Instructions

The group A must do: The List of Activities(5pts) and Group A problem at the end(5pts).
The group B must do: The List of Activities(5pts) and Group B problem at the end(5pts).
The group C must do: The List of Activities(5pts) and Group C problem at the end(5pts).

Josephus Problem

The problem is named after Flavius Josephus, a Jewish historian living in the 1st century. As the legend goes, he and his 40 comrade soldiers were trapped in a cave, surrounded by Romans. They chose suicide over capture and decided that they would form a circle and start killing themselves using a step of three. As Josephus did not want to die, he was able to find the safe place, and stayed alive with his comrade, later joining the Romans who captured them. (The only statement given by Josephus himself is that by luck, or maybe by the hand of God, he and another man remained the last and gave up to the Romans.)

List of activities:

The task is to write a list of activities(questions) related to the Josephus Problem. Here are the rules:

1- Write at least 15 activities(questions).
2- Avoid repeating the questions. For example do not ask to find $J(200)$ after you already ask to find $J(150)$.
3- Avoid questions which ask one to make an observation by counting the number of certain occurrences in the finite table of $J(n)$. This can be used only as part (a) in your question. For example:

Question:
(a) Find how many times 1 appears in your table.
(b) Find how many times 1 appears in the sequence $J(n), n = 1, 2, \ldots, M$.

4- Order your questions according to difficulty and the way they are related. (Recall that in a class we discussed the questions’ web.)
5- After you listed your questions give your arguments for their order. Describe how the questions are related and how did you judge the level of difficulty.
Problem- Group C

Find $J(N)$, where $N$ is given by the formula:

$$N = (\text{date} \times \text{month})^2 + 2 \times \text{year}$$

where $\text{date} = \text{date of your birthday}$, $\text{month} = \text{the month of your birthday}$ and $\text{year} = 4$ digit year in which you were born.

Problem- Group B

Let $J(N) = 1$. Find the first integer $m$ after $N$ such that $J(m) = 1$ or $J(m) = 2$.

Problem- Group A

Recall that in class we defined blocks of $J(n)'s$ as the consecutive sequence of $J(n)$ starting with 1 or 2 and ending before you reach the next 1 or 2.

Furthermore, let $s(k) = \text{the length of the k-th block}$. Find the limit of $\frac{s(k+1)}{s(k)}$ as $k$ is approaching $\infty$. Hint: First compute the formula for a length of the block which start at $N$. Then use it to find the length of the next block. Divide your result and compute the limit.