Non-Examined Assessment

Band 4 Exemplar Learner Response

NCFE Level 1/2 Technical Award in Engineering (603/7006/3)

V1.0 October 2023

Contents

Introduction

The following are sample learner responses for each task within an assignment alongside examiner commentary for each assignment. They show how learners might respond and can help assessors in making their overall marking decisions.

Learner responses

Each learner response should demonstrate **what** a **mark band 4/top band** response looks like alongside any evidence which is required to be completed. All responses use content from the mark schemes and align with the standards in the mark band descriptors and indicative content.

Assessor commentary

The assessor commentary demonstrates **why** the responses given throughout the assignment meet the criteria for the mark band they have been awarded. The assessor commentary will be linked to, and supported by, the descriptors in the mark scheme.

Task 1 – Materials selection		
Band	**Marks**	**Descriptors**
4	10–12	**AO1 – excellent** ability to research, reflecting a wide range of research sources in relation to the brief. All elements will be researched in a **detailed** and **effective** way. **AO2 – excellent** ability to apply knowledge and understanding to the scenario within the brief. **Highly suitable** creative selections, **very relevant** to the engineering piece. **AO3 – excellent** analysis of the brief, showing analytical thinking skills, with **highly reasoned** justifications and decisions in the choice of materials and tools/machinery. Learner has offered well considered approaches in order to meet the brief.
3	7–9	**AO1 – good** ability to research, reflecting a wide range of research sources in relation to the brief. Most elements of the brief will be researched in a **detailed** way. **AO2 – good** ability to apply knowledge and understanding to the scenario within the brief. **Suitable** creative selections, relevant to the engineering piece. **AO3 – good** analysis of the brief, showing some analytical thinking skills, with **reasoned** justifications and decisions in the choice of materials and tools/machinery. Learner has offered considered approaches in order to meet the brief.
2	4–6	**AO1 – reasonable** ability to research, reflecting a range of research sources in relation to the brief. **Some** elements will be researched in a reasonably detailed way. **AO2 – reasonable** ability to apply knowledge and understanding to the scenario within the brief. **Some** suitable creative selections, relevant to the engineering piece. **AO3 – limited** analysis of the brief, showing a limited level of analytical thinking, with **poorly** reasoned justifications and decisions in the choice of materials and tools/machinery. Learner has shown **limited** consideration of approaches to meet the brief.
1	1–3	**AO1 – limited** ability to research, reflecting limited use of research sources in relation to the brief. **Some** elements may be researched in a limited way. **AO2 – limited** ability to apply knowledge and understanding to the scenario within the brief. **Limited** suitable creative selections, relevant to the engineering piece. **AO3 – limited** analysis of the brief, showing limited analytical thinking, justification and decisions in the choice of materials and tools/machinery. Learner has shown **very limited** consideration of approaches to meet the brief.
0	0	No rewardable material

Project brief

You work for a mechanical engineering company who manufacture light fittings for household and office furnishing companies.

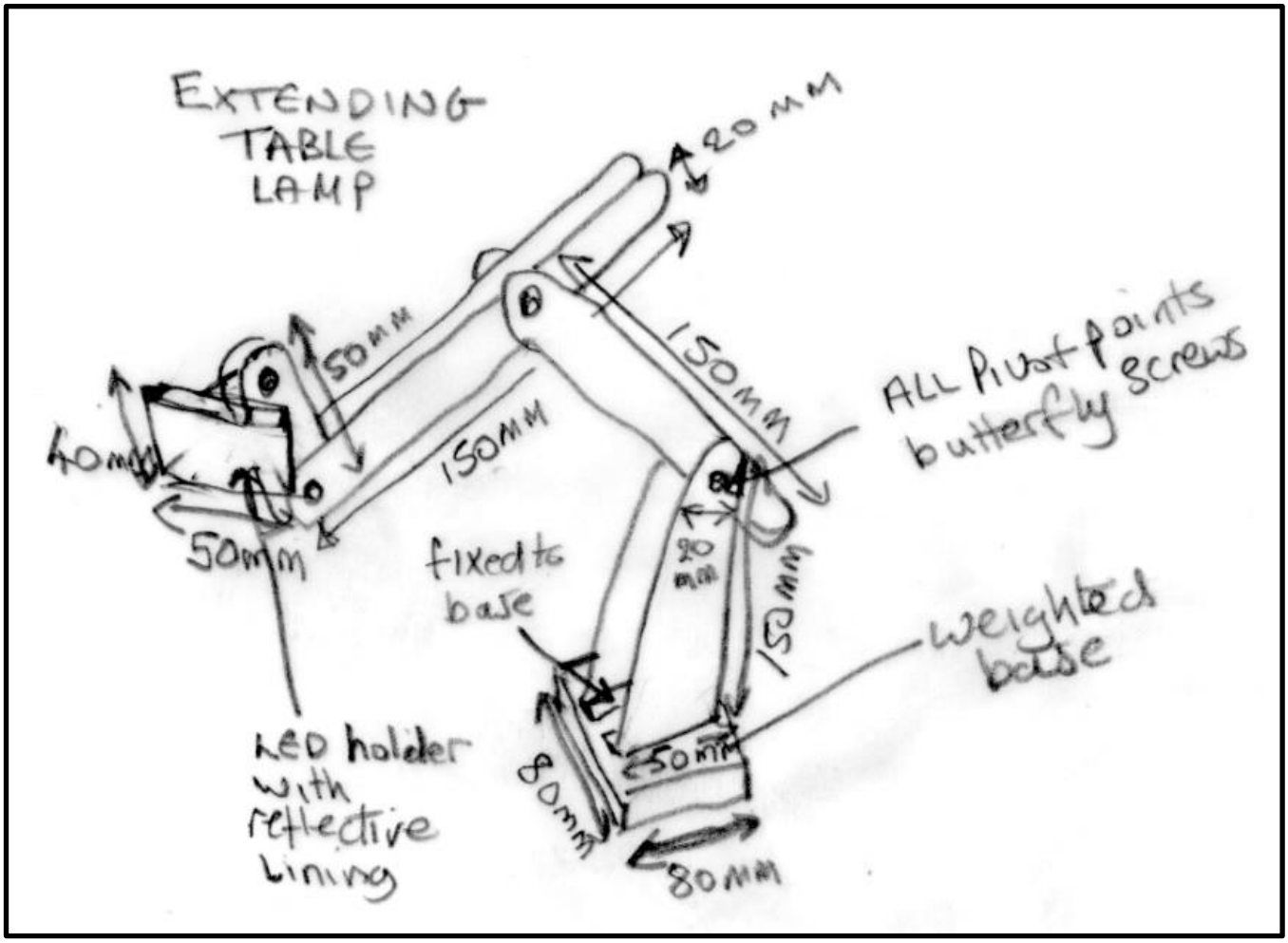
You have been asked to work on a new model of an LED table lamp and are required to produce a working, scaled model of the object to present to the board of directors.

You are required to produce a portfolio to accompany the model.

The portfolio should include isometric engineering drawings of the LED table lamp, a plan of production, evidence of testing and an evaluation.

You have been provided the free-hand sketch of the new LED table lamp.

Use this sketch throughout the project, as required.



Task 1: Materials research and materials selection

Evidence

Information on materials, tools and/or machinery.

You need to show that you have researched and selected:

- materials required to manufacture
- tools and/or machinery required to manufacture.

You need to show:

- supporting information to justify the selection of materials, tools and/or machinery.

You must include your internet browsing history used for research and planning purposes.

You could use the following formats to provide evidence for your research:

- written report
- annotated diagrams
- digital presentation.

According to the project brief and provided free sketch, the proposed table lamp has an extended arm which gives the user more flexibility to be manipulated and angled, which will provide the user with the right amount of light for the working area at office or home.

