



OCR – H446 – Computer Science

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What do we learn in A Level CS?

Computer Systems (01)

140 marks

2 hours and 30 minutes written paper (40%)

(no calculators allowed)

- 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

Algorithms and programming (02*)

140 marks

2 hours and 30 minutes written paper (40%)

(no calculators allowed)

- Elements of computational thinking
 - Problem solving and programming
- Algorithms to solve problems and standard algorithms

Programming project (03*) 70 marks (20%)

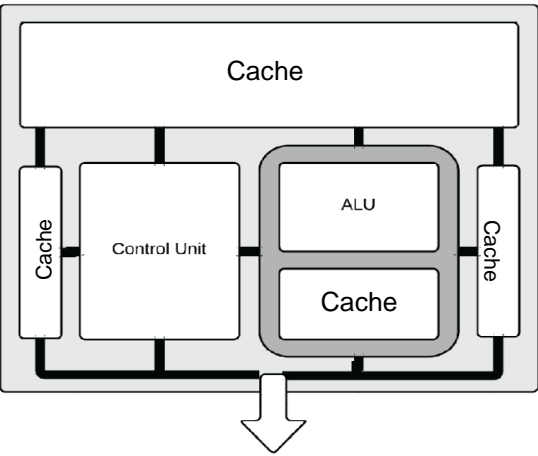
Non-exam assessment

- Analysis of the problem
- Design of the solution
- Developing the solution
 - Evaluation

We follow the OCR H446 Specification.

What is the purpose of the CPU?

Explain what the different parts of the CPU do



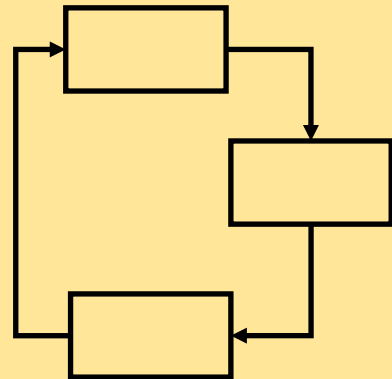
Part of CPU	What it Does
Cache	
ALU	
Control Unit	

Match the different registers to a description of what they do. You can draw lines between them using the tools.

Register
Accumulator (ACC)
Program Counter (PC)
Current Instruction Register (CIR)
Memory Address Register (MAR)

Description
This stores the memory address of the next instruction. At each fetch-execute cycle it will be incremented (1 is added to it)
Results from the ALU are temporarily stored here until they are written to memory
The current instruction is stored in this register.
The stores the data that was read from or written to memory

Label the diagram, with decode, execute and fetch



Stage	What happens
Fetch	
Decode	
Execute	

CPU

How does the following affect CPU speed?

Factor	How does it affect CPU speed?
Clock Speed	
Number of Cores	
Cache Size	

Embedded Systems

System	Description	Examples
General Purpose		
Embedded		

Decide which of the following are benefits or drawbacks of embedded systems

Statement	Benefit (a)	Drawback (a)
They do not need an operating system as they are completing simple tasks		
They can only perform a limited number of functions		
Cheap to produce as they require less processor power		
They are difficult to upgrade due to their limited storage and processing power		
They can be small in size so are good for small devices		
The hardware used to create them is often far more rugged and can be used in a range of scenarios		

1.1 System Architecture

Von Neumann

Storage Type	Advantages	Disadvantages	Example of Storage
Optical			
Magnetic			
Flash			

Answer the following about **Virtual Memory**:

What is it?	
When it is used?	
What happens to the processing speed when it is used?	
Why does the processing speed change?	

Storage Devices

Calculate the amount of storage required for each of the questions below. Use the multiplier of 1000 rather than 1024.

File Type	Size
1 page word processed file with no images	0.2Mb
Postcard sized photograph	3.5 Mb
3 minute MP3 music file	7 Mb
1 minute compressed video file	45 Mb

Calculating File Size

Question	Answer (including working)
100, 15 minutes videos to be streamed over the internet	
56 student essays, each two pages with no images	
450 postcard sized photographs	
An album of 10 music tracks, 5 minutes each	

1.2 Memory & Storage

Explain how ROM is used to boot a computer when it is turned on.

Features of RAM	Features of ROM
1.	1.
2.	2.
3.	3.

For each scenario choose a suitable storage device and justify your choice.

Scenario 1: A school needs to back-up its data every evening	Scenario 2: A media student needs to store a video they have made to distribute to their friends

Units

Rearrange the following names into order with the largest at the and smallest at the bottom:

Gigabyte

Byte

Megabyte

Nibble

Terabyte

Bit

Kilobyte

Biggest number of bytes

Smallest number of bytes

How many bytes are there in the following:

a) 1 KB _____ bytes

b) 3 MB _____ bytes

c) 5 GB _____ bytes

	1	0	1	0
+	0	1	1	0

	0	1	1	1	0	0
+	1	1	0	1	0	1

	0	1	1	0	1	1	0	0
+	1	0	0	1	0	0	1	1

	1	0	0	0	1	0	1	1
+	0	1	0	1	1	0	1	1

Complete the following binary addition and explain the problem with the answer:

	1	1	1	1	1	1	1	0
+	1	1	0	1	0	1	0	1

Binary Addition

What problem has occurred? What does this mean?

Why does data need to be in binary format to be understood by a computer?

Binary Conversion

Binary	Denary	Denary	Binary
101100		9	
101011		25	
1101		32	
11101110		98	
00010111		143	
10101010		178	
11111110		211	

1.2 Memory & Storage

Complete the table below turning denary numbers in hexadecimal.

