Cambridge International AS & A Level

**Cambridge International Examinations**
Cambridge International Advanced Subsidiary and Advanced Level

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|---|---|---|---|---|---|---|---|---|---|
| CANDIDATE NAME | | | | | | | | | |
| CENTRE NUMBER | | | | | | CANDIDATE NUMBER | | | |

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**COMPUTER SCIENCE** **9608/12**

Paper 1 Theory Fundamentals **October/November 2018**

**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 **13** printed pages and **3** blank pages.




CAMBRIDGE International Examinations

**1** A company is designing a website.

**(a)** The company creates a 4-colour bitmap image for the website as shown.

Each colour is represented by a letter, for example, G = grey, K = black.

| | | | | | |
|---|---|---|---|---|---|
| G | R | G | K | W | R |
| G | R | G | K | W | R |
| G | R | G | K | W | R |
| G | R | G | K | W | R |
| G | G | G | K | K | R |
| W | W | W | W | K | R |

**(i)** State the minimum number of bits needed to represent each pixel in the image in **part (a)**.

..... [1]

**(ii)** Calculate the minimum file size of the image shown in **part (a)**. Show your working.

Working .....

.....

.....

.....

File size .....

[3]

**(b)** The company takes a photograph of their office to put on the website. The photograph has a resolution of 1000 pixels by 1000 pixels. Two bytes per pixel are used to represent the colours.

**(i)** Estimate the file size of the photograph in megabytes. Show your working.

Working .....

.....

.....

.....

Estimated file size .....

[4]

**(ii)** The file size of the photograph needs to be reduced before it is placed on the website.

Draw lines to link each method of reducing the file size of the image to:

- its description and
- its compression type, where appropriate.

| Description | Method | Compression type |
|---|---|---|
| Removes pixels | Crop the photograph | Lossy |
| Reduces number of pixels per inch | Use run-length encoding | Lossless |
| Uses fewer bits per pixel | Use fewer colours | |
| Stores colour code and count of repetitions | | |

[5]

**(c)** The company has created a logo for the website. The logo is a vector graphic.

Describe **two** reasons why a vector graphic is a sensible choice for the logo.

Reason 1 .....

.....

.....

.....

Reason 2 .....

.....

.....

.....

[4]

**2** Gopal types the Uniform Resource Locator (URL) of a website into a web browser.

**(a)** The following sequence (1 to 5) describes the steps that take place. There are three missing statements.

1 Gopal types into the web browser.

2 .....

3 DNS looks up the URL in table

4 .....

5 .....

Three statements **A**, **B** and **C** are used to complete the sequence.

| | |
|---|---|
| **A** | DNS finds corresponding IP address |
| **B** | Web browser sends URL to Domain Name Service (DNS) |
| **C** | DNS returns IP address to web browser |

Write one of the letters **A** to **C** in the appropriate rows (2, 4 and 5) to complete the sequence. [2]

**(b)** Describe the purpose of an IP address.

.....

.....

.....

..... [2]

**(c)** A telecommunications operator has installed fibre-optic cables in Gopal's neighbourhood.

**(i)** Give **three** benefits of fibre-optic cable over copper cable.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

**(ii)** Give **two** drawbacks of fibre-optic cable over copper cable.

1 .....

.....

2 .....

.....

[2]

**3** The following table shows assembly language instructions for a processor which has one general purpose register, the Accumulator (ACC) and an Index Register (IX).

| Instruction | | Explanation |
|---|---|---|
| **Op code** | **Operand** | |
| LDD | <address> | Direct addressing. Load the contents of the location at the given address to ACC. |
| LDX | <address> | Indexed addressing. Form the address from <address> + the contents of the Index Register. Copy the contents of this calculated address to ACC. |
| LDR | #n | Immediate addressing. Load the number n to IX. |
| STO | <address> | Store contents of ACC at the given address. |
| ADD | <address> | Add the contents of the given address to ACC. |
| INC | <register> | Add 1 to the contents of the register (ACC or IX). |
| DEC | <register> | Subtract 1 from the contents of the register (ACC or IX). |
| CMP | <address> | Compare contents of ACC with contents of <address>. |
| JPE | <address> | Following compare instruction, jump to <address> if the compare was True. |
| JPN | <address> | Following compare instruction, jump to <address> if the compare was False. |
| JMP | <address> | Jump to the given address. |
| OUT | | Output to the screen the character whose ASCII value is stored in ACC. |
| END | | Return control to the operating system. |

**(a) (i)** State what is meant by **absolute addressing** and **symbolic addressing**.

Absolute addressing .....

.....

Symbolic addressing .....

.....

[2]

**(ii)** Give an example of an ADD instruction using both absolute addressing and symbolic addressing.

Absolute addressing .....

Symbolic addressing .....

[2]

**(b) (i)** State what is meant by **indexed addressing** and **immediate addressing**.

Indexed addressing .....

.....

Immediate addressing .....

.....

[2]

**(ii)** Give an example of an instruction that uses:

Indexed addressing .....

Immediate addressing .....

[2]

**(c)** The current contents of a general purpose register (X) are:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| X | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |

**(i)** The contents of X represent an unsigned binary integer.

Convert the value in X into denary.

..... [1]

**(ii)** The contents of X represent an unsigned binary integer.

Convert the value in X into hexadecimal.