Regarding other materials that could be considered when producing a lamp as described above, we can consider metal, wood and polymer (plastic). The details of these are described below:

1. **Metal**
   Metal can be considered in two categories: ferrous metal and non-ferrous metal.

- Ferrous metals. These are magnetic, strong, hard and contain iron. The two types of widely used ferrous metals include steel and cast/wrought iron. My research has shown that ferrous metals have the following characteristics:

Ferrous metals share some basic properties, including being prone to rust and being magnetic. The list of common ferrous metal properties include:

- *Durable*
- *Good tensile strength*
- *Good electrical conductivity*
- *Low corrosion resistance*
- *Silver in colour*
- *Recyclable*
- *Usually magnetic*
  https://www.twi-global.com/technical-knowledge/faqs/what-metals-are-ferrous#:~:text=The%20word%20'ferrous'%20comes%20from,such%20as%20with%20stainless%20steel)

Assessor comments

The learner has provided a detailed analysis of the task and the research is targeted and relevant. They have shown excellent understanding of the brief and the needs of the prototype when selecting highly relevant materials.

The learner has carried out research using a wide range of relevant sources on lighting. For this, the learner has found out the intended use of this table lamp and then, based on its application, tried to choose the proper materials and tools for prototyping.

The materials considered for prototyping based on the project brief are metal, wood and polymer (composite). Their selection is justified, demonstrating effective reasoning and knowledge and understanding of the materials.

However, since ferrous metals have relatively high amount of iron this makes them prone to rust when exposed to moisture. They are also heavy in weight and steel in particular, tends to be used in the construction industry. Iron has a wide range of uses. Cast iron can be used for plumbing applications and cookware. Wrought iron is often used in fencing and gates. Due to these factors using heavy weight and potentially rust prone ferrous metals are out of question when constructing the lamp.

- Non-ferrous metals. These metals are malleable and lighter than ferrous metals and they are also resistant to corrosion/rusting due to the fact that they contain no iron. However, this type of metal is generally more expensive than ferrous metals. My research has shown that non-ferrous metals have the following characteristics:

  These attributes include lighter weights, conductivity, corrosion resistance and non-magnetic properties. Non-ferrous metals also tend to be softer and more malleable than ferrous metals, meaning they can also provide aesthetic applications, as with gold and silver.

  The properties of non-ferrous metals include:
  - *Easy to fabricate (including machinability, casting, and welding)*
  - *High corrosion resistance*
  - *Good thermal and electrical conductivity*
  - *Low density*
  - *Non-magnetic*
  - *Colourful*

  https://www.twi-global.com/technical-knowledge/faqs/what-metals-are-non-ferrous

Some examples of non-ferrous metals are: copper, lead, aluminium and titanium. As they are non-magnetic this type of metal is particularly useful for electronic and wiring applications. Therefore, although they are expensive, they would be a suitable material to develop a table lamp with. Specifically, aluminium would be the most appropriate metal from which to make a table lamp as it is easy to manipulate into the size and shape required and is less expensive than some of the other metals (e.g. titanium, gold and silver). It can also be painted with the desired coloured metal paint.

Assessor comments

The learner has researched only the most relevant materials and shows a well-considered approach. Here they show their knowledge and understanding of all the materials as well as the requirements of the task.

They have shown knowledge and understanding of the properties of a wide range of materials within the three categories.

2. Wood

Wood can create a sturdy base and arm and is the easiest material to use in many applications since it is easy to drill and cut and it also has high mechanical properties and is a natural insulator to heat and electricity. Because wood is readily available, relatively inexpensive, easily sourced and biodegradable, it is more desirable to use for prototyping.

Types of wood that could be considered for the lamp prototype are:

- Plywood. This type of wood is strong and is attractive in appearance. Also, it can be easily sanded to create a fine finish. Also, it can be easily painted or varnished to achieve an attractive final appearance. Compared to some other types of wood (e.g. oak) it is relatively inexpensive and therefore is a good option when developing prototypes.

As we can see here, the strength of this wood comes with the layers that are included. We can also see that it is quite smooth and therefore can be finished well to achieve an attractive appearance.

- Oak. This is an attractive wood that is strong but relatively expensive. Also, it is hard to achieve an attractive hand finished appearance. Therefore, for the purpose of the lamp prototype it should not be considered.

We can see here that this wood has a very attractive and very smooth finish. However, this would have required a great deal of time and work to achieve this.

- Pine. This wood is easy to cut, shape and finish and can be used for a range of different purposes. It is inexpensive but may not be strong enough to use for the lamp prototype.

We can here that this type of wood has a distinctive grain and although it appears strong, it might not be strong enough for our purposes.

- Beech. This wood is hard and difficult to break and can therefore be considered for use when constructing the lamp prototype. However, it can warp when exposed to humidity so this needs to be considered when we store and use the lamp.

  We can see here that this wood is smooth and can therefore provide a good finish. However, what we can't see is the worry of warping which is something that would be unacceptable in a lamp which has long arms/stand.

  https://www.designingbuildings.co.uk/wiki/Physical_Properties_of_Wood
  https://marteloandmo.co.uk/blogs/news/what-are-the-types-and-characteristics-of-hardwoods-we-use
  https://www.homesdirect365.co.uk/blog/2020/07/a-guide-to-wood-types/
  https://www.bbc.co.uk/bitesize/guides/zjgyb82/revision/3

3. Polymers

Polymers are organic compounds which are the main substance of plastic and most of them are oil-based. Polymer materials have been widely used in different industries due to their superior properties such as waterproof, anticorrosion, wear resistance, lightweight, good strength, low cost and good electrical insulation.
These materials are easy to drill and cut and also available in different size, shape and colours. However, the main drawback is they are not really biodegradable since it takes a long time to break down, so end up in landfill sites for decades.
Compared to wood, polymers are generally more expensive. Also, depending on the bulb used in the table lamp, it could produce heat and potentially melt the polymer. Therefore, using this material to produce the prototype table lamp probably shouldn't be considered due to the possibility of heat coming from the bulb.

https://www.hindawi.com/journals/ijps/2020/8838160/
https://www.bbc.co.uk/bitesize/guides/z9twsrd/revision/4
https://www.bbc.co.uk/bitesize/guides/zrstng8/revision/1

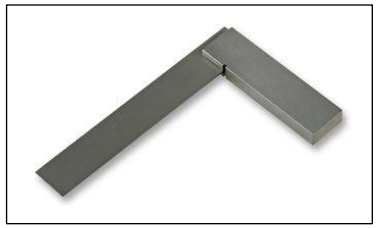
According to the project brief and provided free sketch, different type of tools would be needed to be used for prototyping, which will depend on the material(s) we select for production. Here is information on the tools we can use for prototyping the LED Lamp:

1. **Marking-out tools**
    - Scriber (marking off material (such as wood or metal) to be cut).

We can see here the sharp ends that can be used to mark out when planning for cutting. As we will be cutting materials in the prototype, it would be useful to have a scriber available.

- Steel ruler (measuring the dimensions of material). To ensure that the dimensions of the lamp are in accordance with the engineering drawings, having a ruler available is very important.
- Engineer's square (for accurately check and mark angles)

We can see here that this tool provides a clear 90 degree angle to help ensure that corner angles are accurate. As there are a number of right angles in the lamp (specifically in the stand), having a square would be important for accuracy.



- Marking gauge (woodworking)

This tool marks out accurately lines on wood that are both accurate and clear. Having one of these available could be useful but if I measure and mark out accurately, it might not be necessary.

Assessor comments

The learner has shown an understanding of the need for accurate marking out of components, modifying the components to comply with drawing dimensions, joining the components correctly and finishing the prototype to ensure effective operation. Their planning takes account of all of these elements.

- Dot punch (mark the centre of a hole for drilling)

We can see here that this is a strong tool as it will be hit with a hammer to mark out a point for drilling. This may be useful for ensuring that holes for butterfly screws are accurately drilled. However, these are usually used for metal but my prototype is to be made of wood.