0	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15

Denary	Hexadecimal
15	
30	
55	
88	
101	
240	

Hexadecimal	Denary
1A	
3B	
27	
7C	
AB	

Denary to Hexadecimal

Binary to Hexadecimal

Binary	Hexadecimal	Hexadecimal	Binary
00011000		1A	
01100110		24	
11001111		5F	
11111011		AB	
11101011		F2	
01010101		67	

Give 2 reasons why a computer programmer would prefer to write a number in hexadecimal rather than binary?

Sound

	Description
Amplitude	
Bit Rate	
Sample Rate	

How does the sample rate and/or bit rate affect file size?

How do binary codes represent characters? What are the two most common forms of character representation in binary?

Why is ASCII not always a suitable method of representation characters? How is this overcome?

Characters

What is a character set?

1.2 Memory & Storage

How many colours can be represented with the following bits:

Number of Bits	Number of Colours
1	
2	
6	
8	

Images

	Description
Resolution	
Colour/Bit Depth	
Pixel	

What does metadata for an image store?

If you increase the resolution or bit depth of an image, what happens to the file size? Why?

Denary	Hexadecimal	Hexadecimal	Denary
45		F0	
76		45	
104		78	
167		EE	
192		A6	

Denary	Binary	Binary	Denary
67		01101101	
106		1110011	
185		01010101	
209		11110011	
226		11011011	

Binary	Shift	Answer
01001010	Left 2	
01101011	Right 1	
10110110	Left 1	
01011010	Right 3	
01110111	Left 3	

What issue can occur when you perform a binary shift right?

Binary Shifts

Compression

For each of the file types below decide which file type matches which description.

ZIP MP3 PDF JPEG MPEG

File Type	Description
	Storing still images using lossy compression
	Representing documents in the same way no matter what software is being used to display them
	Representing digital audio using lossy compression
	Representing videos and movie films using lossy compression
	A compressed collection of files

Describe the difference between lossless and lossy compression methods

1.2 Memory & Storage

Compression Method	Description/How it works	Example of Use
Lossy		
Lossless		

Hosting & The Cloud

What is web hosting?

What is cloud storage?

Reason	Ad of Web Hosting?
More people are likely to view your website	
A backup server will ensure that if your website goes down it will be restored immediately	
You have to have technical knowledge to host the website as well as making it	
You do not need to worry about your bandwidth at home being used up	
You are insured against data loss should your website be hacked	

Statement about Cloud Storage	Advantage	Disadvantage
No need to pay IT staff to manage the hardware		
You depend on the hosts for security and backups		
Need a connection to the internet to be able to access files		
You can access the same files from any device with an internet connection		
Cloud software will be updated automatically		
You may have to pay a subscription for cloud storage		
Not always clear who owns the intellectual property for content stored in the cloud		

Compare the use of wired and wireless in the following areas.

Transmission Media

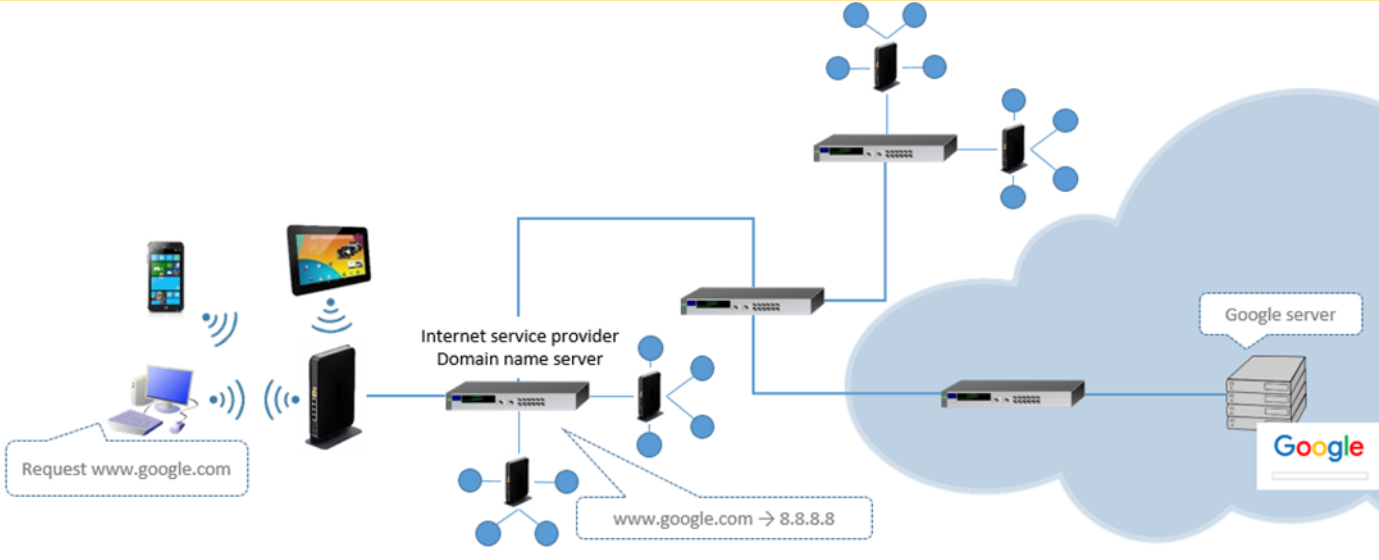
	Wired	Wireless
Bandwidth		
Installation		
Cost		
Security		
Interference		
Mobility		

DNS

1.3 Computer networks, connections and protocols

Network Performance

Annotate the diagram below to explain how DNS works. (use a text box)



Factor affecting network performance	Explanation of how it can affect network performance
Number of Users	
Transmission Media	
Latency	
Bandwidth	
Error Rate	

IP & MAC Addresses

Keyword	Description
IP address	
MAC address	
Packet	
Protocols	

Explain the difference between an IP address and a MAC address

Wired Methods

Cable Type	Description / used for?
Ethernet	
Coaxial	
Fibre	

1.3 Computer networks, connections and protocols

Network Topologies

Protocols

Protocol	Description, what is it used for?
TCP/IP	
HTTP / HTTPS	
FTP	
POP3	
IMAP	
SMTP	

Star Topology	
Advantages:	Disadvantages:

Mesh Topology	
Advantages:	Disadvantages:

Wi-Fi

Keyword	Description
Channels	
Bands	

Wireless Networks	
Advantages	Disadvantages

What are layers?

