

Venn Diagrams

19R 17K 15J

1) How many only have R

2

2) How many only have J

Zero

3) How many only have K

3

4) How many have K & R, but Not J

4

5) How many have J & K, but not R

2

6) Only one of the options

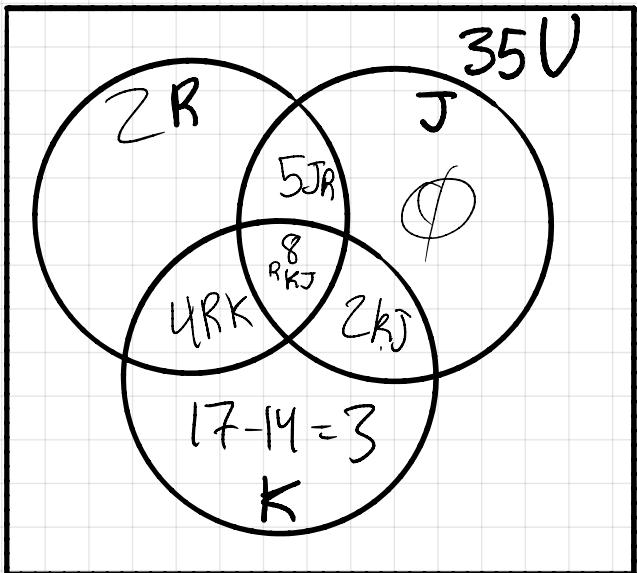
5 only R & J only have an option of itself $2+3=5$

7) None of these options

Of all the cars that have options

$2+8+5+2+4+3=24$ subtracted from all boats from Survey

$35 - 24 = 11$



$$\begin{aligned}35 - 24 \\ \therefore 11\end{aligned}$$

Spring 2020 - Assignment #1 - Sets

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Set Notation

For the following set definitions, list all the items in the set.

1. $A = \{x \mid x \text{ is a letter in "Sacramento State"}\}$
2. $B = \{x \mid x \text{ is a vowel and } x \in A\} \quad // A = \text{Question #1}$
3. $C = \{x \mid x \in \mathbb{Z} \text{ and } 20 < x \leq 32\}$
4. $D = \{5x \mid x \in \mathbb{N} \text{ and } x < 7\}$

1) $A = \{S, a, c, r, m, e, n, t, o\}$

2) $B = \{a, e, o\}$

3) \mathbb{Z} is all Integers ... -2, -1, 0, 1, 2

x is a member of integers

$\& 20 < x \leq 32$

$\therefore x = \{21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32\}$

Set Operators

1) $A \cap B$ Intersection/AND (the two sets overlap)

$A = \text{rat, rabbit, snake, sheep, dog}$

$B = \text{tiger, horse, monkey, dog}$

$\therefore \text{Dog}$

Note

\mathbb{Z} is all Int = -2, -1, 0, 1, 2

\mathbb{N} is Natural = 1, 2, 3, 4, 5

\mathbb{R} is Rational = $-\frac{a}{b}, \frac{a}{b}$

\mathbb{U} is Universe = $-\infty, \infty$

2) $A \cap C$ Intersection/AND (the two sets overlap)

$A = \text{rat, rabbit, snake, sheep, dog}$

$C = \text{rat, tiger, dragon, horse, monkey, pig}$

$\therefore \text{rat}$

3) $B \cup C$ Union/OR (is two merged sets)

$B = \text{tiger, horse, monkey, dog}$

$C = \text{rat, tiger, dragon, horse, monkey, pig}$ *Duplicates do not matter

$\therefore \text{tiger, horse, monkey, dog, rat, dragon, pig}$

4) A' (Elements removed from the universe)

$U = \text{rat, ox, tiger, rabbit, dragon, snake, horse, sheep, monkey, rooster, dog, pig}$

$A' = \text{rat, rabbit, snake, sheep, dog}$

$\therefore \text{ox, tiger, dragon, horse, monkey, rooster, pig}$

5) $C \setminus B$ Difference (Excludes all items found in one set from another)

$C = \text{rat, tiger, dragon, horse, monkey, pig}$

$B = \text{tiger, horse, monkey, dog}$

$\therefore \text{rat, dragon, pig}$

6) $[A \cup B] \setminus C$

$A \cup B = \text{Dog}$

$C = \text{rat, tiger, dragon, horse, monkey, pig}$

$\therefore \text{Dog}$

Set Algebra

Simplify the following. Use set algebra. Label all the laws you apply.

