

**Instructions:** Show all work. Use exact answers unless specifically asked to round. Be sure to complete all parts of each problem.

1. Let  $A$  be the set of letters in the name CAROLINGIAN and let  $B$  be set of letters in the name PERPENDICULAR.

- a. List the elements in set  $A$  using proper set notation. (3 points)

$$A = \{C, A, R, O, L, I, N, G\}$$

- b. List the elements in set  $B$  using proper set notation. (3 points)

$$B = \{P, E, R, N, D, I, C, U, L, A\}$$

- c. Find  $A \cap B$ . (3 points)

$$\{A, C, I, L, N, R\}$$

- d. Find  $A \cup B$ . (3 points)

$$\{A, C, D, E, G, I, L, N, O, P, R, U\}$$

- e. What is the cardinality of set  $A$ , i.e.  $n(A) = |A|$ ? (2 points)

$$8$$

- f. What is the cardinality of set  $A \cup B$ ? (2 points)

$$12$$

- g. What is the cardinality of  $A \times B$ ? (Do not attempt to list all the elements, just say how big the set is.) (3 points)

$$8 \times 10 = 80$$

2. Answer the following questions about sets:

a. List the elements in the set  $C = \{x \mid x \text{ is an even counting number less than } 10\}$ . (3 points)

$$\{2, 4, 6, 8\}$$

b. List the elements in set  $D = \{x \mid x \text{ is an integer between } -1 \text{ and } 1 \text{ inclusive}\}$ . (3 points)

$$\{-1, 0, 1\}$$

c. List the elements in  $C \times D$ . (4 points)

$$\{(2, -1), (2, 0), (2, 1), (4, -1), (4, 0), (4, 1), (6, -1), (6, 0), (6, 1), (8, -1), (8, 0), (8, 1)\}$$

d. How many elements are in  $C \times C \times C = C^3$ ? (3 points)

$$4^3 = 64$$

e. For each of the following questions, answer TRUE or FALSE. (1 point each)

i.  $4 \in C$

true

ii.  $C \cap D = \emptyset$

true

iii.  $\emptyset \in C$

false

iv.  $1 \subset D$

false

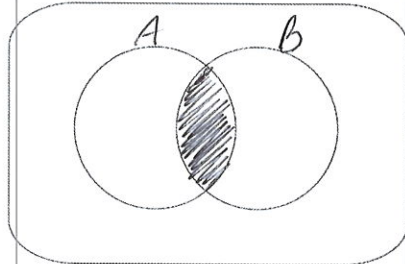
v.  $\{(2, 1), (2, 0), (2, -1)\} \subset C \times D$

true

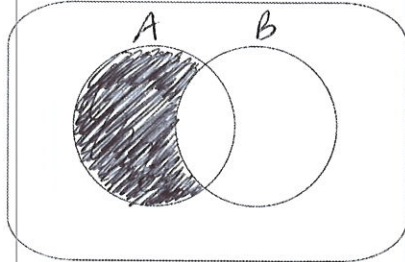
f. List all the subsets of  $D$ . [Hint: there are 8 of them.] (6 points)

$$\{-1, 0, 1\}, \{-1, 0\}, \{-1, 1\}, \{0, 1\}, \\ \{-1\}, \{0\}, \{1\}, \emptyset$$

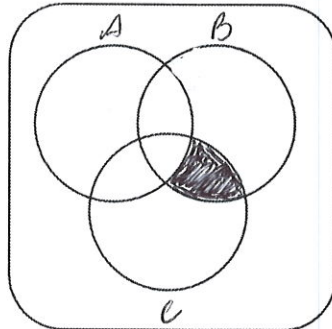
3. Draw a Venn Diagram that illustrates each of the following sets. (3 points each)