Explain 2 advantages of using network layers.

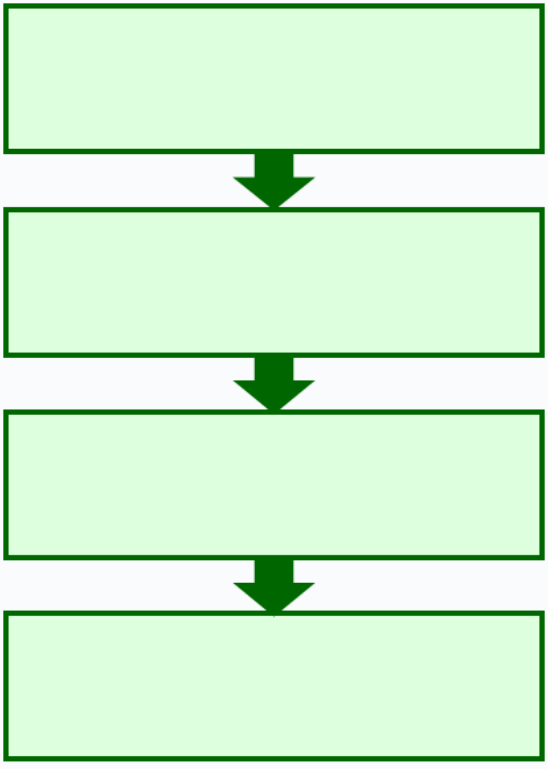
1.

2.

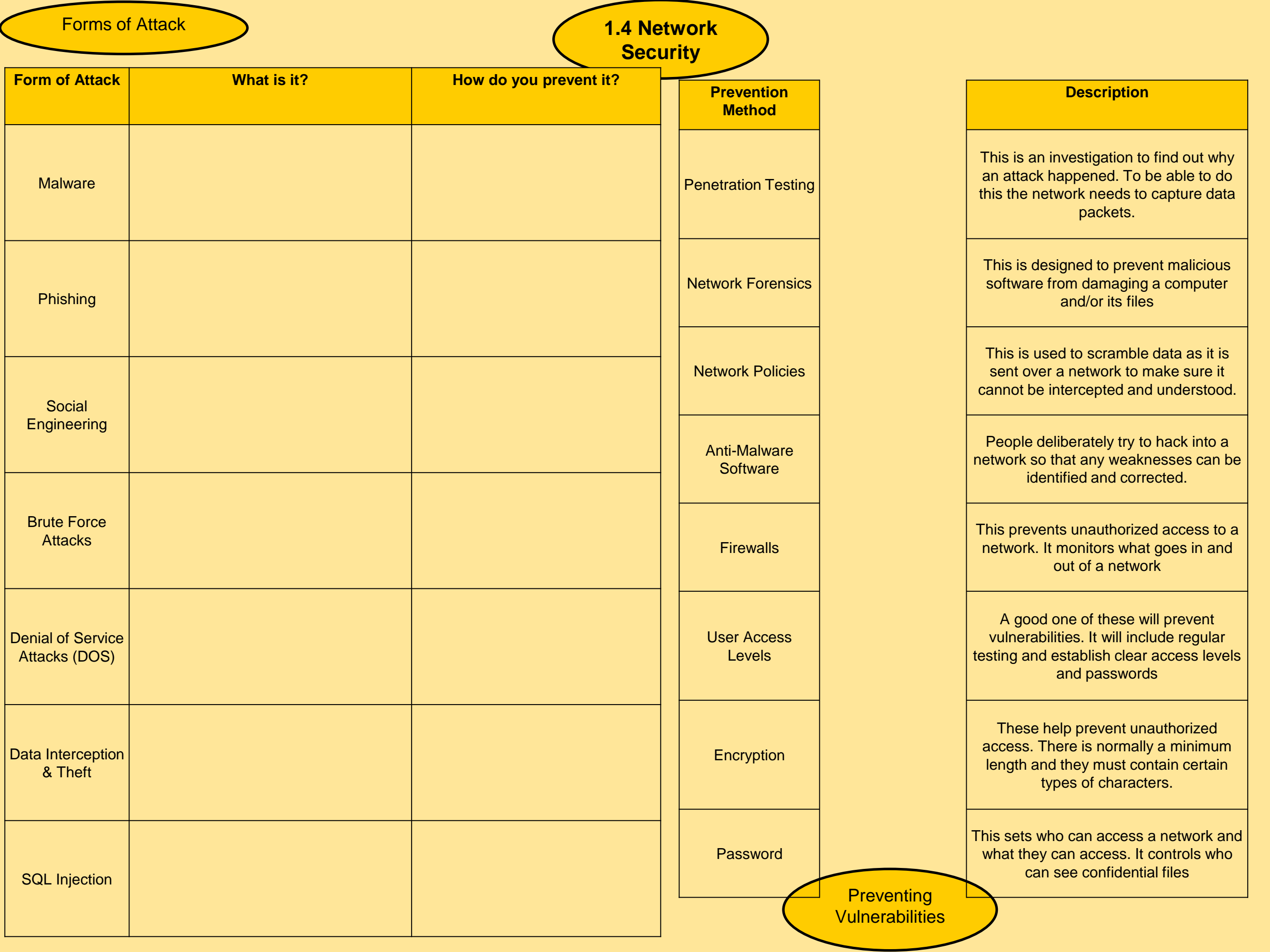
1.3 Computer networks, connections and protocols

Layers

Label the diagram to show the different network layers.