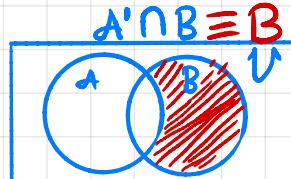
Proof. $(A' \cap B) \cup (C \cap C') \cup (A' \cap B')$

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

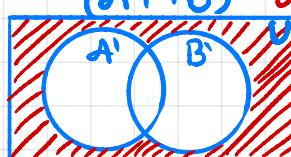
$$(A' \cap B) \cup \emptyset \cup (A' \cap B')$$

Complement Law
 $C \cap C' = \emptyset$

$$(A' \cap B) \cup \emptyset \cup (A' \cap B')$$



$$B \cup \emptyset \cup (A' \cap B')$$



$$B \cup \emptyset \cup (A' \cap B')$$

Identity Law
 $B \cup \emptyset = B$

$$B \cup \cup$$

Domination Law
 $B \cup \cup = \cup$

$$\therefore \cup$$

Floating Point Numbers

- Encode the number **34.25** (34 and 1/4) to a single-precision (32 bit) floating point. Write down its binary representation. You don't have to convert to hex, but please put spaces either between each byte or each field. Show your work.
- What is **01000010100110001100000000000000** when interpreted as a floating-point number?
- What is **01111111100010000000000000000001** when interpreted as a floating-point number?

1|34.25 → Binary (Step 1: Convert to binary)

$$34 \rightarrow 0010 \quad 0010 \quad \begin{matrix} 2^7 & 2^6 & 2^5 & 2^4 \\ 2^3 & 2^2 & 2^1 & 2^0 \end{matrix} \quad 32 + 2 = 34$$

$$0.25 \rightarrow 1/4 \rightarrow \begin{matrix} 2^0 & 2^{-1} & 2^{-2} & 2^{-3} \end{matrix} \quad \frac{1}{2^2} = 0.25$$

$$0010 \quad 0010.01 \quad \begin{matrix} 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \\ 1 \end{matrix}$$

(Step 2: Scientific Notation)

$$0010 \quad 0010.01 \rightarrow 1.0001001 \times 2^5$$

$$\rightarrow \begin{matrix} 0 & 1000 & 0100 \end{matrix} \quad \begin{matrix} 1.0001001 & \times 2^5 \end{matrix} \quad \begin{matrix} 0010 & 0010 & 0000 & 0000 & 0000 \end{matrix}$$

Sign Exponent Fraction

Floating Point Numbers

- Encode the number 34.25 (34 and $1/4$) to a single-precision (32 bit) floating point. Write down its binary representation. You don't have to convert to hex, but please put spaces either between each byte or each field. Show your work.
- What is $01000010100110000000000000000000$ when interpreted as a floating-point number?
- What is $01111111100010000000000000000001$ when interpreted as a floating-point number?

2|0100 0010 1001 1001 1100 0000 0000 0000

Positive Exponent
 $133 - 127 = 6$

0 0 1 1 0 1 1 1 0

fraction
 $2^{22} + 2^{21} + 2^{20} + 2^{19} + 2^{18} + 2^{17} + 2^{16} + 2^{15} + 2^{14} + 2^{13} + 2^{12} + 2^{11} + 2^{10} + 2^9 + 2^8 + 2^7 + 2^6 + 2^5 + 2^4 + 2^3 + 2^2 + 2^1 + 2^0$
 $8,388,608 + 1,048,576 + 524,288 + 65,536 + 32,768 + 16,384$
 $= 1,687,552$

