

**GCE**

**Design and Technology**

**H406/02: Problem solving in Product Design**

A Level

**Mark Scheme for June 2023**

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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**MARKING INSTRUCTIONS****PREPARATION FOR MARKING  
RM ASSESSOR**

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal <http://www.rm.com/support/ca>
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **number of required** standardisation responses.

YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

**MARKING**

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the RM Assessor messaging system, or by email.
5. **Crossed Out Responses**  
Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

**Rubric Error Responses – Optional Questions**

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

**Multiple Choice Question Responses**

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).

*When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.*

**Contradictory Responses**

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

**Short Answer Questions** (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

**Short Answer Questions** (requiring a more developed response, worth **two or more marks**)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

**Longer Answer Questions** (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there, then add a tick to confirm that the work has been seen.
7. Award No Response (NR) if:
  - there is nothing written in the answer space

Award Zero '0' if:















- anything is written in the answer space and is not worthy of credit (this includes text and symbols).

Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

- The RM Assessor **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**  
If you have any questions or comments for your team leader, use the phone, the RM Assessor messaging system, or e-mail.
- Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.
- For answers marked by levels of response:
  - To determine the level** – start at the highest level and work down until you reach the level that matches the answer
  - To determine the mark within the level**, consider the following

Descriptor	Award mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of marks available)
Consistently meets the criteria for this level	At top of level

## 11. Annotations

Annotation	Meaning
	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
	Tick
	Cross
	Confused (replaces the question mark)
	Benefit of doubt
	AO1 – Knowledge and understanding
	AO2 – Apply knowledge and understanding
	AO3 - Analyse
	AO4 - Evaluation
	Omission
	Not answered question
	Noted but no credit given
	Too vague
	Own figure rule

## 12. Subject Specific Marking Instructions

### INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet Instructions for Examiners. If you are examining for the first time, please read carefully Appendix 5 Introduction to Script Marking: Notes for New Examiners.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question		Answer	Mark	Guidance	
				Content	Levels of Response
1 *		<p><b>Indicative content:</b></p> <p>Location/ergonomics/musculoskeletal issues:</p> <p>Sofa working on coffee table:</p> <ul style="list-style-type: none"> <li>The low height of coffee table / requires user to lean forward / putting significant strain on lower back and neck. Back muscles work harder and the ligaments flex and stretch. The discs get squeezed. As they are squeezed, they can press on different parts of the spine, including nerves. This can cause back pain. If you bend forward over and over for months or years, the discs are weakened, which may lead to disc rupture (or “herniation”).</li> <li>It is not possible to have legs beneath the table/ which leads to over-reaching / causing lower back strain and neck strain. Back muscles work harder and the ligaments flex and stretch. The discs get squeezed. As they are squeezed, they can press on different parts of the spine, including nerves.</li> </ul> <p>Kitchen table:</p> <ul style="list-style-type: none"> <li>Height is often higher than required / leading to over-reaching of arm as shown in photograph / this increases strain on shoulder and neck.</li> <li>Kitchen tables often have quite thick rails or under-hung drawers / that can cause taller users to have insufficient leg clearance to have legs positioned in the optimum ergonomic position resulting in legs put out diagonally ahead, or chair further back / and excessive force being put on thighs on the chair leading to pain or circulation issues.</li> </ul> <p>Kitchen counter:</p> <ul style="list-style-type: none"> <li>Stool height leads to an overly elevated position / and the need to lean forward to lower arms to the keyboard counter height / leading to an increase in strain on shoulder and neck with resulting pain.</li> </ul>	12	<p>All responses should be in relation to the information provided.</p> <p>Problems should be identified.</p> <p>Responses are likely to include evidence of all bullet points (see examples).</p> <p>Candidates may extract information from the Resource Booklet. RB information can be used in support of the critical evaluation, but no marks</p>	<p><b>Level 4 [10-12 marks]</b></p> <p>A <b>comprehensive</b> examination of the problems that will be experienced. Comprehensive understanding of the problems that will be experienced by employees working at home. Comprehensive understanding of the <b>three</b> elements specified in question. Information in RB is used effectively to fully exemplify the points being made. Well-constructed response in relation to question with a clear and developed narrative.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p>



Question	Answer	Mark	Guidance
	<ul style="list-style-type: none"> <li>It may not be possible to get legs beneath the counter / which leads to reaching forward / causing strain on shoulder and neck with resulting pain. Shoulder can ache over time and tire easily. This over-reaching can lead to bursitis, tendinitis and even rotator-cuff tears.</li> </ul> <p>Sofa/working on lap:</p> <ul style="list-style-type: none"> <li>Looking down at the laptop screen causes a forward head posture and the centre of gravity of the head to be in front of the neck and shoulders / leading to upper back pain and neck strain and shoulder pain. When the neck is bent forward, or bent frequently, the muscles work harder and the ligaments flex and stretch. Eventually, the ligaments can partially tear, resulting in neck sprain.</li> <li>There is a tendency to arch the back / putting strain on the lower back. Back muscles work harder and the ligaments flex and stretch. The discs get squeezed. As they are squeezed, they can press on different parts of the spine, including nerves. This can cause back pain. If you bend forward over and over for months or years, the discs are weakened, which may lead to disc rupture (or “herniation”).</li> </ul> <p>Award credit for any other valid suggestion.</p>		<p>should be awarded simply for duplicating text.</p> <p>There is no analysis or evaluation in Level 1.</p> <p><b>Level 3 [7-9 marks]</b> A <b>good</b> examination of the problems that will be experienced. Good level of understanding of the problems that will be experienced by employees working at home. Good understanding of <b>at least two</b> elements specified in question. Information in RB is used for the most part effectively to exemplify points being made although one or two opportunities are missed. Well-constructed response in relation to question although one or two opportunities missed to develop narrative.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is in the most part relevant</i></p>

Question	Answer	Mark	Guidance
			<p><i>and supported by some evidence.</i></p> <p><b>Level 2 [4-6 marks]</b>                      A <b>sufficient</b> examination of the problems that will be experienced. Sufficient understanding of the problems that will be experienced by employees working at home. Sufficient understanding of <b>two of the</b> elements specified in question. Information in RB is used to exemplify some points being made although much more could have been done to exploit the stimulus material available. Reasonable response in relation to the question although narrative at times lacks depth and cohesion.</p> <p><i>The information has some relevance and is presented with limited structure. The</i></p>