Layer Name	Description	Protocol Examples
Application Layer		
Transport Layer		
Network Layer		
Data Link Layer		



Forms of Attack

1.4 Network Security

Preventing Vulnerabilities

Operating System

Interface Type	How they work?
Command Line	
GUI	
Natural Language	

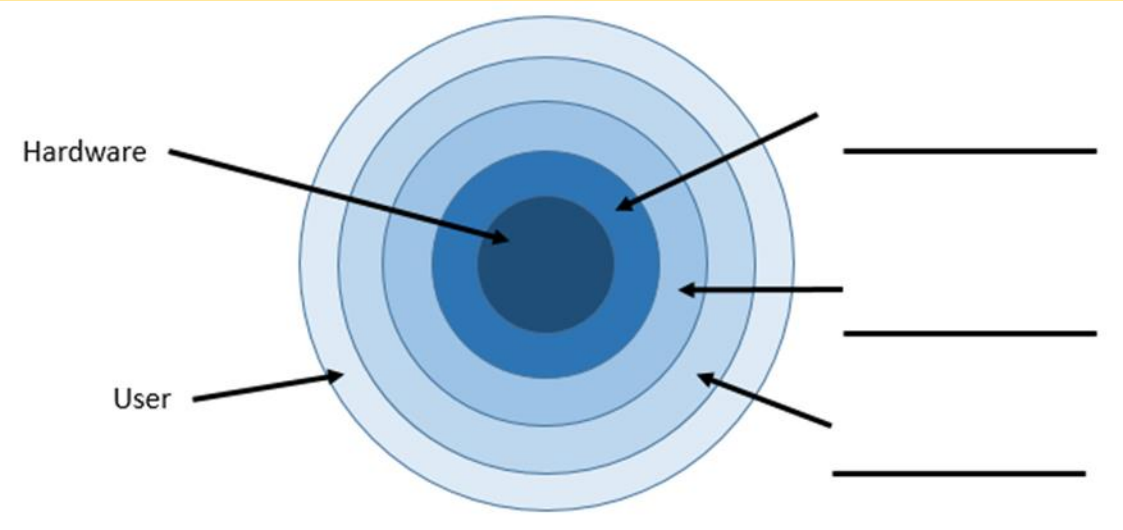
	How do operating systems deal with:
Memory Management	
Computer Security	
File Systems (Folders etc.)	
Handling peripherals	

Utility Software	How it works?
Defragmentation	
Encryption	
Compression	

1.5 Systems Software

Utility Software

Types of Software



	Advantages	Disadvantages
Proprietary	1. 2.	1. 2.
Open Source	1. 2.	1. 2.

Environmental Issues

Environmental Problem	Ways to Reduce the Problem
E-Waste—old unused computer equipment	
Pollution— in the creation and disposing of computer systems	
Energy—all computers use electricity	

Type of Software	What is it?
Proprietary	
Open Source	

	Advantages	Disadvantages
Proprietary	1. 2.	1. 2.
Open Source	1. 2.	1. 2.

What is the key difference between CDPA and Creative Commons Licencing

Act	Description
Data Protection Act	
Name 4 of the principles of the Data Protection Act	1. 2. 3. 4.

What is the Copyright Designs and Patents Act?

What is the difference between a Copyright and a Patent?

1.6 Ethical, Legal, Cultural, Environmental Issues

Types of Licence	What is it?
Attribution	
No derivative works	

Legislation

Act	Description
Computer Misuse Act	
What are the three key offences in this act?	1. 2. 3.

Why is enforcing Copyright becoming more difficult?

Types of Software

Types of Licence	What is it?
Share a like	
Non-commercial	

Algorithms

What is an algorithm

What are the two methods of creating an algorithm?

1.

2.

Complete the following table about flowcharts

Symbol	Shape	Description
Start/Stop		
Input/Output		
Process		
Decision		

```
INPUT a
INPUT b
WHILE a <= b AND b < 20
    a = a + b
    OUTPUT a
END WHILE
OUTPUT "END"
```

```
INPUT a
INPUT b
FOR i = a TO b
    OUTPUT i * b
NEXT i
```

A	B	Output
23	23	
12	12	
12	13	
13	12	

A	B	Output
1	5	
3	3	
-5	-3	

num	age	Output
4	9	
3	7	
6	13	
15	20	
21	30	

2.1 Algorithms

Read the following algorithms, write what the outputs would be for each based on the inputs.

