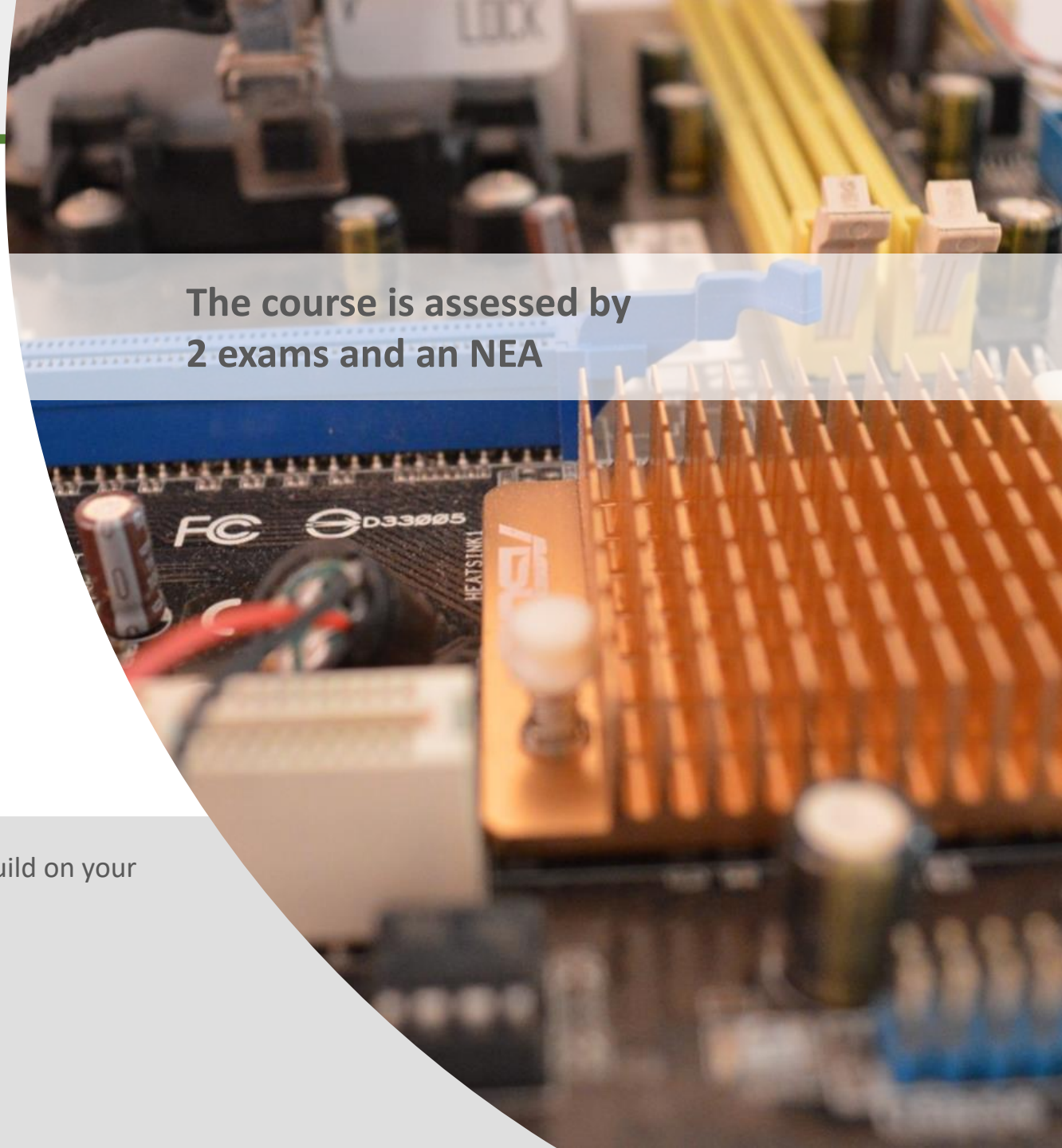


# Computer Science Transition workbook

- The topic of **Computer Science** is at the heart of the modern world
- Studying it can make you extremely sought after in today's job market
- The transition from GCSE to A level is significant, this includes:
  - An increased emphasis on **technical content**
  - An increased emphasis **independent research**

This workbook is designed to allow you to practice some of these skills and build on your existing knowledge.