- Callipers (measuring the dimensions of material parts outside and inside).

This is a useful tool to accurately measure dimensions and be able to replicate this elsewhere. This is particularly useful when measuring hard to access spaces. For the purposes of creating the lamp prototype, it is unlikely that we would need this tool.

2. Modifying materials

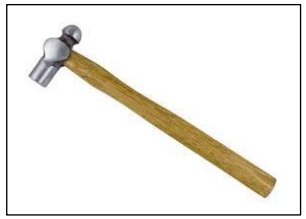
- Pliers/wire cutters

We can see here the two most common types of pliers and a pair of wire cutters (to the left). Needle nosed pliers (centre) are useful when working in close spaces and the regular pliers are strong due to their shape and size. The wire cutter has sharp jaws to cut wire and possibly to remove plastic sheathing from wire. I don't think that pliers will be required for this project but it might be useful to have them just in case.

- Hammers

There are many different types of hammer, but the two types that I am likely to use in this project are the claw hammer and possibly the ball peen hammer.
The claw hammer (shown here), is a good general purpose tool and can be used for striking a dot punch, hammering in nails and removing nails that are no longer required.

The ball peen hammer (shown here) has a rounded surface that can be used to reshape metal as well as a flat surface for general use. When developing the lamp prototype, it is unlikely that I would need this tool as the piece is made of wood.



- Cordless drills

Not only for drilling holes but also work really well for driving fasteners in plastic, wood, and metal, though maybe when drilling into metal we may need to drill a pilot hole first. These tools are useful as they are portable due to the fact they are powered by batteries rather than the mains. I will need a drill to create the joining holes so this tool is a must for this project.

- Saws (electrical or manual)

- Coping saw. These are used on wood and enable detailed cuts to created. It is therefore lightweight and has a thin blade. This saw shouldn't be used to cut large pieces. As the lamp is constructed of several small pieces with some curved pieces, then this saw would be extremely useful to have.

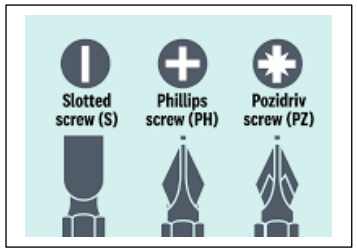
- Hack saw for cutting metal or plastic. These are strong saws that can be used on a wide range of metals and plastics due to the strong steel blade. It is unlikely that we would need this tool for the lamp prototype as it is made of wood.

- Jigsaw for plastic, thin metal and wood cutting. This tool can be used to make curved cuts but the blade is quite lightweight so shouldn't be used for cutting larger work pieces. For this project having this tool available would be useful to rough cut the components before finishing.

3. Joining materials

- Screwdriver for fixing screws into place.

There are three main types of screwdriver. It is important to select the correct one to avoid damaging the screw. It will be useful to have these available along with a selection of screws should the final design require this.



- Spanner for tightening nuts to bolts where required.

These come in a range of sizes. The correct size must be selected to ensure that the nut is held correctly by the spanner. It is unlikely that this project will need nuts to be tightened to bolts as butterfly screws can be hand tightened.

- Nails for joining two pieces of wood.

Nails come in many sizes and shapes. Depending on the job/the items to be joined, the correct nail must be selected. For example, if we want the nail to be as discreet as possible we would use a finishing nail. Also, we must select the correct size of nail depending on the strength required. It will be useful to have these available for this project as the primary construction material is wood and joining these (particularly the base) may be needed.

- Rivets for securely joining two pieces of metal.

Rivets provide a very secure and long lasting join. However, as this project does not require the joining of metal, rivets will not be required.

- Nuts and bolts.

The only type of joining material under this category would be the butterfly screws to join the pivot points together. These can be hand tightened in the position that the user wants. This means that the lamp can be put into the exact position required.

- Stick soldering (for metals welding).

This method of joining is only used for joining two pieces of metals and uses high temperature to melt the rods (shown left) to attach the two work pieces. We would not need to solder in this project due to the fact that the piece is made of wood and joining metal is not required.

4. Finishing materials

- Hand sander (wood).

This is mainly achieved with sandpaper (although sanding blocks do a similar job). Sand paper has a grit number (which can be seen on the reverse. The smaller the number the more abrasive it is. We can see this in the example to the right.

The lower the grit the more material will be removed but the finish will be rougher. Therefore, to achieve a good finish on the lamp we will start with a low grit and get progressively higher until we reach the finish that we want.

- Polishing wheel (metal).

These come in a wide range of designs depending on the material to be polished and the finish required. As we are not using metal in the lamp's construction, this will not be used.

Additionally, control measures must be considered to ensure good health and safety during the production process. Firstly, I must not use any tool or equipment that I haven't been trained to use and don't feel confident using. Secondly, I must ensure that effective personal protective equipment (PPE) is used and that it is used correctly. With regards to the table lamp prototype it is important that goggles or safety glasses are worn to protect the eyes from dust and materials when cutting materials to size. Also, it could be necessary to wear gloves should glue/adhesive be used to join components to protect the hands from any excess glue that might be spilt. Finally, I must be familiar with the requirements of reporting of injuries, diseases and dangerous occurrences regulations (RIDDOR) and ensure that anything that happens that needs to be recorded then it must be.

Internet Browsing History / References

1. https://richporterlighting.com/en/blog-what-are-the-different-types-of-lighting/#task-lighting
2. https://www.pooky.com/blogs/inspiration/desk-lamps-how-the-choose-the-right-one-for-yourstudy#:~:text=What%20is%20the%20desk%20light,%2C%20writing%20with%20a%20pen.
3. https://www.eclipsemagnetics.com/resources/the-difference-between-ferrous-and-non-ferrous-metals/
4. https://ledsupplier.co.uk/blogs/news/different-types-of-lamp-holders-that-you-should-know-about
5. https://www.nature.com/articles/d41586-022-01467-8
6. https://www.snhu.edu/about-us/newsroom/stem/what-is-environmental-sustainability
7. https://www.hindawi.com/journals/ijps/2020/8838160/
8. https://kempner.co.uk/2019/05/08/the-advantages-and-disadvantages-of-polyethylene-blog/
9. https://youmatter.world/en/definition/definition-eco-design-examples-definition/
10. https://www.mdpi.com/2071-1050/13/2/488

Task 2: BS8888 and hand-drafted engineering drawings

Evidence

Your evidence **must** include:

- your description of BS 8888
- hand-drawn engineering drawing(s) of the LED table lamp.

BS 8888 defines the requirements for the technical specification of products and their component parts. The standard explains the way in which engineering drawings outline and present these specifications and covers all of the symbology and information that engineers and designers need to include on their drawings, whether they are produced in 2D or in 3D, created using CAD systems and 3D modelling.
BS 8888 brings together all international standards needed to prepare technical product specifications.
https://www.bsigroup.com/en-GB/about-bsi/media-centre/press-releases/2017/february/uks-national-standard-for-engineering-drawings-revised/
https://blogs.glowscotland.org.uk/nl/public/standrewstechnical/uploads/sites/27423/2016/03/Guide-to-British-Standards.pdf
Drawings using BS8888 must include the following so that they can be recognised by any designer or engineer.

6. Title block – at the bottom of the page in the right corner. A title block should include information about the product – name / projection symbol / title / date / scale used / drawing number / tolerance of the dimensions. This ensure that anyone using the drawings has the necessary information to allow them to develop an accurate product in line with the drawing requirements.
7. Drawing scales allow anybody looking at the drawing to work out how much bigger the product would be compared to the drawing. For example, a scale of 1:5 indicates the product would be 5 times larger than the drawing on the page. This allows users to be able to appreciate the size of the actual piece and how it relates to the drawing provided.
8. Line types – different lines indicate different parts of the drawing / product or whether something would not be seen on the product from that view. Some lines are just projection lines which carry dimensions from one view to another view drawing.
9. BS8888 drawings use a layout called 3RD Angle orthographic. A third angle orthographic drawing has three views on the drawing.
10. Tolerances are an important requirement of BS8888 because they provide the acceptable variance of dimensions which should not be exceeded.

