Cambridge International Examinations
Cambridge International Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

7098878869

COMPUTER SCIENCE **9608/32**

Paper 3 Advanced Theory **October/November 2016**

1 hour 30 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

No calculators allowed.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces at the top of this page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
No marks will be awarded for using brand names of software packages or hardware.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

The maximum number of marks is 75.

This document consists of **12** printed pages.

DC (ST/JG) 116627/3

CAMBRIDGE International Examinations

[Turn over

1 In a particular computer system, real numbers are stored using floating-point representation with:

- 8 bits for the mantissa
- 8 bits for the exponent
- two's complement form for both mantissa and exponent

(a) Calculate the floating point representation of +3.5 in this system. Show your working.

Mantissa

●							

Exponent

....

....

....

....

....

.... [3]

(b) Calculate the floating-point representation of –3.5 in this system. Show your working.

Mantissa

●							

Exponent

....

....

....

....

....

.... [3]

(c) Find the denary value for the following binary floating-point number. Show your working.

Mantissa

0 ●	1	1	1	0	0	0	0

Exponent

0	0	0	0	0	1	0	0

....

....

....

....

....

.... [3]

(d) (i) State whether the floating-point number given in **part (c)** is normalised or not normalised.

.... [1]

(ii) Justify your answer given in **part (d)(i)**.

....

.... [1]

(e) Give the binary two's complement pattern for the negative number with the largest magnitude.

Mantissa

●							

Exponent

[2]

2 There are four stages in the compilation of a program written in a high-level language.

(a) Four statements and four compilation stages are shown below.

Draw a line to link each statement to the correct compilation stage.

Statement	**Compilation stage**
This stage can improve the time taken to execute the statement: `x = y + 0`	Lexical analysis
This stage produces object code.	Syntax analysis
This stage makes use of tree data structures.	Code generation
This stage enters symbols in the symbol table.	Optimisation

[4]

(b) Write the Reverse Polish Notation (RPN) for the following expression.

`P + Q - R / S`

.... [2]

(c) An interpreter is executing a program. The program uses the variables `a`, `b`, `c` and `d`.

The program contains an expression written in infix form. The interpreter converts the infix expression to RPN. The RPN expression is:

```
b a * c d a + + -
```

The interpreter evaluates this RPN expression using a stack.

The current values of the variables are:

```
a = 2  b = 2  c = 1  d = 3
```

(i) Show the changing contents of the stack as the interpreter evaluates the expression.

The first entry on the stack has been done for you.

2								

[4]

(ii) Convert back to its original infix form, the RPN expression:

```
b a * c d a + + -
```

....

.... [2]

(iii) One advantage of using RPN is that the evaluation of an expression does not require rules of precedence.

Explain this statement.

....

....

....

.... [2]

3 A computer operating system (OS) uses paging for memory management.

In paging:

- main memory is divided into equal-size blocks, called page frames
- each process that is executed is divided into blocks of the same size, called pages
- each process has a page table that is used to manage the pages of this process

The following table is the incomplete page table for a process, Y.

Page	Presence flag	Page frame address	Additional data
1	1	221	
2	1	222	
3	0	0	
4	0	0	
5	1	542	
6	0	0	
249	0	0	

(a) State **two** facts about Page 5.

1 ....

....

2 ....

.... [2]

(b) Process Y executes the last instruction in Page 5. This instruction is not a branch instruction.

(i) Explain the problem that now arises in the continued execution of process Y.

....

....

....

....

....

.... [2]

(ii) Explain how interrupts help to solve the problem that you explained in **part (b)(i)**.

....

....

....

....

....

.... [3]

(c) When the next instruction is not present in main memory, the OS must load its page into a page frame. If all page frames are currently in use, the OS overwrites the contents of a page frame with the required page.

The page that is to be replaced is determined by a page replacement algorithm.

One possible algorithm is to replace the page which has been in memory the shortest amount of time.

(i) Give the additional data that would need to be stored in the page table.

....

.... [1]

(ii) Complete the table entry below to show what happens when Page 6 is swapped into main memory. Include the data you have identified in **part (c)(i)** in the final column. Assume that Page 1 is the one to be replaced.

In the final column, give an example of the data you have identified in **part (c)(i)**.

Page	Presence flag	Page frame address	Additional data
6	…………	…………..……	……………………..……

[3]

Process Y contains instructions that result in the execution of a loop, a very large number of times. All instructions within the loop are in Page 1.

The loop contains a call to a procedure whose instructions are all in Page 3.

All page frames are currently in use. Page 1 is the page that has been in memory for the shortest time.

(iii) Explain what happens to Page 1 and Page 3, each time the loop is executed.

....

....

....

....

....

.... [3]

(iv) Name the condition described in **part (c)(iii)**.

.... [1]

4 Both clients and servers use the Secure Socket Layer (SSL) protocol and its successor, the Transport Layer Security (TLS) protocol.

(a) **(i)** What is a protocol?

....

....

....

.... [2]

(ii) Name the client application used in this context.

.... [1]

(iii) Name the server used in this context.

.... [1]

(iv) Identify **two** problems that the SSL and TLS protocols can help to overcome.

1 ....

2 .... [2]

(b) Before any application data is transferred between the client and the server, a handshake process takes place. Part of this process is to agree the security parameters to be used.

Describe **two** of these security parameters.

1 ....

....

....

....

2 ....

....

....

.... [4]

(c) Name **two** applications of computer systems where it would be appropriate to use the SSL or TLS protocol. These applications should be different from the ones you named in **part (a)(ii)** and **part (a)(iii)**.

