The answers must be the original work of the author. While discussion with others is permitted and encouraged, the final work should be done individually. You are not allowed to work in groups. You are allowed to build on the material supplied in the class. Any other source must be specified clearly.

1. *(10+10 points)* Consider the following regular set over $\Sigma = \{a, b\}$.

$$S_1 = \{a\}^* \{a, b\}^* \{b\}^*$$

(a) Write the regular set as a regular expression.
$a^*(a \cup b)^* b^*$

(b) Which of the following correctly represents the language given by S_1 (2 points)?
Explain your answer (8 points).

    1. Set of all strings that start with 'a'
    2. Set of all strings that end with 'b'
    3. Set of all strings that start with 'a' and end with 'b'
    4. Set of all strings in Σ^*
    5. None of the above (provide your own answer and explanation.)

4. is the corect answer. a^* and b^* can be λ this means $a^*(a \cup b)^* b^* = (a \cup b)^*$.Σ is $(a \cup b)$ therefor $a^*(a \cup b)^* b^* = (\Sigma)^*$

2. *(10+10 points)* Consider the following regular expression over $\Sigma = \{a, b\}$.

$$S_2 = a^+ (a \cup b)^* b^+$$

(a) Write the regular expression as a regular set.

(b) Which of the following correctly represents the language given by S_2 (2 points)?
Explain your answer (8 points).

    1. Set of all strings that start with 'a'
    2. Set of all strings that end with 'b'
    3. Set of all strings that start with 'a' and end with 'b'
    4. Set of all strings in Σ^*
    5. None of the above (provide your own answer and explanation.)

3. *(10+10 points)* Consider the following regular expression over $\Sigma = \{a, b\}$.

$$S_3 = a^+ (a \cup b)^+ b^+$$

(a) Write the regular expression as a regular set.
$\{a\}^+ \{a, b\}^+ \{b\}^+$
(b) Which of the following correctly represents the language given by S_3 (2 points)?
Explain your answer (8 points).

  1. Set of all strings that start with 'a'
  2. Set of all strings that end with 'b'
  3. Set of all strings that start with 'a' and end with 'b'
  4. Set of all strings in Σ^*
  5. None of the above (provide your own answer and explanation.)

5. is the corect answer. The language will be the set of all strings that start with 'a' and end with
'b' and with size grater than 2. Each part of the reguler expration can not be λ so there must be at
least 3 characters long.

4. *(10+10 points)* Consider the set L_4 of strings over $\Sigma = \{1, 2, a, b, c\}$ that start and end with a
number.

Strings can have a length of one or greater.

(a) Give a regular set for L_4 (10 points) . Explain your answer (10 points).

$(1 \cup 2)^+ (1 \cup 2 \cup a \cup b \cup c)^* (1 \cup 2)^+$
the only constrate is that the string must start and end with a number. There can be anything
including λ in betwean the two numbers.

(b) Write the regular set in part (a) as a regular expression.

$\{1, 2\}^+ \{1, 2, a, b, c\}^* \{1, 2\}^+$

5. *(10+10 points)* Consider the set L_5 of strings over $\Sigma = \{1, 2, a, b, c\}$ that contain exactly two
numbers and the sum of the numbers is even.

(a) Give a regular set for L_5 (10 points). Explain your answer (10 points).
$\{2\}\{2, \lambda\}$
This has 2 and 22 as the only numbers in the set and the sum of 2 and 22 is 24 witch is even.
(b) Write the regular set in part (a) as a regular expression
$2(2, \lambda)$