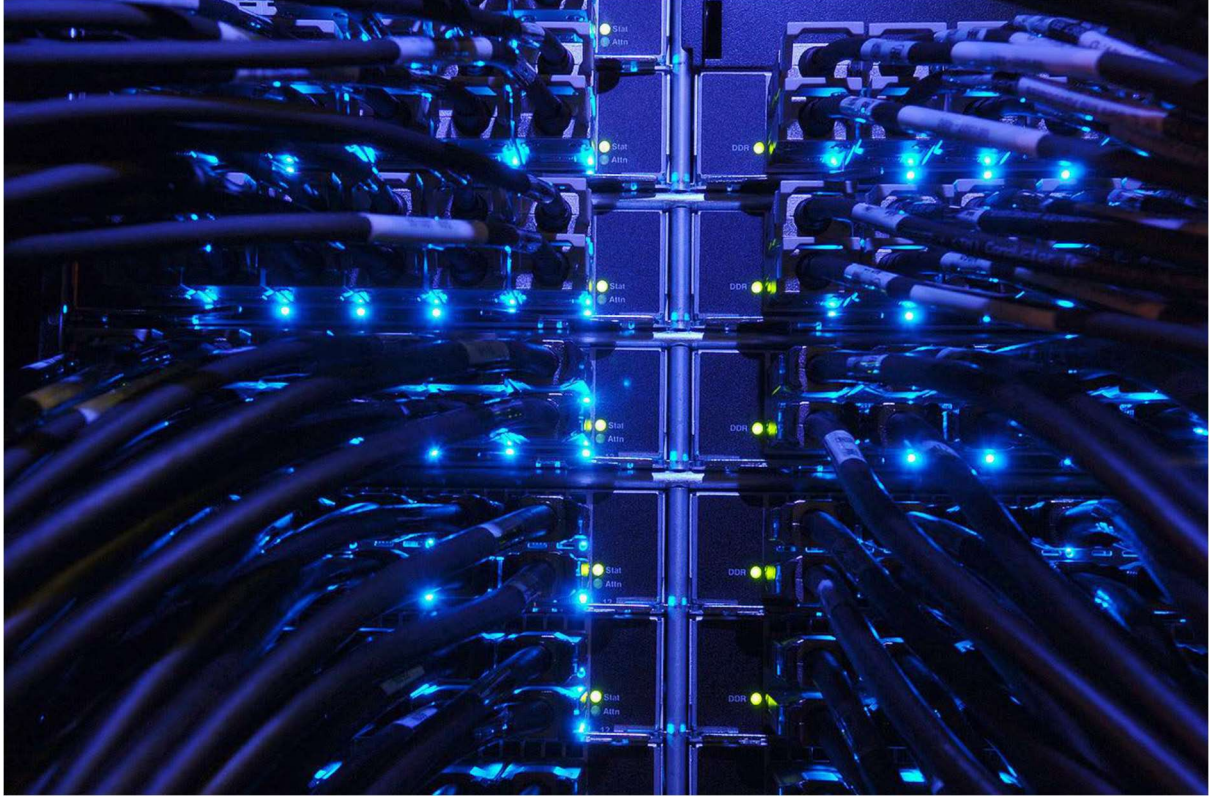


A-LEVEL Computing



Revision Guide

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A-LEVEL Computer Science Revision Guidance

The course outline

Component 01: Computer systems

This component will introduce you to the internal workings of the Central Processing Unit (CPU), the exchange of data and will also look at software development, data types and legal and ethical issues. It is expected that you will draw on this underpinning content when studying computational thinking, developing programming techniques and devising your own programming approach in the Programming project component (03).

Component 02: Algorithms and programming

This component will incorporate and build on the knowledge and understanding you gained in the Computer systems component (01). You will understand what is meant by computational thinking, the benefits of applying computational thinking to solving a wide variety of problems and the principles of solving problems by computational methods. You will be able to use algorithms to describe problems and analyse a problem by identifying its component parts.