1 ....

....

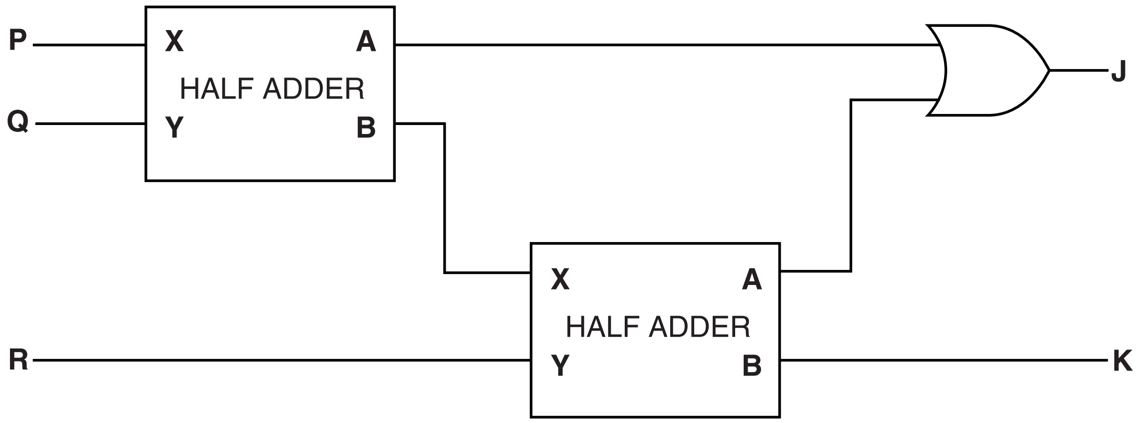
2 ....

.... [2]

5 **(a)** **(i)** A half adder is a logic circuit with the following truth table.

Input		**Output**	
X	**Y**	**A**	**B**
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

The following logic circuit is constructed.



Complete the following truth table for this logic circuit.

Input			**Working space**	**Output**	
P	**Q**	**R**		**J**	**K**
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

[2]

(ii) State the name given to this logic circuit.

.... [1]

(iii) Name the labels usually given to **J** and **K**.

Label **J** ....

Label **K** ....

Explain why your answers are appropriate labels for these outputs.

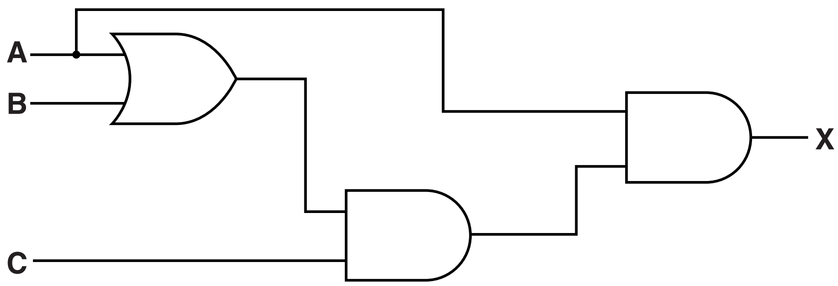
....

....

....

.... [4]

(b) (i) Write down the Boolean expression corresponding to the following logic circuit:



.... [2]

(ii) Use Boolean algebra to simplify the expression given in **part (b)(i)**.

Show your working.

....

....

....

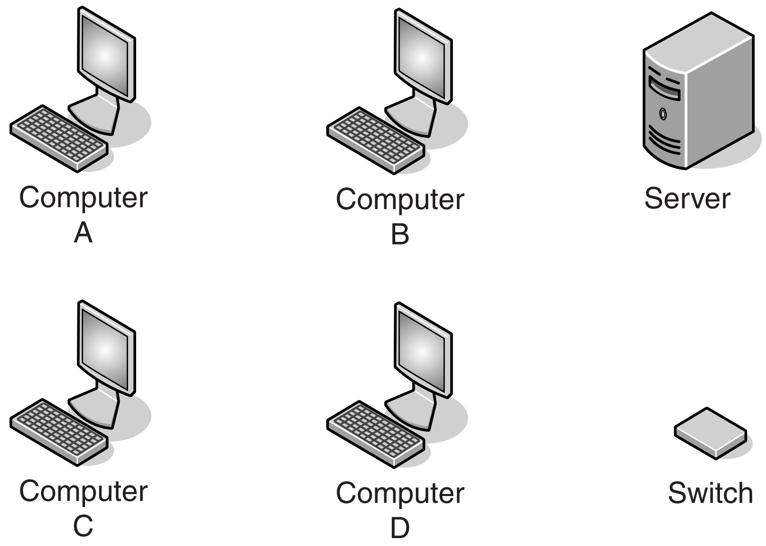
....

....

.... [4]

6 A Local Area Network (LAN) consists of four computers, one server and a switch. The LAN uses a star topology.

(a) Complete the diagram below to show how to connect the devices.



[2]

(b) The LAN uses packets to transfer data between devices.

Three statements are given below.

Tick (✓) to show whether each statement is true or false.

Statement	True	False
All packets must be routed via the server.		
Computer B can read a copy of the packet sent from the Server to Computer A.		
No collisions are possible.		

[3]

(c) In the same building as this star network, there is another star network.

(i) Name the device needed to connect the two networks together.

.... [1]

(ii) Explain how the device in **part (c)(i)** decides whether to transfer a packet from one network to the other.

....

....

....

.... [2]