**1.** (a) Complete the truth table for the XOR logic gate.

| A | B | A XOR B |
|---|---|---|
| 0 | 0 | |
| 0 | 1 | |
| 1 | 0 | |
| 1 | 1 | |

**(1)**

(b) A game uses three sensors.

A red light (**R**) in the game switches on if **all** of the following conditions are true:

- sensor **D** is off
- sensor **L** is on
- sensor **W** is on.

Complete the logic circuit for this game.

You **must** use the correct symbols for the logic gates.


**(3)**

(c) Another circuit in the game will output True if any two sensors are activated or if all three sensors are activated. This has been represented as the Boolean expression:

(W . D) + (D . L) . (W . L)

The expression contains an error.

Shade **one** lozenge that shows the expression with the error corrected.

**A** (W . D) . (D . L) . (W . L) ⬭

**B** ($\overline{W}$ . D) . (D . L) + (W . L) ⬭

**C** (W . D) + (D . L) + (W . L) ⬭

**D** ($\overline{W}$ . D) + (D + L) . (W . L) ⬭

**(1)**

(d) A green light (**G**) in the game switches on if **all** of the following conditions are true:

- sensor **D** is off
- sensor **L** is off
- sensor **W** is on.

Write a Boolean expression for this logic circuit.

You **must** use Boolean expression operators in your answer.

**(3)**

**(Total 8 marks)**

**2.** Describe what is meant by the terms system software and application software.

**(Total 2 marks)**

**3.** State **four** functions of an operating system.

**(Total 4 marks)**

**4.** Programming languages can be classified as low-level or high-level.

Shade **two** lozenges to show the statements that are true about code written using a low-level language instead of a high-level language.

| | | |
|---|---|---|
| **A** | The code more closely resembles English. | ⬭ |
| **B** | The code is easier to write. | ⬭ |
| **C** | The code is not translated using a compiler. | ⬭ |
| **D** | The code is quicker to write. | ⬭ |
| **E** | The code can directly manipulate computer registers. | ⬭ |
| **F** | The code never needs to be translated before being executed. | ⬭ |

**(Total 2 marks)**

**5.** Assemblers and interpreters are two types of program translator.

State the purpose of an assembler.

**(Total 1 mark)**

**6.** Assemblers and interpreters are two types of program translator.

Explain how an interpreter works.

**(Total 4 marks)**

**7.** State **two** reasons why computers have more RAM than cache memory.

**(Total 2 marks)**

**8.** Data is increasingly being stored ‘in the cloud’.

State **two** advantages of using cloud storage instead of local storage.

**(Total 2 marks)**

**9.** Many new computers use solid-state storage for secondary storage rather than magnetic storage.

Explain why solid-state storage is **not** fitted to every new computer.

**(Total 2 marks)**

**10.** The following are three types of program translator:

**A** Assembler

**B** Compiler

**C** Interpreter

Write the label (**A**–**C**) for the type of translator next to the description.

| **Description** | **Label (A–C)** |
|---|---|
| Converts a low-level language designed to be human-readable into machine code. | |
| Reads a high-level program line-by-line and calls corresponding subroutines. | |
| Takes the entire high-level program as input and produces machine code. | |

**(Total 2 marks)**

**11.** State **two** advantages of programming using a high-level language compared with programming using a low-level language.

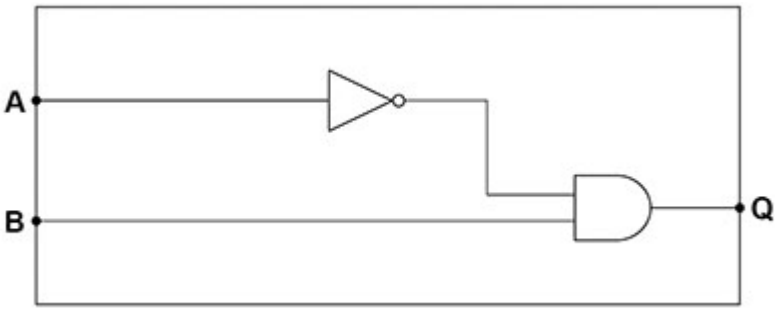
**(Total 2 marks)**

**12.** Draw the logic circuit, using only one logic gate, that is represented by the following truth table:

| Input A | Input B | Output Q |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |


**(Total 1 mark)**

**13.** Shade **one** lozenge to show the Boolean expression that is equivalent to the logic circuit shown in the diagram below.




**A** A AND NOT B

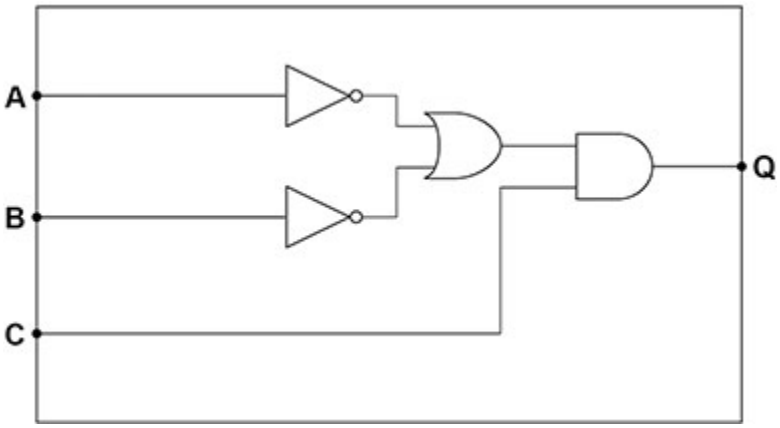
**B** NOT (A AND B)

**C** (NOT A) AND B

**D** (NOT A) AND (NOT B)

**(Total 1 mark)**

**14.** Shade **one** lozenge to show the Boolean expression which is equivalent to the logic circuit shown in the diagram below.




**A** `NOT ((A OR B) AND C)` ⬭

**B** `(NOT A) OR ((NOT B) AND C)` ⬭

**C** `(NOT (A OR B)) AND C` ⬭

**D** `((NOT A) OR (NOT B)) AND C` ⬭

**(Total 1 mark)**

**15.** The code below shows an algorithm.

```
x ← True
y ← False
IF NOT (x AND y) THEN
   OUTPUT 'A'
   IF NOT((NOT x) OR (NOT y)) THEN
      OUTPUT 'B'
   ELSE
      OUTPUT 'C'
   ENDIF
ELSE
   OUTPUT 'D'
   IF (NOT x) AND (NOT y) THEN
      OUTPUT 'E'
   ELSE
      OUTPUT 'F'
   ENDIF
ENDIF
```

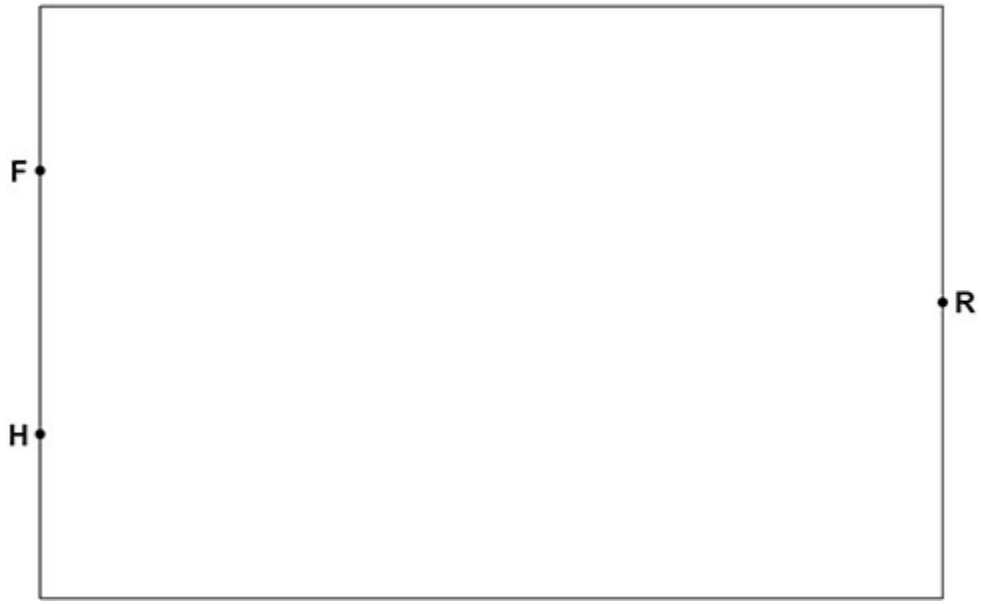
State the output from the algorithm shown in the code above.

**(Total 2 marks)**

**16.** Draw a logic circuit in the box below for the following scenario.

A sewing machine is running (R) if either the foot pedal is on (F) or the hand dial is on (H) but not both.

You should use **only** the gates AND, OR and NOT in your answer.




**(Total 3 marks)**

**17.** Shade **two** lozenges to show which of the following are functions of an operating system.

| | | |
|---|---|---|
| **A** | Address filtering | ⬭ |
| **B** | Application management | ⬭ |
| **C** | Clock speed management | ⬭ |
| **D** | Data encryption | ⬭ |
| **E** | Processor management | ⬭ |

**(Total 2 marks)**

**18.** Define the term **application software**.

**(Total 1 mark)**

**19.** Give **two** examples of application software. You must **not** use brand names in your answer.

**(Total 2 marks)**

**20.** This description of how a magnetic hard disk drive works is partially correct but contains some errors:

'A magnetic hard disk spins very quickly. The surface of the disk has a groove on it where data is stored. There is a needle that runs along the groove and detects bumps. One of the components of the drive is a read/write head.'

(a) Describe **three** factual errors in the description.

**(3)**

(b) State **one** correct fact in the description.

**(1)**

**(Total 4 marks)**

**21.** Shade the **two** lozenges that are correct statements about RAM.

**A** It is only used in solid state storage devices. ⬭

**B** It is used for main memory. ⬭

**C** It is used for secondary storage. ⬭

**D** It is volatile memory. ⬭

**E** It never loses data. ⬭

**F** It permanently stores programs and files. ⬭

**(Total 2 marks)**

**22.** Three factors that affect the performance of a CPU are:

- clock speed
- number of processor cores
- cache size.

Explain how each of these factors affects CPU performance.

