2018\_L1\_Electronics\_AS1.5\_Glossary

AS1.5 Clarification Document

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# Achieved Criteria

A student needs to show evidence to support each of the following for Achieved.

## Using appropriate resources and techniques

“using appropriate resources and techniques when developing a functional combination of hardware and software that performs to specifications”

* Hardware: All electronic components and connectors, including the power supply, microcontroller(s) and board the circuit is constructed on. This could be a breadboard, patch board, or even copper tape on mdf. No requirement that the board is a PCB, although a PCB is a nice outcome)
* Software- the program on the microcontroller
* Combination of hardware and software- the project
* Specifications- may be teacher-given or developed and agreed in consultation with the student. The specifications will include guidelines for selecting appropriate components for the chosen context\* and define the expected performance of the project
* Functional- the project meets the specifications

\*Note: a context is a real-world application that gives relevance to the project. Typical contexts could include environment monitoring and control, robotics, human assistance, sport and games etc etc.

## Modifying and debugging embedded software

“modifying and debugging embedded software”

* Embedded software- the program that has been downloaded to the microcontroller.
* Debugging- identifying errors in the program that prevent it running properly, or if it runs, it results in poor performance of the system.
* Modifying- Correcting program errors as well as improving the program so that the system performs to specifications.

## Undertaking testing procedures

“undertaking testing procedures, to debug and diagnose the electronic system”

* testing procedures are those that include
	+ visual examination of hardware components and connections to identify faults
	+ visual checking the program code and running the program to identify problems
	+ a systematic approach, such as testing suspect hardware components and connections, and breaking down the program into functional blocks which can be tested separately
* Diagnose means identifying faults and errors
* Debugging means fixing the faults, errors and problems found in the testing process

##

## Describing the interfaces and functions

“describing the interfaces and functions of components and systems used

* Interfaces: there are hardware and software interfaces.
	+ hardware interfaces are the parts of the circuit that connect the input sensor(s) to the microcontroller and the microcontroller to the output devices
	+ software interfaces are the sections of the program code that enable the hardware interfaces to work
* Describing the interfaces means the student can identify clearly the location of the hardware interfaces on a circuit diagram or actual circuit and can also identify the segments of code in the program that allow these interfaces to work.
* Describing the functions: the function of a component is to perform a single job, whether alone, or as part of a small group of components that work together with it (a sub-system). The student should be able to identify the different jobs the circuit is performing and identify the individual components and subsystems performing these jobs.

**Further Information**

Student provides evidence of understanding that may include:

* component identification and selection,
* describe current & voltage in series and parallel circuits,
* description the voltage / current flow through the interfaces.
* Use a multimeter to label voltage loss across components and voltage gain from power supply.
* identify purpose and function of series resistors
* Identify purpose and function of voltage dividers

To describe a student will

* (a) provide labelled photographs and circuit schematics with all the correct symbols and conventions. Using this the student has provided evidence of understanding that may include:
	+ component identification and component function,
	+ describe current & voltage in series and parallel circuits,
	+ describe the voltage and current flow through the interfaces.
* Use a multimeter to label voltage loss across components and voltage gain from power supply.
* identify purpose of series resistors and voltage dividers.

##

## Describing relevant implications.

Which ‘relevant implications’ are relevant will depend on the context the student’s electronics outcome is designed for. The student should be able to identify which of the categories below are the most important for their project and be able to briefly explain why.

Social

* Is the electronic system suitable for the intended user (understandable and usable)
* What does the client want, and does your electronic system deliver?

Legal (copyright and privacy)

* Did you avoid breaking copyright
* Did you get permission to place electronic system in situ
* Is the data your electronic system captures private or sensitive?

Accessibility

* Does your electronic system provide easy access to batteries
* Does your electronic system provide easy access to Power on/off

Usability

* Can the user use the electronic system easily/intuitively
* Does your electronic system show current status of system

Functionality of electronics system

* Functionality is about whether the electronic system does what is is supposed to
* Circuit boards securely mounted, Batteries securely mounted
* Displays (LED’s) are securely mounted and visible
* good solder joints, wire insulation stripped correctly, no loose or cut strands of wire
* no stress on wires
* heat shrink used to cover solder joints to stop shorting and provide mechanical strength
* label all user controls

Aesthetics

* Making something beautiful, giving it a pleasing appearance
* Elegant- a solution achieved using well-chosen components, concise coding and a simple, yet clever, design

Sustainability and future proofing

* Comments in code
* Validating my code to ensure it is correct

End-user considerations

* What does the user want, and can you provide it
* Who is using your electronic system– old people need bigger buttons / LEDS. , young people will view on phones

Health and safety implications

* Ensuring the electronic system can be safely accessed.

Environmental

* Use of recycled or recyclable materials
* Minimise use of hazardous materials

Software Codes of Practice

* files are backed up often to other locations,
* title block at beginning of code to explain operation
* comments used throughout code to explain function
* code broken up into subroutines or procedures
* labels and variables have useful names

# Merit Criteria

## Logical and readily understandable

“modifying, debugging and commenting software so that the program is logical and readily understandable”

* Program is Logical
This refers to the program- what makes a program logical is its structure (each sub-task is well-defined, self-contained and linked to the previous one) and sequence (order each task is tackled in).
* Readily understandable
Readily understandable: indentation and annotation are the main things here, as are sensible descriptive labels for each task (function) in the program. A readily understandable program can be easily debugged

Logical and readily understandable code will make use of:

* constant and variable definitions, meaningful naming conventions for constants, variables, subroutines or functions
* code comments that allow another programmer to understand the purpose / function of code blocks.