$(1 + .1687552) \times 2^6 = 74.8003328$

3|0111 1111 1000 1000 0000 0000 0000 0001

Sign Positive Exponent
 $255 - 127 = 128$

0 0 0 1 0

Fraction
 $2^{22} + 2^{21} + 2^{20} + 2^{19} + 2^{18} + 2^{17} + 2^{16} + 2^{15} + 2^{14} + 2^{13} + 2^{12} + 2^{11} + 2^{10} + 2^9 + 2^8 + 2^7 + 2^6 + 2^5 + 2^4 + 2^3 + 2^2 + 2^1 + 2^0$
 $524,288 + 1$
 $= 524,289$

$(1 + .524,289) \times 2^{128} = 5.18688\overline{6688}$

Teacher's Solution

Set Notation

For the following set definitions, list all the items in the set.

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3. $C = \{x \mid x \in Z \text{ and } 20 < x \leq 32\}$
4. $D = \{5x \mid x \in N \text{ and } x < 7\}$

- 1) $A = \{S, a, c, r, m, e, n, t, o\}$
- 2) $B = \{a, e, o\}$
- 3) $C = \{21, 22, 23, \dots, 32\}$
- 4) $D = \{5, 10, 15, 20, 25, 30\}$

Set Operators

Given the following sets:

$$\begin{aligned} U &= \{\text{rat, ox, tiger, rabbit, dragon, snake, horse, sheep, monkey, rooster, dog, pig}\} \\ A &= \{\text{rat, rabbit, snake, sheep, dog}\} \\ B &= \{\text{tiger, horse, monkey, dog}\} \\ C &= \{\text{rat, tiger, dragon, horse, monkey, pig}\} \end{aligned}$$

Find the following:

- 1) $A \cap B = \{\text{Dog}\}$
- 2) $A \cap C = \{\text{rat}\}$
- 3) $B \cup C = \{\text{tiger, horse, monkey, dog, rat, dragon, pig}\}$
- 4) $(A \cup B) \setminus C = \{\text{ox, tiger, dragon, horse, monkey, rooster, pig}\}$
- 5) $C \setminus B = \{\text{rat, dragon, pig}\}$
- 6) $A \cup B = \{\text{rat, rabbit, snake, sheep, dog, tiger, horse, monkey}\}$
 $A \cup B \setminus C = \{\text{rabbit, snake, sheep, dog}\}$

Teacher's Solution

Venn Diagrams

Bikini Bottom is having a sale on used boats. Woo hoo! Now, you just have to pass the driving exam!

A survey was taken on 35 boats. Three different options were counted: radios, Krabby Patty holders (much better than cup holders), and jellyfish nets. The following information was gathered:

- 19 have radio (R)
- 17 have Krabby Patty holders (K)
- 15 have jellyfish nets (J)