Question	Answer	Mark	Guidance
			<p><i>information is supported by limited evidence.</i></p> <p><b>Level 1 [1-3 marks]</b>                      A <b>limited</b> examination of the problems that will be experienced. Limited knowledge and next to no understanding of the problems that will be experienced by employees working at home. Limited understanding of <b>one</b> element specified in question. Use of information from the RB is used in a simplistic way and adds limited value to the points being made. Limited response in relation to question. Narrative is basic and unstructured.</p> <p><i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the</i></p>

Question		Answer	Mark	Guidance																
				<p><i>evidence may not be clear.</i></p> <p><b>0 marks – No answer or answer not worthy of credit.</b></p>																
2	i)	<table border="1"> <thead> <tr> <th>Dimensions in mm</th> <th>Total height range mm:</th> </tr> </thead> <tbody> <tr> <td>Sitting height</td> <td>800 - 970</td> </tr> <tr> <td>Sitting eye height</td> <td>700 - 860</td> </tr> <tr> <td>Sitting shoulder height</td> <td>530 - 660</td> </tr> </tbody> </table> <p>Or</p> <table border="1"> <thead> <tr> <th>Dimensions in mm</th> <th>Total height range mm:</th> </tr> </thead> <tbody> <tr> <td>Sitting height</td> <td>170</td> </tr> <tr> <td>Sitting eye height</td> <td>160</td> </tr> <tr> <td>Sitting shoulder height</td> <td>130</td> </tr> </tbody> </table>	Dimensions in mm	Total height range mm:	Sitting height	800 - 970	Sitting eye height	700 - 860	Sitting shoulder height	530 - 660	Dimensions in mm	Total height range mm:	Sitting height	170	Sitting eye height	160	Sitting shoulder height	130	1	<p>Award one mark for a complete set of answers.</p> <p>If candidate has inverted the range e.g. 970 – 800 then still award credit accordingly.</p> <p><b>Or</b></p> <p>If the candidate has correctly calculated the range for all three award credit</p>
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Dimensions in mm	Total height range mm:																			
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	ii)	<p>Mean thigh thickness</p> $= \frac{(155+150)}{2} [1]$ $= \frac{305}{2} = 152.5\text{mm} [1]$ <p>Or</p> $= \frac{(130+155+180+120+150+180)}{6} [1]$	2	<p>Award two marks as follows:</p> <p>One mark for extracting the 50% percentile for men <b>and</b> women from the data set.</p> <p>One mark for calculating the mean thigh thickness of the population if there are equal numbers of men and women.</p> <p><b>Or</b></p> <p>One mark for extracting all percentiles for men <b>and</b> women from the data set.</p>																

Question	Answer	Mark	Guidance
	$= \frac{915}{6} = 152.5\text{mm [1]}$		<p>One mark for calculating the mean thigh thickness of the population by dividing by 6.</p> <p>If correct answer is given without working out shown <b>award full marks.</b></p> <p>Where an incorrect answer is given working out should be used to credit appropriate mark.</p>
iii)	<p>Minimum elbow to floor distance = 5%ile female sitting elbow height + 5%ile female popliteal height</p> $= 190 + 370 = 560\text{mm [1]}$ <p>Identify maximum standing elbow height = 95th%ile male standing elbow height = <b>1180mm [1]</b></p> <p>Maximum rising distance = <b>1180 – 560 = 620mm [1]</b></p>	<b>3</b>	<p>Award three marks as follows:</p> <p>One mark for calculating the minimum elbow to floor distance.</p> <p>One mark for identifying the maximum standing elbow height from the data set.</p> <p>One mark for calculating the maximum distance the desk must rise to maintain a comfortable elbow height position for 90% of the user population.</p> <p>If correct answer is given without working out shown award full marks.</p> <p>Where an incorrect answer is given working out should be used to credit appropriate marks.</p> <p>*Allow Error Carried Forward (ECF) if 5%ile female sitting elbow height (190mm) is substituted with 95%ile female thigh thickness (180mm) = 550mm</p>



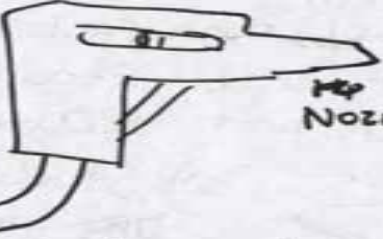

Question	Answer	Mark	Guidance	
			<p>*Maximum rising distance = 630mm</p> <p>*Award a maximum total of <b>2 marks</b> in this instance.</p>	
3	<p><b>Indicative content:</b></p> <p><b>Design Requirements</b></p> <p>Aesthetics:</p> <ul style="list-style-type: none"> <li>• Domestic considerations – colour scheme / material surface finish complementing intended environment.</li> <li>• Black / white frame colour choices – provide some choice and are popular. They can complement a range of environment colour palettes.</li> <li>• A choice of surface finishes to provide opportunities to complement existing colours or wood finishes (of existing furniture) in the domestic environment.</li> </ul> <p>Functionality:</p> <ul style="list-style-type: none"> <li>• Maintenance – ease of cleaning by a single user. Wipe clean materials, resistant to anti-bacteria agent.</li> <li>• Material/structural integrity – desk to withstand load of computer, work, cups, force from leaning user etc up to 125kg.</li> <li>• Structure – use of strong materials such as mild steel tubing for the frame to support a load of up to 125kg.</li> <li>• Durability – resist chemical reaction of cleaning products, staining by water-based liquid/food spills.</li> <li>• Lifting speed - 38mm/s to lift the desktop from 600mm to 1250mm in less than 20 seconds (17.1sec).</li> </ul>	12	<p>All responses should be in relation to the information provided.</p> <p>Challenges should be identified.</p> <p>Candidates may extract information from the Resource Booklet. RB information can be used in support of the critical evaluation, but no marks should be awarded simply for</p>	<p><b>Level 4 [10-12 marks]</b> A <b>comprehensive</b> examination of the design requirements that would have been considered. Comprehensive understanding of the needs and requirements of employees working at home. Comprehensive understanding of the <b>three</b> elements specified in question. Information in RB is used effectively to fully exemplify the points being made. Well-constructed response in relation to question with a clear and developed narrative.</p> <p><b>Level 3 [7-9 marks]</b> A <b>good</b> examination of the design requirements</p>



