Engineering Bridging Project

On the following pages you will find tasks which represent the type of work you will be completing on the L3 Engineering course.

You will need to develop comprehensive research skills, which requires you to dig deeply into topics to give you enough information to complete tasks. You will also need to check the accuracy of the research by comparing information with other sources.

You will need to present your work in a logical order, making sure it has an introduction which explains the task, present your information that answers the task and then produce a conclusion.

It is also a requirement to reference your source material so you will need to copy web addresses and add them to your report/s. If this is not done your work will be classed as plagiarised and you will be asked to repeat it.

Engineering Materials and Processes

You will need to be familiar with lots of different engineering materials and processes. To get you started I would like you to research the following products and explain the materials and processes used in their manufacture. To go a little further, can you explain why these materials and processes were the best choice by comparing them with other possible options. Aim to do at least 5 and you don't have to stick to the suggestions below.

A good source of information are the 'How its made' videos available on Youtube.

- Engine block
- A shock absorber spring
- A metal kitchen sink
- Electric cables
- A toothbrush
- A drinks can
- A Coke bottle

Engineering Drawing

The images below show an isometric drawing and a 3rd angle orthographic projection.

Isometric drawing is used mostly during the design stages and is a quick way to represent a design in 3D. it can be used with or without shading and colour but should include accurate proportions of the object. Dimensions do not need to be shown but these drawings are usually supported by written notes explaining to the reader your thinking behind the design, rough sizes, materials, colours etc.

I would like you to research the drawing rules for this type of sketch. Then I would like you to sketch everyday objects in isometric to develop your skills. Start with cuboid objects and then move on to those which have a round base, such as a drinks can. Can you represent the printed design on the can in isometric? After that try complicated objects such as a dining chair or a kettle.

Bring your drawings to school for the first session of the course.

The 3rd angle orthographic is a finished engineering drawing. These will be done using computer software in school, but you need to be familiar with the rules for the layout of the drawing. All dimensions are in millimetres and the drawing must be to scale.



I would like you to familiarise yourself with this type of drawing by learning the rules, attempting a drawing of a household object, to scale, dimensioned correctly and the 3 views arranged in the correct orientation.

Bring any drawings you have done to the first lesson.



Engineering Problem Solving

Have you ever bought a product and thought this could be better?

The external design task of the course requires you to problem solve products by redesigning the object and/or changing the materials to produce better results. I have included an example task below for you to have a go at.

You are given Part A before the exam and are allowed to prepare 2 sides of A4 research material which you can take with you into the exam. You have 3 hours to complete part A.

Part B is the actual exam, which is done over 8 hours, over a 5 day period.

All work must be conducted under exam conditions.

Set Task Brief

You should spend no more than three hours on your research.

The product is a jig. A machine shop supervisor has asked you, as a junior tooling designer, to redesign a jig that is not working effectively.

You should research the design and manufacturing requirements that are relevant to jigs and their application.

Your research may consider:

- existing designs for jigs
- the manufacturing processes and technologies that are being used and possible alternatives
- the health and safety requirements for the manufacturing processes and technologies
- environmental considerations including sustainability
- material requirements and suitable material properties
- any other relevant factors, such as ease of use. In

Part A Set Task Information

The product is a jig. The jig holds a sprinkler component when it is drilled. Operators place the sprinkler component into the jig to drill two 3 mm holes using a bench drill.

The jig itself is held in a machine vice that is clamped to the bench drill table.

Currently, the jig is made from low carbon steel and there are six jigs in use at any one time, with a number of spare jigs available.

The sprinkler components are made from aluminium alloy, manufactured in batches of 1000, and are used in washing machines and dishwashers.



Jig dimensions: L= 56 mm, W= 56 mm, H=20 mm

Part B Client Brief

The machine shop supervisor is aware that the current jig has a number of issues, but the redesign has been triggered by complaints from washing machine manufacturers that the 3 mm drilled holes in the sprinkler component are not positioned correctly.

The bench drill operators have provided feedback to the machine shop supervisor that the jig is not effective for a number of reasons; these include problems with holding the sprinkler component securely and drilling the holes in the correct position and to the correct size.

The machine shop supervisor needs the tooling designer to identify all of the reasons why the jig is not effective and design a solution that solves the current issues.

The bench drill operators use a gauge to check the size of the 3 mm drilled holes in the sprinkler component. They have reported that the holes in the sprinkler component change in size after the jig has been used for a period of time.

The machine shop supervisor asked each of the operators to measure and record the size of one of the mm holes after every 10th sprinkler component had been drilled using their jig. The information provided by the machine shop supervisor is found in Table 1, which can be used to perform a statistical analysis of drilling precision.

