Q.
Chemical formula of a compound represents constituent element's(atom) proportions. Example: H_2O, chemical formula of water implies two Hydrogen(H_2) atoms and one Oxygen(O_1) atom combine. Hydrocarbons are compounds consisting of Hydrogen(H) and Carbon(C). Based on proportions of C and H, hydrocarbons can be classified as alkane, alkene and alkyne; represented by C_nH_{2n+2} , C_nH_{2n} and C_nH_{2n-2} respectively.

Example: Ethane, C_2H_6 – has two carbon and six hydrogen atoms, and is a alkane as it satisfies C_nH_{2n+2} .

Write a shell script that:
- a)   Reads from end user using suitable messages:
    - i.   Number of Carbon atoms (an integer)
    - ii. Number of Hydrogen atoms (an integer)
- b)   Validate C and H , that is are entered values logically correct
- c)   Classify input hydrocarbon as alkane, alkene or alkyne
- d)   Print with suitable message:
    - i.   Hydrocarbon compound composition as C followed by number of Carbon atoms ; and H followed by number of Hydrogen atoms
    - ii. Type of hydrocarbon (whether its alkane, alkene or alkyne)

Q.
Deoxyribonucleic acid, **DNA** is made up nucleotides and is a thread-like chain structure carrying the genetic instructions for all living organisms. Nucleotides are bases (compounds) called as **A**denine, **T**hymine, **C**ytosine and **G**uanine; represented as A, T, C and G respectively. Genome sequence is complete DNA sequence of an organism. Assume: Genome represents sequence of A, T, C and G without spaces.
        Example: CATGACTCAGGG.
Assume: 1 byte is required to store each character 'A', 'T', 'C' and 'G' on computer.
        Example: Human genome is 3.2 billion bases long ($1\,billion=10^9$), hence requires $3.2*10^3$ MB.
Assume: $1\,kB(1\,kilobyte)=1000\,bytes$ and $1\,MB(1\,megabyte)=1000\,kB$

Write a shell script that:
- a)   Reads from end user using suitable messages:
    - i.   Name of living organism (a string , like "mouse" , "fruitfly")
    - ii. Number of bases in genome sequence, N (integer)
- b)   Validate N , which is: is entered value logically correct
- c)   Calculates space required to store N bumber of bases sequence on computer in terms of *bytes*
- d)   Use the result to calculate space required in terms of *megabytes*
- e)   Prints with suitable message the name of the organism and its genome size in **MB**

Q.
A straight line in two dimension can be represented with $y=mx+c$, where y and x are y and x coordinates of the point on line in two dimension space respectively. m is slope of the line and c is intercept made by the line with y axis. Slope can be calculated by $m=\dfrac{y_2-y_1}{x_2-x_1}$, where (x_1, y_1) and (x_2, y_2) are any two points on the straight line.

        Example: For points (10 , 5) and (11 , 6) , $m=\dfrac{6-5}{11-10}$, $m=1$

            If $c=2$, then straight line can be written as $y=x+2$

Write a shell script that:
- a)   Reads from end user using suitable messages:
    - i. x and y coordinates of any two points $P_1(x_1, y_1)$ and $P_2(x_2, y_2)$ (all as integers)
    - ii. Intercept c (as integer)
- b)   For read points (P_1 and P_2) calculate slope m
- c)   Prints with suitable message: Equation form of the line $y=mx+c$

Q.
Write a shell program to to accept a integer from the terminal and convert to binary number. Number 5_{10} in decimal = 101_2 in binary(Convert base 10 to base 2).

Q.
Write a shell program to to accept a integer from the terminal and convert to hexadecimal number. Number 255_{10} in decimal = FF_{16} in hexadecimal(Convert base 10 to base 16).

Q.
Write a shell program to to accept a integer from the terminal and convert to octal number. Number 21_{10} in decimal $= 25_8$ in octal(Convert base 10 to base 8).

Q.
Write a shell program to to accept a integer from the terminal and check if its a palindrome. A number is palindrome if the reverse of the number turns out to be the same number. Number 12321 , whose reverse is 12321 , which is also the original number, hence its a palindrome.

Q.
Write a shell program to to accept a integer from the terminal and check if its a prime number. A number is prime if it is only divisible by 1 and itself.

Q.
Write a shell program to to accept a positive integer *n* from the terminal and print *n* th Fibonacci number. A number in Fibonacci series is expressed as sum of its previous two numbers.
$fibonacci(\textbf{\textit{n}}) = fibonacci(\textbf{\textit{n-1}}) + fibonacci(\textbf{\textit{n-2}})$; given $fibonacci(\textbf{1}) = \textbf{0}$ and $fibonacci(\textbf{2}) = \textbf{1}$

Q.
Write a shell program to to accept a positive integer number from the terminal and calculate the factorial of the number. Factorial of a number *n* is defined as $factorial(n) = n * (n\text{-}1) * \ldots * 2 * 1$; given $factorial(\textbf{0}) = \textbf{1}$

Q.
Trusses are used commonly in Steel buildings and bridges. A truss consists of straight members, connected together with pin joints, and connected only at the ends of the members and all external forces (loads and reactions) are applied only at the joints. For simple trusses to be a valid structure the necessary condition is :
$2n = m + r$, where *n* are joints, *m* are members and *r* are reactions respectively. Write a shell script that:
   a)   Reads from user: *n* , *m* and *r* (all positive integers) with suitable messages
   b)   Validate *n* , *m* and *r*
   c)   Prints with suitable message if the simple truss is a valid structure.

Q.
A bigger cube is to be built using *n* number of smaller cubic blocks with side of one unit length (assume all smaller unit side length cubes are used to build bigger cube). Write a shell script that:
   a)   Read *n* from user using suitable messages
   b)   Check if *n* is valid
   c)   A bigger cube is built using *n* number of smaller cubic blocks of side of one unit length. Calculate the surface area of bigger cube
   d)   One smaller cubic block is now removed from every corner of the cube. Calculate the surface area of bigger cube
   e)   Prints with suitable message, both surface areas.

Q.
Moore's law is the observation that the number of transistors in a dense integrated circuit doubles approximately every two years. A transistor is a semiconductor device used to build electronic circuits. An integrated circuit (*IC*) is a set of electronic circuits on one small flat piece of semiconductor material.
      Example: Assume if in year 2000, 1 transistor was present on IC, then in year 2002 : 2 transistors , 2004 : 4 transistors and in year 2010 : 32 transistors would be present on IC respectively. Write a Shell script that:
   a)   Reads from end user using suitable messages:
        i. Year, Y_P (a year where number of transistors on IC are known) and
        ii. Number of transistor on IC during that year, T_{IC} (both integers)
        iii. (As compared to Y_P , a) Year in future, Y_F (integer)
   b)   Checks if Y_P, T_{IC} and Y_F are logicall correct
   c)   Predicts number of transistors that would be present on IC in year Y_F
   d)   Prints with suitable message, future year Y_F and predicted number of transistors on IC for that year