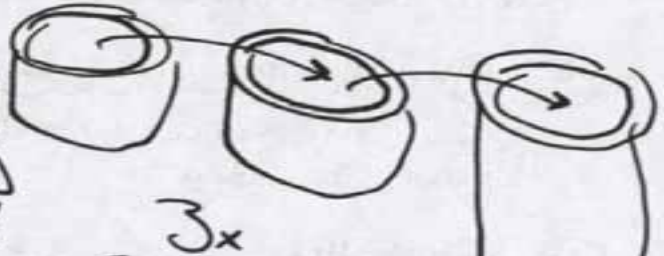
Question	Answer	Mark	Guidance
	<p>Anthropometrics:</p> <ul style="list-style-type: none"> <li>• 1250mm maximum height to exceed the 95<sup>th</sup>ile elbow height of men (tallest users).</li> <li>• 600mm minimum height to be appropriate for 5<sup>th</sup>ile male user elbow height from ground when considering elbow height (210mm) and lower leg length (410mm).</li> <li>• However, 5<sup>th</sup>ile female elbow height is 560mm not including height of footwear, so most users are considered in the height range of the standing desk.</li> <li>• Desk depth of 580mm to enable users with minimum 400mm elbow fingertip length (5<sup>th</sup>ile female) to access most items on the desk without reaching.</li> <li>• Desk width of 1200mm. Lateral arm span of 5<sup>th</sup>ile female is 1520mm and 95<sup>th</sup>ile male is 1950mm. With the largest desktop in use the user should be able to access most items without reaching.</li> <li>• 600mm deep desktop - deep enough to enable thighs of the majority of users to clear beneath when sat up to the desk. This is based on 600mm being larger than 95<sup>th</sup>ile male buttock-knee length of 670mm with abdominal depth 5<sup>th</sup>ile male 220mm subtracted = 450mm without even needing to consider lower back curvature.</li> </ul> <p>Award credit for any other valid suggestion.</p>		<p>duplicating text.</p> <p>There is no analysis or evaluation in Level 1.</p> <p>that would have been considered. Good level of understanding of the needs and requirements of employees working at home. Good understanding of <b>at least two</b> elements specified in question. Information in RB is used for the most part effectively to exemplify points being made although one or two opportunities are missed. Well-constructed response in relation to question although one or two opportunities missed to develop narrative.</p> <p><b>Level 2 [4-6 marks]</b> A <b>sufficient</b> examination of the design requirements that would have been considered. Sufficient understanding of the needs and requirements of employees working at</p>


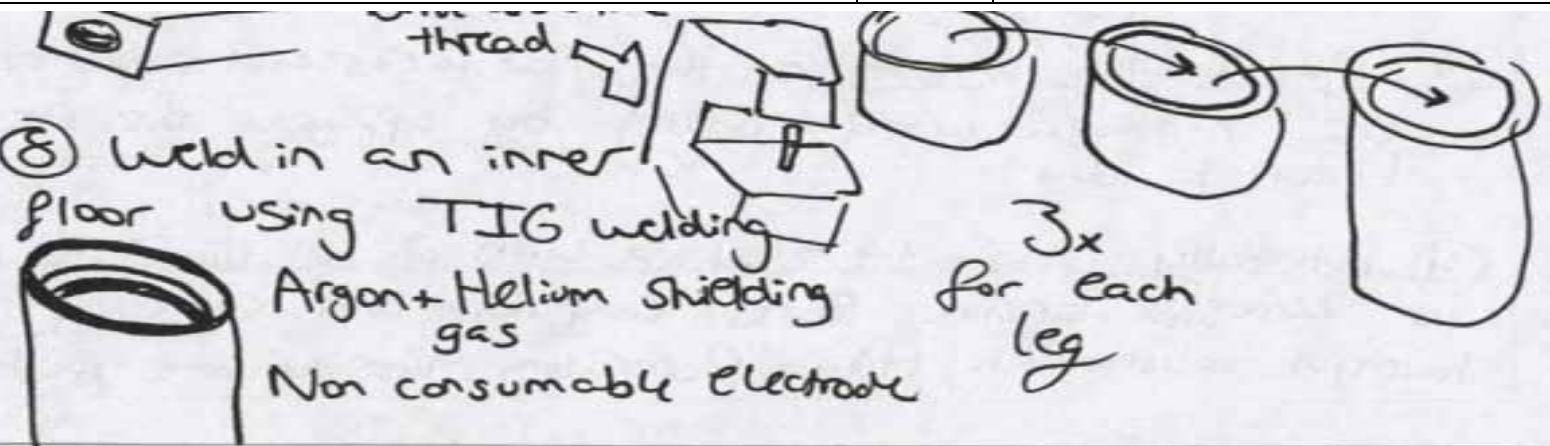
Question	Answer	Mark	Guidance
			<p>home. Sufficient understanding of <b>two of the</b> elements specified in question. Information in RB is used to exemplify some points being made although much more could have been done to exploit the stimulus material available. Reasonable response in relation to the question although narrative at times lacks depth and cohesion.</p> <p><b>Level 1 [1-3 marks]</b>                      A <b>limited</b> examination of the design requirements that would have been considered. Limited knowledge and next to no understanding of the needs and requirements of employees working at home. Limited understanding of <b>one</b> element specified in question. Use of information from the RB is used in a simplistic</p>



Question	Answer	Mark	Guidance
			<p>way and adds limited value to the points being made. Limited response in relation to question. Narrative is basic and unstructured.</p> <p><b>0 marks – No answer or answer not worthy of credit.</b></p>
<p>4 TOP BAND RESPONSE</p>	<p>① Order in material from suppliers that agree Total Quality Management.</p> <p>i) A type of manufactured board like MDF, or blockboard in board stock form 1200mm x 600mm.</p> <p>ii) Veneers for bamboo, oak, walnut or Melamine Formaldehyde.</p> <p>iii) Standard components like brackets, screws, motors, mechanisms, keypad</p> <p>Check quality like warping by placing on a flat surface</p> <p>② Apply an adhesive like Polyvinyl Acetate or Epoxy Resin → Q.C Apply evenly by spreading out the adhesive and ensure</p>		

Question	Answer	Mark	Guidance
	<p>③ Attach the veneers on the flat faces and edges of the manufactured board by applying <u>even pressure</u>. Leave to dry</p> <p>④ Potentially finish the desktop with an oil like Danish Oil or varnish. Ensure RoHS Compliant and not using harmful substances. H&amp;S: Respiratory Mask for some finishes.</p>		
	<p>⑤  Apply a powder coating to all the <del>the</del> mild steel parts and standard components like brackets.</p> <p>Use either:</p> <p>Q.C Use soapy water to break down grease              ↓              Consistent powder coat</p> <p>OR</p> <p>Electrostatic Spray Deposition gun</p> <p> A fluidised bath with polymer powder</p> <p> Nozzle</p> <p> Workpiece e.g. the hollow cylinders</p> <p>⑥ Attach the brackets to the end of the cylinders</p>		