Assessment overview

Content Overview	Assessment Overview	
<ul style="list-style-type: none">• The characteristics of contemporary processors, input, output and storage devices• Software and software development• Exchanging data• Data types, data structures and algorithms• Legal, moral, cultural and ethical issues• Elements of computational thinking• Problem solving and programming• Algorithms to solve problems and standard algorithms <p>You will choose a computing problem to work through according to the guidance in the specification.</p> <ul style="list-style-type: none">• Analysis of the problem• Design of the solution• Developing the solution• Evaluation	Computer systems (01) 140 marks 2 hours and 30 minutes written paper (no calculators allowed)	Worth 40% of total A-LEVEL
	Algorithms and programming (02*) 140 marks 2 hours and 30 minutes written paper (no calculators allowed)	Worth 40% of total A-LEVEL
	Programming project 03 – Repository 70 marks Non-exam assessment	Worth 20% of total A-LEVEL

Exam dates

1/06/2020 **Computer systems** **AM 2h 30m**

9/06/2020 **Algorithms and programming** **AM 2h 30m**

Useful Websites

<https://www.senecalearning.com/>

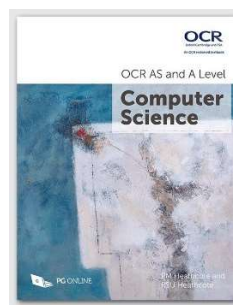
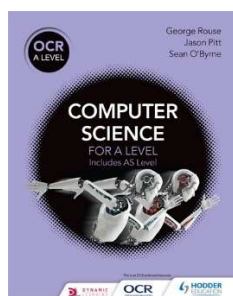
<https://ocr.org.uk/qualifications/as-and-a-level/computer-science-h046-h446-from-2015/>

<https://student.craigndave.org/a-level-videos>

<https://www.learnpython.org/>

<https://www.youtube.com/channel/UC9-y6csu5WGm29I7JiwpnA>

Revision guides



What do I need to revise for Computer systems (01)

1.1 The characteristics of contemporary processors, input, output and storage devices

Components of a computer and their uses

1.1.1 Structure and function of the processor

- (a) The Arithmetic and Logic Unit; ALU, Control Unit and Registers (Program Counter; PC, Accumulator; ACC, Memory Address Register; MAR, Memory Data Register; MDR, Current Instruction Register; CIR). Buses: data, address and control: how this relates to assembly language programs.
- (b) The Fetch-Decode-Execute Cycle; including its effects on registers.
- (c) The factors affecting the performance of the CPU: clock speed, number of cores, cache.
- (d) The use of pipelining in a processor to improve efficiency.
- (e) Von Neumann, Harvard and contemporary processor architecture.

1.1.2 Types of processor

- (a) The differences between and uses of CISC and RISC processors.
- (b) GPUs and their uses (including those not related to graphics).
- (c) Multicore and Parallel systems.

1.1.3 Input, output and storage

- (a) How different input, output and storage devices can be applied to the solution of different problems.
- (b) The uses of magnetic, flash and optical storage devices.
- (c) RAM and ROM.
- (d) Virtual storage.

1.2 Software and software development	
Types of software and the different methodologies used to develop software	
1.2.1 Systems Software	<ul style="list-style-type: none"> (a) The need for, function and purpose of operating systems. (b) Memory Management (paging, segmentation and virtual memory). (c) Interrupts, the role of interrupts and Interrupt Service Routines (ISR), role within the Fetch-Decode-Execute Cycle. (d) Scheduling: round robin, first come first served, multi-level feedback queues, shortest job first and shortest remaining time. (e) Distributed, embedded, multi-tasking, multi-user and Real Time operating systems. (f) BIOS. (g) Device drivers. (h) Virtual machines, any instance where software is used to take on the function of a machine, including executing intermediate code or running an operating system within another.
1.2.2 Applications Generation	<ul style="list-style-type: none"> (a) The nature of applications, justifying suitable applications for a specific purpose. (b) Utilities. (c) Open source vs closed source. (d) Translators: Interpreters, compilers and assemblers. (e) Stages of compilation (lexical analysis, syntax analysis, code generation and optimisation). (f) Linkers and loaders and use of libraries.
1.2.3 Software Development	<ul style="list-style-type: none"> (a) Understand the waterfall lifecycle, agile methodologies, extreme programming, the spiral model and rapid application development. (b) The relative merits and drawbacks of different methodologies and when they might be used. (c) Writing and following algorithms.
1.2.4 Types of Programming Language	<ul style="list-style-type: none"> (a) Need for and characteristics of a variety of programming paradigms. (b) Procedural languages. (c) Assembly language (including following and writing simple programs with the Little Man Computer instruction set). See appendix 5d. (d) Modes of addressing memory (immediate, direct, indirect and indexed). (e) Object-oriented languages (see appendix 5d for pseudocode style) with an understanding of classes, objects, methods, attributes, inheritance, encapsulation and polymorphism.