**(Total 6 marks)**

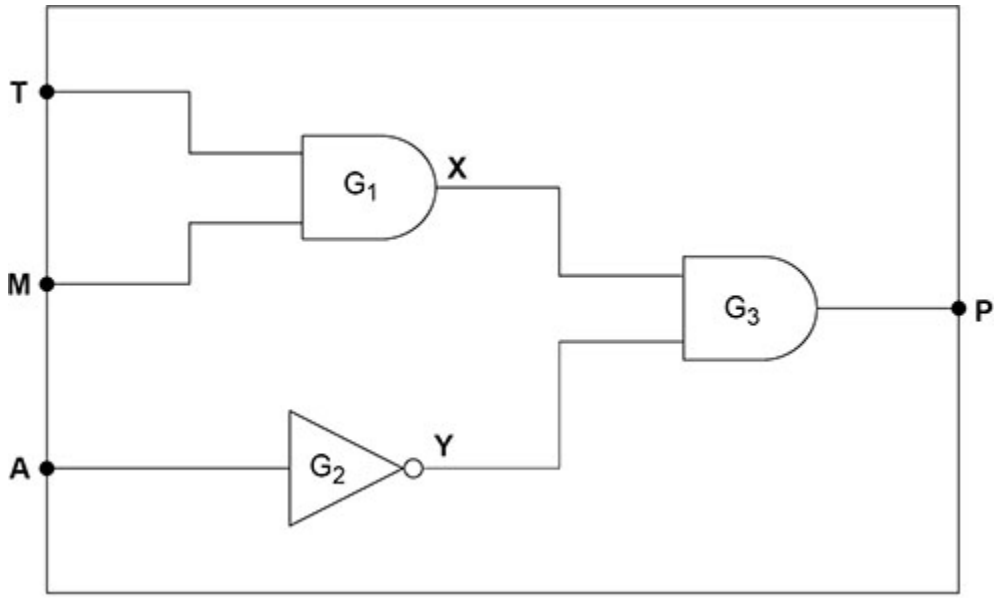
**23.** A farmer uses an automated system to indicate if soil conditions are right for planting.

The conditions are right for planting if the soil is:

- warm
- wet
- the correct acidity.

**Figure 1** shows the logic circuit for this system.

**Figure 1**




The inputs to the system are:

Soil temperature (**T**):
0 if the soil is cold
1 if the soil is warm.

Soil moisture (**M**):
0 if the soil is dry
1 if the soil is wet.

Soil acidity (**A**):
0 if the soil is the correct acidity
1 if the soil acidity needs adjusting.

The output (**P**) is:
0 if the conditions for planting have not been met
1 if the conditions for planting have been met.

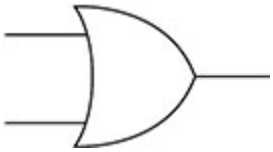
(a) Complete the truth table for the circuit in **Figure 1**.

| T | M | A | X | Y | P |
|---|---|---|---|---|---|
| 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 type of logic gate shown in **Figure 2**.

**Figure 2**



**(1)**

(c) The farmer wants to modify the system so that it will indicate that the soil conditions are right for planting if **at least one** of the three conditions has been met.

Describe changes that could be made to the logic circuit in **Figure 1** to allow this to happen.

**(2)**

**(Total 6 marks)**

**24.** Describe **two** differences between an embedded system and a non-embedded system.

**(Total 2 marks)**

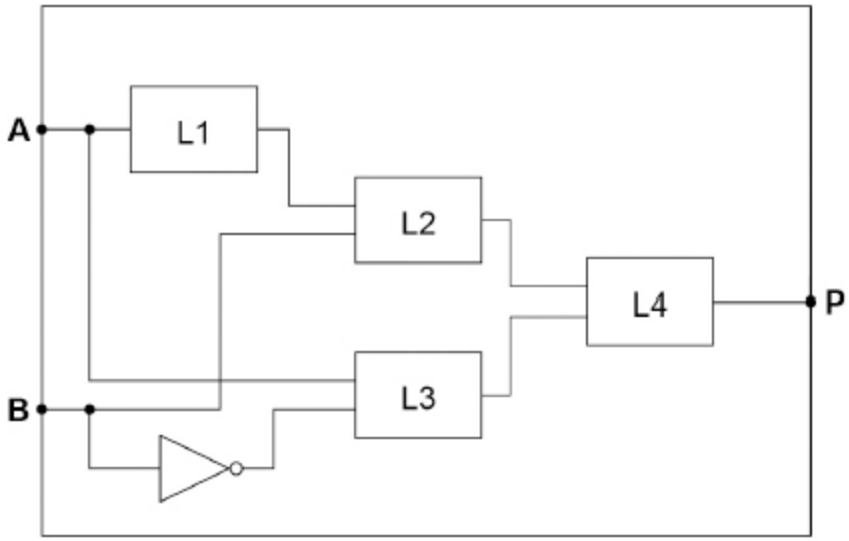
**25.** State the name of the logic gate represented by the following truth table.

| Input A | Input B | Output |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

**(Total 1 mark)**

**26.** A partially complete logic circuit shown below detects if a computer system has been set up correctly. There are two keyboard input devices, keyboard **A** and keyboard **B**, and either one can be connected to the computer system. However, if they are both connected then the computer system will not work.

Output **P** has the value 1 if either keyboard **A** or keyboard **B**, but not both, is connected to the computer system and 0 otherwise.




State the name of the logic gates that should be placed in the positions indicated by the labels **L1**, **L2**, **L3** and **L4** above.

| Label | Logic gate |
|---|---|
| **L1** | |
| **L2** | |
| **L3** | |
| **L4** | |

**(Total 3 marks)**

**27.** State what an assembly language program must be translated into before it can be executed by a computer.

**(Total 1 mark)**

**28.** State **two** reasons why a programmer, who can program in both high-level and low-level languages, would usually choose to develop in a high-level language rather than a low-level language.

**(Total 2 marks)**

**29.** Shade **three** lozenges to show which of the following are essential components of the Von Neumann architecture.

| | | |
|---|---|---|
| **A** | BIOS | ⬭ |
| **B** | Control unit | ⬭ |
| **C** | Keyboard | ⬭ |
| **D** | Memory | ⬭ |
| **E** | Movement sensor | ⬭ |
| **F** | Multiple cores | ⬭ |
| **G** | Network socket | ⬭ |
| **H** | Shared bus | ⬭ |

**(Total 3 marks)**

**30.** Main memory is any form of memory that is directly accessible by the CPU, except for cache and registers.

Explain how main memory is used.

**(Total 3 marks)**

**31.** The cost and physical size of RAM and secondary storage are normally different.

Describe **two** other differences between RAM and secondary storage.

**(Total 2 marks)**

**32.** An operating system manages the memory of a computer.

State **two** other things that are managed by the operating system.

**(Total 2 marks)**

**33.** The three examples of code shown in the table below are all equivalent to one another.

| Example 1 | Example 2 | Example 3 |
|---|---|---|
| a ← 4<br>b ← 3<br>IF a = b THEN<br>  c ← a + b<br>ENDIF | MOV R0, #4<br>MOV R1, #3<br>CMP R0, R1<br>BNE end<br>ADD R2, R0, R1<br>end:<br>HLT | 1001 0000 0100 0000<br>1001 0001 0011 0000<br>0100 0000 0001 0000<br>1010 0101 0000 0000<br>1100 0010 0000 0001<br>1111 0000 0000 0000 |

Shade **one** lozenge to show the statement that is true about the examples of code.

**A** None of the examples of code is in a low-level language. ⬭

**B** Only one of the examples of code is in a low-level language. ⬭

**C** Only two of the examples of code are in a low-level language. ⬭

**D** All three of the examples of code are in a low-level language. ⬭

**(Total 1 mark)**

**34.** Explain why a developer, who is good at both low-level and high-level programming, would normally use high-level languages when writing programs.

**(Total 4 marks)**

**35.** Statements **A** and **B** refer to two different types of program translator.

**Statement A:** This type of translator can convert a high-level language program into machine code. The source code is analysed fully during the translation process. The result of this translation can be saved, meaning the translation process does not need to be repeated.

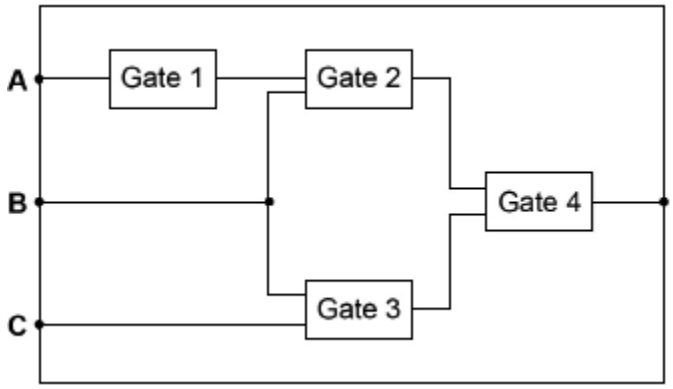
**Statement B**: This type of translator was used to convert the code in **Example 2** to the code in **Example 3** in the table below.

| Example 1 | Example 2 | Example 3 |
|---|---|---|
| a ← 4<br>b ← 3<br>IF a = b THEN<br>  c ← a + b<br>ENDIF | MOV R0, #4<br>MOV R1, #3<br>CMP R0, R1<br>BNE end<br>ADD R2, R0, R1<br>end:<br>HLT | 1001 0000 0100 0000<br>1001 0001 0011 0000<br>0100 0000 0001 0000<br>1010 0101 0000 0000<br>1100 0010 0000 0001<br>1111 0000 0000 0000 |

State the type of program translators referred to in statements **A** and **B**.

**(Total 2 marks)**

**36.** The expression `(B AND (NOT A)) OR (B AND C)` can be represented by the logic circuit shown below. In the circuit the logic gates are marked with labels instead of their proper symbols.




(a) State the name of the logic gate used at Gate 1 in the logic circuit.

**(1)**

(b) State the name of the logic gate used at Gate 2 in the logic circuit.

**(1)**

(c) Draw the logic circuit symbol in the space below for the logic gate used at Gate 3 in the logic circuit.

**(1)**

(d) Draw the logic circuit symbol in the space below for the logic gate used at Gate 4 in the logic circuit.

**(1)**

**(Total 4 marks)**

**37.** Complete the truth table for the Boolean expression:

`(X AND Y) OR (NOT X)`

| X | Y | X AND Y | NOT X | (X AND Y) OR (NOT X) |
|---|---|---|---|---|
| 0 | 0 | | | |
| 0 | 1 | | | |
| 1 | 0 | | | |
| 1 | 1 | | | |

**(Total 3 marks)**

**38.** A truth table for the complex Boolean expression:

```
(A1 AND (NOT A2) AND A3) OR (A1 AND A2 AND A3)
```

is shown below.

| A1 | A2 | A3 | OUTPUT |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |

Shade **one** lozenge which shows a simpler expression which is the equivalent of the original, more complex, expression.