**Please complete by your first lesson back in September.**



The course is assessed by  
2 exams and an NEA

## 2 Independent research task

### Emerging computer technology

Expected time to complete: 2 hours

In this task you get to investigate any area of emerging computer technology which interests you.

You can pick any area which interests you, but examples could be:

- Artificial intelligence
- Robotics
- Automated self driving cars
- Quantum computing

In no more than ONE side of A4 summarise the area you have chosen under the following four headings:

1. What is it?
2. What are the possible Social, Moral, Cultural and Ethical **benefits** of this technology on society
3. What are the possible Social, Moral, Cultural and Ethical **risks** of this technology on society
4. My conclusion on this technology and what it will mean for our world 10 years from now

#### Additional help:

For additional help and support in structuring your answer you might like to watch some of the videos from the following Craig 'n' Dave playlists:

OCR:

SLR 17 – Ethical, morale and cultural issues

<https://student.craigndave.org/videos/slr-17-ethical-moral-and-cultural-issues>

AQA:

SLR 19: Moral, social, legal, cultural issues

<https://student.craigndave.org/videos/slr19-moral-social-legal-cultural-issues>



## Getting to grips with terminology

An important aspect of being successful with your study of Computer Science is getting to grips with subject related terminology. There are over 240 specific terms you will need to learn!

Below are a handful of the key terms you will need to become familiar with.

<b>Control Unit</b>	<b>Register</b>	<b>Busses</b>
<b>Von Neuman Architecture</b>	<b>Optical Storage</b>	<b>Operating System</b>
<b>Intermediate Code</b>	<b>Device Driver</b>	<b>Compiler</b>
<b>Assembly Language</b>	<b>Machine Code</b>	<b>Lossy Compression</b>
<b>Hashing</b>	<b>Normalisation</b>	<b>TCP/IP Stack</b>
<b>Packet Switching</b>	<b>ASCII</b>	<b>Problem Decomposition</b>

1. Research each of the key terms and write a definition.
2. Resist the urge to simply cut and paste a definition from the first website you find. Many definitions found on The Internet are overly complicated and wordy.
3. Ask yourself:
  - Does my definition make sense?
  - Is it succinct, to the point?
  - Does the definition have appropriate depth and detail for A'Level?
  - Could I give this definition to another student so they could revise from it?

Expected time to complete: 2 hours





## Programming basics

Expected time to complete: 6 hours

Learning to “code” is a fun and essential part of A Level Computer Science. This task is ideal if you haven't done the GCSE in Computer Science or you simply want a nice refresher ahead of starting your A Level course.

1. Head over to the web site: <https://www.learnpython.org/>
2. Complete the following python tutorials under the heading:
  - Hello, World!
  - Variables and Types
  - Lists
  - Basic Operators
  - String Formatting
  - Basic String Operations
  - Conditions
  - Loops
  - Functions
3. Each section presents you with theory, code to run and exercises to try out.
4. If you want to practice writing your own python programs you can download and install a simple python development tool here: <https://www.python.org/downloads/>



### Additional note:

This task is most suited to students who intend to do the A Level and have not previously gained much / or any programming experience from the GCSE Computer Science course.

Although the language chosen here is Python, and that may not be what you will be using at A Level, it is the underlying programming concepts which are important.

The list of topics above cover the standard set of programming concepts you would be expected to know having completed a GCSE and Computer Science and so will prepare you well for the A level.



## Looking under the hood of the processor

Expected time to complete: 2 hours

The CPU “Central Processing Unit” is the central core of any computer system. You will study what it contains and how it works it in depth at A Level.

1. Start by watching the following 3 videos from Craig ‘n’ Dave
  1. **AQA:** <https://student.craigndave.org/videos/aqa-alevel-sl17-the-processor-and-its-major-components>
  2. **AQA:** <https://student.craigndave.org/videos/aqa-alevel-sl17-alu-cu-registers-and-buses>
  3. **AQA:** <https://student.craigndave.org/videos/aqa-alevel-sl17-performance-of-the-cpu>
2. Produce a fully annotated diagram on a single sheet of A4 / A3 paper which shows how the CPU works.
3. Make sure the diagram includes and covers:
  - Major CPU components and what they are for:
    - Arithmetic Logic Unit (ALU)
    - Control Unit (CU)
    - Cache
  - The main registers
    - Program Counter (PC)
    - Memory Address Register (MAR)
    - Current Instruction Register (CIR)
    - Memory Data/Buffer Register (MDR / MBR)
  - Fetch-decode-execute cycle
  - Include annotations which explain how the performance of a CPU can be improved by:
    - Increasing the clock speed
    - Increasing the cache size
    - Increasing the number of cores