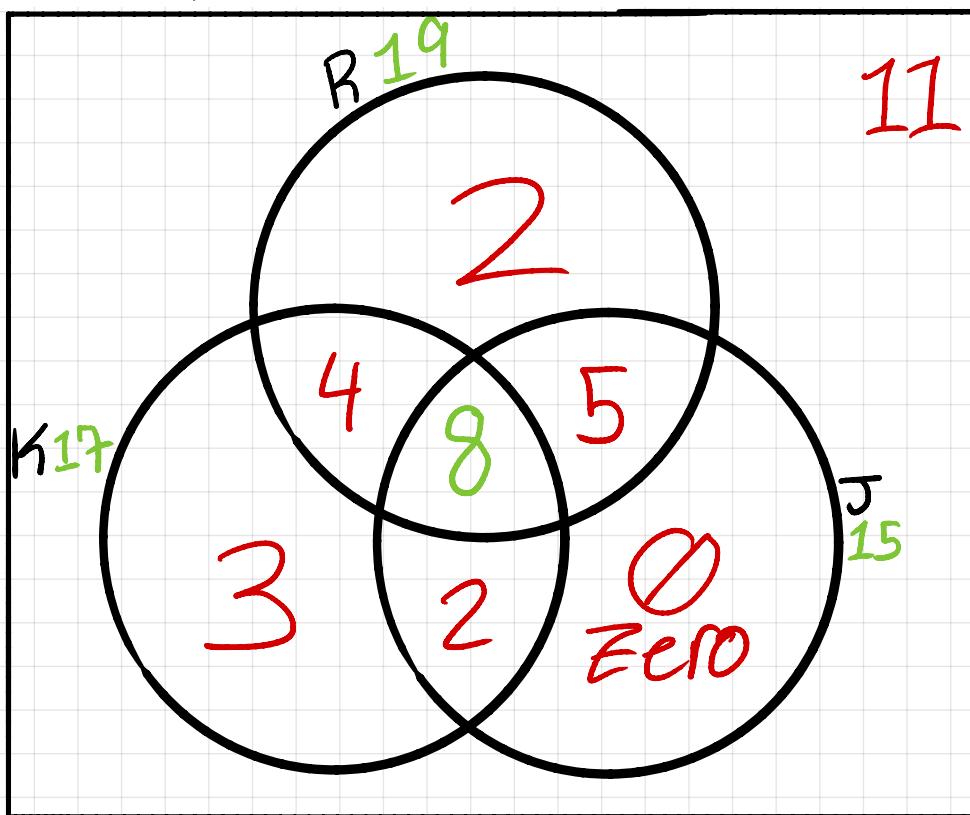
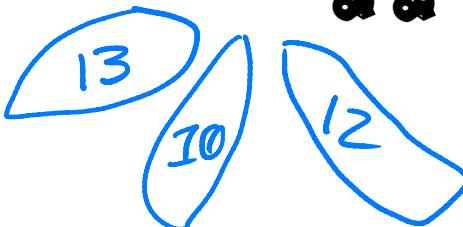


Also...

- 13 have J and R
- 10 have K and J
- 12 have R and K
- 8 have all three options

Using a Venn Diagram to figure out the following:

1. How many only have R
2. How many only have J
3. How many only have K
4. How many have K and R, but not J
5. How many have J and K, but not R
6. Only one of the options
7. None of these options



- 1) 2 Two
- 2) 0 Zero
- 3) 3 Three
- 4) 4 Four
- 5) 2 TWO
- 6) 5 Five
- 7) 11 Eleven

Teacher's Solution

Set Algebra

Simply the following. Use set algebra. Label all the laws you apply.

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

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

$$(A' \cap B) \cup \emptyset \cup (A' \cap B')$$
 Complement

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

Identity

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

Distributive

$$A' \cup U$$

Complement

$$A'$$

Solution

Floating Point Numbers

1. Encode the number **34.25** (34 and 1/4) to a single-precision (32 bit) floating point. Write down its binary representation. You don't have to convert to hex, but please put spaces either between each byte or each field. Show your work.
2. What is **01000010100110001100000000000000** when interpreted as a floating-point number?
3. What is **011111110001000000000000000001** when interpreted as a floating-point number?

1) Step 1. 100010.01

34.25

Step 2. 1.0001001 $\times 2^5$
fraction

3) NAN

ASKWHY

Step 3.

2) Step 1. 0 1000 0101 001100011000000000... 0)

Handwritten notes for floating-point conversion:

- Exponent: 1000 0101 (base 2)
- Exponent value: $133 - 127 = 6$
- Mantissa: 001100011000000000... 0)
- Mantissa in scientific notation: 1.001100011×2^6
- Final result: $1.001100011 \times 2^6 \rightarrow 76.375$

Teacher's Solution

Bit Vectors

Convert the following into bit vectors and then solve the questions below. Keep the result in bit-vector form.

$$U = \{1, 2, 3, \dots, 10\}$$

$$A = \{1, 8, 4, 6\}$$

$$B = \{1, 9, 4, 7\}$$

Find the following:

$$1. A \cap B$$

$$2. A \cup B$$

$$3. A'$$

$$4. A \setminus B$$

$$A = 100101010100$$

$$B = 100100101010$$

$$1) A \cap B = 100100000000$$

$$A \cup B = 100101111100$$

$$A' = 011010101111$$

$$A \setminus B = 000001010100$$