1.3 Exchanging data	
How data is exchanged between different systems	
1.3.1 Compression, Encryption and Hashing	(a) Lossy vs Lossless compression. (b) Run length encoding and dictionary coding for lossless compression. (c) Symmetric and asymmetric encryption. (d) Different uses of hashing.
1.3.2 Databases	(a) Relational database, flat file, primary key, foreign key, secondary key, entity relationship modelling, normalisation and indexing. See appendix 5f. (b) Methods of capturing, selecting, managing and exchanging data. (c) Normalisation to 3NF. (d) SQL – Interpret and modify. See appendix 5d. (e) Referential integrity. (f) Transaction processing, ACID (Atomicity, Consistency, Isolation, Durability), record locking and redundancy.
1.3.3 Networks	(a) Characteristics of networks and the importance of protocols and standards. (b) The internet structure: <ul style="list-style-type: none"> • The TCP/IP Stack. • DNS • Protocol layering. • LANs and WANs. • Packet and circuit switching. (c) Network security and threats, use of firewalls, proxies and encryption. (d) Network hardware. (e) Client-server and peer to peer.
1.3.4 Web Technologies	(a) HTML, CSS and JavaScript. See appendix 5d. (b) Search engine indexing. (c) PageRank algorithm. (d) Server and client side processing.

1.4 Data types, data structures and algorithms

How data is represented and stored within different structures. Different algorithms that can be applied to these structures

1.4.1 Data Types

- (a) Primitive data types, integer, real/floating point, character, string and Boolean.
- (b) Represent positive integers in binary.
- (c) Use of sign and magnitude and two's complement to represent negative numbers in binary.
- (d) Addition and subtraction of binary integers.
- (e) Represent positive integers in hexadecimal.
- (f) Convert positive integers between binary hexadecimal and denary.
- (g) Representation and normalisation of floating point numbers in binary.
- (h) Floating point arithmetic, positive and negative numbers, addition and subtraction.
- (i) Bitwise manipulation and masks: shifts, combining with AND, OR, and XOR.
- (j) How character sets (ASCII and UNICODE) are used to represent text.

1.4.2 Data Structures

- (a) Arrays (of up to 3 dimensions), records, lists, tuples.
- (b) The following structures to store data: linked-list, graph (directed and undirected), stack, queue, tree, binary search tree, hash table.
- (c) How to create, traverse, add data to and remove data from the data structures mentioned above. *(NB this can be **either** using arrays and procedural programming **or** an object-oriented approach).*

1.4.3 Boolean Algebra

- (a) Define problems using Boolean logic. See appendix 5d.
- (b) Manipulate Boolean expressions, including the use of Karnaugh maps to simplify Boolean expressions.
- (c) Use the following rules to derive or simplify statements in Boolean algebra: De Morgan's Laws, distribution, association, commutation, double negation.
- (d) Using logic gate diagrams and truth tables. See appendix 5d.
- (e) The logic associated with D type flip flops, half and full adders.

1.5 Legal, moral, cultural and ethical issues	
The individual moral, social, ethical and cultural opportunities and risks of digital technology. Legislation surrounding the use of computers and ethical issues that can or may in the future arise from the use of computers	
1.5.1 Computing related legislation	(a) The Data Protection Act 1998. (b) The Computer Misuse Act 1990. (c) The Copyright Design and Patents Act 1988. (d) The Regulation of Investigatory Powers Act 2000.
1.5.2 Moral and ethical Issues	The individual moral, social, ethical and cultural opportunities and risks of digital technology: <ul style="list-style-type: none"> • Computers in the workforce. • Automated decision making. • Artificial intelligence. • Environmental effects. • Censorship and the Internet. • Monitor behaviour. • Analyse personal information. • Piracy and offensive communications. • Layout, colour paradigms and character sets.

