1) Explain the following components of a CPU:

   a) Control unit

- Communicates with memory and gets the next instruction to be executed.
- Decodes the instruction and instructs the ALU what operations to perform.

   b) ALU

- Performs arithmetic and logic operations.
- Executes operations as instructed by the CU.

   c) Memory address register

- To send an address to RAM the CPU places it in the MAR. From here the address is sent to RAM by means of the address bus.

   d) Memory data register   (4)

- Data to be sent to RAM is placed in the MDR. From here it is sent to RAM via the data bus.
- It is also used as a depositary that holds data coming from the RAM.

2) What are the following components used for?

   a) ROM

- ROM stands for Read Only Memory and is non-volatile.
- It is used to hold the software required to initiate bootstrapping. It also holds a program to perform diagnostics on the computer and software drivers which interface between the operating system and hardware.

   b) RAM

- It is volatile and holds the core of the operating system and the programs currently being executed (or the important parts required for execution at the moment). It is made up of DRAM chips.

   c) Cache   (6)

- Cache is a small and fast memory that holds the most accessed software and data. Since it is fast it saves time on reading from memory.
- It is made of SRAM chips.

3) Explain what 'virtual memory' is. (2)

- Virtual memory is a technique that uses secondary storage as if it was part of RAM. This is done to execute more programs concurrently. When a part of a program that resides in the secondary storage is required in RAM, this is swapped with software residing in the RAM that is not currently being used.

4) For the following logic circuit:
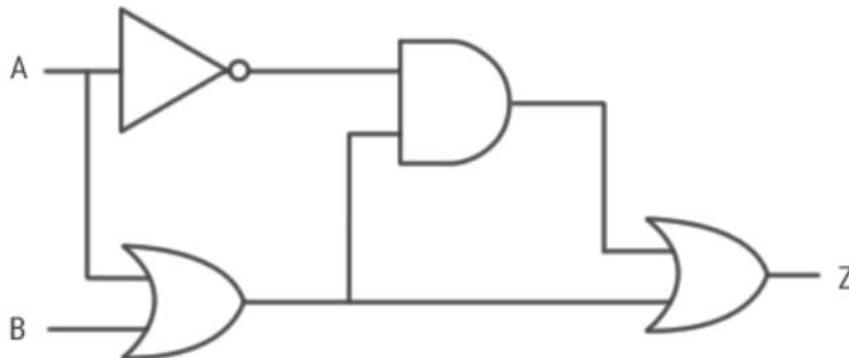
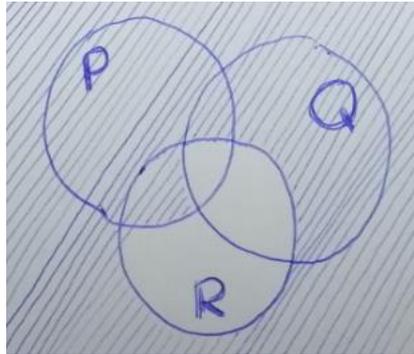a) Express the corresponding Boolean expression. (1)

A'(A + B) + (A + B)

b) Write its truth table. (2)

A	B	A+B	A'	A'(A+B)	A'(A+B) + (A+B)
0	0	0	1	0	0
0	1	1	1	1	1
1	0	1	0	0	1
1	1	1	0	0	1

c) Find the output when the input is: A=0 and B=1. (1)

From the above table one can see that this is equal to 1.

5) Draw the Venn Diagram for the expression $P.\bar{Q} + \bar{R}$. (2)

6) Show that: $\bar{A}.\bar{B} + A.\overline{B.C} \equiv \bar{B} + A.\bar{C}$.

(2)

LHS = A'B' + A.(B' + C')   (De Morgan's Laws)

= A'B' + AB' + AC'   (distributive laws)

= (A' + A).B' + AC'   (distributive laws)

= 1.B' + AC'   (complement laws)

= B' + AC'   (identity laws)