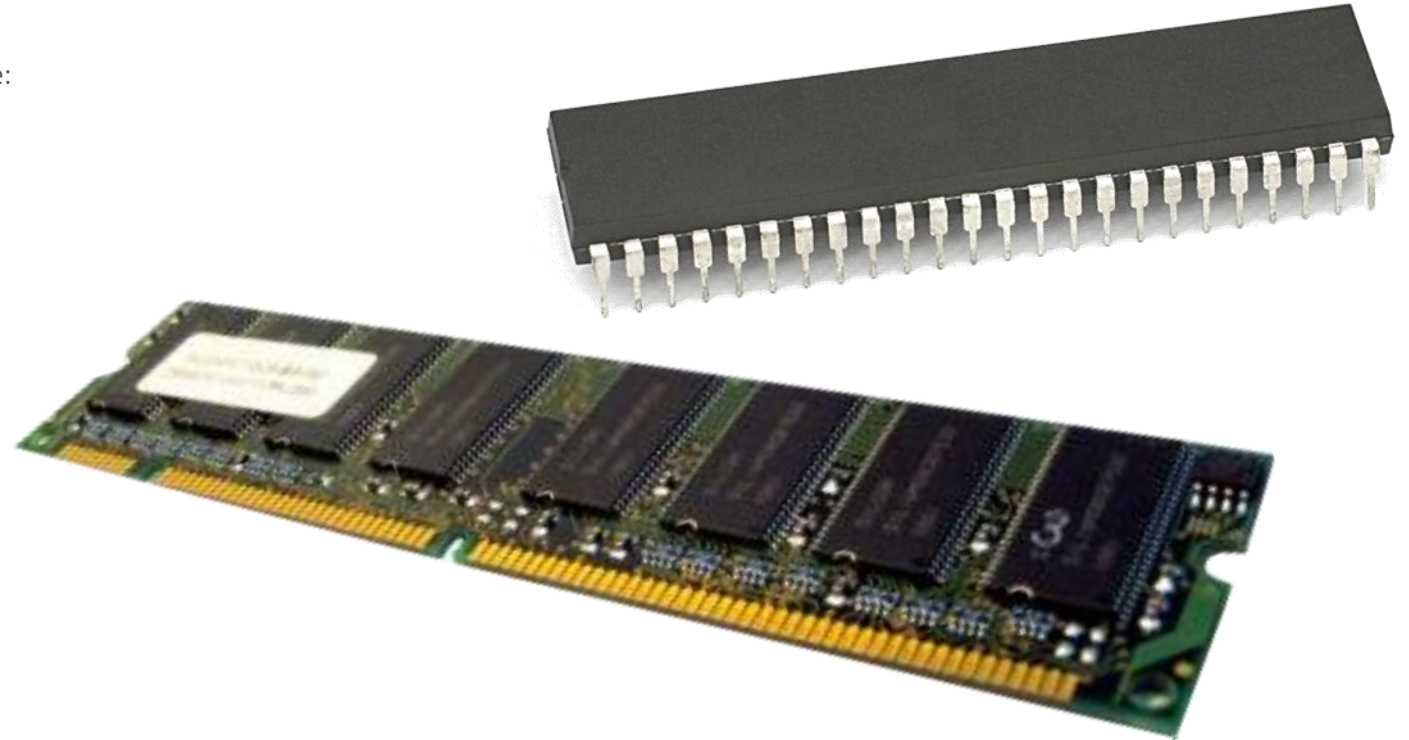
## Different types of memory

Computer memory comes in many different forms, some of the main ones are:

- Random Access Memory (RAM)
- Read Only Memory (ROM)
- Virtual Memory

Carry out some research into these forms of memory and then complete the tasks on the following slide.