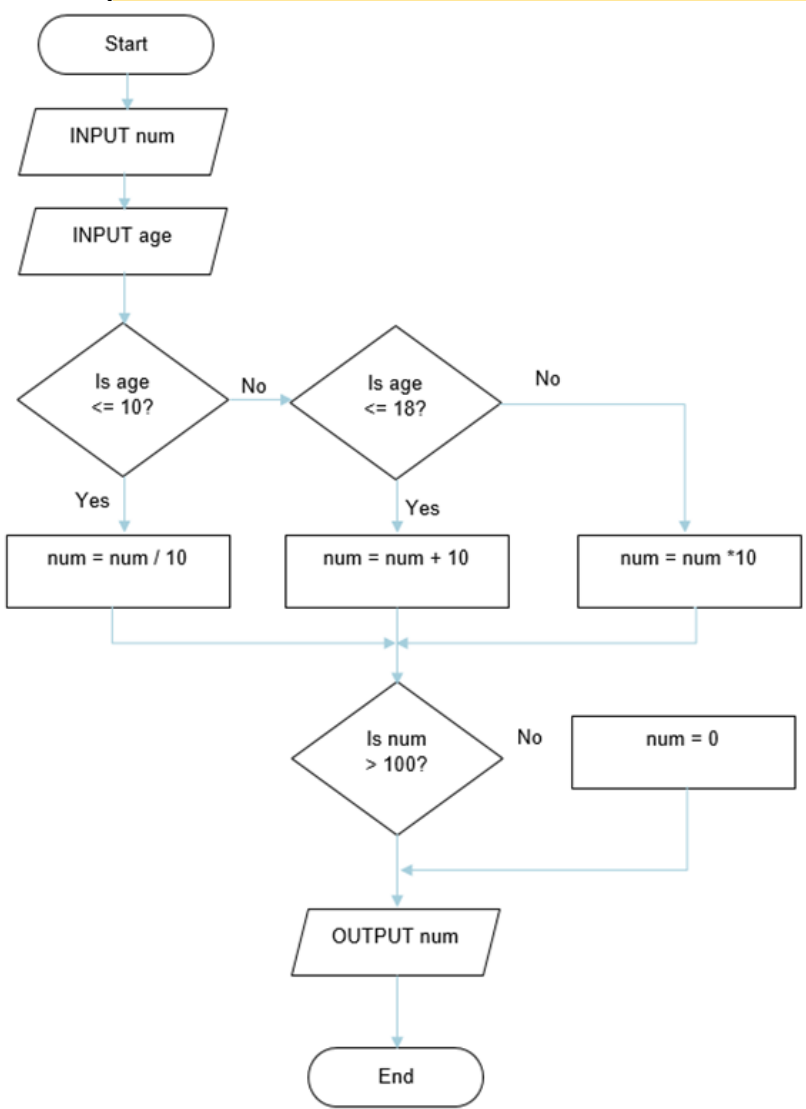
```
IF username = "smithp" THEN
    IF password = "awer" THEN
        OUTPUT "Logged in"
    ELSE
        OUTPUT "Incorrect password"
    ELSE
        OUTPUT "Incorrect username"
    END IF
END IF
```

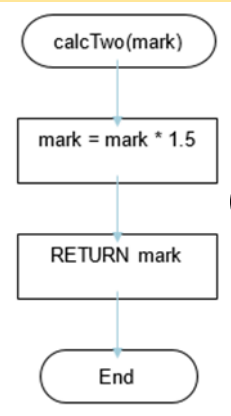
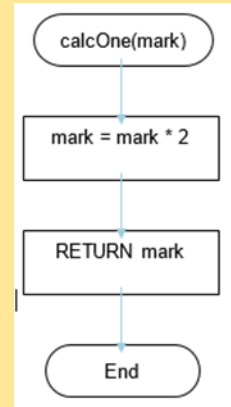
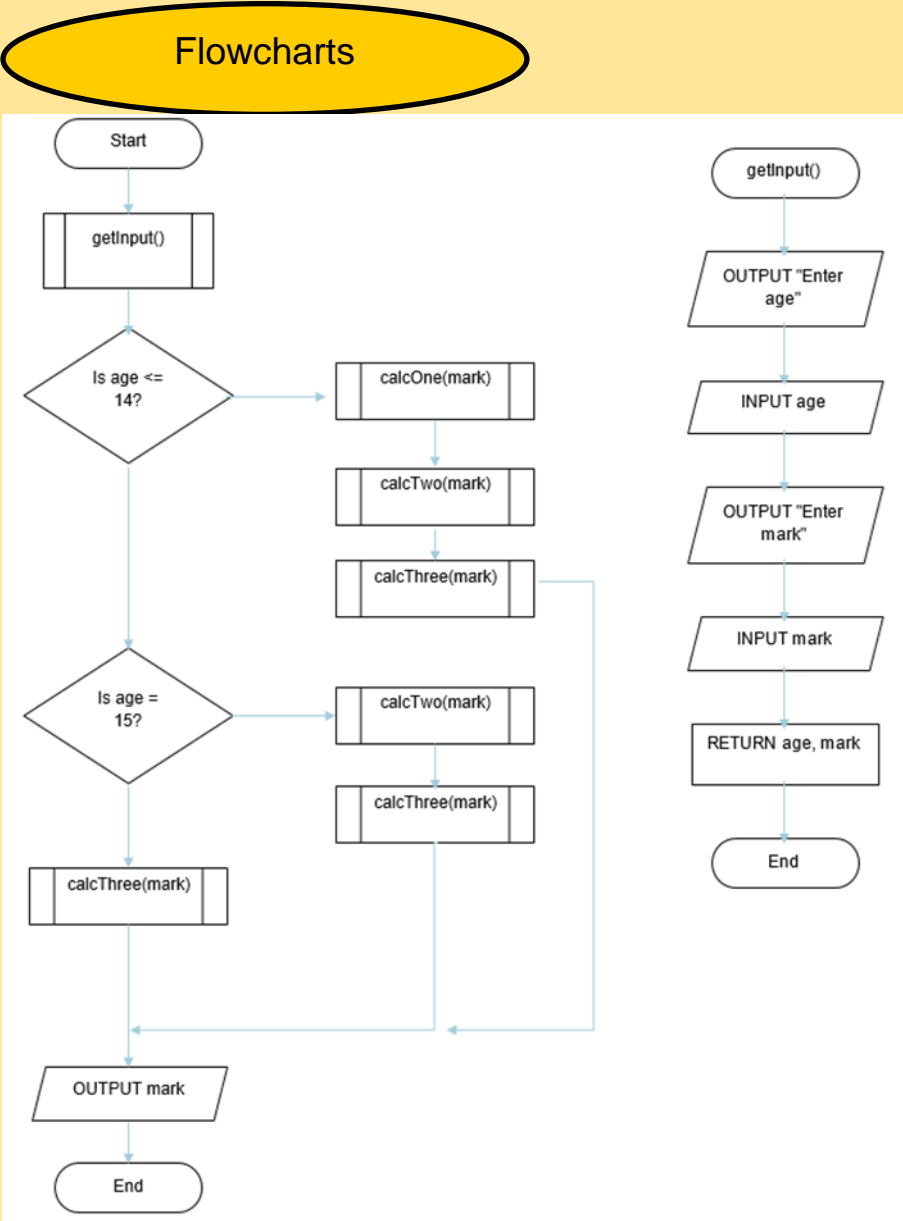
Username	Password	Output
Smithp	Awer	
Smithp	Blogs	
Jonest	awer	

```
INPUT a
INPUT b
IF a > b AND
    (a < 20 OR b >= 13) THEN
    OUTPUT "A"
ELSE
    OUTPUT "B"
    IF b = a THEN
        OUTPUT "C"
    END IF
END IF
```