**A** `NOT A1` ⬭

**B** `A2 OR A3` ⬭

**C** `A1 AND (NOT A2)` ⬭

**C** `A1 AND A3` ⬭

**(Total 1 mark)**

**39.** Which **two** of the following are components of a CPU?

Shade **two** lozenges.

**A** Arithmetic logic unit ⬭

**B** Control unit ⬭

**C** Fan ⬭

**D** Hard disk drive ⬭

**E** Keyboard ⬭

**F** Power supply unit ⬭

**(Total 2 marks)**

**40.** A computer game is one type of application software. State **two** other types of application software. You must **not** use brand names in your answer.

**(Total 2 marks)**

**41.** Select the **correct** statement about secondary storage.

Shade **one** lozenges.

**A** Secondary storage is a type of ROM. ⬭

**B** Secondary storage is non-volatile. ⬭

**C** Secondary storage is temporary. ⬭

**D** Secondary storage loses its content when it is turned off. ⬭

**(Total 1 mark)**

**42.** Describe how an optical disk is read.

**(Total 4 marks)**

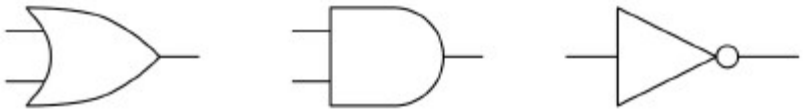
**43.** Define the term **embedded system**.

**(Total 2 marks)**

**44.** A burglar alarm sounds an alarm when it is armed (turned on) and the window or door is opened.

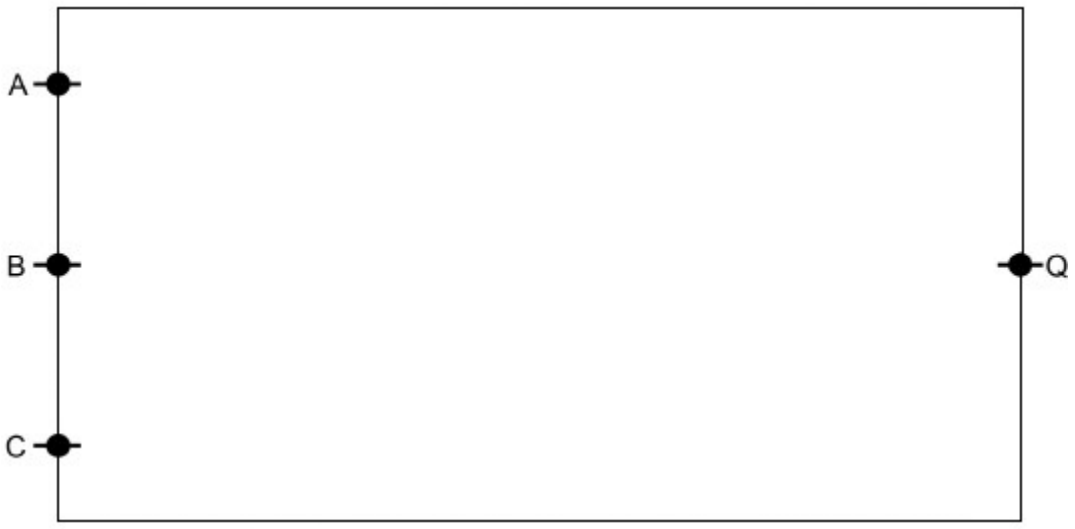
The truth table for this basic system is below.

| **Armed (A)**<br>**0 = Off**<br>**1 = On** | **Door (B)**<br>**0= Closed**<br>**1 = Open** | **Window (C)**<br>**0 = Closed**<br>**1 = Open** | **Alarm (Q)**<br>**0 = Off**<br>**1 = On** |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 |



OR AND NOT

Draw a logic circuit that represents the truth table above. You **must** use the correct symbols for logic gates. You may not need to use all the gates shown.




**(Total 3 marks)**

**45.** Specifications for two different devices are shown in the table below.

Discuss the advantages and disadvantages of **Device A** compared to **Device B**.

Your answer should explain the impact each advantage / disadvantage will have on the operation of the device.

You should assume that any aspects of the specifications **not** mentioned below are the same for both devices.

| Device A | Device B |
|---|---|
| Quad (4) core 1.6 GHz CPU with 8 MB cache | Dual (2) core 3.9 GHz CPU with 2 MB cache |
| 16 GB RAM | 4 GB RAM |
| 2 TB Hard Disk Drive (HDD) | 250 GB Solid State Drive (SSD) |

**(Total 12 marks)**

**46.** An SD card is a type of solid state storage.

State **two** advantages of solid state storage compared to magnetic storage.

**(Total 2 marks)**

**47.** Many modern desktop computers have both solid state drives and magnetic hard disk drives.

Give **two** reasons why desktop computers have a magnetic hard disk drive and a solid state drive instead of having just a solid state drive.

**(Total 2 marks)**

**48.** Describe how data is stored on, and read from, a magnetic hard disk.

**(Total 4 marks)**

**49.** In recent years, there has been a large growth in the use of cloud storage.

Discuss the advantages and disadvantages of using cloud storage.

In your answer you should include an explanation of the reasons for the large growth in recent years and consider any legal, ethical and environmental issues related to the use of cloud storage.

**(Total 9 marks)**

**50.** Many computers use the Von Neumann architecture.

In a computer that uses the Von Neumann architecture, bit patterns can be stored in the main memory. Shade the correct lozenge to indicate what these bit patterns could represent. You should only shade **one** lozenge.

**A** Data ⬭

**B** Instructions ⬭

**C** Data and instructions ⬭

**D** Data or instructions, but not both ⬭

**(Total 1 mark)**

**51.** Five components of a CPU are given below. For each row in the table, choose the letter **A**, **B**, **C**, **D**, **E** that best matches the description.

Letters should not be used more than **once**.

**A.** Bus
**B.** Arithmetic Logic Unit
**C.** Control Unit
**D.** Clock
**E.** Register

| Description | Letter |
|---|---|
| Sends a continuous series of electronic pulses | |
| Decodes the current instruction | |
| Completes calculations | |

**(Total 3 marks)**

**52.** Complete the truth table for the AND logic gate.

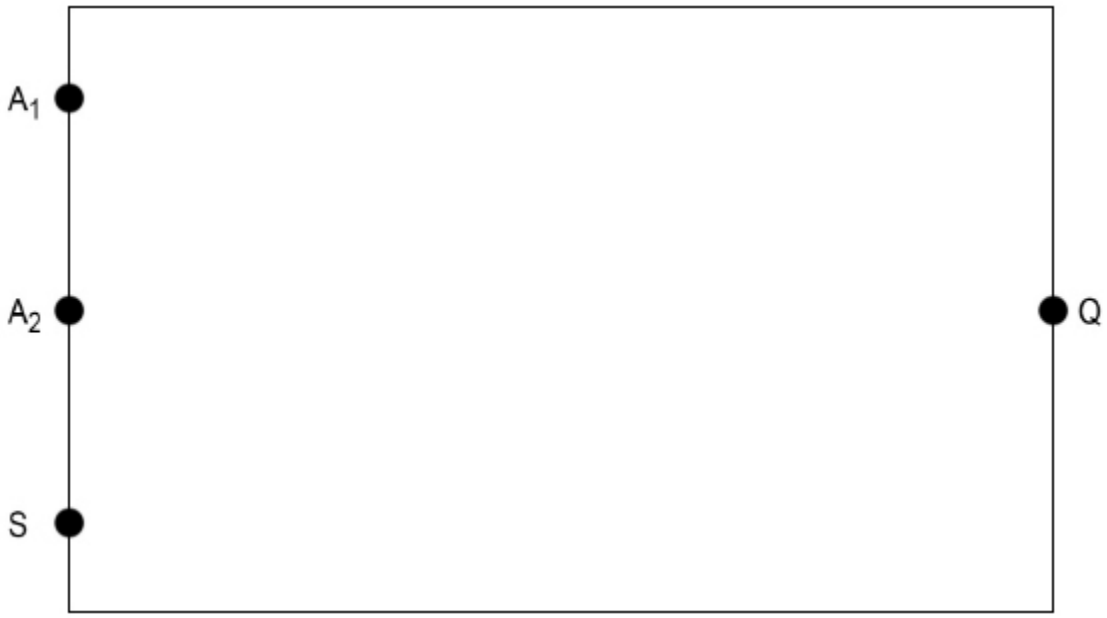
| A | B | A AND B |
|---|---|---|
| 0 | 0 | |
| 0 | 1 | |
| 1 | 0 | |
| 1 | 1 | |

**(Total 1 mark)**

**53.** A logic circuit is being developed for an audio advert in a shop that plays automatically if a customer is detected nearby.

- The system has two sensors, $A_1$ and $A_2$, that detect if a customer is near. The audio plays if either of these sensors is activated.
- The system should only play if another audio system, S, is not playing.
- The output from the circuit, for whether the advert should play or not, is Q.

Complete the logic circuit for this system.