Expected time to complete: 1 hour



### Additional help:

For additional help and support in completing this task you might like to watch some of the following videos from Craig 'n' Dave:

RAM and ROM:

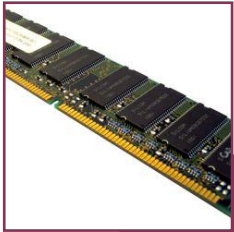
<https://student.craigndave.org/videos/ocr-gcse-sl1-2-ram-and-rom>

The need for Virtual Memory:

<https://student.craigndave.org/videos/ocr-gcse-sl1-2-the-need-for-virtual-memory>

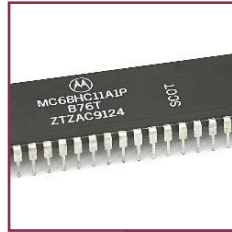


## Different types of memory



### Random Access Memory (RAM)

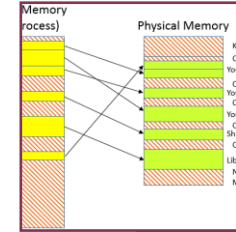
- <Enter a definition for RAM>
- <State if RAM is volatile or non volatile>
- <State if RAM is read only or read & writable>
- <Describe what sort of information RAM typically holds>



### Read Only Memory (ROM)

- <Enter a definition for ROM>
- <State if ROM is volatile or non volatile>
- <State if ROM is read only or read & writable>
- <Describe what sort of information ROM typically holds>

Expected time to complete: 1 hour



### Virtual Memory

- <Enter a definition for Virtual Memory>
- <Explain why virtual memory is needed>



## Truth tables to circuit diagrams

An important area of computer science is understanding the logic gates and diagrams which are used to represent the physical circuitry of computer systems.

Carry out some research into the following areas:

- Logic gates:
  - AND
  - NAND
  - NOR
  - NOT
  - OR
  - XOR
- Truth tables
- Boolean expressions
- Circuit diagrams

Complete the tasks on the following slides.

### Additional help:

For additional help and support in structuring your answer you might like to watch some of the videos from the following Craig 'n' Dave playlists:

OCR: SLR 15 – Boolean algebra

<https://student.craigndave.org/videos/slr-15-boolean-algebra>

AQA: SLR16 – Logic gates & Boolean algebra

<https://student.craigndave.org/videos/slr16-logic-gates-boolean-algebra>

Expected time to complete: 2 hours

P	Q	$\neg P \vee Q$
1	1	0
1	0	1
0	1	1
0	0	1

A	B	$A \rightarrow \neg B$
1	1	0
1	0	1
0	1	1
0	0	1

$(P \wedge Q) \leftrightarrow \neg((R \wedge Q) \vee P)$				
1	0	0	1	1
1	0	0	0	1
0	1	0	0	1
0	1	0	0	1
0	1	0	1	1
0	0	1	0	0
0	0	1	0	0
0	0	0	0	0