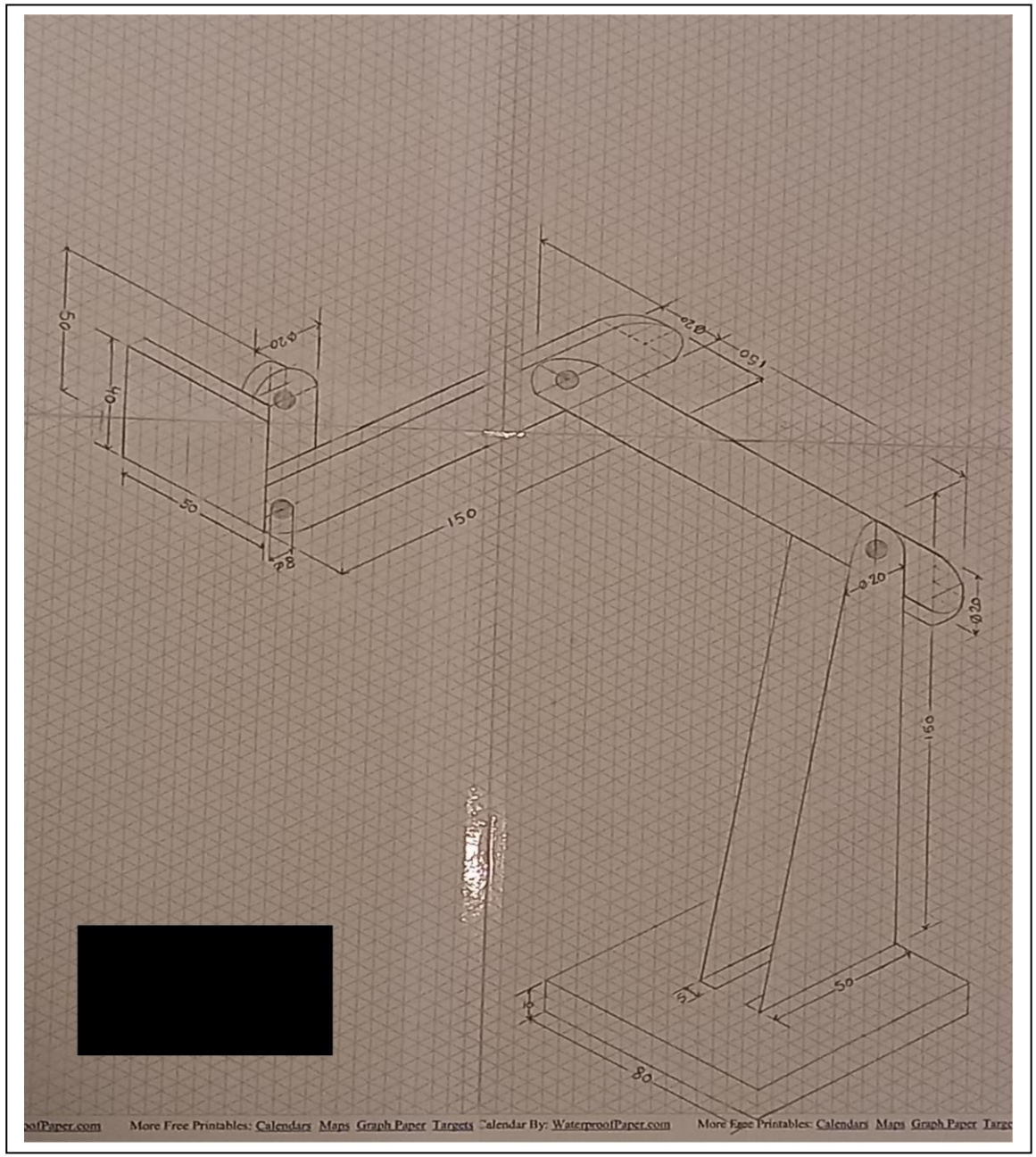
Assessor comments

The learner has a well-developed understanding of the relevant British Standard. There is a wide-ranging explanation of BS8888 presented that covers the key elements of the standard. There is also a useful reference provided as the source of information.

11. Drawings should also include information on the materials to be used when producing the final piece. This will ensure that the item is produced in the way expected and performs correctly.
12. Information should also be provided on the expected surface texture of the piece. This will provide information on how the item should be finished and how the aesthetic appearance should be considered.

The front view is at the bottom of the page on the left with a plan or top view directly above it and the side view directly to the right of the front view.
Each view should be drawn in line with the other two views using projection lines between them which helps to keep the dimensions exact and the positions of each drawing correct.

Because BS888 is generally accepted as the standard way to produce engineering drawings, it means that anyone with background training will be able to use a drawing to develop a final product because they will have all of the information that they require.



Assessor comments

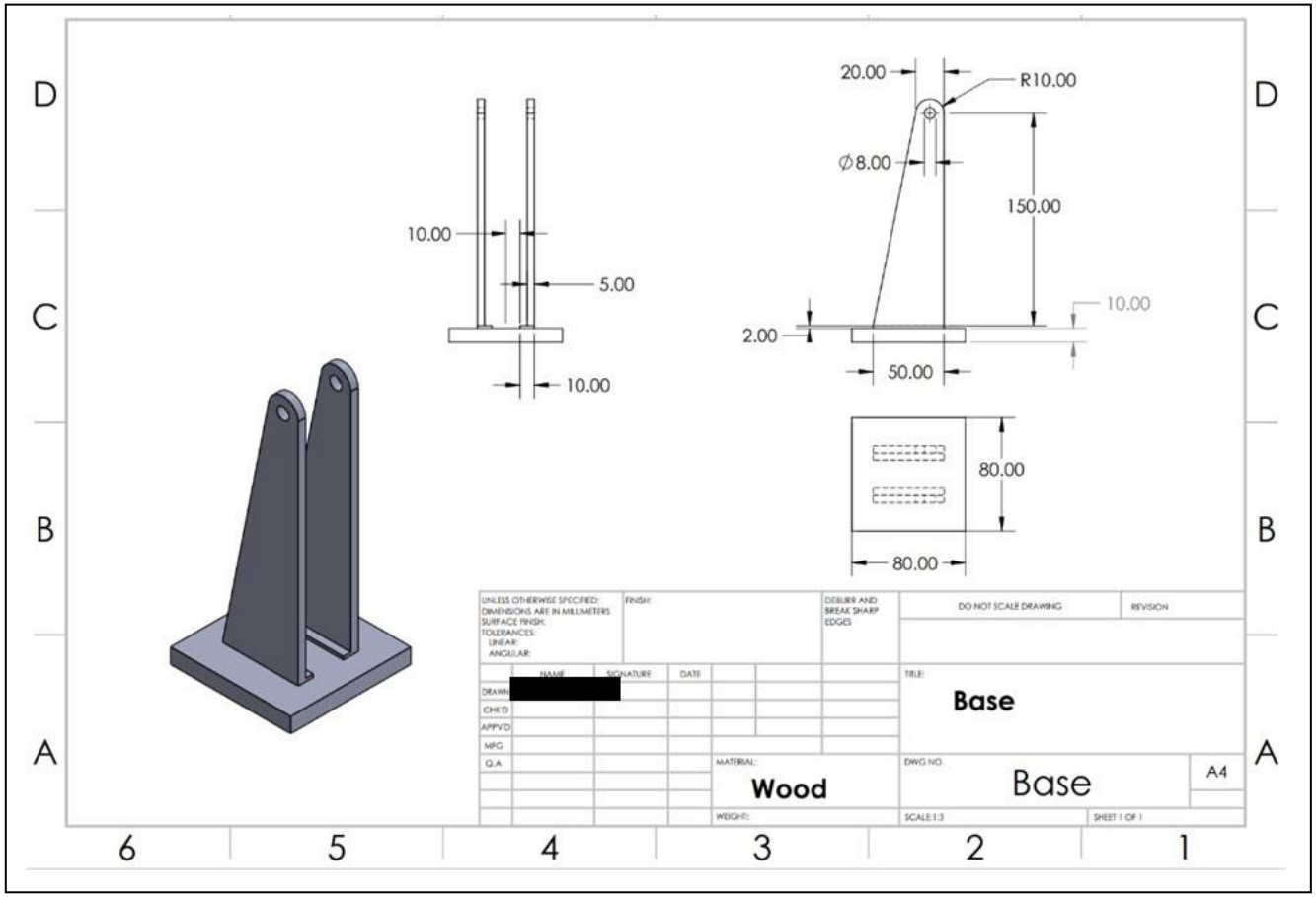
There is good demonstration of how to construct a hand-drawn engineering drawing, which is detailed, accurate and provides all the necessary dimensions. It is clear that the learner understands the requirements of a hand-drafted engineering drawing and has produce a well-developed drawing.