A	B	Output(s)
5	3	
6	6	
20	12	
22	13	

Flowcharts





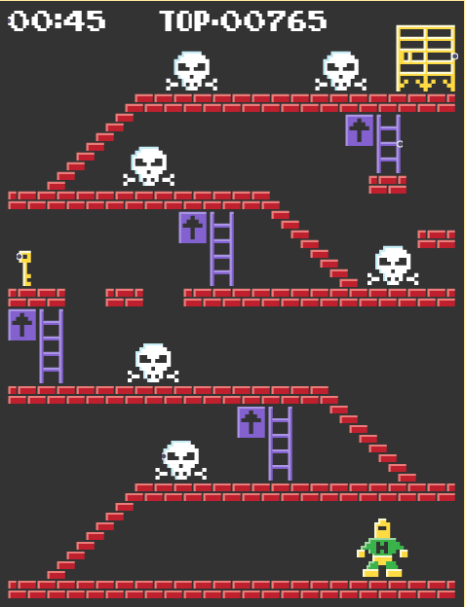
age	mark	Output
13	50	
14	25	
15	60	
16	100	
17	20	

Cornerstone	Description	Why is it important?
Decomposition		
Pattern Recognition		
Abstraction		
Algorithms		

2.1 Algorithms

Look at the arcade game to the right. Abstract the key components from the game and explain how each of them could operate.

Component	How they could work
Good Guy	Move left and right, kick to fight the baddies



Searching Algorithm	How it Works?
Linear Search	
Binary Search	

Searching Algorithms

Perform a linear search on the following values.
NOTE: Each time you discard a value, you should represent this on a new line (write out the list again)

Find the number 15 from the following list: 3 5 8 14 15 17 19 24
Fine the word elephant from the following list: Aardvark cheetah elephant fox gorilla hippo

Perform a binary search on the following values.
NOTE: Each time you discard values, you should represent this on a new line (write out the list again)

Find the number 26 from the following list: 3 5 8 14 15 17 19 24 26 30
Fine the name Sally from the following list: Ben Claire Edward Harry Libby Miranda Peter Robert Sally Tim Willow

Perform a insertion sort on the following values.
NOTE: Each time you check an item you should create a new list. You should show the sorted and unsorted list after each check.

Perform a insertion sort on the following values: 9 5 4 15 3 8 11 2

2.1 Algorithms

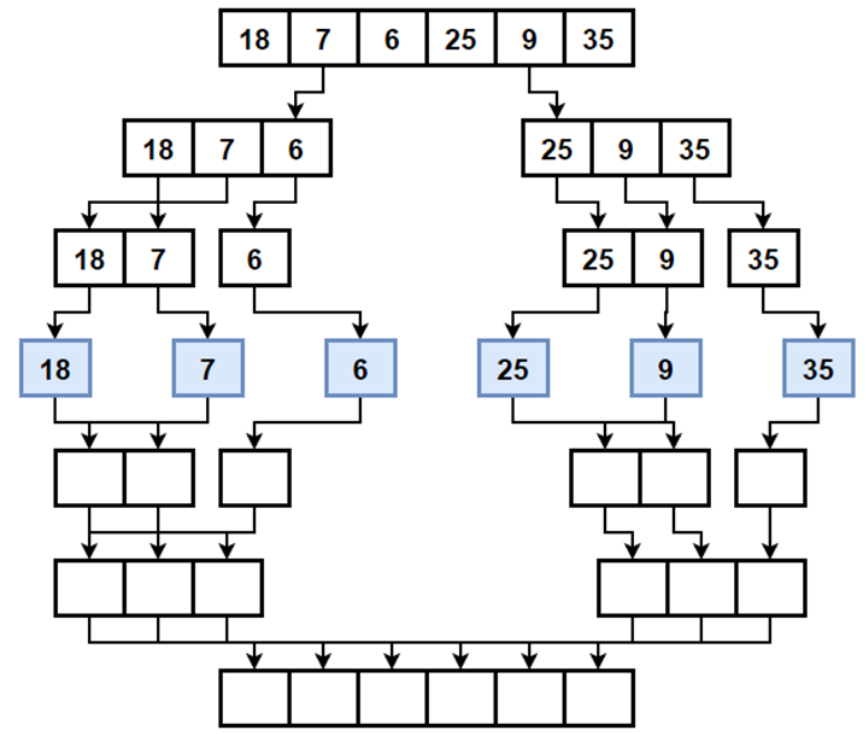
Sorting Algorithm	How it Works?
Bubble Sort	
Insertion Sort	
Merge Sort	

Perform a bubble sort on the following values.
NOTE: Each time you complete a pass, you should represent this on a new line

Sort the following list: 8 5 6 9 12 3	Sort the following list: 17 92 61 44 84 32 78 52

Perform a merge sort on the following values.