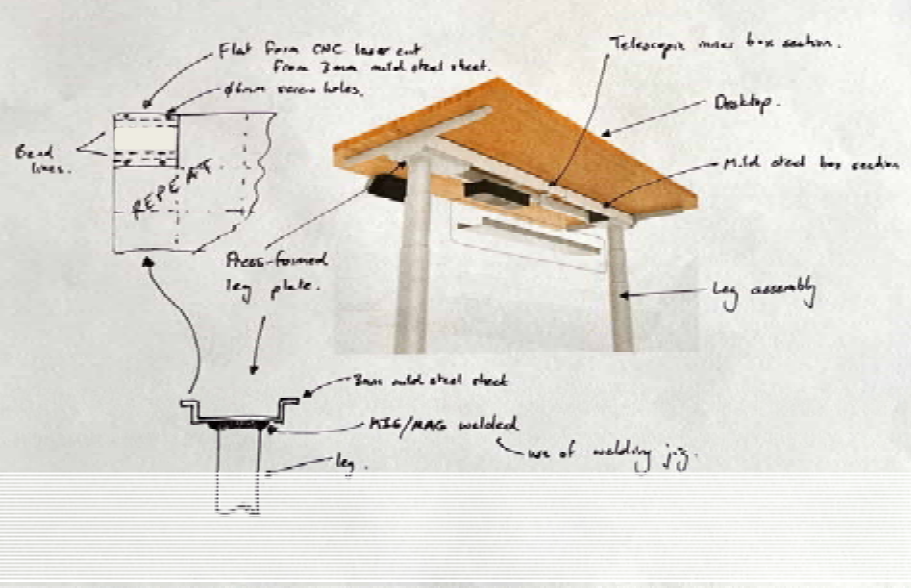
Question	Answer	Mark	Guidance
	<p>⑥ Attach the brackets to the end of the mild steel horizontal bars.</p>  <p>Use galvanized screws and create a metal thread in the cross section of the bar → Pillar Drill</p>  <p>⑦ 3 hollow cylindrical tube stack form we already powder coated, slight smaller each time</p>  <p>3x</p> <p>⑧ Weld in an inner floor using TIG welding</p>		<p>e.g. The hollow cylinders</p>

Question	Answer	Mark	Guidance
	<p>⑧ Weld in an inner floor using TIG welding Argon+Helium shielding gas Non consumable electrode</p> <p>⑨ Weld the assembled legs to i. the Desk Feet      ii) The horizontal Bars/brackets again using TIG due to thin material</p> <p>⑩ Screw in standard components like the motor, possibly by slotting it into its own frame</p>  <p>In a frame to attach it without damaging</p>		 <p>3x for each leg</p> <p>Can use rubber frame to minimise vibrations of the motor Attach the polypropylene cable tidy with adhesive</p>

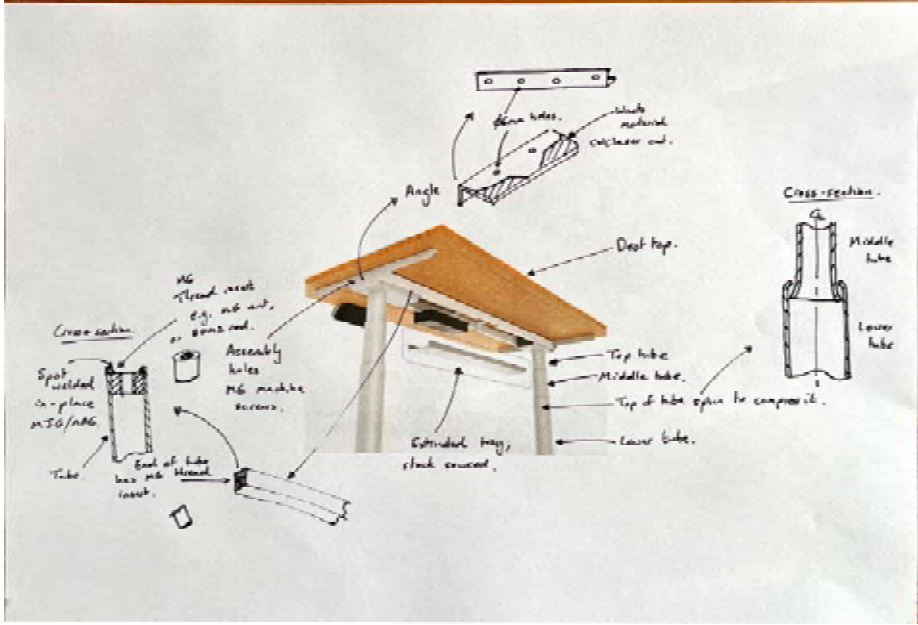
Question	Answer	Mark	Guidance
4	<p><b>Indicative content:</b></p> <p>Sketches and/or notes to outline suitable methods of manufacture and assembly for the features of the standing desk concept design as shown in <b>Fig. 5</b> of the Resource Booklet.</p> <p>Answers <b>must</b> include references to the following:</p> <p>Laminate desktop with candidate's choice of surface finish from the options given:</p> <p>Manufacturing processes:</p> <ul style="list-style-type: none"> <li>• Laminated boards are produced by gluing layers together in a well-organised structure. The adhesive used is usually a synthetic resin that sets rapidly during manufacture, using heat and pressure.</li> </ul> <p>For natural bamboo, oak and walnut surface finishes:</p> <ul style="list-style-type: none"> <li>• Thin veneers of real wood are applied and bonded to the top and bottom surfaces of MDF or chipboard through compression using a synthetic resin.</li> <li>• Compressed boards such as MDF and chipboard are made from fibres or chips respectively, that are glue together, under a compressive force to produce large, flat sheets.</li> <li>• MDF is manufactured from fine fibres of wood and synthetic resin to a density of 600kg/m<sup>3</sup>.</li> <li>• Chipboard is made from small (2 x 3mm) chips of timber often from waste by-product of another production process.</li> <li>• Desktops are likely to be sourced directly from factories where the laminates are made using large presses.</li> </ul>	16	<p>Responses should provide details of processes to make and assemble the features of the standing desk in a batch of 100</p> <p>Answers should include methods of manufacture and assembly for the features of the standing desk concept design for each of the aspects in bullet points in the question.</p> <p>Candidates can draw on practical experience to support responses.</p> <p><b>Level 4 [13-16 marks]</b> A <b>comprehensive</b> demonstration of methods of manufacture and assembly for the features of the standing desk concept design. Comprehensive understanding of the <b>four aspects</b> specified in question in relation to <b>both</b> the desktop and frame. Information in RB is used effectively to fully exemplify the points being made. Sketches will be clear and supported with relevant notes. The methods will be technically accurate and clear in the way they are explained.</p> <p><b>Level 3 [9-12 marks]</b> A <b>good</b> demonstration of methods of manufacture and assembly for the features of the standing desk concept design. Good understanding of <b>at least three</b> aspects</p>

