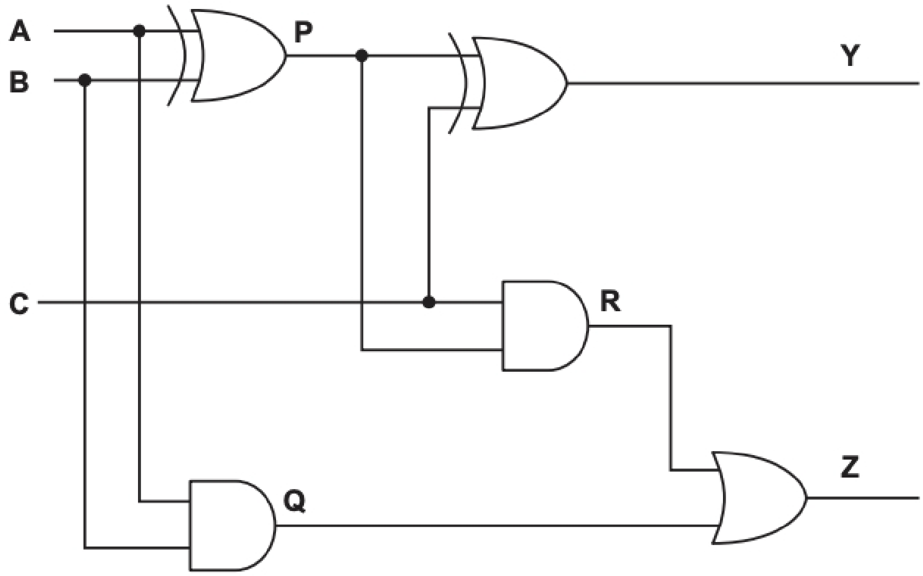
7 The diagram shows a logic circuit.



(a) Complete the truth table for the given logic circuit. Show your working.

Inputs			Working space			Outputs	
A	**B**	**C**	**P**	**Q**	**R**	**Y**	**Z**
0	0	0					
0	0	1					
0	1	0					
0	1	1					
1	0	0					
1	0	1					
1	1	0					
1	1	1					

[3]

(b) State the name of the logic circuit.

.... [1]

(c) Write the Boolean expressions for the two outputs **Y** and **Z** in the truth table as sum-of-products **and** state the purpose of each output.

Y = ...

Purpose ....

Z = ...

Purpose ....

[4]

7 **(a)** Write the Boolean expression that corresponds to the given truth table as a sum-of-products.

INPUT				**OUTPUT**
A	**B**	**C**	**D**	**Z**
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

Z = ...

.... [3]

(b) (i) Complete the Karnaugh map (K-map) for the given truth table.

CD \ AB	00	01	11	10
00				
01				
11				
10				

[2]

(ii) Draw loop(s) around appropriate group(s) of 1s in the K-map to produce an optimal sum-of-products. [2]

(iii) Write the Boolean expression from your answer to **part b(ii)** as a simplified sum-of-products.

Z = ...

.... [2]

(iv) Write the simplified Boolean expression for your answer to **part b(iii)**.

Z = ...

.... [1]

4 Reduced Instruction Set Computers (RISC) and Complex Instruction Set Computers (CISC) are two types of processor.

(a) Describe what is meant by **RISC** and **CISC processors**.

RISC ....

....

....

....

CISC ....

....

....

....

[4]

(b) Identify **two** differences between RISC and CISC processors.

1 ....

....

....

2 ....

....

....

[2]

6 A virtual machine is used to emulate a new computer system.

Describe **two** benefits and **one** limitation of using a virtual machine for this purpose.

Benefit 1 ....

....

....

....

....

Benefit 2 ....

....

....

....

....

Limitation ....

....

....

....

.... [6]

9 The table shows assembly language instructions for a processor that has one general purpose register, the Accumulator (ACC).

	Instruction		Explanation
Label	**Opcode**	**Operand**	
	`LDM`	`#n`	Load the number n to ACC
	`LDD`	`<address>`	Load the contents of the given address to ACC
	`LDI`	`<address>`	The address to be used is at the given address Load the contents of this second address to ACC
	`ADD`	`<address>`	Add the contents of the given address to the ACC
	`STO`	`<address>`	Store the contents of the ACC at the given address
`<label>:`		`<data>`	Gives a symbolic address <label> to the memory location with the contents <data> <label> can be used in place of <address>
# denotes a denary number, e.g. #123			

(a) The address `500` contains the value `100` and the address `100` contains the value `20`.

State the addressing mode and the contents of ACC after each instruction has been executed.

`LDM #500` Addressing mode ....

Contents of ACC ....

`LDD 500` Addressing mode ....

Contents of ACC ....

`LDI 500` Addressing mode ....

Contents of ACC ....

[3]

(b) Use only the given instruction set to write **assembly language** code to:

- use the constant 20 which needs to be stored
- add this constant to the value stored in the address contained in the variable Y
- store the result in variable Z.

Label	Instruction	
	Opcode	**Operand**

[7]

7 **(a)** Complete the Karnaugh map (K-map) for the Boolean expression.

$$Z = \overline{A}.\ B.\ \overline{C}.\ \overline{D} + \overline{A}.\ B.\ \overline{C}.\ D + A.\ B.\ \overline{C}.\ \overline{D} + A.\ B.\ \overline{C}.\ D + A.\ \overline{B}.\ \overline{C}.\ \overline{D} + A.\ \overline{B}.\ \overline{C}.\ D$$

CD \ AB	00	01	11	10
00				
01				
11				
10				

[2]

(b) Draw loop(s) around appropriate group(s) in the K-map to produce an optimal sum-of-products. [2]

(c) Write the Boolean expression from your answer to **part (b)** as a simplified sum-of-products. Use Boolean algebra to give your answer in its simplest form.

Simplified sum-of-products

Z = ...

Simplest form

Z = ...

[3]

8 Virtual memory, paging and segmentation are used in memory management.

(a) Explain what is meant by **virtual memory**.

....

....

....

....

....

.... [3]

(b) State **one** difference between paging and segmentation in the way memory is divided.

....

.... [1]

10 Reduced Instruction Set Computers (RISC) and Complex Instruction Set Computers (CISC) are two types of processor.

(a) Tick (✓) **one** box in each row to show if the statement applies to RISC or CISC processors.

Statement	RISC	CISC
uses a smaller instruction set		
uses single-cycle instructions and limited addressing modes		
uses fewer general-purpose registers		
uses both hardwired and micro-coded control unit		
uses a system where cache is split between data and instructions		

[2]

(b) Describe the process of pipelining during the fetch-execute cycle in RISC processors.

....

....

....

....

....

....

....

.... [4]