What do I need to revise for Algorithms and programming (02)

2.1 Elements of computational thinking	
Understand what is meant by computational thinking	
2.1.1 Thinking abstractly	(a) The nature of abstraction. (b) The need for abstraction. (c) The differences between an abstraction and reality. (d) Devise an abstract model for a variety of situations.
2.1.2 Thinking ahead	(a) Identify the inputs and outputs for a given situation. (b) Determine the preconditions for devising a solution to a problem. (c) The nature, benefits and drawbacks of caching. (d) The need for reusable program components.
2.1.3 Thinking procedurally	(a) Identify the components of a problem. (b) Identify the components of a solution to a problem. (c) Determine the order of the steps needed to solve a problem. (d) Identify sub-procedures necessary to solve a problem.
2.1.4 Thinking logically	(a) Identify the points in a solution where a decision has to be taken. (b) Determine the logical conditions that affect the outcome of a decision. (c) Determine how decisions affect flow through a program.
2.1.5 Thinking concurrently	(a) Determine the parts of a problem that can be tackled at the same time. (b) Outline the benefits and trade offs that might result from concurrent processing in a particular situation.

2.2 Problem solving and programming

How computers can be used to solve problems and programs can be written to solve them
(Learners will benefit from being able to program in a procedure/imperative language and object oriented language.)

2.2.1 Programming techniques

- (a) Programming constructs: sequence, iteration, branching.
- (b) Recursion, how it can be used and compares to an iterative approach.
- (c) Global and local variables.
- (d) Modularity, functions and procedures, parameter passing by value and by reference.
- (e) Use of an IDE to develop/debug a program.
- (f) Use of object oriented techniques.

2.2.2 Computational methods

- (a) Features that make a problem solvable by computational methods.
- (b) Problem recognition.
- (c) Problem decomposition.
- (d) Use of divide and conquer.
- (e) Use of abstraction.
- (f) Learners should apply their knowledge of:
 - backtracking
 - data mining
 - heuristics
 - performance modelling
 - pipelining
 - visualisation to solve problems.

2.3 Algorithms

The use of algorithms to describe problems and standard algorithms

2.3.1 Algorithms

- (a) Analysis and design of algorithms for a given situation.
- (b) The suitability of different algorithms for a given task and data set, in terms of execution time and space.
- (c) Measures and methods to determine the efficiency of different algorithms, Big O notation (constant, linear, polynomial, exponential and logarithmic complexity).
- (d) Comparison of the complexity of algorithms.
- (e) Algorithms for the main data structures, (stacks, queues, trees, linked lists, depth-first (post-order) and breadth-first traversal of trees).
- (f) Standard algorithms (bubble sort, insertion sort, merge sort, quick sort, Dijkstra's shortest path algorithm, A* algorithm, binary search and linear search).

Command Words for the exams

Command words	Meaning
Add	Join something to something else so as to increase the size, number, or amount.
Annotate	Add brief notes to a diagram or graph.
Calculate	Obtain a numerical answer showing the relevant stages in the working.
Complete	Provide all the necessary or appropriate parts.
Convert	Change the form, character, or function of something.
Define	Give the precise meaning of a word, phrase, concept or physical quantity.
Design	Produce a plan, simulation or model.
Draw	Produce (a picture or diagram) by making lines and marks on paper with a pencil, pen, etc.
Give	Present information which determines the importance of an event or issue. Quite often used to show causation.
Outline	Give a brief account or summary.
How	In what way or manner; by what means.
Identify	Provide an answer from a number of possibilities. Recognise and state briefly a distinguishing factor or feature.
Label	Add title, labels or brief explanation(s) to a diagram or graph.
List	Give a sequence of brief answers with no explanation.
Order	Put the responses into a logical sequence.
Outline	Give a brief account or summary.
Show	Give steps in a derivation or calculation.
Solve	Obtain the answer(s) using algebraic and/or numerical and/or graphical methods.
State	Give a specific name, value or other brief answer without explanation or calculation.
Tick	Mark (an item) with a tick or select (a box) on a form, questionnaire etc. to indicate that something has been chosen.
What	Asking for information specifying something.

Tackling Essay Questions

It is important when revising for essay-style examinations that you are familiar with the wording that may be used for the question.