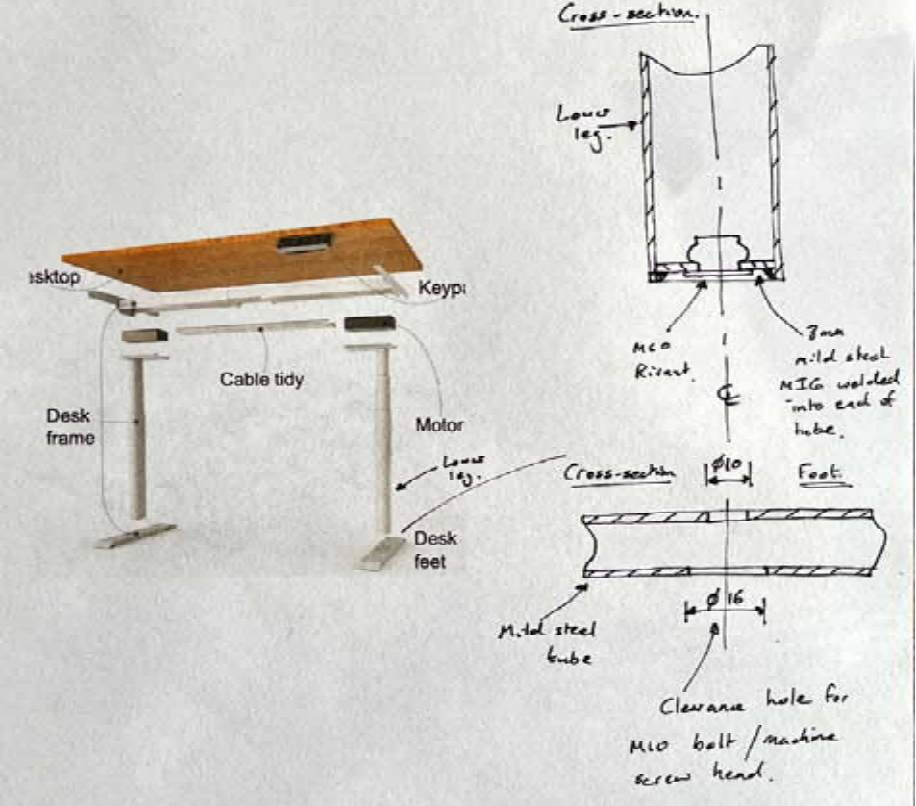
Question	Answer	Mark	Guidance
	<ul style="list-style-type: none"> <li>• Desktops bought in standard sizes of 1210mm x 2420mm (4' x 8') pre-veneered from manufactured board wholesaler / distributor. Two desktops can be cut from each board.</li> <li>• Desktops cut to size using panel saws with repeat stop set for repeat cutting of a batch of 100.</li> <li>• Edging veneers, such as iron-on edging, are applied through heat and compression.</li> </ul> <p>For melamine black, white and marble effect surface finishes:</p> <ul style="list-style-type: none"> <li>• Processes as above.</li> <li>• Use of fine-toothed high-speed panel saws to prevent chipping of melamine.</li> <li>• All edging bonded with synthetic resin under compression.</li> </ul> <p>Additional manufacturing of manufactured boards for assembly:</p> <ul style="list-style-type: none"> <li>• Desktops pre-drilled to limited depth using drilling jigs and power drills (with depth stop) to accept e.g. M6 thread inserts to which to assemble frame.</li> <li>• Desktops pre-prepared for assembly with CNC routed holes to accept e.g. M6 thread inserts to which to assemble frame.</li> <li>• Desktops pre-drilled with pilot holes to accept screws for later assembly, at e.g. 4mm diameter.</li> </ul> <p>Finishes:</p> <ul style="list-style-type: none"> <li>• For natural finishes such as bamboo, oak and walnut, desktops sprayed with sanding sealer to seal the surface and raises the wood fibres so that they can be sanded. Sanding with orbital sanders. Varnish applied by spraying.</li> </ul>		<p>Candidates are expected to demonstrate understanding of the processes through annotated sketches and/or notes.</p> <p>specified in question in relation to <b>both</b> the desktop and frame, although one or two opportunities are missed. Information in RB is used for the most part effectively to exemplify points being made. Sketches will for the most part be clear and supported with relevant notes. The methods will be technically accurate and for the most part be clear in the way they are explained.</p> <p><b>Level 2 [5-8 marks]</b> A <b>sufficient</b> demonstration of methods of methods of manufacture and assembly for the features of the standing desk concept design. Sufficient understanding of <b>at least two</b> aspects specified in question in relation to <b>either</b> the desktop and/or frame.</p>

Question	Answer	Mark	Guidance
	<ul style="list-style-type: none"> <li>• Melamine surfaces are self-finished.</li> </ul> <p>Assembly methods:</p> <ul style="list-style-type: none"> <li>• Desktop attached to frame via e.g. M6 machine screws that are screwed through holes in the frame into thread inserts screwed into pre-drilled blind holes in the underside of the desktop.</li> <li>• Screws e.g. 6 x 12mm pozidrive, used to attach frame to desktop. Blind pilot holes pre-drilled in the underside of the desktop to accept screws. Cordless combi-drill/screwdrivers used to screw in screws with clutch set to avoid over tightening.</li> <li>• The frame and desktop can be assembled on site.</li> <li>• Standing desk is designed for flat-packing, so may require some assembly by the user using a screwdriver to attach the desktop to the frame, or a spanner to attach the feet to the legs.</li> </ul> <p>Mild steel frame:</p> <p>Manufacturing processes:</p> <ul style="list-style-type: none"> <li>• Equal angle / square box section tube / round tube mild steel sourced to section and cut to length using a metal cutting chop saw, or slitting saw with a repeat stop used for repeat work.</li> <li>• Round tubes used for telescopic sections to be from extruded stock to avoid electric arc welds scraping adjacent tubes.</li> <li>• Sections stacked and drilled in batches of four using a drill press/ pillar drill and drilling jig.</li> <li>• 6mm diameter or larger holes drilled in the frame through which screws / machine screws can be used to attach desktop. Holes drilled using pillar drills.</li> <li>• Top leg tube (narrower) MIG/MAG welded to press-formed plate.</li> </ul>		<p>Information in RB is used to exemplify some points being made although much more could have been done to exploit the stimulus material available. Sketches will be adequate and supported with notes. The methods will not always be technically accurate with some knowledge gaps evident.</p> <p><b>Level 1 [1-4 marks]</b>  A <b>limited</b> demonstration of methods of methods of manufacture and assembly for the features of the standing desk concept design. Limited understanding of <b>one</b> aspect specified in question in relation to <b>either</b> the desktop and/or frame. Use of information from the RB is used in a simplistic way and adds limited value to the points being made. Sketches if used</p>

