



**For the next three problems:** Sharper Stick produces two kinds of pencils: regular and stocky. The regular pencil uses 10 units of wood and 5 units of eraser material, while the stocky pencil uses 3 units of wood and 4 units of eraser material. The regular pencil sells for 20 cents and the stocky pencil sells for 5 cents. Furthermore no more than 12 regular pencils can be produced per minute due to an extremely slow old pencil-making machine. If there are 135 units of wood and 100 units of eraser material available each minute, how many of each type of pencil should Sharper Stick manufacture each minute to maximize revenue?

Let  $x$  = number of regular pencils

Let  $y$  = number of stocky pencils

Maximize  $R = 20x + 5y$

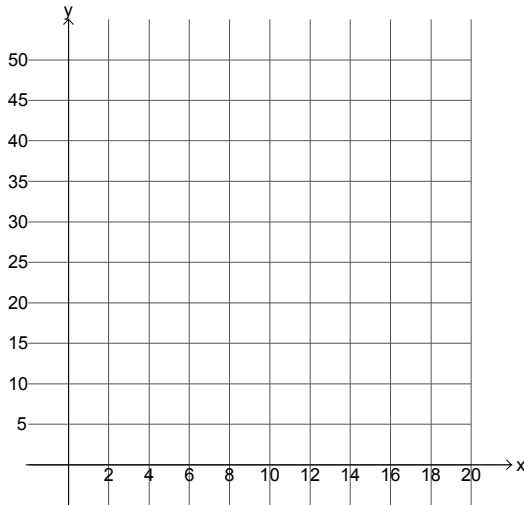
Constraints:  $10x + 3y \leq 135$

$5x + 4y \leq 100$

$x \leq 12$

$x \geq 0, y \geq 0$

1. (9pts) Graph the constraints, shade the feasible region, and label your corner points (vertices).



2. (5pts) What is the maximum revenue and how many of each type of pencil should Sharper Stick manufacture each minute to maximize revenue?

- The maximum revenue of \$2.70 occurs when 13.5 regular pencils and no stocky pencils are produced and sold.
- none of these
- The maximum revenue of \$2.57 occurs when 9.6 regular pencils and 13 stocky pencils are produced and sold.
- The maximum revenue of \$2.65 occurs when 12 regular pencils and 5 stocky pencils are produced and sold.
- The maximum revenue of \$4.00 occurs when 20 regular pencils and no stocky pencils are produced and sold.

3. (5pts) Discuss any leftover resources.

- There would be no wood leftover and 32.5 units of erasers left over.
- There would be no wood leftover and no erasers left over.
- none of these
- There would be 65 units of wood leftover and no erasers left over.
- There would be no wood leftover and 20 units of erasers leftover.

4. (5pts) A clothing store has 3 identical maroon XS shorts, 2 identical maroon S shorts, 1 maroon M short, and 5 identical maroon L shorts. If the shorts are hung on a single straight rack, in how many distinct ways can this be done?

- a. none of these
- b. 2520
- c. 311,850
- d. 27,720
- e. 39,916,800

5. (5pts) If a pair of fair dice is rolled, what is the probability the **product** is 12 or one of the die shows a 2?

- a.  $\frac{13}{36}$
- b.  $\frac{4}{9}$
- c.  $\frac{5}{12}$
- d. none of these
- e.  $\frac{7}{18}$

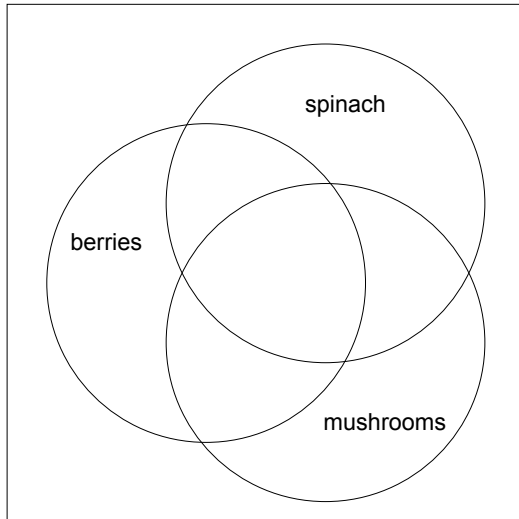
6. (12pts) True False: Circle the correct answer.

- True    False    a. If  $n(B) = 6$ , then B has 62 proper, nonempty subsets.
- True    False    b. For all sets A,  $A \subseteq A$ .
- True    False    c. Events A and B are mutually exclusive if  $A \cap B = \emptyset$ .
- True    False    d. The empty set is only a subset of every nonempty set.
- True    False    e.  $A = B$  if, and only if,  $n(A) = n(B)$ .
- True    False    f. If  $m \in A \cap B$ , then  $m \in A \cup B$ .
- True    False    g. For any event E,  $0 \leq P(E) \leq 1$ .
- True    False    h. If A and B are finite sets such that  $A \subset B$ , then  $n(A) < n(B)$ .
- True    False    i. If  $p \in A \cup B$ , then  $p \in A^c$ .
- True    False    j. If E and F are any two events of an experiment,  
 $P(E \cap F) = P(E) + P(F) - P(E \cup F)$ .
- True    False    k.  $(A \cup B)^c = A^c \cup B^c$ .
- True    False    l. If  $A = \{v, r, 8\}$  and  $B = \{r, 9\}$ , then  $A \cup B = \{v, r, 8, r, 9\}$ .