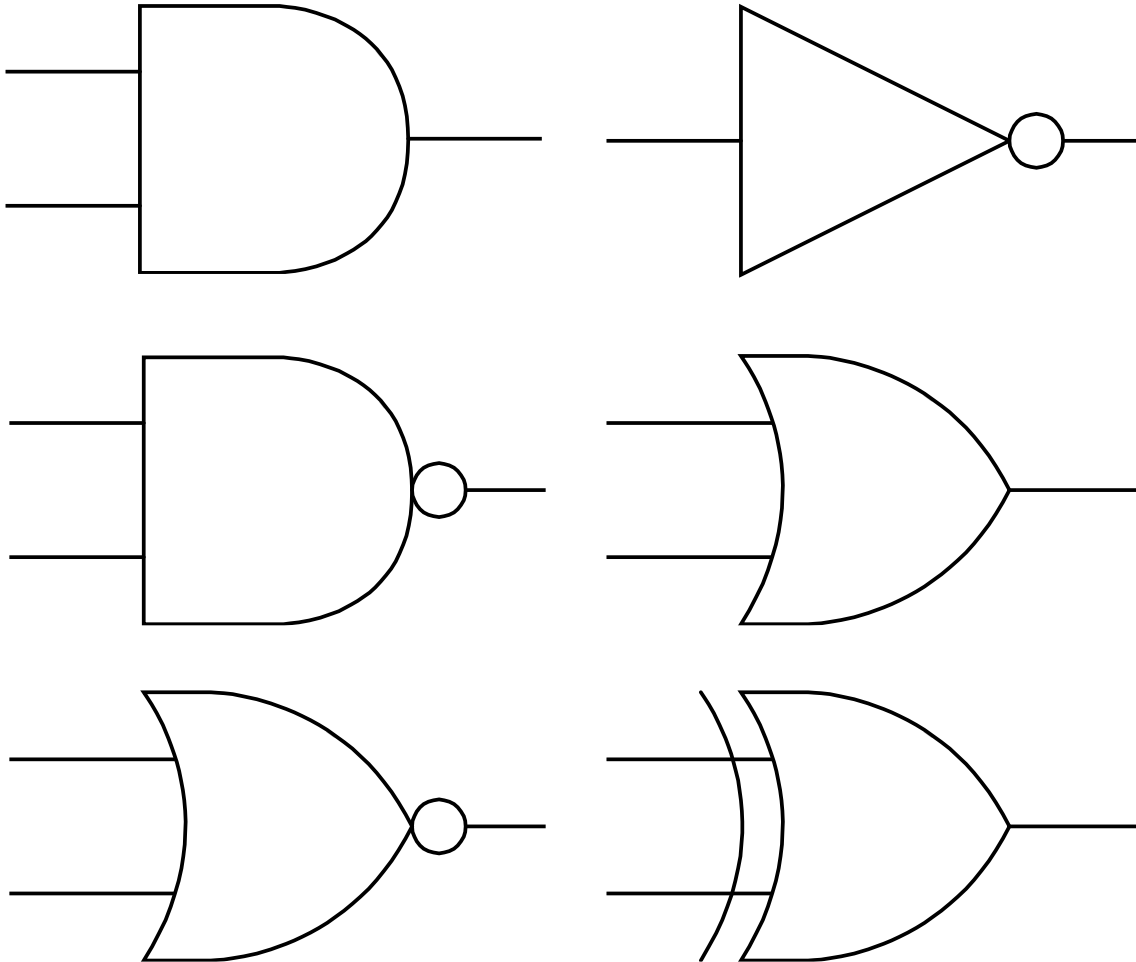




## Truth tables to circuit diagrams

Expected time to complete: 2 hours

1. Drag the labels into their correct place on the following diagram:



OR

AND

XOR

NOT

NAND

NOR

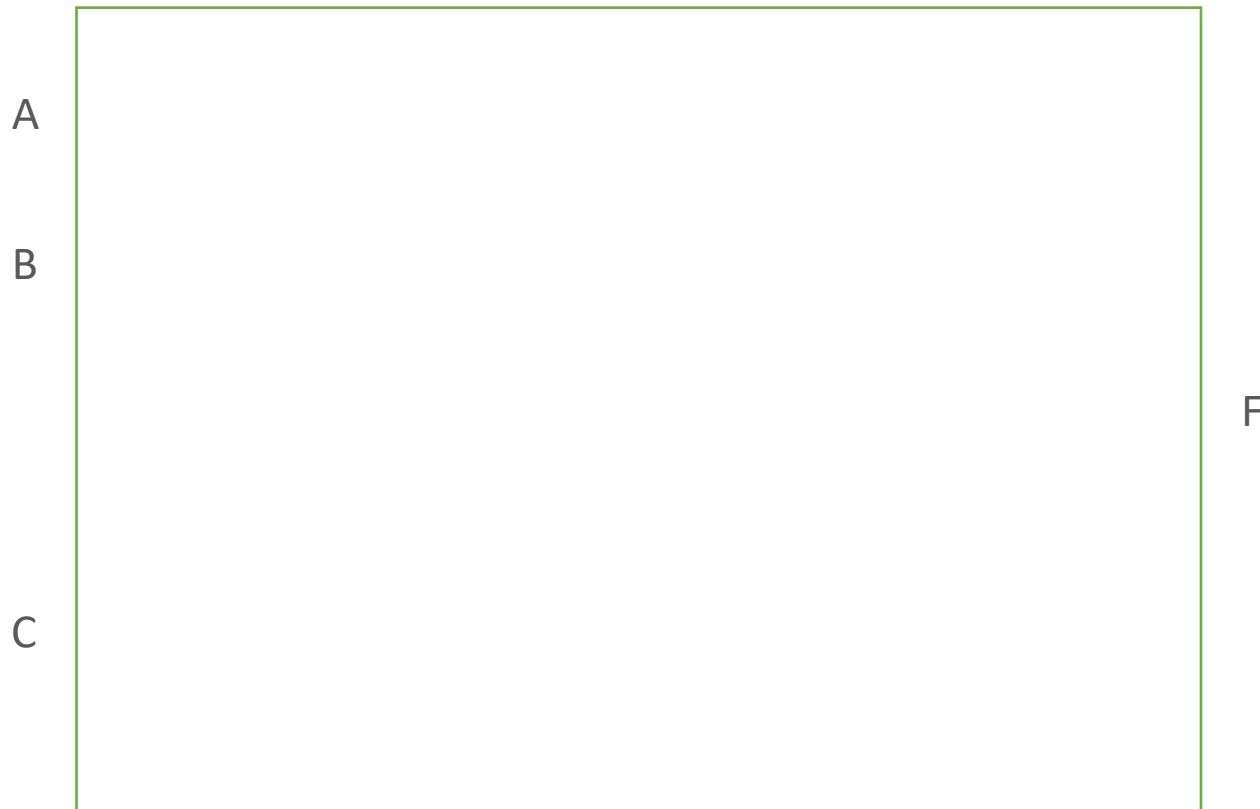


## Truth tables to circuit diagrams

2. Draw the circuit diagram which would represent the following Boolean expression:

$$\text{AQA Boolean Expression: } F = \overline{(A \oplus B)} \bullet \overline{C}$$

$$\text{OCR Boolean Expression: } F = \neg(\neg C \wedge (A \vee B))$$



Expected time to complete: 2 hours

3. Complete the truth table for the circuit diagram you have drawn

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



## Representing negative numbers in binary

Expected time to complete: 1½ hours

In GCSE computer science you will have learnt how to represent positive whole numbers in binary e.g. 47

At A Level you will need to know how to represent negative as well e.g. -47

Start to recapping (or learning if you didn't do the GCSE) how to represent positive whole numbers between 0-255 in binary

Now research how to represent negative numbers in binary using the method known as:

- Two's complement

Complete the tasks on the following slides.

### Additional help:

For additional help and support in structuring your answer you might like to watch some of the following videos from Craig 'n' Dave:

GCSE recap: How to represent positive binary values 0-255