Question	Answer	Mark	Guidance
	 <ul style="list-style-type: none"> <li>• Sheet material 3mm thick for plate at top of leg, CNC laser cut, then press formed, or folded on a bench bending apparatus with repeat stops in place / jig.</li> </ul>		<p>will be unclear with only basic notes to accompany them. The methods may lack technical detail and be basic in nature.</p> <p><b>0 marks – No answer or answer not worthy of credit.</b></p>



Question	Answer	Mark	Guidance	
	 <ul style="list-style-type: none"> <li>• Bottom leg tube (larger) to have mild steel sheet 3mm MIG/MAG welded in place. Plate previously drilled with 10mm / 12mm diameter hole to accept an M10/M12 thread rivnut.</li> <li>• Desk feet – rectangular box section MS tube cut at ends to angle using chop saw / slitting saw with repeat stop. E.g. 1.6mm MS sheet MIG/MAG welded to ends to close off tubes. Ground using angle grinder.</li> </ul>			

Question	Answer	Mark	Guidance
	 <ul style="list-style-type: none"> <li>• Centre of desk foot drilled to hole diameter 10mm/12mm using drilling jig to accept machine screw to attach leg. Bottom of box section drilled to a larger diameter to allow for machine screw head clearance.</li> <li>• Under desktop supporting box-sections to be drilled and have, e.g. M6 rivnuts, fitted for later assembly to the top leg press-formed plate.</li> <li>• Telescopic tubes – ends spun to narrow / enlarge ends respectively so that tubes do not pull out of each other when extended.</li> </ul>		

Question	Answer	Mark	Guidance	
	<p>Standard components to be used:</p> <ul style="list-style-type: none"> <li>• E.g. M6 machine screws to join top leg press-formed plate to under desk-top frame box sections.</li> <li>• E.g. M10/M12 machine screw to join foot to lower leg tube threaded insert / rivnut. M10/M12 penny washers used to spread load. M10/M12 sprung washers used to prevent machine screws loosening.</li> <li>• Stock form for mild steel angle / square box section tube / round tube a further viable response</li> </ul> <p>Finishes:</p> <ul style="list-style-type: none"> <li>• Powder coating</li> </ul> <p>Assembly methods:</p> <ul style="list-style-type: none"> <li>• Standing desk is designed for flat-packing, so may require some assembly by the user using a screwdriver, e.g. PZ No.2, to attach the desktop to the frame, or a spanner, e.g. 13mm, to attach the feet to the legs.</li> <li>• MIG/MAG welding of top tube to press-formed plate.</li> <li>• E.g. M6 machine screws to join press-framed top of leg plate to under desktop frame box sections previously fitted with M6 rivnuts.</li> <li>• E.g. M10/M12 machine screws used to join desk foot to lower desk leg.</li> </ul> <p>Award credit for any other valid suggestion.</p>			