**(Total 3 marks)**

**54.** Complete the truth table for the AND logic gate.

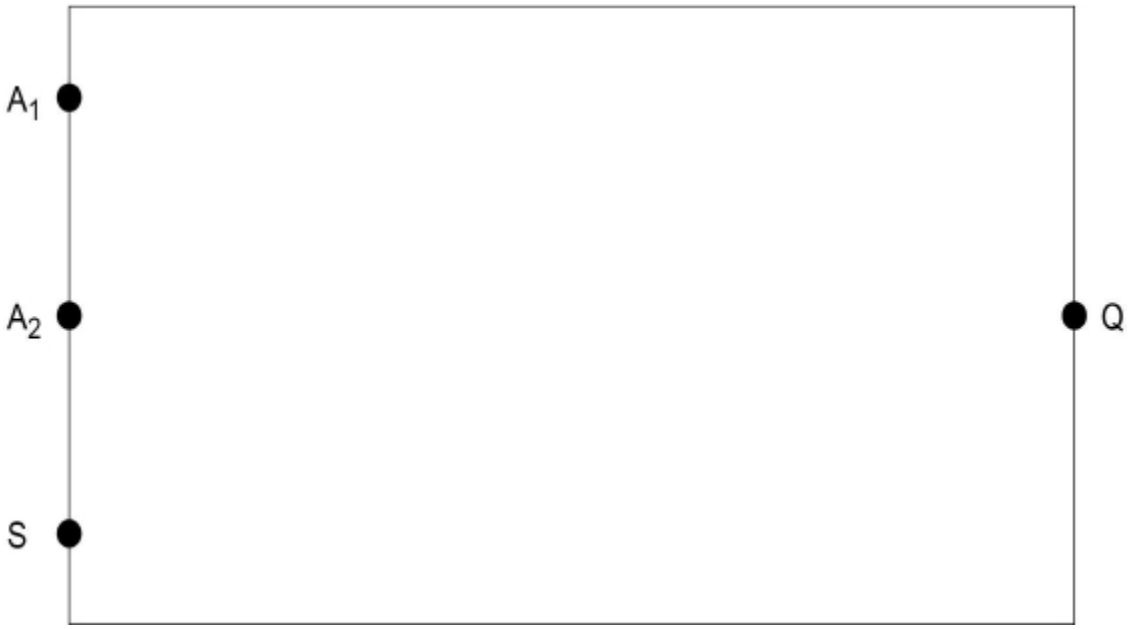
| A | B | A AND B |
|---|---|---|
| 0 | 0 | |
| 0 | 1 | |
| 1 | 0 | |
| 1 | 1 | |

**(Total 1 mark)**

**55.** A logic circuit is being developed for an audio advert in a shop that plays automatically if a customer is detected nearby.

- The system has two sensors, $A^1$ and $A^2$, that detect if a customer is near. The audio plays if either of these sensors is activated.
- The system should only play if another audio system, S, is not playing.
- The output from the circuit, for whether the advert should play or not, is Q.

Complete the logic circuit for this system.




**(Total 3 marks)**

**56.** ROM is a type of memory used in computers.

Shade **two** lozenges to show which statements are true about ROM.

**A** Desktop computers usually store application software in ROM ⬭

**B** Desktop computers typically have more ROM than RAM ⬭

**C** ROM is commonly used to store start-up instructions ⬭

**D** ROM is non-volatile ⬭

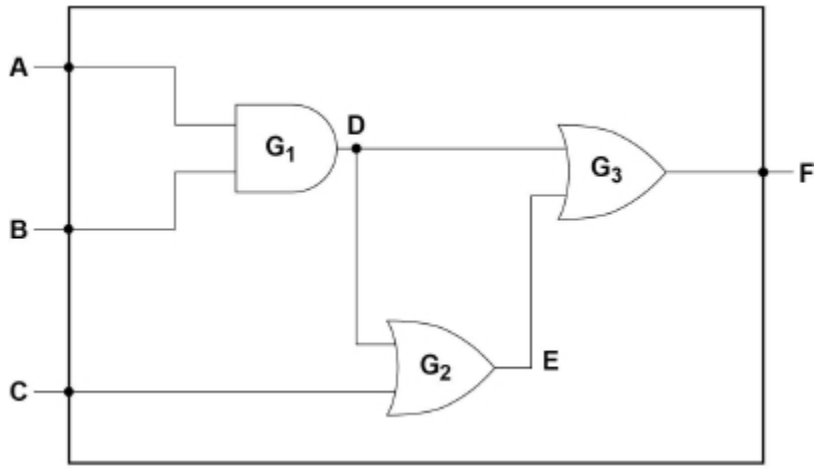
**E** ROM is used to increase the quality of graphics on a computer ⬭

**(Total 2 marks)**

**57.** Explain how a magnetic hard disk drive (HDD) operates.

**(Total 4 marks)**

**58.** The diagram below shows a logic circuit.




(a) State the type of logic gate labelled **$G_1$** in the diagram.

**(1)**

(b) State the type of logic gate labelled **$G_2$** in the diagram.

**(1)**

(c) State what a NOT gate does.

**(1)**

(d) Complete the following truth table for the logic circuit shown in the diagram above by filling in the grey shaded cells.

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | | | |
| 1 | 0 | 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | | |
| 1 | 1 | 1 | | | |

**(3)**

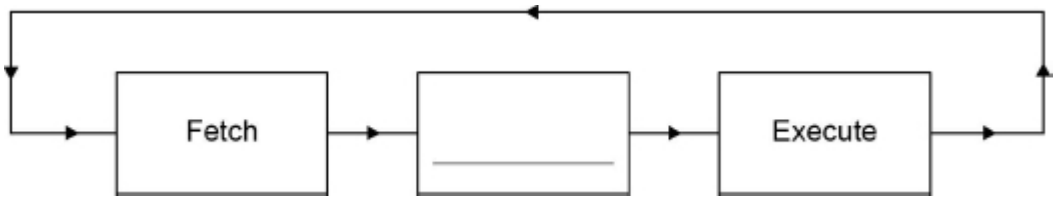
**(Total 6 marks)**

**59.** State **three** components of the CPU and describe their purpose.

**(Total 6 marks)**

**60.** The diagram below shows a simplified diagram of the Fetch-Execute cycle.

Fill in the name of the missing stage in the diagram below.




**(Total 1 mark)**

**1.**

(a) **Mark is for AO1 (understanding)**

| A | B | A XOR B |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

1 mark for correct column **A XOR B**;

**A.** F / FALSE / False / Off instead of 0
**A.** T / TRUE / True / On instead of 1
**R.** if correct outputs but mix of styles given eg F, T, T, 0.

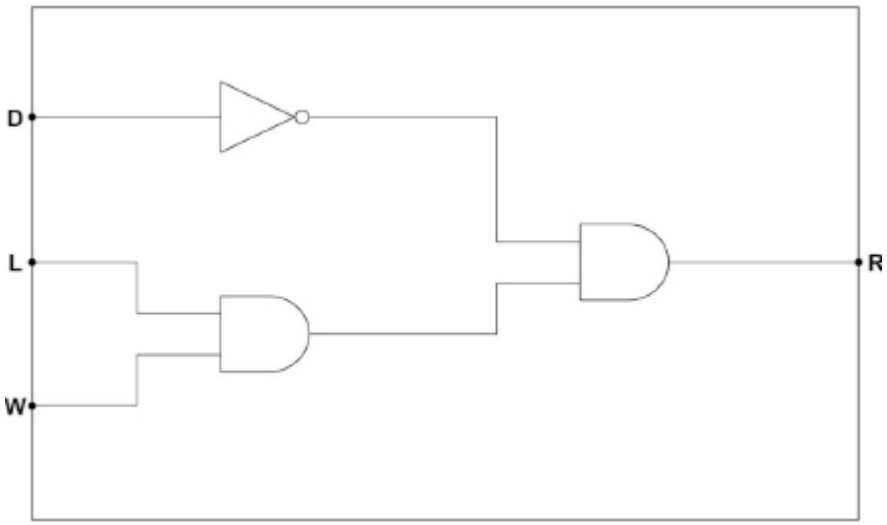
**1**

(b) **3 marks for AO2 (apply)**

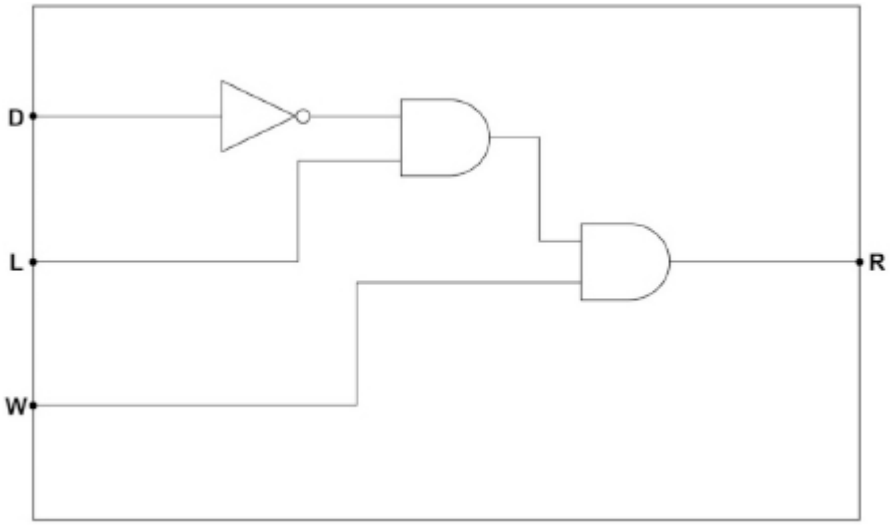
Maximum of **two** marks (if not fully correct) from:

- **D** is always the only input to a NOT gate with correct symbol used;
- AND gate with two correct inputs with correct symbol used;
- **R** is always the only output from a second AND gate with correct symbol used;

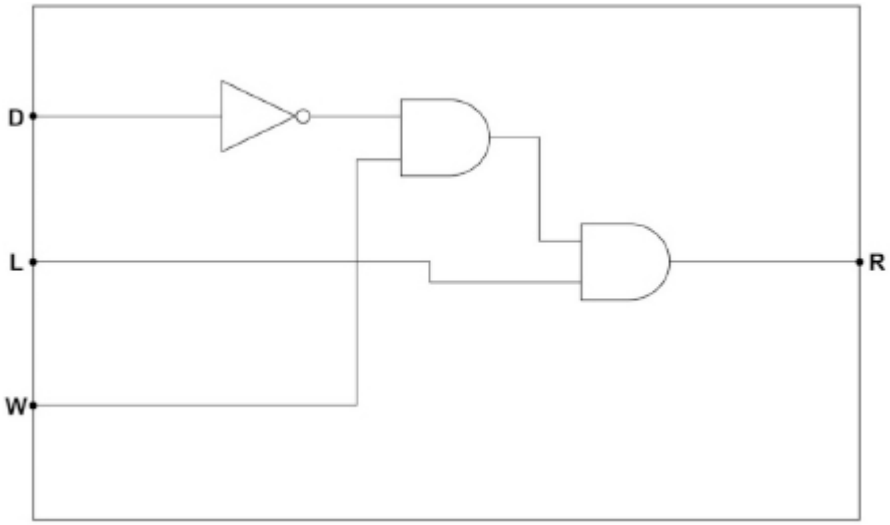
**Example 1**



**Example 2**




**Example 3**




**R.** incorrect symbols

**3**

(c) **Mark is for AO2 (apply)**

**C** `(W.D) + (D.L) + (W.L);`

**R.** if more than **one** lozenge shaded

**1**

(d) **3 marks for AO2 (apply)**

$\overline{D}.\overline{L}.W$ // $W.(\overline{D+L})$ // $(\overline{D}.W).(\overline{L}.W)$ ;;;

