S \cup T)'$. 