5 *		<p><b>Indicative content:</b></p> <p>Inclusivity:</p> <ul style="list-style-type: none"> <li>• Provision of specific desks or areas for users with specific needs, such as physical disabilities, may cause them to feel isolated/segregated and not have the options available to other employees.</li> <li>• If wheelchair friendly desks are provided in multiple spaces, will they all be used, could this be a poor return on investment?</li> <li>• Single desk heights may not be suitable for all users.</li> </ul> <p>Privacy:</p> <ul style="list-style-type: none"> <li>• Some employees will prefer private space to work or have tasks that need to be done in quiet spaces. Accountants are likely to need to concentrate intensely at times.</li> <li>• From OCR Accountants' perspective, could there be a reduction in work efficiency/output as a result of much more communal spaces and distractions? Are human errors likely to feature more?</li> </ul> <p>Storage of personal belongings:</p> <ul style="list-style-type: none"> <li>• Outdoor clothing – where can coats, umbrellas, footwear be stored. Does a cloak room need to be provided?</li> <li>• Handbags, wallets, keys – where can valuables be stored temporarily? Could options such as lockers be provided. Or, lockable drawers under desks for temporary use. How would employees be encouraged to empty them when they have finish? Could this lead to further inconvenience with lost keys or codes for lockers?</li> <li>• Food, drinks and snacks – where are these stored when not required? Will employees care for workspaces the same if they spill food or drink at a hot-desk?</li> <li>• Temporary storage of clothes – will lockers or similar be required if employees want to change out of clothes to, for example, go for a lunchtime run.</li> </ul>	12	<p>All responses should be in relation to the information provided.</p> <p>Challenges should be identified.</p> <p>Candidates may extract information from the Resource Booklet. RB information can be used in support of the critical evaluation, but no marks should be awarded simply for duplicating text.</p> <p>There is no analysis or evaluation in Level 1.</p>	<p><b>Level 4 [10-12 marks]</b></p> <p>A <b>comprehensive</b> examination of the challenges that will be faced. Comprehensive understanding of the challenges that will be faced to provide an effective open plan office with hot desks for employees. Comprehensive understanding of the <b>four</b> elements specified in question. Information in RB is used effectively to fully exemplify the points being made. Well-constructed response in relation to question with a clear and developed narrative.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Level 3 [7-9 marks]</b></p>
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	<p>Digital technology:</p> <ul style="list-style-type: none"> <li>• Monitor – will this have an adjustable height range to suit the ergonomic requirements of all users. May taller users need to lift up on a book or box. Could this lead to wear and tear of cables and strain on connectors?</li> <li>• Dock – constant plugging and unplugging will lead to wear and tear on dock cables and connectors leading to increased maintenance / renewal costs. Employees may treat equipment with less respect than they might their own.</li> <li>• Keyboard and mouse – vulnerable to spills from drinks and crumbs. Will need to be regularly cleaned to reduce the transfer of viruses.</li> </ul> <p>Award credit for any other valid suggestion.</p>		<p>A <b>good</b> examination of the challenges that will be faced. Good level of understanding of the challenges that will be faced to provide an effective open plan office with hot desks for employees. Good understanding of <b>at least three</b> elements specified in question. Information in RB is used for the most part effectively to exemplify points being made although one or two opportunities are missed. Well-constructed response in relation to question although one or two opportunities missed to develop narrative.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.</i></p> <p><b>Level 2 [4-6 marks]</b></p>
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					<p>A <b>sufficient</b> examination of the challenges that will be faced. Sufficient understanding of the challenges that will be faced to provide an effective open plan office with hot desks for employees. Sufficient understanding of <b>at least two</b> elements specified in question. Information in RB is used to exemplify some points being made although more could have been done to exploit the stimulus material available. Reasonable response in relation to the question although narrative at times lacks depth and cohesion.</p> <p><i>The information has some relevance and is presented with limited structure. The information is supported by limited evidence.</i></p> <p><b>Level 1 [1-3 marks]</b></p>
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					<p>A <b>limited</b> examination of the challenges that will be faced. Limited knowledge and next to no understanding of the challenges that will be faced to provide an effective open plan office with hot desks for employees. Limited understanding of <b>one</b> element specified in question. Use of information from the RB is used in a simplistic way and adds limited value to the points being made. Limited response in relation to question. Narrative is basic and unstructured.</p> <p><i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</i></p>
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						<b>0 marks – No answer or answer not worthy of credit.</b>
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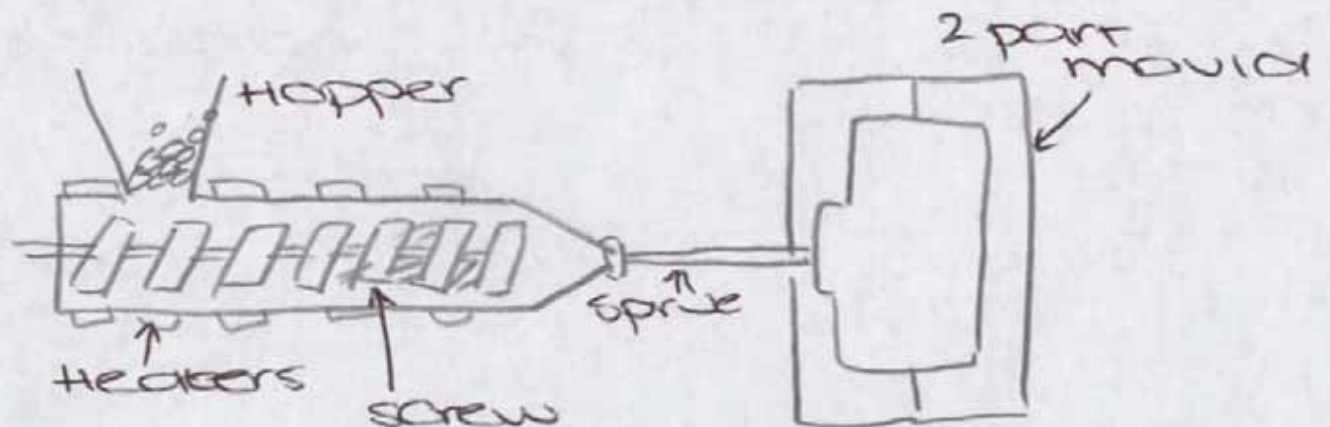


6 TOP  
BAND  
RESPONSE

consumer testing would require products to have high accuracy for appropriate feedback.

using either 3D printing or injection moulding would provide accuracy of the design, though initial set up costs may be high.

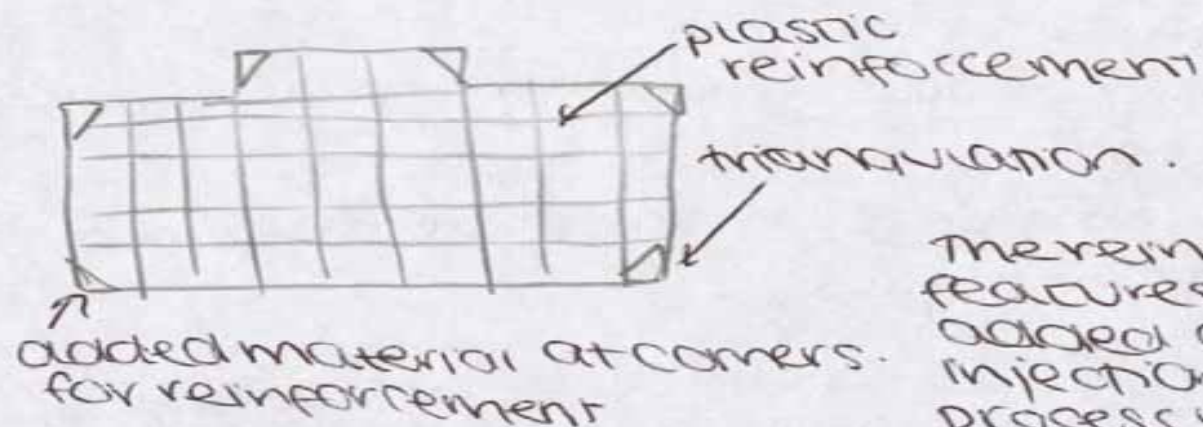
injection moulding.



- ① 2 part mould created
- ② Thermopolymer pellets such as HDPE placed into hopper,
- ③ pellets are heated and travel along screw to sprue, where at pressure, molten plastic is injected into the 2 part mould
- ④ plastic is left to cool and mould is removed

13

Structural reinforcement can be achieved through triangulation and extra material added to corners of the laptop shelf.



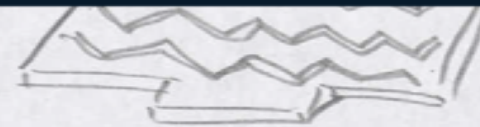
The reinforcement features can be added during injection moulding process with 2 part mould.

To provide a textured, non-slip surface, this can be achieved either after the injection moulding process, or as part of the 2 part moulds design.