Command words	Meaning
Analyse	Break down in order to bring out the essential elements or structure. To identify parts and relationships, and to interpret information to reach conclusions.
Compare	Give an account of the similarities and differences between two (or more) items or situations, referring to both (all) of them throughout.
Describe	Give a detailed account or picture of a situation, event, pattern or process
Differentiate	Explore and explain the differences.
Discuss	Offer a considered and balanced review that includes a range of arguments, factors or hypotheses. Opinions or conclusions should be presented clearly and supported by appropriate evidence.
Evaluate	Assess the implications and limitations; to make judgements about the ideas, works, solutions or methods in relation to selected criteria.
Explain	Give a detailed account including reasons or causes.
Justify	Give valid reasons or evidence to support an answer or conclusion.

Try to use the following writing frame as a 'recipe' to construct your answer so that you are presenting a balanced view point that meets mark band 3.




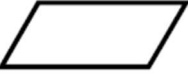


The Recipe – for essay type exam questions

Introduction			
+ Impact	Consequence	- Impact	Consequence
+ Impact	Consequence	- Impact	Consequence
+ Impact	Consequence	- Impact	Consequence
Conclusion			

Flowchart symbols

Flow charts

Flow charts like pseudocode are informal but the most common flow chart shapes are:

	Line	An arrow represents control passing between the connected shapes.
	Process	This shape represents something being performed or done.
	Sub Routine	This shape represents a subroutine call that will relate to a separate, non-linked flow chart
	Input/Output	This shape represents the input or output of something into or out of the flow chart.
	Decision	This shape represents a decision (Yes/No or True/False) that results in two lines representing the different possible outcomes.
	Terminal	This shape represents the "Start" and "End" of the process.

Additional useful supporting materials from the spec

The next few pages are taken from the specification. Please familiarise yourself with the specific notation adopted by OCR for the various technical topics.

Variables

Variables are assigned using the = operator.

```
x=3
name="Bob"
```

A variable is declared the first time a value is assigned. It assumes the data type of the value it is given.

Variables declared inside a function or procedure are local to that subroutine.

Variables in the main program can be made global with the keyword `global`.

```
global userid = 123
```

Casting

Variables can be typecast using the `int`, `str` and `float` functions.

```
str(3) returns "3"
int ("3") returns 3
float ("3.14") returns 3.14
```

Outputting to Screen

```
print(string)
```

Example

```
print("hello")
```

Taking Input from User

```
variable=input(prompt to user)
```

Example

```
name=input("Please enter your name")
```

Iteration – Count Controlled

```
for i=0 to 7
    print("Hello")
next i
```

Will print hello 8 times (0–7 inclusive).

Iteration – Condition Controlled

```
while answer!="computer"
    answer=input("What is the password?")
endwhile

do
    answer=input("What is the password?")
until answer=="computer"
```

Logical Operators

AND OR NOT

e.g.

```
while x<=5 AND flag==false
```

Comparison Operators

==	Equal to
!=	Not equal to
<	Less than
<=	Less than or equal to
>	Greater than
>=	Greater than or equal to

Arithmetic Operators

+	Addition e.g. $x=6+5$ gives 11
-	Subtraction e.g. $x=6-5$ gives 1
*	Multiplication e.g. $x=12*2$ gives 24
/	Division e.g. $x=12/2$ gives 6
MOD	Modulus e.g. $12\text{MOD}5$ gives 2
DIV	Quotient e.g. $17\text{DIV}5$ gives 3
^	Exponentiation e.g. 3^4 gives 81

Selection

Selection will be carried out with if/else and switch/case

if/else

```
if entry=="a" then
    print("You selected A")
elseif entry=="b" then
    print("You selected B")
else
    print("Unrecognised selection")
endif
```

switch/case

```
switch entry:
    case "A":
        print("You selected A")
    case "B":1
        print("You selected B")
    default:
        print("Unrecognised selection")

endswitch
```

String Handling

To get the length of a string:

```
stringname.length
```

To get a substring:

```
stringname.substring(startingPosition, numberOfCharacters)
```

NB The string will start with the 0th character.

Example

```
someText="Computer Science"
```

```
print(someText.length)
```

```
print(someText.substring(3,3))
```

Will display

```
16
```

```
put
```

5

Subroutines

```
function triple(number)
```

```
    return number*3
```

```
endfunction
```

Called from main program

```
y=triple(7)
```

```
procedure greeting(name)
```

```
    print("hello"+name)
```

```
endprocedure
```

Called from main program

```
greeting("Hamish")
```

Unless stated values passed to subroutines can be assumed to be passed by value.

