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## Homework 2: Algorithm and Pseudocode

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**Question 1:** Using the rates below and the current U.S. population (328,441,687), write an algorithm to calculate the U.S. population in exactly one year (365 days).

- a. There is a birth every 8 seconds
- b. There is a death every 12 seconds
- c. There is a new immigrant every 27 seconds

### Pseudocode:

Population = 328,441,687

Day = 0

While day <= 365

    Day = day+1

    Seconds = 0

        While seconds < 86,400

            Seconds = seconds+1

            If seconds mod 8 is equal to 0

                Set population = population +1

            If seconds mod 12 is equal to 0

                Set population = population-1

            If seconds mod 27 is equal to 0

                Set population= population+1

Output (population)

**Question 2:** A day has 86,400 seconds ( $24 \times 60 \times 60$ ). Given a number of seconds in the range of 0 to 1,000,000 seconds, output the time as days, hours, minutes, and seconds for a 24 hour clock. Your program should have user input that is the number of seconds to convert, and the use then use that number in your calculations. If your results are W, X, Y, and Z, then your output should be displayed as: The time is W days, X hours, Y minutes, and Z seconds.

**Pseudocode:**

Input (userSeconds) (between 0 and 1,000,000)

Days = 0

Hours = 0

Minutes = 0

Seconds = 0

While userSeconds > 86400

    userSeconds = userSeconds – 86400

    Days = days+1

While userSeconds > 3600

    userSeconds = userSeconds – 3600

    Hours = hours +1

While userSeconds > 60

    userSeconds = userSeconds – 60

    Minutes = minutes + 1

While userSeconds > 0

    userSeconds = userSeconds -1

    Seconds = seconds +1

Output(The time is #days, #hours, #minutes, and #seconds)

**Question 3:** In text-based choose-your-own-adventure games, the game player is presented with choices throughout the game and then the game responds based on the user's choice. Write an algorithm for a choose-your-own-adventure superhero game where the user has three choices:

- a. Fight the villain
- b. Save the citizen
- c. Return to secret base

The game should repeatedly ask the user which of the three options they want to do until the user says "Return to secret base". When "Return to secret base" is selected, the loop should exit, which effectively ends the game. If the user selects "Fight the villain", the algorithm should output "You win!". If "Save the citizen" is selected, the algorithm should output "You saved the citizen". If "Return to secret base" is selected, the algorithm should output "Who will save the world?". You can set up your algorithm to check for the user's input in any way you like. Checking for the actual words, such as "Save the citizen" is one option. If you want to assign a number to each option and check for the number, that also works.

**Pseudocode:**

Choice = " "

A = "fight the villain"

B = "save the citizen"

C = "return to secret base"

While choice not = C

    Input(choice)

    If choice = A

        Output("You win!")

    If choice = B

        Output("You saved the citizen")

Output("Who will save the world?")

**Question 4a:** A bank account has an initial deposit of \$10,000. Every month \$500 is withdrawn to meet college expenses. After the money is withdrawn, an interest is computed at the rate of 6 percent per annum (0.5 percent per month). This interest is compounded monthly. Write an algorithm to find how many years it takes for the account balance to become \$0.

**Pseudocode:**

Balance = 10000

Months = 0

While balance > or = 0

    Months = months + 1

    Balance = balance – 500

    Interest = balance\*0.005

    Balance = balance + interest

Years = rounded to 2 decimal places(months/12)

Output(years)

**Question 4b:** Make changes to the algorithm to ask the user to input the values for principal, rate and monthly expenditure.

**Pseudocode:**

Input(balance)

Input(rate) (in decimal form)

Input(monthlyExpenditure)

Months = 0

While balance > or = 0

    Months = months + 1

    Balance = balance – monthlyExpenditure

    Interest = balance\*rate

    Balance = balance + interest

Years = rounded to 2 decimal places(months/12)

Output(years)

**Question 5:** Write an algorithm that will ask the user to enter 10 characters. Letters 'a', 'e', 'i', 'o', 'u' in the English alphabet are vowels. The algorithm should then count and display the total number of vowels among the 10 characters entered by the user.

**Pseudocode:**

letterCount = 0

letterVowels = 0

While letterCount < or = 10

    letterCount = letterCount +1

    Input(character)

    If character = 'a', 'e', 'i', 'o' or 'u'

        letterVowels = letterVowels +1

Output(letterVowels)

**Question 6:** Albert Einstein's famous equation  $E=mc^2$  relates energy (E) and mass (m) via the speed of light constant (c). Write an algorithm to convert a given mass into energy using this formula. Use the SI value for the speed of light (299,792,458 m/s), and assume that the input mass will be in units of kilograms (kg), such that the resulting energy will be in units of Joules (J).

**Pseudocode:**

Input(mass)

C = 299792458

Energy = mass\*C ^2

Output(Energy)