**For the next two problems:** A survey was completed by 114 college students to see if they consumed berries, spinach and mushrooms, all three of which are considered super foods, on a regular basis.

- 16 consumed just berries and spinach
- 35 consumed mushrooms
- 21 consumed berries and mushrooms
- 32 only consumed spinach
- 38 consumed only two of these three super foods
- 3 consumed all three of these super foods
- 63 consumed berries

7. (8pts) Use the information to fill in the provided Venn diagram.



8. (5pts) How many of these students consumed only mushrooms from these three super foods or did not regularly consume any of these three super foods?

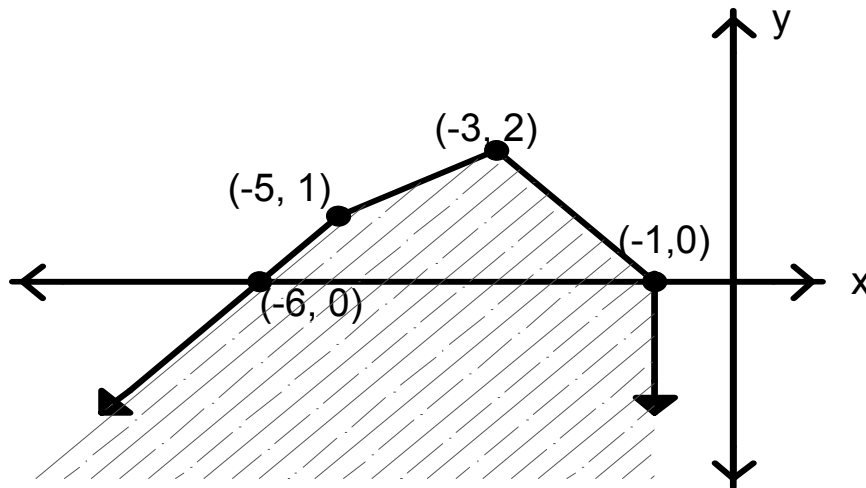
9. (5pts) If you roll two fair 4-sided die (regular tetrahedrons), circle all of the following that would be true about the probability distribution associated with the sum of the numbers on the bottom of the rolled die.

- a.  $P(\text{sum is } 4) = \frac{3}{16}$
- b. The possible sums are  $\{1, 2, 3, 4, 5, 6, 7, 8\}$
- c. The probability that the sum is 5 or 8 is 0.3125
- d.  $P(\text{sum is } 2) + P(\text{sum is } 3) + P(\text{sum is } 4) + P(\text{sum is } 5) + P(\text{sum is } 6) + P(\text{sum is } 7) + P(\text{sum is } 8) = 1$
- e. none of these

10. (5pts) A dance club needs a president, a treasurer, 2 public relations (PR) officers, and a performance team that consists of 4 males and 4 females. A member can only hold one office (president, treasurer, PR) and an officer can be on the performance team. If the dance club has 10 males and 8 females, how many different ways can the offices and performance team be filled?

- 1,606,793,760
- 110,270,160
- 539,784,000
- none of these
- 51,420

**For the next three problems:** Given the shaded feasible region and the objective function  $F = 4x + y$ .



11. (5pts) Is the feasible region BOUNDED or UNBOUNDED? (Circle one.)

12. (5pts) If it exists, find the maximum value of  $F$  over the region and where it occurs.

- The maximum value of  $F$  is  $-24$  and occurs at  $(-6, 0)$ .
- There is no maximum value of  $F$ .
- none of these
- The maximum value of  $F$  is  $-10$  and occurs at every point on the line segment with endpoints  $(-5, 1)$  and  $(-3, 2)$ .
- The maximum value of  $F$  is  $-4$  and occurs at  $(-1, 0)$ .

13. (5pts) If it exists, find the minimum value of  $F$  over the region and where it occurs.

- The minimum value of  $F$  is  $-24$  and occurs at  $(-6, 0)$ .
- There is no minimum value of  $F$ .
- The minimum value of  $F$  is  $-19$  and occurs at  $(-5, 1)$ .
- The minimum value of  $F$  is  $-4$  and occurs at  $(-1, 0)$ .
- none of these

14. (7pts) A survey of male whippersnappers found the probability that a whippersnapper was an Eagle Scout was 0.65, the probability that he was a certified lifeguard was 0.32, and the probability that he was both was 0.24. One of these whippersnappers is selected at random; find the probability that he is an Eagle Scout or a lifeguard.

15. (5pts) A fair nickel is tossed two times. Circle all of the following that could describe a sample space of the experiment.

- a. {HH, HT, TH, TT}
- b. HH, HT, TH, TT
- c. {2H, 1H1T, 2T}
- d. none of these
- e. {0, 5, 10}

16. (9pts) Jimbo wants to invest in value, blend and growth mutual funds. He can expect dividends from the value funds to be 5.5%, from blend funds to be 8.45%, and from the growth funds to be 12.8%. To offset some of the risks, Jimbo wants at least three times as much blend funds as growth funds. Per each dollar invested it takes Jimbo 5 seconds to research the value funds, 6 seconds to research the blend funds, and 9 seconds to research the growth funds. If Jimbo has at most \$963,000 to invest and no more than 115200 seconds (which is 32 hours) of time to conduct his research, how much money should he invest in each type of mutual fund to maximize his return. Set up this linear programming problem but DO NOT SOLVE IT. Precisely define your variables.