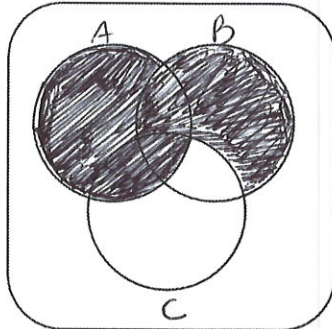
a.  $A \cap B$



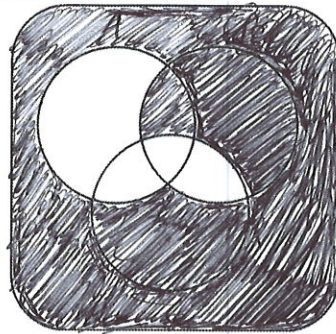
b.  $A - B$



c.  $(A' \cap B) \cap C$

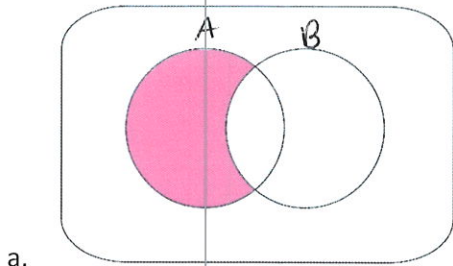


d.  $(B - C) \cup A$

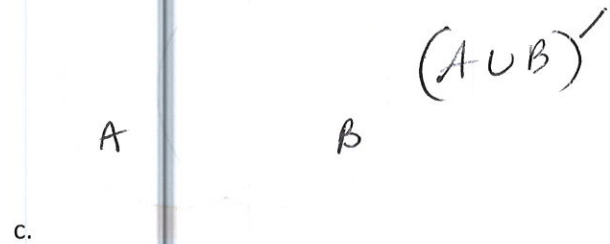


e.  $(A' \cup B) - (C \cap B)$

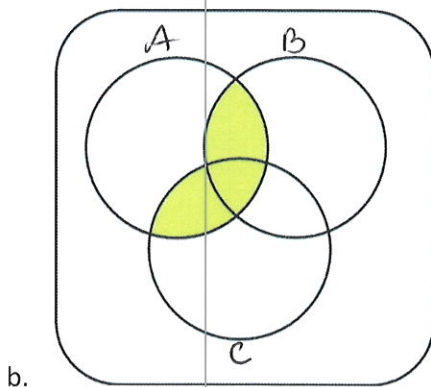
4. For each of the following Venn diagrams, write set notation that describes the indicated set. (3 points each)



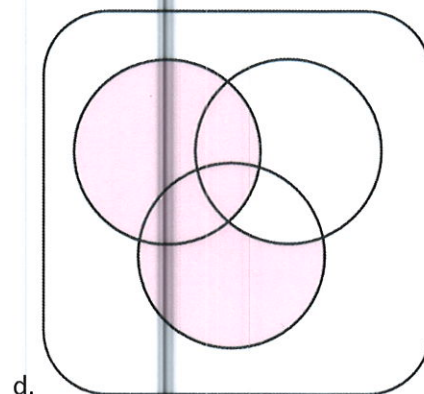
$A - B$



$(A \cup B)^c$

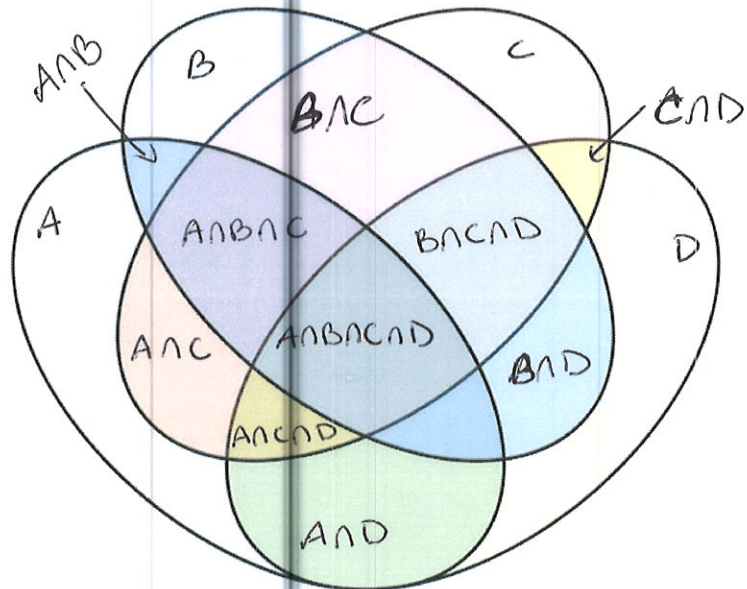


$(A \cap B) \cup (A \cap C)$



$A \cup (C - B)$

5. A 4-set Venn diagram is shown here. Label all the sections of the diagram with appropriate intersection notation. Use arrows if the region is too small to write in. Label the main 4 sets A, B, C, D. (6 points)



6. A survey was conducted among 75 patients admitted to a hospital cardiac unit during a two-week period. Let  $B$  be the set of patients with high blood pressure,  $C$  be the set of patients with high cholesterol levels, and  $S$  the set of patients that smoke cigarettes. Fill in the Venn diagram below using the following data, and then use the diagram to answer the questions that follow. (16 points)

- The number of patients with high blood pressure was 47
- The number of patients with high cholesterol was 46
- The number of patients who smoke is 52.
- The number of patients who smoke and have high blood pressure is 33
- The number of patients who both have high blood pressure and high cholesterol is 31
- The number of patients who have all three conditions is 21
- The number of patients with ~~exactly~~ *at least* two conditions is 51

a. Find the number of patients who had either high blood pressure or high cholesterol, but not both.

$$4 + 7 = 11$$

b. Find the number of patients who had one or none of these conditions.

$$2 + 11 + 4 + 7 = 24$$

c. Find the number of patients who have none of these conditions.

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