Bench drill	Coolant Spindle sp	Spindle speed	Hole size (mm) after x sprinkler components drilled									
operator	(Yes/No)	(reomin)	x = 10	x = 20	x = 30	x = 40	x = 50	x = 60	x = 70	x = 80	x = 90	x = 100
A	Y	1000	3.10	3.15	3.20	3.25	3.30	3.35	3.40	3.50	3.55	3.60
8	Y	1200	3.10	3.10	3.15	3.20	3.25	3.30	3.35	3.40	3.50	3.55
c	N	1000	3.30	3.30	3.35	3.40	3.40	3.45	3.50	3.60	3.70	3.80
D	N	1400	3.20	3.20	3.25	3.30	3.35	3.45	3.50	3.55	3.60	3.70
E	Y	1100	3.20	3.25	3.25	3.30	3.35	3.40	3.45	3.45	1.50	3.55
F	N	1200	3.20	3.20	3.30	3.35	3.40	3.45	3.50	3.55	3.65	3.75

Table 1 - Drilling precision based on bench drill operator measurements

The machine shop supervisor has asked the tooling designer to come up with an alternative solution for the jig that can also take into account the most efficient use of materials and manufacturing processes; however, the tooling designer also has an opportunity to optimise the design in terms of form, sustainability and other factors.

The jig must:

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- be able to be held in a machine vice or clamped to the table of the bench drill
- hold the existing design for the sprinkler component
- allow the 3 mm holes to be drilled accurately into the existing sprinkler component
- enable the operators to complete the drilling process safely and quickly for each sprinkler component
- be capable of being manufactured in small batches.

Tasks:

At the start of the task create a short outline project time plan in your task booklet. During the other activities (2 to 5), you should also record in the Activity 1 section of your task booklet:

- why changes were made to the design during each session
- action points for the next session.

Interpret the client brief into operational requirements, to include:

- product requirements
- opportunities and constraints
- interpretation of numerical data
- key health and safety, regulatory and sustainability factors. 6 marks

Produce a range of (three or four) initial design ideas based on the client brief, to include:

- sketches
- annotations.

Develop a modified product proposal with relevant design documentation. The proposal must include:

- a solution (including a final drawing). The proposal must consider:
- existing products
- materials
- manufacturing processes
- sustainability
- safety
- other relevant factors.

Your final task booklet entry must evaluate:

- success and limitations of the completed solutions
- indirect benefits and opportunities
- constraints
- opportunities for technology-led modifications.

9 marks

30 marks

6 marks

9 marks

Answers to external task problem solving.

This unit is marked holistically so there are no specific answers. Use the criteria below to determine if you have met the requirements of the task.

Assessment focus	Band 0	Band 1	Band 2	Band 3	Band 4
Carry out an	0	1-2	3-4	5-6	n/a
iterative development process	Level of response not worthy of credit	 Entries demonstrate an unstructured or linear approach to the design process. Development activities lead to design refinements that may not be relevant to the brief. A limited justification of the changes made in order to fulfil the requirements of the brief. 	 Entries demonstrate some evidence of an iterative approach to the design process. Development activities lead to design refinements that are partially linked to the requirements of the brief. Some justification of the changes made throughout the development process to fulfil the requirements of the brief. 	 Entries demonstrate a logical and iterative approach to the design process. Development activities lead to design refinements that are coherently linked to research and the requirements of the brief. Thorough justification of changes made throughout the development process to fulfil the requirements of the brief. 	
		 Action points are vague, incomplete or not present. 	 Action points for the next external assessment session are identified but not well defined or prioritised. 	 Well defined, logical and prioritised action points for the next external assessment session are identified. 	

Assessment focus	Band 0	Band 1	Band 2	Band 3	Band 4
Interpreting	0	1-2	3-4	5-6	n/a
brief into operational requirements	Level of response not worthy of credit	 Interpret the brief into some key product requirements, opportunities and/or constraints that partially meet the brief and are not cohesively linked. 	 Interpret the brief into a cohesive set of product requirements, opportunities and constraints that meets the brief. 	 Interpret the brief into a cohesive and comprehensive set of product requirements, feasible opportunities and constraints that meets the brief and considers enhanced 	
		 Limited calculation and interpretation of numerical data that may include some errors. 	 Mostly accurate calculation and interpretation of numerical data that may include minor errors. 	 Product performance. Accurate calculation and interpretation of numerical data. 	
		Consideration of some health and safety, regulatory and/or sustainability factors with limited relevance to the given context.	 Consideration of key health and safety, regulatory and sustainability factors with some relevance to the given context. 	 Consideration of key health and safety, regulatory and sustainability factors with relevance to the given context. 	