NOTE: You should show the stages of separation and how the values are sorted when combined back together.



Handling Data

What is a variable?

What is a constant?

Complete the table naming the different data types. Identify the data type described and provide an example for each.

Data type	Description	Example of use
	TRUE or FALSE	
	Single alpha character	
	Whole number values, positive or negative, no decimal point	
	A combination of alpha characters	
	Numbers with a decimal point	

What is an array?

For the array below, complete the following calculations, in this example number(1) is 7.

15	7	12	17	4	9
----	---	----	----	---	---

Calculation	Answer
Number[5] - number[1]	
Number[0] + number[3]	
Number[4] / number[2]	
Number[4] * number[5]	
(Number[3]-number[1])*number[5]	

Name the different variable and constant in this program.

Output "Welcome"

Input name

Output "Hello" + name

Input radius

Pi = 3.141592654

Area = 2 * Pi * radius

Output area

Variable

Constant

String Manipulation

Answer the following questions in the table below using the string letters.

letters = "ghjghgsdsfjkdnwqeiumnsaseasbmuioqlwer"

Code	Output
letters.length	
letters.substring(3,3)	
letters.substring(0,3)+" "+films.substring(6,4)	
letters.substring(25,8).upper	
letters.substring(10,6)+letters.substring(22,3).lower	

Field Name	Data Type	Field Name	Data Type
Telephone Number		Supplier Name	
Product Cost		Postcode	
Free Delivery?		Delivery Date	

Data Type	Description
String	
Integer	
Real	
Character	
Boolean	

2.2 Programming Fundamentals

Arrays

The array below is called distanceRun. Answer the questions below.

		Days of the week						
		0	1	2	3	4	5	6
Runner	0	9	10	8	12	0	6	9
	1	10	12	15	15	0	0	10
	2	15	14	13	16	0	8	9
	3	6	8	9	10	12	12	0

Calculation	Answer
distanceRun[1,2] + distanceRun[2,1]	
distanceRun[3,5]*distanceRun[1,5]	
distanceRun[0,2] - distanceRun[2,3]	
distanceRun[1,3]/(distanceRun[1,2]-distanceRun[0,1])	
distanceRun[1,6] * distanceRun[1,0]	

SQL

tblEmployees

EmployeeID	Surname	Forename	Street	City	Sex(M/F)	Years in Employment	Salary (£)
1	Carrillo	Abraham	3792 Etiam St.	Birmingham	M	4	26000
2	Holland	Sarah	991 Erods Rd.	Colchester	F	6	52000
3	Hernandez	Blossom	172-934 Ac Street	Birmingham	F	8	87000
4	Mcleod	Amaya	570-1940 Cras St.	Birmingham	F	4	43089
5	Vincent	Audra	6449 Duis Rd.	Birmingham	F	1	78967
6	Vega	Lucian	3594 Amet St.	Worcester	M	3	34566
7	Cohen	Jessica	2015 Ante St.	Liverpool	F	4	36755
8	Gordon	Micah	6419 Gravida Av.	Southampton	M	3	56787

What EmployeeID's would result from running the following queries:

SELECT EmployeeID FROM tblEmployees WHERE Sex=M	
SELECT EmployeeID FROM tblEmployees WHERE Sex=M AND Years in Employment > 3	
SELECT EmployeeID FROM tblEmployees WHERE Years in Employment < 4 AND Salary > 35000	
SELECT EmployeeID FROM tblEmployees WHERE City = Birmingham OR Years in Employment = 4	
SELECT EmployeeID FROM tblEmployees WHERE NOT(City = Birmingham)	

Write the search criteria to find all female employees who live in Birmingham

Write the search criteria to find employees who have been employed for 2 years or more and have salaries more than £50000.

2.2 Programming Fundamentals

Construct

Description

Selection	
Sequencing	
Iteration	

What is the difference between a procedure and a function?

What is a parameter?

List two benefits of using subroutines in your programming.

1.

2.

Write the pseudocode to define a function called VAT that passes a parameter called total.

Programming Constructs

Validation Type	Description
Length Check	
Type Check	
Range Check	
Presence Check	
Lookup Check	
Format Check	
Check Digit	

Error Type	Description
Syntax Error	
Logic Error	

2.3 Producing Robust Programs

```
INPUT mark
IF mark >=0 OR mark <= 20 THEN
    Percent = mark * 100 / 20
    OUTPUT percent
ELSE
    OUTPUT "Invalid Mark"
END IF
```

Code:	Type of error:	What is the problem?
Print("Hello world)		
Name = input("Enter name") Print("Hi" + "name")		
IF password = "apple" THEN Print("Correct")		
i = 10 WHILE i <> 10 print(i) i = i - 1 ENDWHILE		

Field	Validation Type? How?
Surname	
Telephone Number	
Date of Birth	

Complete the test table for the program

Type of Test	Input Data	Expected Output
	-1	"Invalid Mark"
	0	0
	15	75
	Ten	Error
Valid Extreme		100

Type of Test	Description
Valid	
Invalid	
Extreme	
Out of Range	
Null Value	

Authentication

Authentication Method	Description
Passwords	
Random Character Selection	
Two-Factor Authentication	
Biometrics	

Explain what input sanitisation is.