<https://student.craigndave.org/videos/aqa-gcse-sl13-number-bases>

A Level: Representing negative binary values using Two's Complement

<https://student.craigndave.org/videos/aqa-alevel-sl11-twos-complement>





## Converting between base-2, base-10 and base-16

Expected time to complete: 1½ hours

As humans we have use the decimal or denary number system (base-10), made up of the unique digits 0-9.

Computer systems at the most basic level use only binary 1's and 0's (base-2).

As a computer scientist you will also need to become familiar with the hexadecimal number system (base-16).

You will also need to be comfortable with converting numbers between these three base systems.

Research the following areas:

- Base-2 binary number system
- Base-10 decimal/denary number system
- Base-16 hexadecimal number system
- How to convert between base-2, base-10 and base-16

Complete the tasks on the following slides.

### Additional help:

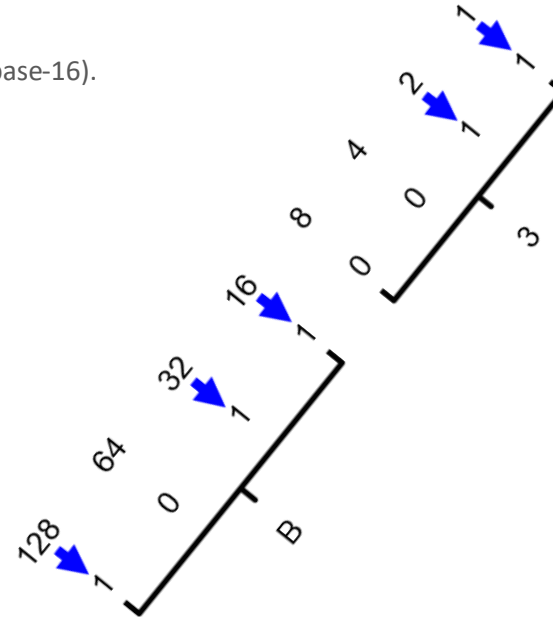
For additional help and support in structuring your answer you might like to watch some of the following videos from Craig 'n' Dave:

Base 2, 10 and 16 number systems:

<https://student.craigndave.org/videos/aqa-alevel-sl10-base-2-10-and-16-number-systems>

Converting between binary, hex and decimal:

<https://student.craigndave.org/videos/aqa-alevel-sl11-aqa-converting-between-binary-hex-and-decimal>



Denary	Binary	Hexadecimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F