## Improved Reliability

undertaking testing procedures, to debug and diagnose the electronic system to improve the reliability”

Clarification of Terms

* Improve the reliability: This applies to both the program and the hardware of the project. The program should do what it is meant to do, consistently, and be able to cope with long periods of inactivity, low battery, and extreme (boundary) input conditions. The hardware should function reliably and repeatedly under a range of conditions (low battery, shock, environmental conditions- whatever context it has been designed to operate in).

Improved Reliability may occur through more detailed testing or improved construction techniques.

* **Improved reliability through testing:**Consider a student that has interfaced an LDR and is testing a range of light input levels and corresponding analog to digital values (0-255).
	+ It would be common for an achieved level student to use just a few light readings such as Dark, Not Dark then pick an integer value to use as a demarcation point.
	+ But for more reliability, a student would test the LDR over a wide range of analogue input levels

##

## Explaining the behaviour and function

“explaining the behaviour and function of the electronics outcome”

Explaining the behaviour and function: The student should be able to explain what the program does and how it does it, also what the electronics do (at subsystem level), and also how both the electronics and software work together to achieve the outcome in the specifications for the project. This all needs not to be excessively detailed

## Addressing relevant implications.

Student has been able to address relevant implications.

must show evidence of addressing implications in their work

● these should have been considered in testing and trialling (for example, usability, functionality)

● informed the development of the outcome

#

# Excellence Criteria

A student needs to show evidence to support each of the following step ups to Excellence

* ensure it is fit for purpose
* iterative improvement
* justifying the choice of components

These 3 points can be seen to work together. The ‘justification’ of choice here would be borne out by the testing and evaluation of the data collected for each possibility the student chooses. To ensure fitness for purpose the student would repeat this process more than once within their development.

## Ensure it is fit for purpose

undertaking testing procedures, to debug and diagnose the electronic system to ensure it is fit for purpose

* At this point in time, assuming a student has shown evidence of Justifying the choice of components and followed an iterative development process, it should now be obvious if a student has ensured fitness for purpose. The outcome will function to specification in its intended environment.

## Iterative improvement

iterative improvement throughout the design, development and testing process

* Iterative improvement within a student's work will look like trialing multiple components and/or techniques and selecting those which ensure the outcomes functions as intended. There must be evidence of small changes being made repeatedly in response to evidence. While it is important that the student shows trialing multiple components and/or techniques, the student needs to show evidence that the outcome is fit for purpose as a result. Iterative at Level 6 should be seen more than once within a students development process.

Examples of iterative improvement (trialing multiple components and/or techniques) could be described by the idea of functional modelling ( Technology Curriculum)

* In the design phase the student has generated two ideas and through functional modelling is able to justify which idea to use
* In the development phases the student has trailed / tested two possible components for an interface and uses results from tests to justify which to use.
When trialling in situ the student has the outcomes robustness and reliability, making refinement to the interfaces or wiring or enclosure etc

Example of iterative development

* Student trials various heights for IR sensor because the differentiation between black and white was not reliable. Sometimes depending on outside light the robot loses the line around the corners.
* Student trials conductivity sensor by varying the distance between the two probes and depth of sensor in soil.

##

## Justifying the choice of components

justifying the choice of components and systems used in the development of the electronics outcome

* Justifying component specifications are a better and broader criteria. Students are selecting components not just because the teacher told them to, but because they understand why a particular component is needed for an interface or electronic system. No student should ever write, it's the one we have access to at school or it's the one the teacher told me to use or it's the one I am familiar with as justification for choosing any device. Remember however that even though this is Excellence, it is after all Level 1, and calculations (if any) are still expected to be very basic.

### Justify from datasheets or specifications

Get the student to add the main specifications for the device from the datasheet (usually the few listed ones on the front page). Look for min/max parameters in terms of current/voltage

Examples for Justifying the choice of components from datasheets / component specifications?

* The selection of resistor values and how that affects the component
	+ A current limit resistor for use with an led, the consideration of the led forward operating voltage and max current allowed and determining minimum resistance needed to ensure max voltage is not exceeded. Determining maximum resistance to ensure it lit up.
	+ The selection of resistor values based on resistor rating such as 1/4 watt, 1/2 watt or 1 watt
* The selection of transistors type for an h-bridge based upon their voltage and current specifications,
* The selection of h-bridge chip based upon motor (steady and stall) current and voltage requirements
* The selection of microcontroller based upon number and type of IO pins, the number of pwm outputs, size of memory in relation to program requirements, any other special interfaces of the micro they might use
* The selection of motor based upon torque requirements
* The selection of led based upon lumen requirements
* The selection of sensor for distance measurement based upon the sensors range and accuracy
* The selection of an op amp because of its slew rate

### Justify as a result of evidence from trailing

In many cases the type of sensor / actuator may be a logical first choice. Trailing various sensor options and justifying the choice of sensor based on accuracy, reliability, sensitivity, easy of use.

What are examples for Justifying the choice of components as a result of evidence from trialing?

* The student designs a device to sound an alarm when the bath or sink has filled to a certain level. The Excellence student tests various sensor options to detect when the water has reached that level (conductivity probe? Light-dependent resistor? Thermistor? etc) and/or output alarm: buzzer? (what about hearing-impaired) etc