Task 3: CAD produced engineering drawings

Evidence

Your evidence **must** include:

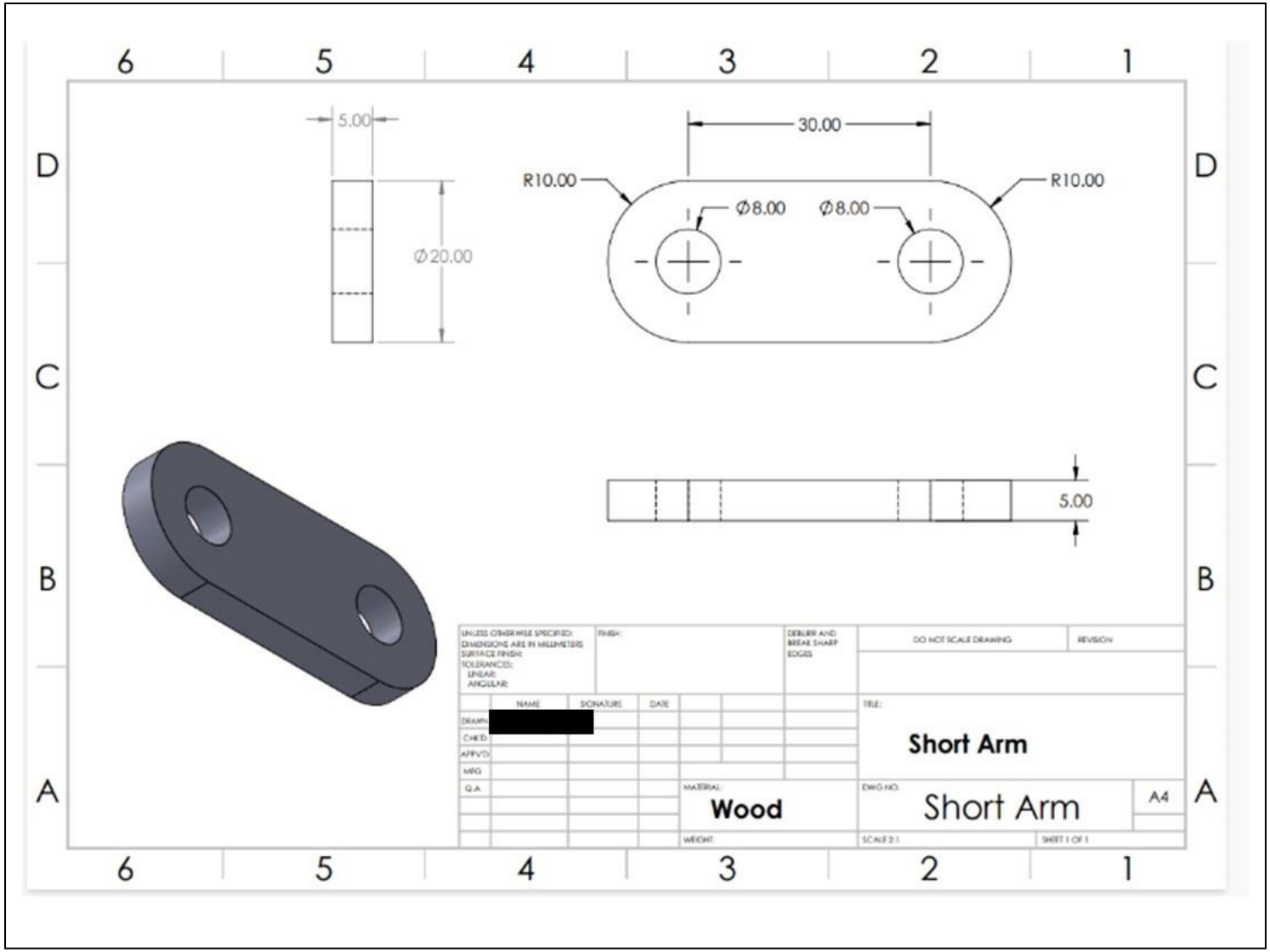
- CAD software engineering drawing(s) of the LED table lamp.



Assessor comments

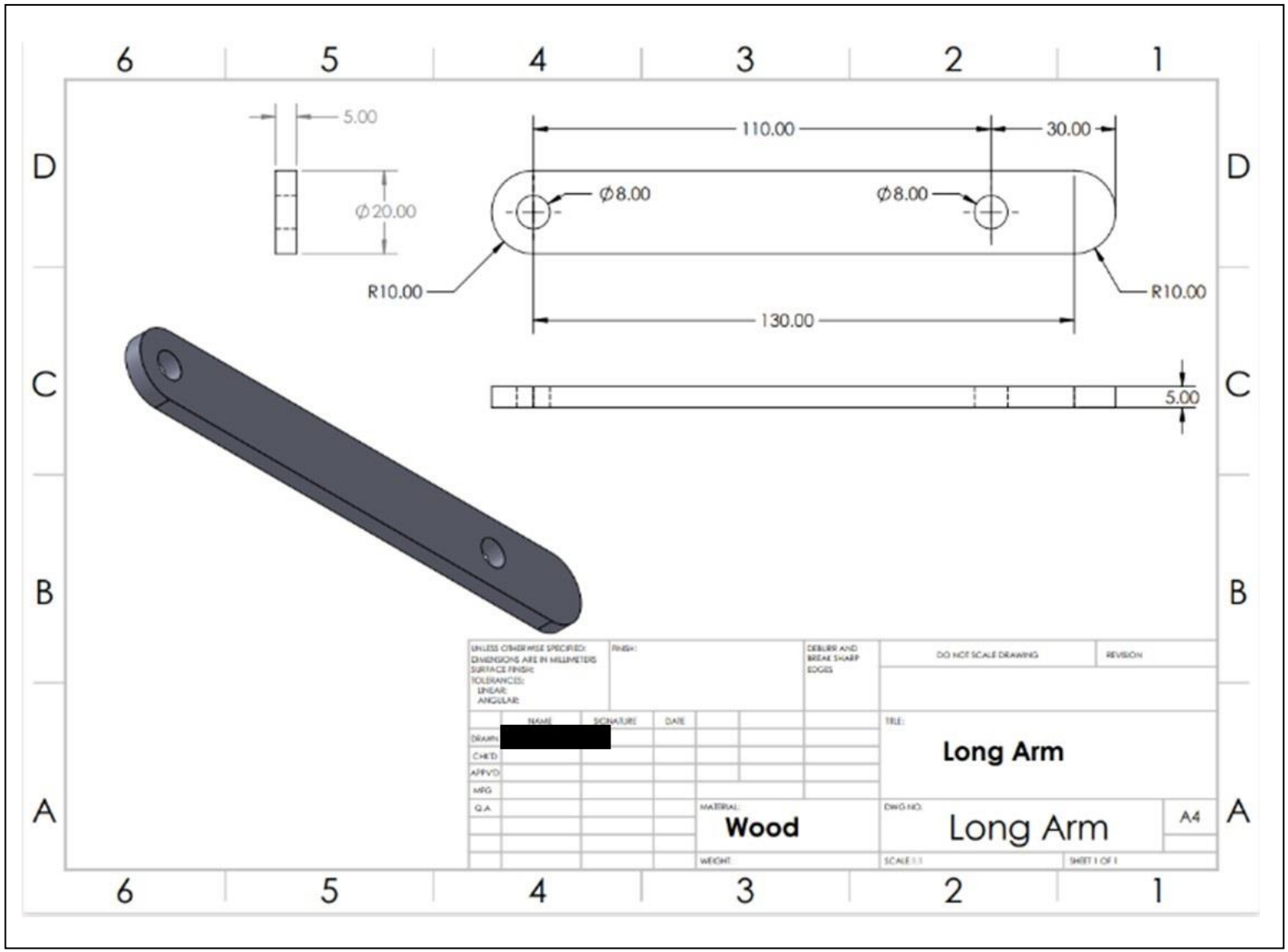
The learner has created a CAD drawing of the free-hand sketch of the new LED table lamp included in the brief. There is a good consideration of all aspects of the brief demonstrated here. The needs of the engineering company are met in an entirely appropriate manner through the creation of a series of accurate and appropriate drawings. The learner has clearly shown a 3-dimensional drawing, comprehensively showing the dimension of the various components.