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Assessment focus	Band 0	Band 1	Band 2	Band 3	Band 4
Initial design	0	1-3	4-6	7-9	n/a
ideas	Level of response not worthy of credit	Limited range of basic ideas that address some aspects of the brief.	 A range of appropriate ideas that address most aspects of the brief. 	 A range of appropriate ideas that comprehensively address the brief. 	
		 Ideas communicated at a simplistic level with limited technical terms. 	 Ideas communicated clearly and suitable use of technical terms that mostly link to the brief. 	Ideas communicated with clarity and concisely and	
		 Ideas that have limited feasibility and may not be fit for purpose. 	 Ideas that are mostly feasible and fit for purpose, but may 	appropriate use of technical terms that link to the brief.	
		1026.2	design elements.	 Ideas that are feasible and fit for purpose. 	

Assessment focus	Subtask	Band O	Band 1	Band 2	Band 3	Band 4
Develop a modified	Solution	0	1-6	7-12	13-18	19-24
product proposal (form, materials and/or manufacturin g processes)		Level of response not worthy of credit	 The solution shows a simple variation in form and/or approach from the brief. The design proposal shows little or no reference to existing alternative products. Appropriate material/s selected that meet the requirements of the brief. Limited investigation of options. Appropriate selection of manufacturing process/es that meet the requirements of the brief. Limited investigation of options. Design proposal show a limited consideration of sustainability at some stages of the 	 The solution is feasible but doesn't represent an improvement from the original product and shows variation in form and/or approach from the brief. The design proposal shows some reference to existing alternative products. Material/s selection is appropriate to the brief and partially justified by an investigation that considers limited options. Selection of manufacturing process/es is appropriate to the brief and partially justified by an investigation that considers limited options. Design proposal show some consideration of sustainability at most stages of the product life 	 The solution is an improvement from the original product, showing a clear variation in form and/or approach from the brief. The design proposal is informed, based on some understanding of existing alternative products. Material/s selection is appropriate to the brief and mostly justified by an investigation of options. Selection of manufacturing process/es is appropriate to the brief and mostly justified by an investigation of options. Design proposal show some consideration of sustainability at most stages of the product life 	 The solution is optimised, demonstrating a justified variation in form and/or approach from the brief. The design proposal is informed, based on a thorough understanding of existing alternative products. Material/s selection is appropriate to the brief and fully justified by balanced investigation of options. Selection of manufacturing process/es is appropriate to the brief and fully justified by balanced investigation of options. Selection of manufacturing process/es is appropriate to the brief and fully justified by balanced investigation of options. Design proposal considers sustainability at all stages of the product life cycle.

Assessment focus	Subtask	Band 0	Band 1	Band 2	Band 3	Band 4
			 product life cycle. Ideas have little or no reference to the safety of the design and/or designing out risks. 	cycle. • Ideas show some reference to the safety of the design and designing out risks.	cycle. • Ideas show some reference to the safety of the design and designing out risks.	 Ideas clearly reference the safety of the design and designing out risks.
	Design	0	1	2-3	4-5	6
	Docume ntation	Level of response not worthy of credit	 Limited formal documentation used to communicate the solution. Little or no annotation used. The use of technical terminology is attempted but it is largely inaccurate. 	 Formal documentation used to communicate the solution. Annotation used to identify some key features of the solution which would allow a competent third party to understand the purpose of the solution. Technical terminology is limited and accurate. 	 An appropriate range of formal documentation used to communicate the solution effectively. Sufficient annotation of the key features of the solution which would allow a competent third party to interpret how to manufacture the solution. Some accurate technical terminology is used. 	 A comprehensive range of relevant formal documentation to communicate the solution effectively. Concise annotation of the solution which would allow a competent third party to effectively interpret how to manufacture the solution. Technical terminology is used accurately throughout.

Assessment focus	Band 0	Band 1	Band 2	Band 3	Band 4
Validating	0	1-3	4-6	7-9	n/a
the design proposal	Level of response not worthy of credit	 Superficial appraisal of: Success and limitations of completed solutions Indirect benefits and opportunities Constraints. Provides a limited rationale for the design solution, which may not relate directly to the brief. Little or no further technology-led modifications communicated. 	Some appraisal, which may be unbalanced or incomplete, of: • Success and limitations of completed solutions • Indirect benefits and opportunities • Constraints. • Provides a partial rationale for why the design solution is more effective in relation to some aspects of the brief. • Further technology-led modifications are communicated with some evidence of how they could improve the effectiveness of the solution.	 Balanced and thorough appraisal of: Success and limitations of completed solutions Indirect benefits and opportunities Constraints. Provides a sound rationale for why the design solution is more effective in relation to the brief. Further technology-led modifications are communicated with detailed evidence of how they could optimise the solution. 	