**2 marks** if fully correct but using different notation, eg
NOT D AND NOT L AND W;;
W AND NOT (D OR L);;
(NOT D AND W) AND (NOT L AND W);;

Maximum of **two** marks (if not fully correct) from:

- **1 mark** for using Boolean operator symbols throughout he expression; (**for this year only**)
- **1 mark** for $W + (\overline{D.L})$;
- **1 mark** for $\overline{D} + \overline{L} + W$;
- **1 mark** for $(\overline{D} + W) + (\overline{L} + W)$;

3

**[8]**

**2.** **2 marks for AO1 (recall)**

System software **(**Maximum of **one** mark from:**)**
- Manages / controls computer hardware;
- Manages application software;
- Manages / runs / controls a computer (system);
- Manages the operation of the computer (system);

Application software
- Is for (end-)user tasks;

**[2]**

**3.** **4 marks for AO1 (recall)**

Maximum of **four** marks from:

- Processor / task / process management;
- Memory management;
- I/O device management; **A.** Peripheral Management (**for this year only**)
- Applications management;
- Security management;
- File / storage management;
- Network management;

**A.** Provides a user interface

**[4]**

**4.** **2 marks for AO1 (understanding)**

**C** The code is not translated using a compiler;

**E** The code can directly manipulate computer registers;

**R.** if more than **two** lozenges shaded

**[2]**

**5.** **Mark is for AO1 (recall)**

To convert / translate / change / turn assembly language into machine code;

**NE.** convert/translate assembly language

**[1]**

**6.** **4 marks for AO1 (understanding)**

| Level | Description | Marks range |
|---|---|---|
| 2 | At the upper end of the mark range the student will have shown a coherent and accurate explanation of how an interpreter works with clear references to the principles of operation.<br>At the lower end of the mark range the student will have demonstrated a good understanding of how interpreters function. | 3-4 |
| 1 | At the upper end of the mark range the student will have included some explanation of how an interpreter works though there may be key steps or elements either missing or described inaccurately.<br>At the lower end of the mark range the student will have made one or two relevant statements but there may be errors or omissions in their understanding of how interpreters function. | 1-2 |
| No creditworthy material. | | 0 |

**Indicative content**

- Interpreters do not produce any machine code so the program needs to be translated each time it is executed.
- They call machine code subroutines within their own code to carry out commands / directly execute the instruction.
- Translating a line / statement at a time (rather than all at once) which it then executes.
- If a runtime error is found the interpreter stops.

**[4]**

**7.** **2 marks for AO1 (understanding)**

- RAM is cheaper (per byte);
- The capacity of cache memory is not enough to store both data and programs.

**[2]**

**8.** **2 marks for AO1 (understanding)**

Maximum of **two** marks from:

- enables user to access their data from more places/devices;
- enables user to more easily share data with others (can make parts of their cloud storage publicly available) // To allow sharing of files;
- increases the amount of potential storage available;
- reduced cost of computing devices for users as no need for as much built-in secondary storage // Can potentially purchase a cheaper (lower spec) computer;
- to allow concurrent access/collaboration;
- cloud storage is automatically backed up by the host;

**R.** Relative cost, unless statement is qualified.

**[2]**

**9.** **2 marks for AO2 (apply)**

Maximum of **two marks** from:

SSDs are relatively expensive // have higher cost per (giga)byte;
SSDs (typically) have lower capacity than magnetic hard drives;

**2 marks** if a valid point is made along with a suitable valid expansion

**A.** magnetic hard drives (usually) have higher write/erase cycles (which can make them more suitable for hard disk recording, eg music, video)
**A.** SSDs have limited write/erase cycles // SSDs degrade over time

**[2]**

**10.** **2 marks for AO1 (understanding)**

1 mark for one row correct;
2 marks for all rows correct;

**R.** any duplicated answers

Correct table as follows:

| Description | Label (A–C) |
|---|---|
| Converts a low-level language designed to be human-readable into machine code. | A |
| Reads a high-level program line-by-line and calls corresponding subroutines. | C |
| Takes the entire high-level program as input and produces machine code. | B |

**[2]**

**11.** **2 marks for AO1 (understanding)**

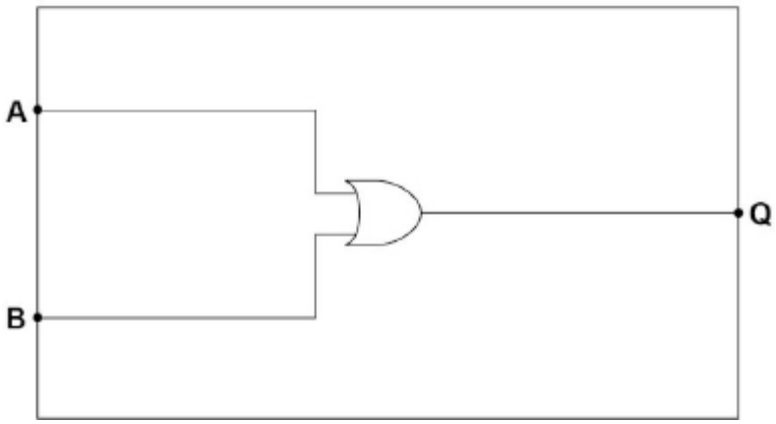
**Max two** from:

(High-level languages) are easier to test // identify mistakes (than low-level languages);
(High-level languages) allow faster development (than low-level languages);
(High-level languages) are better documented (than low-level languages);
(High-level languages) contain complex data structures;
(High-level languages) allow code to be more portable (than low-level languages);

Refer other plausible answers to Team Leader.

**[2]**

**12.** **Mark is for AO2**




Answers **must** show two inputs and one output from the gate.

**I.** any labels on inputs or output.

**[1]**

**13.** **Mark is for AO2**

**C** `(NOT A) AND B;`

**R.** If more than one lozenge shaded

**[1]**

**14.** **Mark is for AO2**

**D** `((NOT A) OR (NOT B)) AND C;`

**R.** If more than one lozenge shaded

**[1]**

**15.** **2 marks for AO2**

```
A;
C;
```

**I.** use of quote marks
**I.** if answers are on the same line or different lines as long as order is clear
**R.** if more than two characters are stated

**[2]**

**16.** **3 marks for AO2**

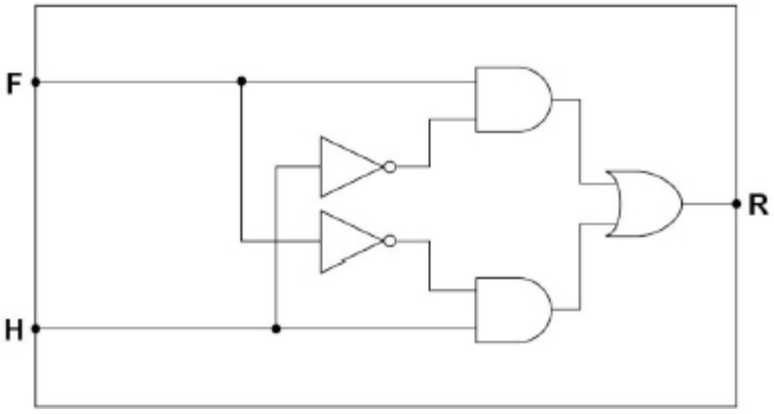
1 mark for using gates to implement (F and NOT H);
1 mark for using gates to implement (H and NOT F);
1 mark for an OR gate having two inputs, whose output is R;

**Max 2 marks if any errors.**

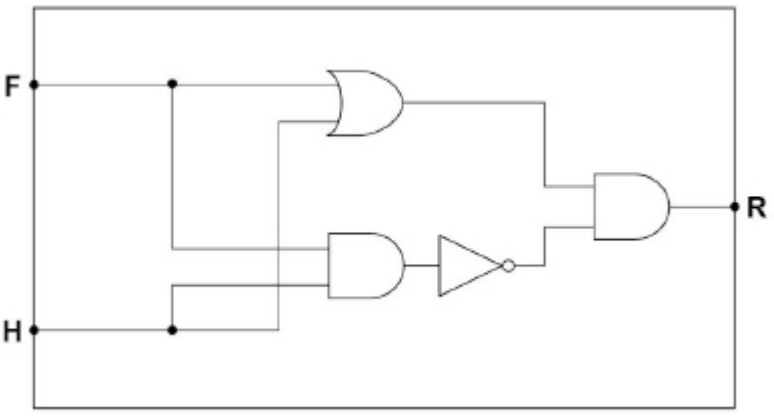
**Award full marks if a different, but logically correct, solution is given using only AND, OR or NOT gates.**

**Max 1 mark if gates other than AND, OR or NOT are used**.

This is an example of a correct logic circuit:




Another example of a correct logic circuit:




**[3]**

**17.** **2 marks for AO1 (recall)**

**B** Application management;
**E** Processor management;

**R.** If more than two lozenges shaded.

**[2]**

**18.** **Mark is for AO1 (recall)**

Example answers:

(Software) that is for end-user tasks;
(Software) that allows the user to carry out day to day tasks/work;

**[1]**

**19.** **2 marks for AO1 (recall)**

Any two relevant examples (maximum of **two** marks), such as:

- word-processing software;
- database software;
- spreadsheet software;
- social media application;
- communication software;
- online ordering applications;
- online auction software;
- gaming software;

**R.** Proprietary names.
**R.** Utility software such as anti-virus, disk defragmenter / disk cleaner.

**[2]**

**20.** (a) **3 marks for AO1 (understanding)**

One mark for each of the following points (maximum of **three** marks):

- there isn't a groove;
- there isn't a needle;
- there aren't any bumps;
- nothing runs along the surface of the disk;

**3**

(b) **Mark is for AO1 (understanding)**

One mark for either of the following points (maximum of **one** mark):

- (a magnetic hard) disk spins (very quickly);
- (one of the components of the drive is) a read / write head;

**1**

**[4]**

**21.** **2 marks for AO1 (recall)**

**B** It is used for main memory;
**D** It is volatile memory;

**R.** If more than two lozenges shaded.

**[2]**

**22.** **6 marks for AO1 (understanding)**

One mark for each point (maximum of **two** marks per section).

**Clock speed:**

- the more pulses a second the more fetch-execute cycles / processes per second;
- each instruction starts on a clock pulse;
- the more pulses per second the more instructions are likely to be carried out // a higher clock speed means more instructions can start per second;

**A.** Opposites of above.
**A.** Limitations including consequences of overclocking; heat build-up affecting performance.