Input	How could you sanitise the input?
Dav3	
Sarah@#gmail.co m	
claire swainsworth	
£546.56.67	
O1982 56O635	

Explain how the following listed below can help improve maintainability

Maintainability

Maintainability	Explanation
Comments	
Indentation	
Variable Names	

2.3 Producing Robust Programs

Rewrite the code to the right so it is in a more maintainable format

```
s = 0
l=3
if l> 0 then
print("Playing game")
l = l-1
endif
print("Game Over")
```

Explain how you have made your re-written code more maintainable.

Complete the tables below for all the logic gates (description, drawing & truth table):

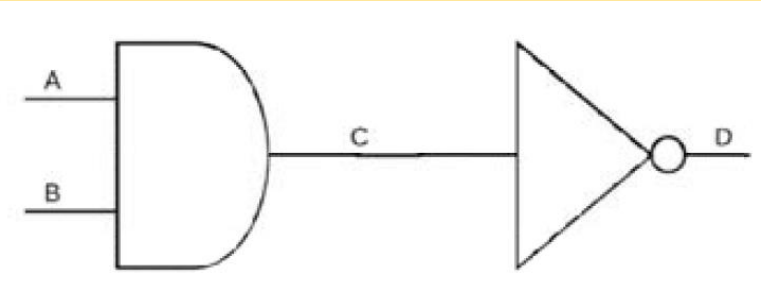
NOT gate		
Description:		
Find an image:	A	B

AND gate			
Description:			
Find an image:	A	B	C

OR gate			
Description:			
Find an image	A	B	C

2.4

Computational Logic



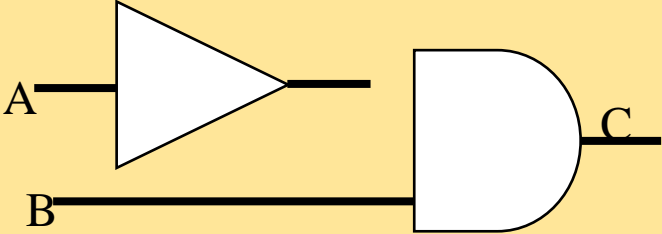
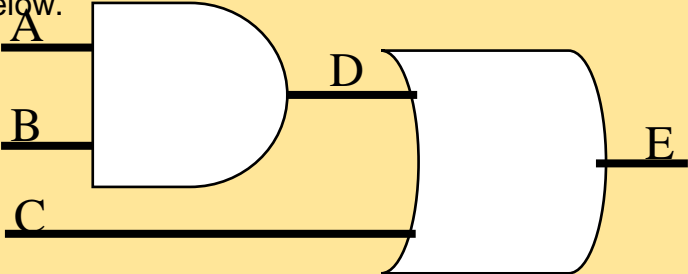
Complete the following truth table for the diagram below.

A	B	C	D
0		0	
	1		
	0		
		1	

Draw a logic circuit for the following expression.
C = ¬ (A ∨ B) (you can use <https://logic.ly/demo/>)

A	B	C	D	E
	0	0		
	0			1
0	1			
	1	1		
1		0		
	0	1		
1		0		
1	1	1		1

Complete the following truth table for the diagram below.



A	B	C

Question	Answer
(12 + 9) / 3	
(24-8)*8	
12*(9+7)	
(6+(6*5))/4	
17 MOD 2	
52 DIV 6	
6 ^ 3	
65 MOD 7	
43 DIV 9	

Programming Languages

Type	Description
Machine Code	
Low Level / Assembly Code	
High Level Code	

Types of Translator

Translator	Description
Compiler	
Interpreter	

Explain why translators are needed to convert high level code to machine code?

2.5 Translators & Languages

IDEs

Statement	True/False
Machine code is easy to understand by humans	
An example of a high level language is Visual Basic	
2 nd generation code is easier to understand by humans than 3 rd generation code	
Each CPU has its own assembly language, therefore it may not run on every CPU	
Each instruction in assembly language can carry out more than one CPU operation	
High level languages can be used with different CPUs and still work	
High level language code is known as object code.	
CPUs can understand low and high level languages in their current format.	
Assembly code is known as 1 st generation code	

Tool	Description
Source Code Editor	
Error Diagnostics	
Run-time environment	
Auto-documentation	

Preparation Checklist

- ✓ Completed subject task (We will ask to see this in the second week of lessons.)
- ✓ Read up on the specification: [OCR A Level Computer Science H446 Specification](#)
- ✓ Practiced some programming, you could use the below to help you:
 - ✓ [BSD Online | Code During Class](#)
 - ✓ [Python Tutorial \(w3schools.com\)](#)
 - ✓ [Trinket: An Hour of Python](#)
- ✓ Emailed Mrs Khalifa (fkhalifa@st-pauls.leicester.sch.uk) with any questions/concerns.
- ✓ Had a well-rested Summer, ready to learn and excel at your A Levels 😊

Super Curricular Resources – things you could do to get a head start

- Watch the GCSE Craig’N’Dave Videos to refresh your knowledge: [GCSE \(J277\): OCR Specification Order – YouTube](#)
- Watch the first few A Level Craig’N’Dave videos to get an understanding of content: [A level: OCR Specification Order - YouTube](#)