..... [1]

**(iii)** The contents of X represent a two's complement binary integer.

Convert the value in X into denary.

..... [1]

**(d)** The current contents of the main memory, Index Register (IX) and selected values from the ASCII character set are:

| Address | Instruction |
|---|---|
| 40 | LDD 100 |
| 41 | CMP 104 |
| 42 | JPE 54 |
| 43 | LDX 100 |
| 44 | CMP 105 |
| 45 | JPN 47 |
| 46 | OUT |
| 47 | LDD 100 |
| 48 | DEC ACC |
| 49 | STO 100 |
| 50 | INC IX |
| 51 | JMP 41 |
| 52 | |
| 53 | |
| 54 | END |
| … | |
| 100 | 2 |
| 101 | 302 |
| 102 | 303 |
| 103 | 303 |
| 104 | 0 |
| 105 | 303 |

| IX | 1 |
|---|---|

**ASCII code table (selected codes only)**

| ASCII code | Character |
|---|---|
| 300 | / |
| 301 | * |
| 302 | - |
| 303 | + |
| 304 | ^ |
| 305 | = |

This is a copy of the instruction set.

| Instruction | | Explanation |
|---|---|---|
| **Op code** | **Operand** | |
| LDD | <address> | Direct addressing. Load the contents of the location at the given address to ACC. |
| LDX | <address> | Indexed addressing. Form the address from <address> + the contents of the Index Register. Copy the contents of this calculated address to ACC. |
| LDR | #n | Immediate addressing. Load the number n to IX. |
| STO | <address> | Store contents of ACC at the given address. |
| ADD | <address> | Add the contents of the given address to ACC. |
| INC | <register> | Add 1 to the contents of the register (ACC or IX). |
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| JPE | <address> | Following a compare instruction, jump to <address> if the compare was True. |
| JPN | <address> | Following a compare instruction, jump to <address> if the compare was False. |
| JMP | <address> | Jump to the given address. |
| OUT | | Output to the screen the character whose ASCII value is stored in ACC. |
| END | | Return control to the operating system. |

**9**

Complete the trace table for the given assembly language program.

| Instruction address | ACC | Memory address | | | | | | IX | OUTPUT |
|---|---|---|---|---|---|---|---|---|---|
| | | 100 | 101 | 102 | 103 | 104 | 105 | | |
| | | 2 | 302 | 303 | 303 | 0 | 303 | 1 | |
| 40 | | | | | | | | | |
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[7]

**4** A student has written the steps of the fetch stage of the fetch-execute (FE) cycle in register transfer notation. The student has made some errors.

```
Line 1      MDR ← [PC]

Line 2      PC ← PC + 1

Line 3      MDR ← [MAR]

Line 4      CIR ← PC
```

**(a)** Identify the line numbers of **three** errors that the student has made. Write the correct notation for each error.

| Line number of error | Correct notation |
|---|---|
| | |
| | |
| | |

[3]

**(b)** One stage of the FE cycle includes checking for interrupts.

**(i)** Give **three** different events that can generate an interrupt.

1 .....

2 .....

3 .....

[3]

**(ii)** Explain how interrupts are handled during the fetch-execute cycle.

.....

.....

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.....

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.....

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..... [5]

**(c)** The processor uses buses in the FE cycle.

The diagram shows three buses and two descriptions.

Draw **one** line from each bus to its appropriate description.

| Bus | Description |
|---|---|
| Control bus | Unidirectional (one direction) |
| Address bus | Bidirectional (two directions) |
| Data bus | |

[2]

**5** This question presents three scenarios. For each scenario, tick (✓) **one** box to show whether you think the person's behaviour is ethical or unethical. Justify your choice.

**(a)** Wendy is a software engineer who is developing a program for her company. Her friend, Noah, is developing a program for a different company. Wendy looks at the code that Noah is writing to get ideas for her own program.

| | |
|---|---|
| Ethical | |
| Unethical | |

Justification .....

.....

.....

..... [2]

**(b)** Amit is fixing some bugs in the computer system of a large multinational company. He is asked to sign a confidentiality agreement. He sees some confidential information which contains the names of other multinational companies that have broken the law. He copies this information and releases it on the Internet.

| | |
|---|---|
| Ethical | |
| Unethical | |

Justification .....

.....

.....

..... [2]

**(c)** Farah is providing a company with an estimate for the cost of writing a program. The company she works for is in financial difficulty so she increases the estimate by 10%.

| | |
|---|---|
| Ethical | |
| Unethical | |

Justification .....

.....

.....

..... [2]

**6** Kim is using her laptop computer to write a program in a high-level language.

**(a)** Kim needs to make sure the program is secure against unauthorised access. She has already set up a username and password on her laptop.

Identify **two** additional electronic measures that Kim can use to keep the program secure.

1 .....

2 .....
[2]

**(b)** Kim will use library routines in her program.

**(i)** Describe what is meant by a **library routine**.

.....

.....

.....

..... [2]

**(ii)** Describe **one** benefit and **one** drawback of using library routines.

Benefit .....

.....

.....

.....

Drawback .....

.....

.....

.....

[4]

**(c)** Kim develops her program and makes it ready for use. To do this, she uses first an interpreter and then a compiler.

Explain why Kim needs to use both an interpreter and a compiler.

Interpreter .....

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.....

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Compiler .....

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[4]

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