**Number of processor cores:**

- affects the number of instructions that may be executed simultaneously // the greater the number of (processor) cores the greater the number of instructions that may be executed simultaneously;
- different (processor) cores dealing with different types of instruction (eg graphics, maths) (improve the execution of software);
- each (processor) core can fetch / execute its own instructions (which increases the speed at which instructions can be executed);

**A.** Opposites of above.

**Cache size:**

- instructions / data take less time to transfer to the processor from cache;
- because cache is held closer to the processor;
- the more cache the more data / instructions can be held (close to the CPU);
- the more cache the faster the CPU can access frequently needed instructions / data;

**A.** Opposites of above.

**[6]**

**23.** (a) **3 marks for AO2 (apply)**

| X | Y | P |
|---|---|---|
| 0 | 1 | 0 |
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 0 | 0 | 0 |
| 1 | 1 | 1 |
| 1 | 0 | 0 |

One mark for each column completed correctly;

**A.** Follow through on column **P** from incorrect columns **X** or **Y**.

**3**

(b) **Mark is for AO1 (recall)**

OR;

**1**

(c) **2 marks for AO2 (apply)**

One mark for each of the following:

- replace (gate) G1 with an OR gate;
- replace (gate) G3 with an OR gate;

**A.** Any other acceptable alternative.

**2**

**[6]**

**24.** **2 marks for AO1 (understanding)**

One mark for any of the following points for embedded systems (maximum of **two** marks):

- embedded systems have a specific purpose while non-embedded systems are general-purpose;
- embedded systems (tend to) have smaller amounts of memory than non-embedded systems;
- embedded systems (tend to) have less processing power than non-embedded systems;
- embedded systems are built into a specific device while non-embedded systems are not;
- embedded systems (tend to) have a higher proportion of ROM than non-embedded systems;

**A.** Opposites of above.

**[2]**

**25.** **Mark is for AO1 (recall)**

AND;

**[1]**

**26.** **3 marks for AO2 (apply)**

1 mark for one correct label;
2 marks for two correct labels;
3 marks for all correct labels;

| Label | Logic Gate |
|---|---|
| L1 | NOT |
| L2 | AND |
| L3 | AND |
| L4 | OR |

**[3]**

**27.** **Mark is for AO1 (understanding)**

Machine code;

**A.** binary;
**A.** object code;

**[1]**

**28.** **2 marks for AO1 (understanding)**

**Max 2 marks from:**

(High-level languages) are better supported;
(High-level languages) provide built-in subroutines;
(High-level languages) provide programming structures such as iteration and selection;
(Code written in high-level languages) is normally shorter;
(High-level languages) allow creation of subroutines;
(High-level languages) provide data structures;
(High-level languages) are easier to understand/read;
(High-level languages) are easier to debug;

**A.** any other correct justification.

**[2]**

**29.** **3 marks for AO1 (recall)**

**B** Control unit;
**D** Memory;
**H** Shared bus;

**R.** if more than three lozenges shaded.

**[3]**

**30.** **3 marks for AO1 (understanding)**

A **maximum of 3 marks** can be awarded.

Example mark points include:

- it stores instructions whilst a program is being executed;
- it stores data whilst a program is being executed;
- each unique memory location in memory holds one value;
- every memory location has a unique address;
- once data has been stored in memory it can be found again later (when it's needed);
- data and instructions are replaced in memory as needed;

**[3]**

**31.** **2 marks for AO1 (understanding)**

A **maximum of 2 marks** can be awarded.

Example mark points include:

- RAM is volatile // the contents of RAM are lost when the power is removed // secondary storage is non-volatile // the contents of secondary storage are not lost when the power is removed;
- RAM capacities are (usually) lower than secondary storage capacities;
- generally (the contents of RAM can be read/written) faster than secondary storage // RAM is physically closer to the CPU;

**R.** references to cost
**R.** references to physical size

**[2]**

**32.** **2 marks for AO1 (recall)**

A **maximum of 2 marks** can be awarded for any two of the following:

- Processor/CPU;
- I/O devices;
- Applications/programs;
- Security;
- File storage/management;

**R.** references to memory

**[2]**

**33.** **Mark is for AO1 (understanding)**

**C** Only two of the examples of code are in low-level languages;
**If more than one lozenge shaded then mark is not awarded**

**[1]**

**34.** **4 marks for AO1 (understanding)**

Maximum four marks from:

- High-level languages have built-in functions;
- High-level languages have built-in libraries;
- High-level languages have more support / help;
- High-level languages have structures (such as selection and iteration);
- High-level languages can be less machine dependent / more portable;
- It (usually) requires fewer lines of code to be written;
- It is (usually) quicker to develop code in high-level languages;
- It is easier to find mistakes in code;
- The code is easier to maintain / understand;
- It is easier to structure code in high-level languages;

**NE.** References to efficiency or speed unless correctly qualified;
**A.** Easier to read in place of easier to understand on this occasion;
**R.** Answers relating to programmer expertise;

**[4]**

**35.** **2 marks for AO1 (understanding)**

[Statement A:] compiler;
[Statement B:] assembler;

**[2]**

**36.** (a) **Mark is for AO2 (apply)**

NOT;

**1**

(b) **Mark is for AO2 (apply)**

AND;

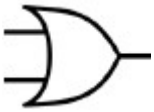
**1**

(c) **Mark is for AO2 (apply)**

**I.** all labels;

**1**

(d) **Mark is for AO2 (apply)**



**I.** all labels;

**1**

**[4]**

**37.** **3 marks for AO2 (apply)**

1 mark for correct column **X AND Y**;
1 mark for correct column **NOT X**;
1 mark for correct **OR** of the answers given in the column **X AND Y** and the column **NOT X** even if the answers for **X AND Y** and **NOT X** are incorrect.

The correctly completed table is:

| X | Y | X AND Y | NOT X | (X AND Y) OR (NOT X) |
|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 0 | 1 |

**A.** follow through from previous columns

**[3]**

**38.** **Mark is for AO2 (apply)**

**D** A1 AND A3;

**If more than one lozenge shaded then mark is not awarded**

**[1]**

**39.** **2 marks for AO1 (recall)**

**A** Arithmetic logic unit;
**B** Control unit;

**If more than two lozenges shaded then marks are not awarded.**

**[2]**

**40.** **2 marks for AO1 (recall)**

Max of two marks.

- Word processor;
- Spreadsheet;
- Presentation;
- Web browser;
- Graphic design//CAD//Computer Aided Design;
- Database//RDMS//Relational Database Management System;
- Media player//Video player//Music player;
- Music creator;
- Bespoke software//Custom designed software;

**A.** Any other appropriate answer that is **not** a software brand.

**R.** Microsoft Word, Corel Draw, Internet Explorer, Chrome as they are brands.
**R.** Utility software such as virus scanner, disk maintenance tools etc.
**R.** Games as it was the given example.

The addition of “software” to the answers is optional.

**[2]**

**41.** **1 mark for AO1 (recall)**

**B** Secondary storage is non-volatile;

**If more than one lozenge shaded then mark is not awarded.**

**[1]**

**42.** **4 marks for AO1 (understanding)**

Max of four marks.

- Disk rotates (at high speed);
- Laser head moves across (radius of) disk;
- Laser shines onto the disk;
- Tiny indentations / pits / bumps reflect light differently (to lands / flats)//Different colour of dye reflects or blocks laser light;
- Reflected light is interpreted into 1s and 0s representing data stored on disk;
- Data is stored on a single spiral track (rather than concentric tracks);

**R.** Reference to pits and lands corresponding to ones and zeros unless combined with a description of how they reflect light.

**[4]**

**43.** **2 marks for AO1 (recall)**

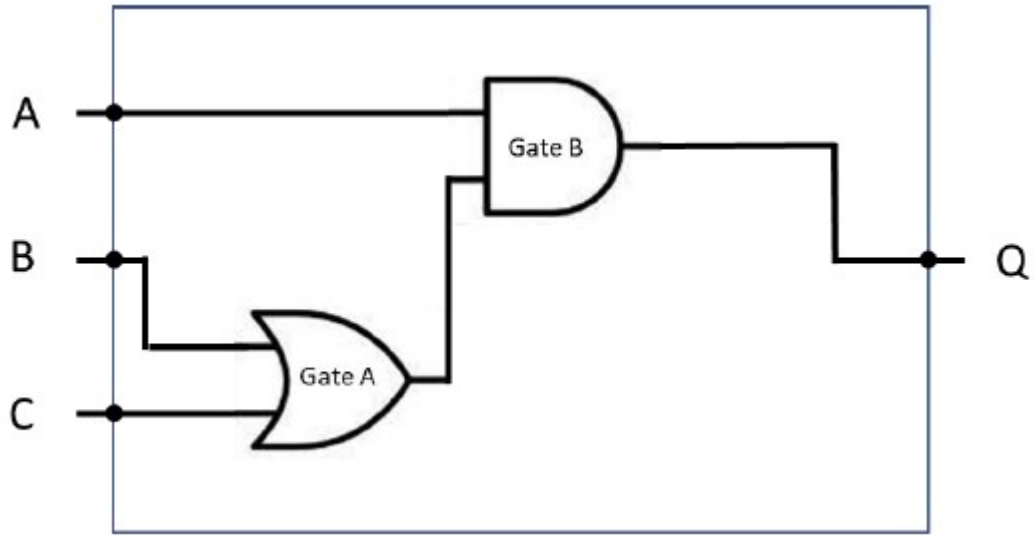
A computer system:
- with a dedicated / specific purpose or function;
- built in to a physical product / device / machine;

**A.** AQ (computer) system with firmware / software inside a product / device;
**A.** Reference to ‘system’ if relevant examples are given for clarification;

**NE.** A specific example e.g. “like in a washing machine” without further qualification.

**[2]**

**44.** **3 marks for AO2 (apply)**




- **OR Gate**, with correct symbol used, with **TWO inputs** from B and C;
- **AND Gate**, with correct symbol used, with **TWO inputs** from A and Gate A (even if Gate A is an incorrect gate);
- Output from Gate B is the only connection to Q (even if Gate B is an incorrect gate);