There is a good ability to construct a drawing along with good technical skills demonstrated. There is a good demonstration of drawing skills using appropriate structure.



Assessor comments

However, a little more detail in the title blocks in the drawings would have been useful. This does not move the learner out of mark band 4 though.


5.00
110.00
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Long Arm
Wood
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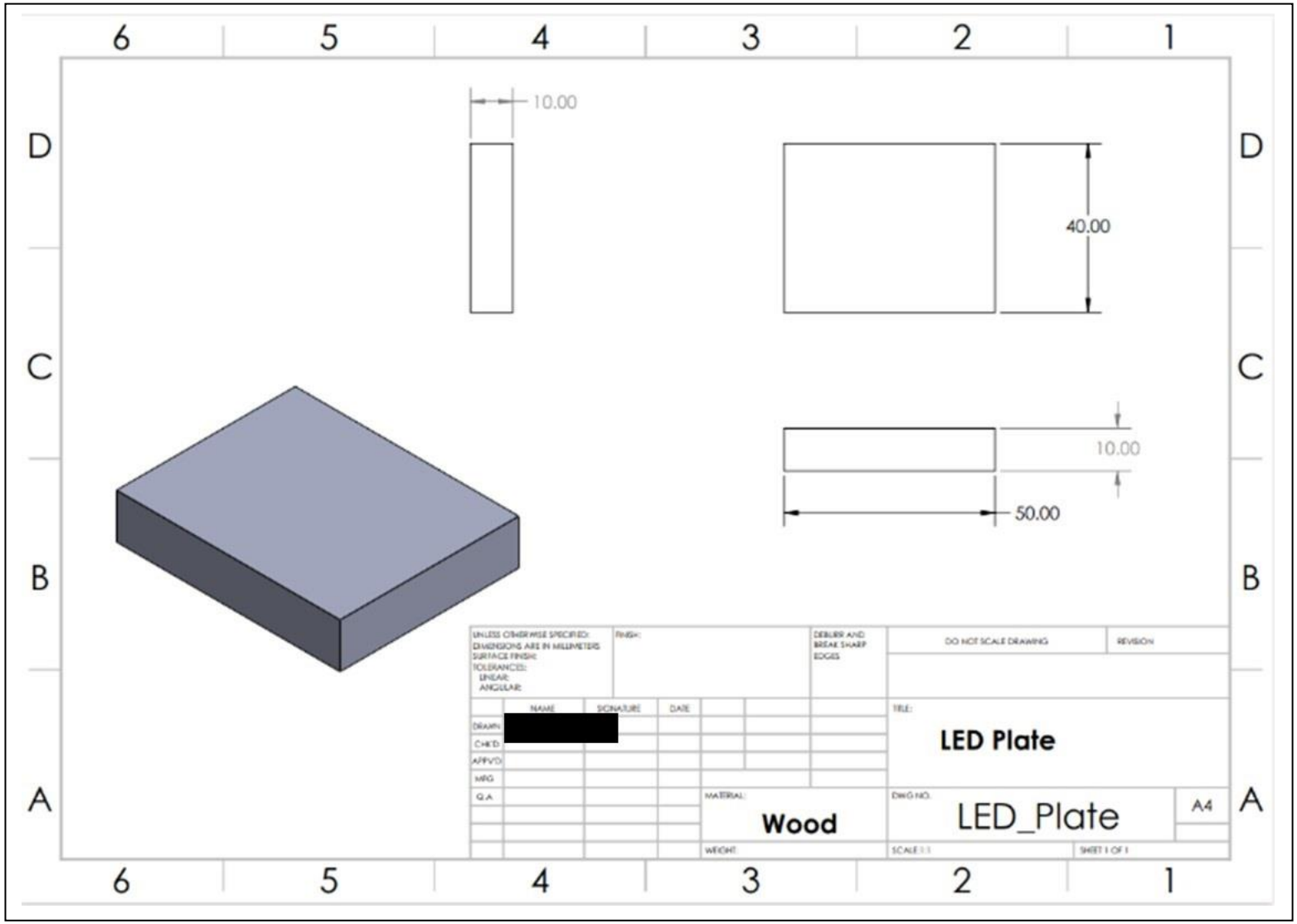
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UNLESS OTHERWISE SPECIFIED:
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NAME
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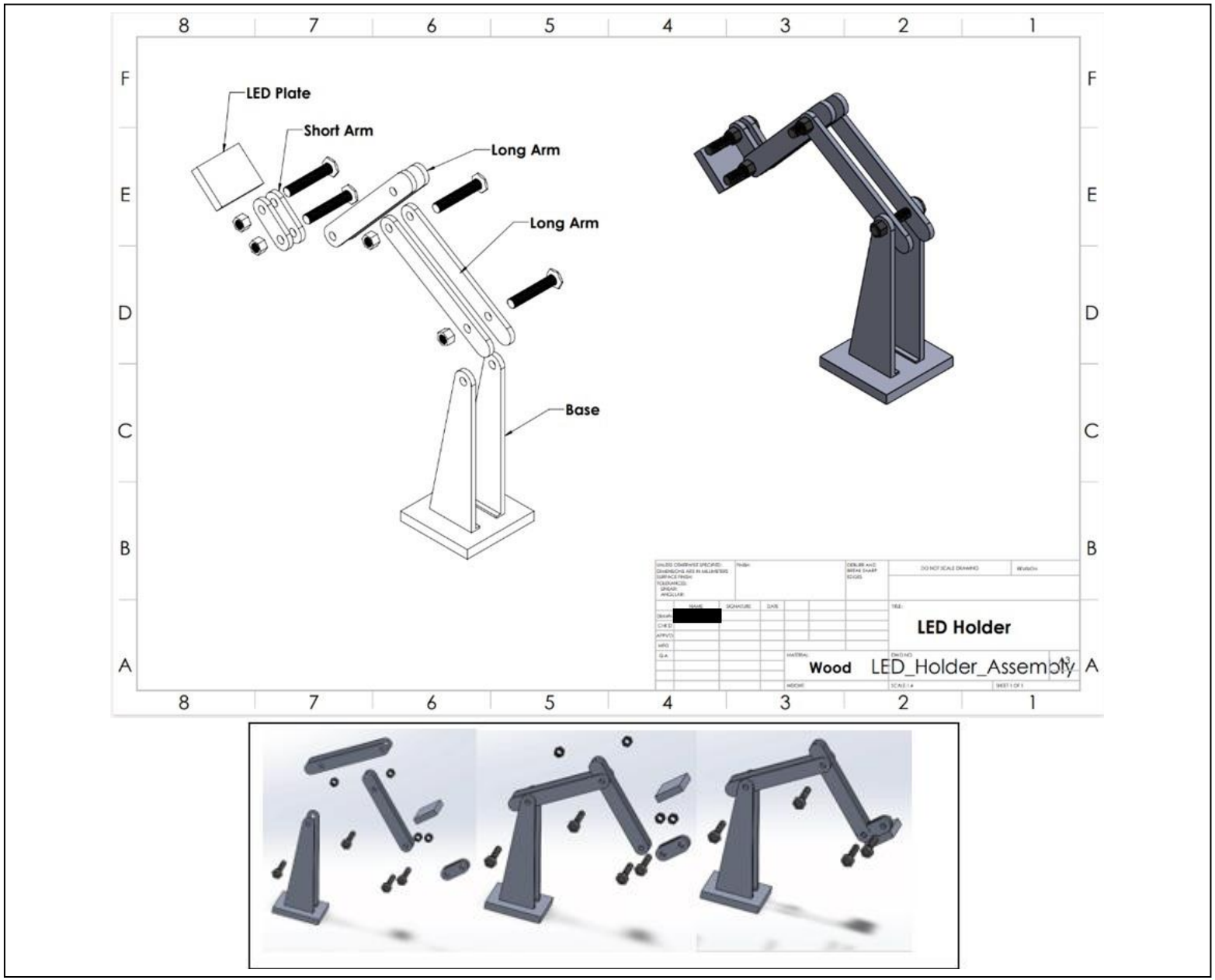
DRAWN
CHK'D
APP'VD
MFG
Q.A
TITLE:
LED Plate
MATERIAL:
Wood
DWG NO.
LED_Plate
A4
WEIGHT:
SCALE:1:1
SHEET 1 OF 1