If this is relevant to the question byVal and byRef will be used. In the case below x is passed by value and y is passed by reference.

```
procedure foobar(x:byVal, y:byRef)
```

```
    ...
```

```
    ...
```

```
endprocedure
```

Arrays

Arrays will be 0 based and declared with the keyword *array*.

```
array names[5]
names[0]="Ahmad"
names[1]="Ben"
names[2]="Catherine"
names[3]="Dana"
names[4]="Elijah"

print(names[3])
```

Example of 2D array:

```
Array board[8,8]
board[0,0]="rook"
```

Reading to and Writing from Files

To open a file to read from `openRead` is used and `readLine` to return a line of text from the file.

The following program makes `x` the first line of `sample.txt`

```
myFile = openRead("sample.txt")
x = myFile.readLine()
myFile.close()
```

`endOfFile()` is used to determine the end of the file. The following program will print out the contents of `sample.txt`

```
myFile = openRead("sample.txt")
while NOT myFile.endOfFile()
    print(myFile.readLine())
endwhile
myFile.close()
```

To open a file to write to `openWrite` is used and `writeLine` to add a line of text to the file. In the program below `hello world` is made the contents of `sample.txt` (any previous contents are overwritten).

```
myFile = openWrite("sample.txt")
myFile.writeLine("Hello World")
myFile.close()
```

Comments

Comments are denoted by `//`

```
print("Hello World") //This is a comment
```

Object-Oriented

Object oriented code will match the pseudocode listed above with the following extensions:

Methods and Attributes:

Methods and attributes can be assumed to be public unless otherwise stated. Where the access level is relevant to the question it will always be explicit in the code denoted by the keywords.

```
public and private.  
  
private attempts = 3  
  
public procedure setAttempts(number)  
    attempts=number  
endprocedure  
  
public function getAttempts()  
    return attempts  
endfunction
```

5

Methods will always be instance methods, learners aren't expected to be aware of static methods. They will be called using object.method so

```
player.setAttempts(5)  
  
print(player.getAttempts())
```

Constructors and Inheritance

Inheritance is denoted by the `inherits` keyword, superclass methods will be called with the keyword `super`. i.e. `super.methodName(parameters)` in the case of the constructor this would be `super.new()` Constructors will be procedures with the name `new`.

```
class Pet  
    private name  
    public procedure new(givenName)  
        name=givenName  
  
    endprocedure  
endclass  
  
class Dog inherits Pet  
    private breed  
  
    public procedure new(givenName, givenBreed)  
        super.new(givenName)  
        breed=givenBreed  
    endprocedure  
endclass
```


Constructors and Inheritance

Constructors will be procedures with the name new.

```
class Pet

    private name
    public procedure new(givenName)
        name=givenName

    endprocedure

endclass
```

Inheritance is denoted by the `inherits` keyword, superclass methods will be called with the keyword `super`. i.e. `super.methodName(parameters)` in the case of the constructor this would be `super.new()`

```
class Dog inherits Pet

    private breed

    public procedure new(givenName, givenBreed)
        super.new(givenName)
        breed=givenBreed
    endprocedure

endclass
```

To create an instance of an object the following format is used

```
objectName = new className(parameters)
```

e.g.

```
myDog = new Dog("Fido", "Scottish Terrier")
```

HTML

Learners are expected to have an awareness of the following tags. Any other tags used will be introduced in the question.

`<html>`

`<link>` to link to a CSS file

`<head>`

`<title>`

`<body>`

`<h1>` `<h2>` `<h3>`

`` including the `src`, `alt`, `height` and `width` attributes.

`<a>` including the `href` attribute.

`<div>`

<form>

<input> where the input is a textbox (i.e. has the attribute type="text" and another attribute name to identify it) or a submit button (i.e. has the attribute type="submit")

<p>

<script>

Any other elements used will be explained in the question.

CSS

Learners are expected to be able to use CSS directly inside elements using the style attribute

```
<h1 style="color:blue;">
```

and external style sheets. In the style sheets they should be able to use CSS to define the styling of elements:

```
h1{  
    color:blue;  
}
```

classes

```
.infoBox{  
    background-color: green;  
}
```

and Identifiers

```
#menu{  
    background-color: #A2441B;  
}
```

They are expected to be familiar with the following properties.

```
background-color  
border-color  
border-style  
border-width  
color with named and hex colours  
font-family  
font-size  
height  
width
```

Any other properties used will be explained in the question.