**[3]**

**45.** **4 marks for AO1 (understanding) 8 marks for AO2 (apply)**

| Level | Description | Mark Range |
|---|---|---|
| 4 | Evidence of a **clear understanding** is shown through **discussion** of the devices' properties.<br>Comparisons are well supported by valid technical explanations for the advantages **and** disadvantages.<br>Explanations are clear and accurate, using correct and detailed technical language **throughout**. | 10-12 |
| 3 | Evidence of a **more developed understanding** is shown through **comparisons** of the devices' properties.<br>Comparisons are supported by explanations that give valid technical reasons for the advantages **and / or** disadvantages.<br>Technical language is used accurately in **most** cases. | 7-9 |
| 2 | Evidence of **some understanding** is shown by making **brief comparisons** of the devices' properties.<br>Comparisons are supported by simple descriptions of the advantages **and / or** disadvantages.<br>There is **some** use of technical language although its use is sometimes inaccurate. | 4-6 |
| 1 | Evidence is shown of **limited understanding** through a **simple identification** of which device's properties are better or worse than the other.<br>**Limited** supporting statements are provided.<br>There is **no** use of technical language, or if there is it is used inaccurately. | 1-3 |
| **No creditworthy material** | | 0 |

**Guidance:**

There are 5 different properties that can be compared between the devices: cores; clock speed; cache; RAM; HDD / SSD.

| Possible comparisons | Device A | Device B |
|---|---|---|
| Core | Quad (4) core<br>• More cores than B.<br>• Can process more commands in same time than dual core. | Dual (2) core<br>• Less cores than A.<br>• Can process fewer commands in same time than quad core. |
| Clock Speed | 1.6 GHz CPU<br>• Lower clock speed than B.<br>• Would process fewer instructions per second than B **if it had the same number of cores**.<br>• Combined with the quad core processor this equates to raw power of 6.4 billion instruction per sec – theoretically worse than B.<br>• Slower processor so more energy efficient. | 3.9 GHz CPU<br>• Higher clock speed than A.<br>• Would process more instructions per second than A **if it had the same number of cores**.<br>• Combined with the dual core processor this equates to raw power of 7.8 billion instructions per sec – so theoretically better than A.<br>• Faster speed means more power consumption/less efficient.<br>• So may run hotter. |
| Cache | 8 MB cache<br>• More cache than B.<br>• Theoretically CPU A will have to wait less time to get instructions.<br>• Despite less raw speed this may mean A is overall faster than B. | 2 MB cache<br>• Less cache than A.<br>• Because it has less cache than A there might be bottlenecks. This might negate B's overall better raw speed than A. |
| RAM | 16 GB RAM<br>• More RAM than B.<br>• Potential boost to A as more programs and data will be held in memory, reducing time to read from secondary storage. | 4 GB RAM<br>• Less RAM than A.<br>• More likely to require use of virtual memory.<br>• Increased access of secondary storage may be balanced by use of faster SSD. |
| Secondary Storage | 2 TB Hard Disk Drive (HDD)<br>• More storage than B.<br>• Slower access than SSD.<br>• Less resilient, as mechanical.<br>• May be more suitable for large media files. | 250 GB Solid State Drive (SSD)<br>• Much less storage than A.<br>• SSDs more resilient.<br>• SSDs faster.<br>• Because uses flash memory.<br>• Less useful for storing large files, e.g. media.<br>• More energy efficient as no |

| | | |
|---|---|---|
| | | motor. |
| Overall comparison | Overall, not much difference in processing speeds but A more suitable for non-mobile device processing lots of media and B fairly powerful mobile computer but with limited storage space. | |

**[12]**

**46.** **All marks AO1 (understanding)**

Lighter; Smaller;

Uses less power; More robust;

Generates less heat; Quieter;

**Max 2**

**[2]**

**47.** **2 marks for AO2 (apply)**

Using just solid state would cost much more;
Can get higher storage capacity by including magnetic hard disk;

**[2]**

**48.** **All marks AO1 (understanding)**

On a hard disk binary data represented by tiny magnetised regions;
where the magnetic orientation in one direction represents 0, and the other direction represents 1;
When reading data the read/write head is moved (to be over correct track); and the platter/disk spins round;
A whole sector/block read in one go (by the read/write head);

**Max 4**

**[4]**

**49.** **All marks AO2 (apply)**

| Level | Description | Mark Range |
|---|---|---|
| 3 | Answer demonstrates a **sustained line of reasoning** with a **substantiated** explanation for the recent large growth in the use of cloud storage that includes **both** technological and social reasons.<br>There is a **logically structured** consideration of the advantages and the disadvantages associated with the use of cloud storage - including **relevant** points covering **at least two** of legal, ethical and environmental issues. | 7 – 9 |
| 2 | Answer includes an explanation for the recent large growth in the use of cloud storage that includes **both** technological and social reasons.<br>There is a **logically structured** consideration of the advantages and the disadvantages associated with the use of cloud storage - including **one or two relevant** points related to legal, ethical and environmental issues. | 4 – 6 |
| 1 | The answer includes either a description of some of the reasons for the recent large growth in the use of cloud computing and/or brief consideration of the advantages and/or disadvantages associated with using cloud storage. | 1 – 3 |
| No creditworthy answer | | 0 |

**Guidance - Indicative Response (reasons for growth)**
Higher bandwidth mobile networks (eg 4G); Increased availability of mobile devices;
Reduction in cost of large capacity storage devices;
Improvements in network security;
People have a higher level of trust in cloud storage; Improvements in web browser software;
Increased availability of supercomputers (for cloud processing);
Companies have managed to develop business models based on cloud computing that allow them to make a profit;

**Guidance - Indicative Response (advantages of cloud storage)**
Enables user to access their data from more places/devices;
Enables user to more easily share data with others (can make parts of their cloud storage publicly available);
Increases the amount of storage available;
Reduced cost of computing devices for users as no need for as much built-in secondary storage;

**Guidance - Indicative Response (disadvantages of cloud storage)**
Increased security risks;
Relies on access to high-bandwidth network connection; Could potentially cost more due to ongoing costs; Reliance on company providing the cloud service;
Increased chance of others accessing personal data (data privacy issues);

**[9]**

**50.** **1 mark for AO1 (understanding)**

**C** Data and instructions;

**R.** If more than one lozenge shaded

**[1]**

**51.** **3 marks for AO1 (understanding)**

| **Description** | **Letter** |
|---|---|
| Sends a continuous series of electronic pulses | D; |
| Decodes the current instruction | C; |
| Completes calculations | B; |

**Mark as follows:**
**1 mark:** one row correct;
**2 marks:** two rows correct;
**3 marks:** all rows correct;

**[3]**

**52.** **Mark is for AO1 (understanding)**

Only reward if column **A AND B** is completely correct;

| **A** | **B** | **A AND B** |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

**[1]**

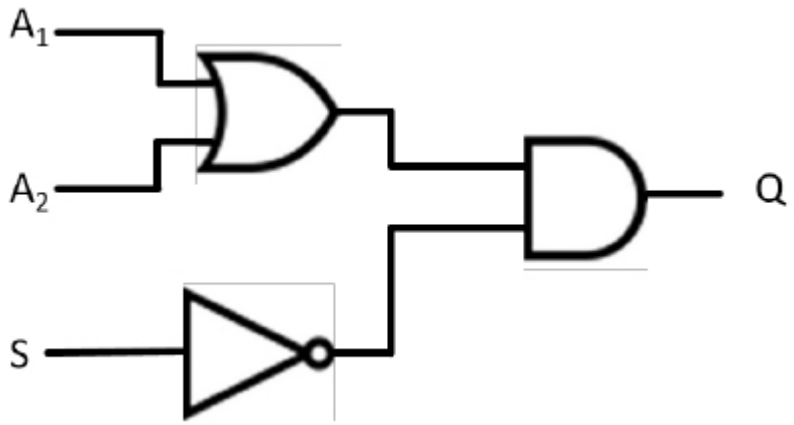
**53.**

**3 marks for AO2 (apply)**

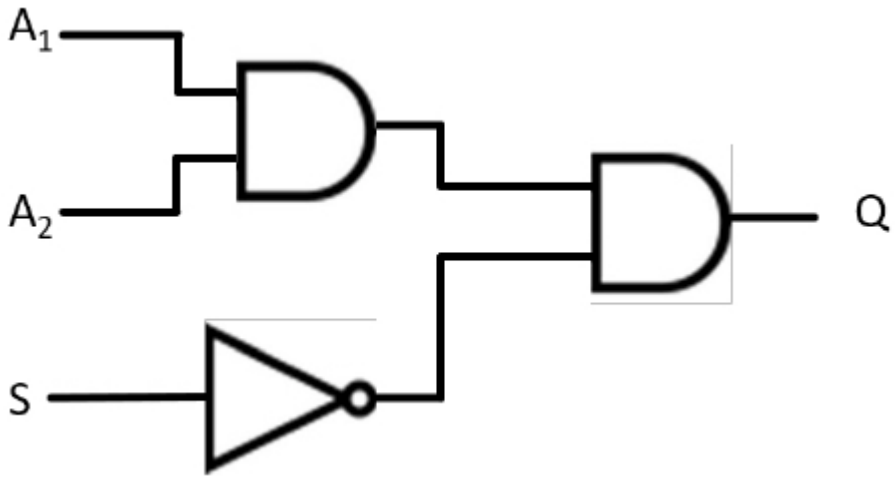
Max 2 marks if not fully correct (the fully correct answer is given in example 1).