LED Plate
Short Arm
Long Arm
Long Arm
Base
LED Holder
Wood
LED_Holder_Assembly

Task 4: Production plan

Evidence

Your evidence **must** include:

- a **plan** of your engineering prototype

Your plan must evidence each of the following areas:

- tools and equipment requirements
- health and safety measures
- quality control measures
- production plan
- time plan (including timescales and deadlines for completion of tasks).

Summary Time Plan

Activity	Time (minutes)	Details
Materials and tools/equipment selection	20	Deciding upon the required materials, ensuring that they are of the right quality and choosing the right tools/equipment. I will also need to ensure that the tools are of good quality.
Measuring and marking out	60	Using the engineering drawings to ensure that I mark out dimensions and drilling points accurately.
Cutting the arm materials (plywood)	45	As this will be done by a band saw, a trained member of staff will have to do this but I will explain what needs to be done.
Cutting the base and spacer	45	As these can be cut with hand saws, I will be able to do this. This is because they are smaller components.
Drilling	30	I will have marked out the drilling points and will therefore be able to accurately drill the holes that I need to connect the components.

Assessor comments

The learner has a clear understanding of the planning process and has effectively applied knowledge and understanding to this. There are a range of planning tools, which have been selected and used successfully. The prototype manufacturing features are described with clear understanding all stages of production.

Requirements, measurements and techniques are described in detail and there is a good understanding of their use within the production of the product.

The planning justification of decisions taken and the conclusions are supported with reasoning and explanations.

Sanding and finishing	40	I will use several grits of sanding paper to give the best finish possible.
Final construction	90	There will be three stages of final production. 1) the base and lower arm. 2) attaching the upper to the lower arm. 3) attaching the final short arm and light housing.
Contingency	30	This will give me some extra time to sort out any problems that I might have.

It is vital that I stick to the above time plan as I cannot go over the maximum project time of 18 hours. If I was to run over on any task this would have a serious impact on the remaining tasks. Therefore, this time plan is very important to make sure that I give the right amount of time to each activity.

Assessor comments

Additionally, the learner has a clear understanding of health and safety and quality measures, and explains these well. These concepts are also applied to the activities and item being developed.

Production and Time Plan

Material and tools/equipment selection (20 minutes)

Based on the analysis conducted in previous tasks, I decided that plywood would be the best material with which to create the prototype. This is because although it is relatively cheap, it is strong and will therefore be able to withstand the testing that I am planning to conduct. To balance strength and weight, I have selected plywood of 5mm thickness. I believe this is the best option to ensure strength but to not have a lamp that is too large and heavy.

As for tools/equipment, I will use a steel ruler, pencil or marking out scribe and callipers. Using these correctly will ensure that I mark out accurately and in accordance with the engineering drawings.

I will use a jigsaw or bandsaw to cut the large sheets of plywood to the marked out lines and various grits of sandpaper to finish. To cut the spacers, I will use a coping saw and/or tenon saw. I will require a drill (ideally cordless for ease of use) and drill bit that fits with the bolts/screws used to attach pivot points. I anticipate using 3mm bolts/screws and therefore a 3mm and 3.5mm drill bits. Screw drivers will also be required.

If time permits, I would like to paint the lamp black to improve the finish so will require paint and paint brushes. However, this is not necessary to the project and will only be done if there is time.

Measuring and marking out (60 minutes)

I will need the CAD engineering drawings printed out and hand drawing to hand. This will make references to dimensions and designs convenient and enable me to make sure that I don't make any mistakes with measuring and marking out. This is an absolutely vital stage because without accurate marking out, my finished product could be out of tolerance. A good saying is 'measure twice, cut once'! I will therefore double check all measurements and marking out to make absolutely sure that everything is within an acceptable tolerance.

Cutting the short and long arm materials (plywood) (45 minutes)

Once I am confident that the marking out is accurate, I will now be able to move onto cutting the arms of the lamp. I have decided that the best piece of equipment to use for this would be a band saw. This is because it provides a very straight and accurate cut. This would be less likely to be achieved with a hand saw or scroll saw. However, a band saw should only be used by a trained technician and therefore the arms are to be cut by a trained member of staff but under my instruction. I observed the cutting of the arms while wearing safety goggles to ensure that any sawdust would not damage my eyes.

Cutting the base and spacers (45 minutes)

Spacers are required for this item as the two arms need to be separated to allow to bolts/screws to be tightened allowing the lamp to be adjusted. I require three of these items. Two to be used to attach the pivot points of the arms and legs and the third to attach the upper arms to light housing.

As these pieces are of a simple rectangular shape, I am able to cut these by hand. Therefore, I will use a coping saw and tenon saw to accurately cut to the marked out dimensions. However, I will ensure a small margin of error that can be sanded to final accuracy when finishing. When cutting these small components, it is important that material is secure and for health and safety not held down by hand. Therefore, I will use a bench vice to safety secure the work piece before I begin to cut.

Drilling (30 minutes)

To enable the pivot points to function and the arms to be joined to one another and to the base, holes will need to be drilled to allow for the connecting bolts to pass through the components. As I am using 3mm bolts I will initially drill 3mm holes but will extend these to 3.5mm should that be required. I will have previously marked out where the holes need to be drilled I will know exactly where the holes need to be, in accordance with the drawings. As before, I will clamp the components to ensure that I can control the drill with two hands and therefore ensure accuracy.

Sanding and finishing (40 minutes)

Now I will have all of the components cuts to shape and size, to ensure a good finish I will sand each piece to a finished quality to make the final lamp look as good as possible. I will use a range of grits to get the best finish possible.

Prototype construction (1 hour 30 minutes)

Stage 1 (30 minutes)

Firstly, I will work on the base and lower arm. This will require me to join the two with the bolts tight enough to ensure that the pivoting can take place. I will need to ensure that the space is accurately located to ensure the two sides of the arm can be securely joined.