JavaScript

Learners are expected to be able to follow and write basic JavaScript code. It is hoped they will get practical experience of JavaScript in their study of the course. They will not be expected to commit exact details of syntax to memory. Questions in the exam will not penalise learners for minor inaccuracies in syntax. Learners *will* be expected to be familiar with the JavaScript equivalents of the structures listed in the pseudocode section (with the exception of input and output (see below)). They will not be expected to use JavaScript for Object Oriented programming or file handling. Questions will not be asked in JavaScript where something is passed to a subroutine by value or reference is relevant.

Input

Input will be taken in by reading values from a form. *NB learners will not be expected to memorise the method for doing this as focus will be on what they do with that input once it is received.*

Output

By changing the contents of an HTML element

```
chosenElement = document.getElementById("example");
chosenElement.innerHTML = "Hello World";
```

By writing directly to the document

```
document.write("Hello World");
```

By using an alert box

```
alert("Hello World");
```

Any other JavaScript used will be explained in the question.

Little Man Computer Instruction Set

In questions mnemonics will always be given according to the left hand column below. Different implementations of LMC have slight variations in mnemonics used and to take this into account the alternative mnemonics in the right hand column will be accepted in learners' answers.

| Mnemonic | Instruction | Alternative mnemonics accepted |
|----------|--------------------|--------------------------------|
| ADD | Add | |
| SUB | Subtract | |
| STA | Store | STO |
| LDA | Load | LOAD |
| BRA | Branch always | BR |
| BRZ | Branch if zero | BZ |
| BRP | Branch if positive | BP |
| INP | Input | IN, INPUT |
| OUT | Output | |
| HLT | End program | COB, END |
| DAT | Data location | |

Structured Query Language (SQL)

Learners will be expected to be familiar with the structures below. Should any other aspects of SQL be used they will be introduced and explained in the question.

SELECT (including nested SELECTs)

FROM

WHERE

LIKE

AND

OR

DELETE

INSERT

DROP

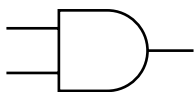
JOIN (Which is equivalent to INNER JOIN, there is no expectation to know about outer, left and right joins)

WILDCARDS (Learners should be familiar in the use of '*' and '%' as a wildcard to facilitate searching and matching where appropriate)

Boolean Algebra

When Boolean algebra is used in questions the notation described below will be used. Other forms of notation exist and below are also a list of accepted notation we will accept from learners.

Conjunction



Notation used:

\wedge e.g. $A \wedge B$

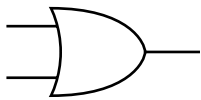
| A | B | $A \wedge B$ |
|---|---|--------------|
| T | T | T |
| T | F | F |
| F | T | F |
| F | F | F |

Alternatives accepted:

AND e.g. $A \text{ AND } B$

e.g. $A.B$

Disjunction



Notation used:

\vee e.g. $A \vee B$

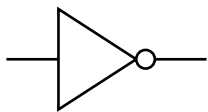
| A | B | $A \vee B$ |
|---|---|------------|
| T | T | T |
| T | F | T |
| F | T | T |
| F | F | F |

Alternatives accepted:

OR e.g. A OR B

+ e.g. A+B

Negation



Notation used:

\neg e.g. $\neg A$

| A | $\neg A$ |
|---|----------|
| T | F |
| F | T |

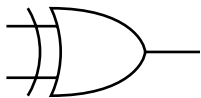
Alternatives Accepted:

bar e.g. \bar{A}

\sim e.g. $\sim A$

NOT e.g. NOT A

Exclusive Disjunction



Notation used:

$\underline{\vee}$ e.g. $A \underline{\vee} B$

| A | B | $A \underline{\vee} B$ |
|---|---|------------------------|
| T | T | F |
| T | F | T |
| F | T | T |
| F | F | F |

Alternatives accepted:

XOR e.g. $A \text{ XOR } B$

\oplus e.g. $A \oplus B$

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Equivalence / Iff

Notation used:

\equiv e.g. $(A \wedge B) \equiv \neg(\neg A \vee \neg B)$

Alternatives accepted:

\leftrightarrow