Mark A if $A_1$ and $A_2$ are the inputs to an OR gate;
Mark B if S is the input to a NOT gate;
Mark C if the output from an AND gate is Q;

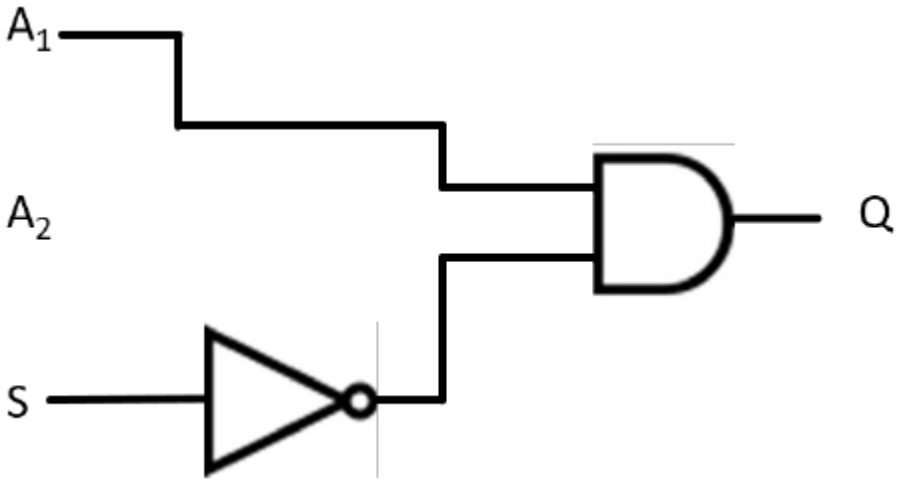
**Example 1 (Fully correct answer)**



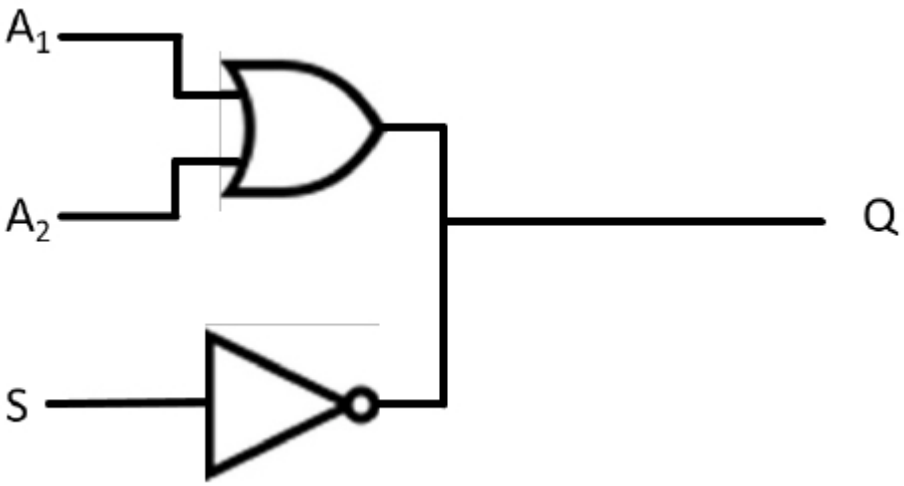

**Example 2 (Marks B and C)**



**Example 3 (Marks B and C)**




**Example 4 (Marks A and B)**




**[3]**

**54.** **Mark is for AO1 (understanding)**

Only reward if column **A AND B** is completely correct;

| A | B | A AND B |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

**A.** F,F,F,T // false, false, false, true // off, off, off, on
**I.** Case and minor spelling mistakes

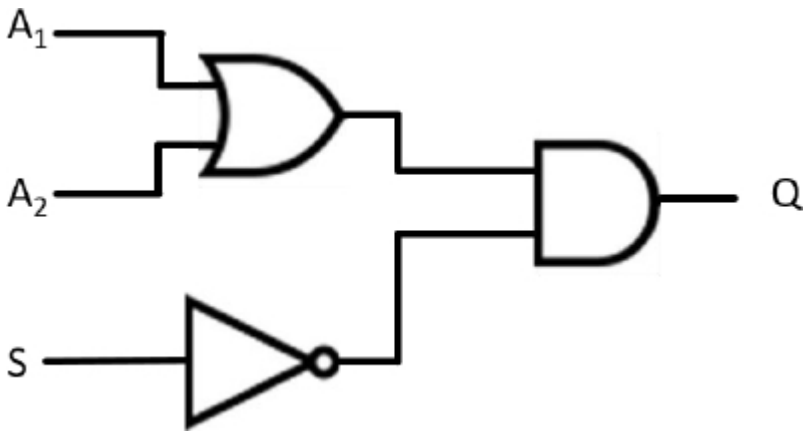
**[1]**

**55.** **3 marks for AO2 (apply)**

Max 2 marks if not fully correct (the fully correct answer is given in example 1).

**Mark A** if $A^1$ and $A^2$ are the inputs to an OR gate;
**Mark B** if S is the only input into a NOT gate;
**Mark C** if Q has a single output connection from an AND gate;

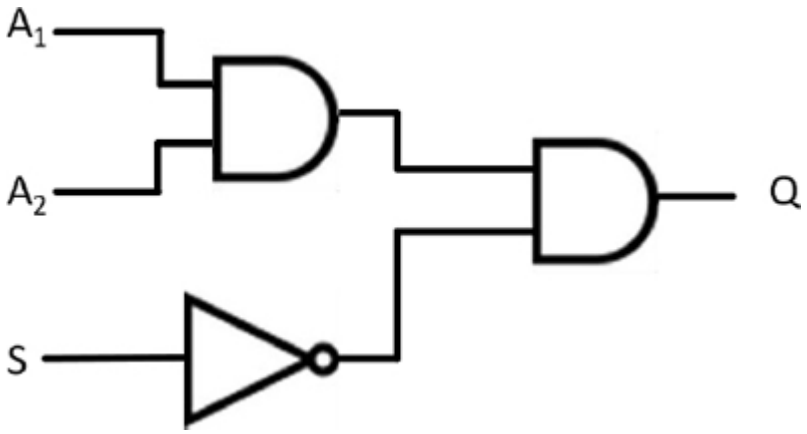
**Example 1 (Fully correct answer)**



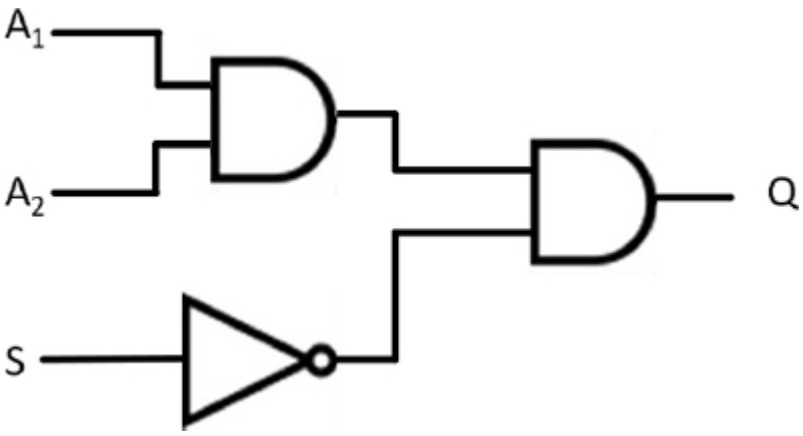

**R.** Incorrect symbols

**Partially correct answers**

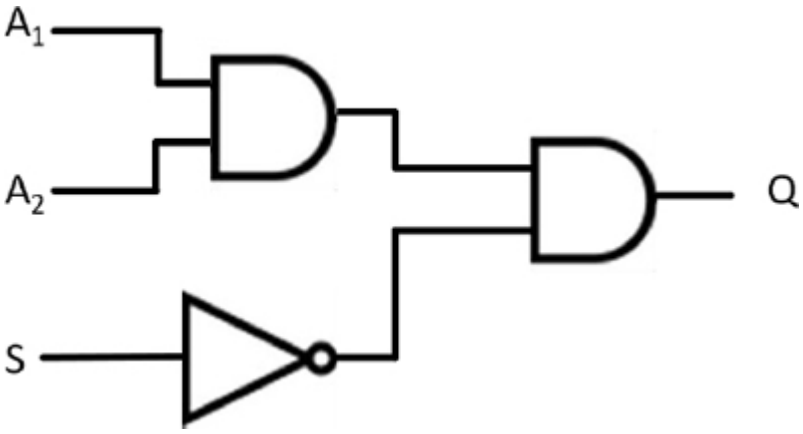
**Example 2 (Marks B and C)**



**Example 3 (Marks B and C)**




**Example 4 (Marks A and B)**




**[3]**

**56.** **2 marks for AO1 (recall)**

**1 mark: C:** ROM is commonly used to store start-up instructions
**1 mark: D:** ROM is non-volatile

**If more than two lozenges shaded then marks are not awarded.**

**[2]**

**57.** **4 marks for AO1 (understanding)**

1 mark for each correct point that explains how a Hard Disk Drive operates, up to a maximum of 4 marks.

**Examples Include:**

- a HDD can contain multiple platters (disks);
- A disk / disks that move / spin
- Each platter is divided into sectors;
- The disks are spun at a very high speed (approximately 7,200 rpm to 10,000 + rpm);
- Read \ write heads (move across the disk to) read and write data;
- There is one read \ write head for each side of a platter ie two heads per platter;
- Data is written to \ read from the disk by magnetising \ polarising \ sensing microscopic regions on the disk;
- Data is organised in concentric rings called tracks;
- There is a small circuit board on the drive that controls the reading and writing of data;
- Data is transferred from and to the disk via a cable / electrical current being passed;
- The intersection of sectors and tracks are called blocks;
- Data is read 1 block at a time;

**NE** Storing binary, or 1s and 0s without reference to magnetising

**[4]**

**58.** (a) **Mark is for AO1 (recall)**

AND (gate);

**1**

(b) **Mark is for AO1 (recall)**

OR (gate);

**1**

(c) **Mark is for AO1 (recall)**

1 mark for any of the following:

- A NOT gate is used to flip / invert / switch an input
- The output will be the opposite of the input
- 0s become 1 **and** 1's become 0s;

**1**

(d) **3 marks for AO2 (apply)**

| INPUTS | | | A AND B | C OR D | D OR E |
|---|---|---|---|---|---|
| A | B | C | D | E | F |
| 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | **0** | **0** | **0** |
| 1 | 0 | 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | **1** | **1** |
| 1 | 1 | 1 | **1** | **1** | **1** |

1 mark for column D correct
1 mark for column E correct
1 mark for column F correct

**A.** Follow through for column F based on incorrect but complete columns D or E

3

**[6]**

**59.** **3 marks for AO1 (recall), 3 marks for AO1 (understanding)**

Max 3 marks for stating the components.
Max 1 description mark for each component stated.

| | |
|---|---|
| Control Unit; | Decodes instruction;<br>Controls the fetching and writing of data; |
| Arithmetic Logic Unit / ALU; | Executes mathematical instructions;<br>Executes logical instructions;<br>Compares values held in registers; |
| Clock; | Controls the number of instructions carried out each second;<br>Allows the CPU to synchronise operations;<br>**R.** allows the computer to display the time |
| Bus; | Used to transfer data / instructions from one component of the CPU to another;<br>**A.** Variations such as Control bus, Address bus, Data bus |
| (L1) Cache; | Very fast memory;<br>Memory close / on CPU;<br>Stores frequently used instructions / data; |
| Register; | Special purpose (small) memory location (on CPU);<br>Used for specific purpose in Fetch-Execute Cycle; |

**R.** RAM / ROM / IAS.

**[6]**

**60.** **Mark is for AO1 (recall)**

decode;

**I.** Minor spelling errors or hyphenated word
**I.** Case

**[1]**