Stage 2 (30 minutes)

Next I will attach the upper arm to the lower arm. This will require me to join the two with the bolts tight enough to ensure that the pivoting can take place. I will need to ensure that the space is accurately located to ensure the two sides of the arm can be securely joined.

Stage 3 (30 minutes)

At this stage I will firstly locate the spacer into the short final arm and secure this in place. Now I will attach the lamp housing to the short final arm and this short arm to the longer upper arm.

Contingency (30 minutes)

Having this in the plan means that if anything unexpected happens I have some time available to fix it and still be within the maximum amount of time.

Health and Safety Measures

It is really important that I plan for health and safety to ensure that no one will be hurt during the production of the prototype.

Firstly, throughout the process I must select the correct tool for the job to ensure that I am not liable to slips and breakages.

Secondly, when the technician is working on the band saw, we must both be wearing effective Personal Protective Equipment (PPE). Firstly, we should both be wearing safety goggles or glasses. Secondly, the technician should also be wearing safety gloves as they will be working closely to the blade.

Thirdly, when cutting the spacers by hand and sanding I should wear safety goggles/glasses. This will ensure that any sawdust does not get into my eyes and cause irritation or damage.

Finally, throughout the process I must be aware of my own level of skill and confidence. If I am unsure of anything I must seek advice to ensure that I am not putting myself or others in danger. I must also ensure that if there are any accidents that I report these because of the Reporting of Injuries, Disease and Dangerous Occurrences Regulation (RIDDOR). This will make sure that we can learn from this and that we are following the law.

Quality Control Measures

To ensure that the final product is of the best quality possible, I will incorporate quality checks at each stage of the process. These are explained below:

1) When selecting tools and equipment, I will ensure that they are well maintained and are functioning correctly. For example, I will ensure that the coping saw has a newly installed blade to ensure that I achieve the cleanest cut.
   I will also check that the drill bit is not blunted.
2) When selecting the materials to be used (plywood) I will measure the thickness to ensure that it of the correct size (5mm). I will also check that the plywood isn't cracked or damaged.
3) When marking out, I will ensure that all dimensions are in accordance with the engineering drawings to ensure that I am within an acceptable tolerance and the final item is of a correct size.
4) When joining the arms, I will test the pivot point to ensure that they function correctly and have the right movement as expected from a lamp.
5) To test the final product, I will put a weight where the light would be attached to ensure that the lamp is able to support this weight. This will let us know the maximum weight that the lamp can support and therefore the maximum weight that the light can be.

Task 5: Functioning prototype manufacture

Evidence

You **must** provide:

- your functioning prototype
- evidence of production processes, skills, and techniques
- evidence of prototype testing.

You could use a range of the following formats to provide evidence of your production process:

- digital presentation
- written report
- annotated screenshots
- annotated images.

Assessor comments

The learner has provided several images of the prototype and provided a good explanation on how the product was tested. This was related to the brief, demonstrating a good understanding on what the brief demanded and how this has been translated into the final product. These tests are well developed and comprehensive.

The learner has then provided some good explanations on how the lamp could be improved. However, some before and after images of the testing process would have been useful. This does not affect the award of mark band 4.

Prototype testing

To ensure that the prototype is effective and able to function as required by the brief, I undertook several tests. These are explained below.

1) The first test that I undertook was a test of each of the pivot point. This was necessary because the user of the lamp will want to adjust the position of the lamp to suit their needs. Each of the pivot points moved well and stayed in place when adjusted. Therefore, the pivot point functioned as expected.
2) Secondly, I carried out a weight test. This involved attaching weights to the part of the lamp that the actual lamp would be attached to. This was necessary to ensure that the lamp is able to effectively hold the bulb without tipping over or failing in some other way. I tested at 50g, 75g, 100g and 150g. At the lower weights the lamp performed well but at 150g the lower pivot point failed and the lamp folded. I wasn't happy with this so made the decision to change the butterfly bolts with screws to see if this would help (these can be seen in the prototype pictures). This solved the problem and still allowed for the pivot points to function. However, the appearance of these is poor and would not be suitable to have a good looking lamp for the office or home. I think that to solve this problem, we would have to source a bulb that is considerably lighter than 150g.
3) Finally, I tested the finishing and appearance by comparing against other office/home lamps. Although I wasn't happy with the final appearance of my prototype, it did not affect the function of the lamp so for a prototype the finish was satisfactory.

N.B. See production plan for the record of processes and tools used.

Task 6: Summative evaluation

Evidence

You **must** provide:

- your evaluation.

You could use the following formats to provide evidence of your evaluation:

- annotated screenshots
- written report.

Now I have gone through the whole process it is a good idea to look back and review my performance, what I'm happy with and what I could improve on.

Functionality evaluation and possible improvements

- The lamp is required to have several pivot points (as show in the various drawings and sketches) and I had to ensure that my prototype was able to do this effectively. In initial testing there were no problems and the pivot points worked as expected. When I moved on to weight testing the lamp failed at the highest weight. I changed the butterfly bolts to screws and this solved the problem but looked poor. Having thought about this, I could have included some rubber washers to the butterfly bolts which hopefully would have gripped the surface better. This improvement would be one that I would make if I did this project again.
- Although the base was effective at supporting the arms I think that I made a mistake when producing the prototype and didn't make this thick enough. This is the only part where I didn't follow the drawing exactly and is something that could be improved.
- Although making the prototype out of wood is a suitable material for a prototype and functioned well, I don't feel like this would be a suitable material from which to produce a finished product as I doubt it would function effectively for the long term. Customers would expect a lamp to last for a long time.
- I feel that the prototype is a close match to the drawings and is therefore likely to function well in accordance with the brief.
- I am very happy with the tools that I selected when producing the prototype. They really helped me to ensure that I developed components that function well individually and as a final product. The only change that I would have made would be to use a wider range of sandpaper.

Assessor comments

Finally, the learner has provided a good evaluation of their performance by providing very well-developed evaluative points. These are provided under two headings relating to functionality and suitability. Each of the points raised are detailed and demonstrate that the learner has really reflected on their performance.

Additionally, suggestions for improvement are also provided. Again, these are well developed and based on the learner's own experience.
It would have been useful to have some images to support the points, but this does not exclude the response from level 4.

Suitability evaluation and possible improvements

- Other than the base the size of the prototype is as per the drawings. This means that the lamp is portable and suitable for home and/or office use due to its size and shape. It could fit on a desk very easily.
- I think that I could have improved the finishing of the prototype. During the production I found myself a little rushed and had to use some of my contingency time. This particularly affected my finishing time and I didn't get the finish on the arms that I wanted or the curves at the end of the arms that I wanted. I only had time to use 80 grit sandpaper which didn't leave a very smooth finish. I did try to achieve a good finish by painting the prototype but I don't think that this was very effective.
- Linked to the previous point, if I was to create the prototype again, I would spend time to round off the ends to the arms to make it more aesthetically pleasing and therefore fulfil the needs of the brief in terms of it being suitable for the home or office.
- I was pleased that I decided to do weight testing as this would replicate what it would be like if a light/bulb was attached to the prototype. Although this was generally successful it did highlight a weakness in the design at a weight of 150g. I did address this, but it negatively affected appearance and therefore would not be a suitable solution for the final piece. This is because for home use in particular users will want the lamp to look good in the home.
- Linked to the previous point, I should have made the base more substantial which would have made it more stable and therefore probably able to support greater weights. Also, although this wasn't in the design, an improvement could be to have the base weighted which would have made it very stable.
- For the lamp to be suitable for home use, I would need to improve the appearance of the base and arms. If I was undertaking this project again, I would allocate more time to finishing and use a range of sandpaper grits to get a smooth finish. I would also think about the paint that I used. I think that varnish or gloss paint would have given a better finish and be more appropriate for the home. This would also allow it to be dusted and cleaned effectively whereas currently this would be a problem as it is fairly rough wood and of a matt finish.