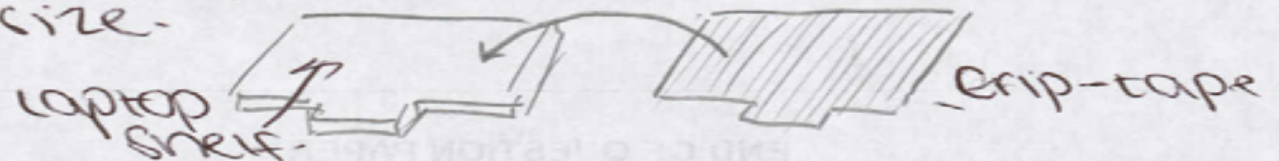
To include the non-slip properties in the design, raised, sunken designs in the laptop shell will provide friction and non-slip properties to the design.



provide friction and non-slip properties to the design.




following manufacture, to ease DFM, a clear adhesive-back grip tape could be cut to size and glued to the flat surfaced laptop shell. This could be laser cut to improve accuracy, or simply cut using scissors to prevent unnecessary costs for the small initial batch size.

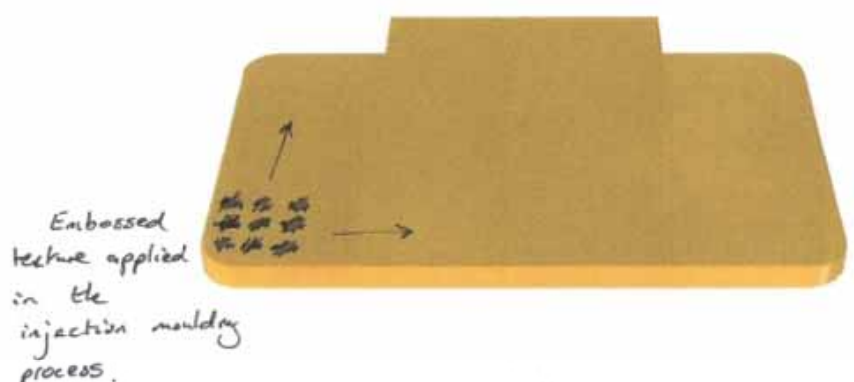
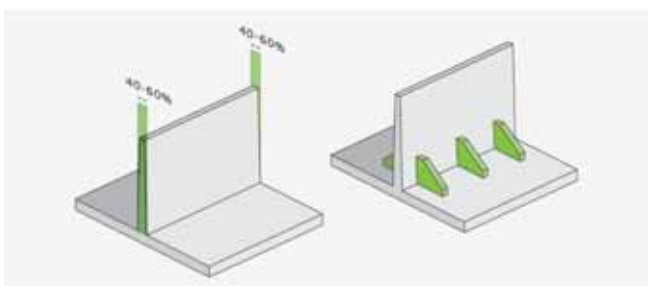


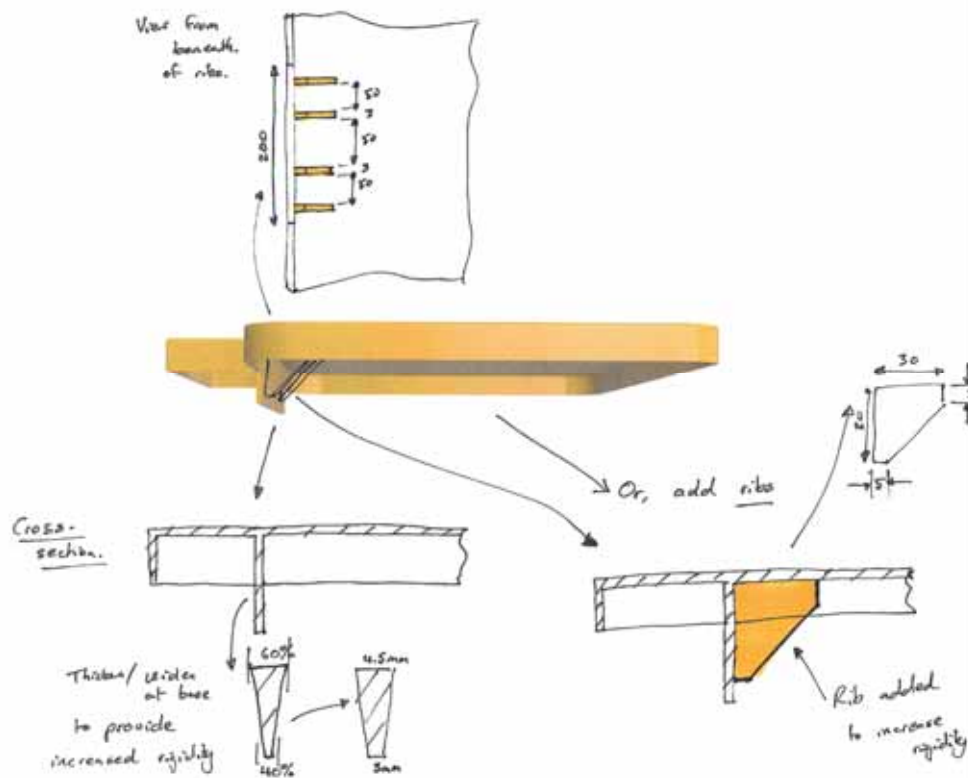
- 3D printing is achieved using CAD.
- ① Design created using CAD software
  - ② Set up on 3D printer
  - ③ Data point set
  - ④ Printed using spool of thermopolymer (molten) built on shape
  - ⑤ Hollow interior with connective reinforcement.
  - ⑥ Sanded and finished

3D printing is less effective for a batch of 100 due to time consumption of manufacture and printing process

↳ Also less structural integrity.

6		<p><b>Indicative content</b></p> <p>Sketches and/or notes to outline suitable methods to meet the following design and manufacturing requirements of 100 polymer laptop shelves:</p> <ol style="list-style-type: none"> <li>1. Include a non-slip texture to the shelf top surface <ul style="list-style-type: none"> <li>• Texture added to design and added to tooling for injection moulding.</li> </ul> </li> </ol> <p>General example – PP tray:</p> 	12	<p>Candidates may use sketches and/or notes to outline suitable methods to meet the design and manufacturing requirements for 100 polymer laptop shelves.</p> <p>Answers should include methods to meet the design and manufacturing requirements of each of the aspects in bullet points in the question.</p>	<p><b>Level 4 [10-12 marks]</b>  A <b>comprehensive</b> demonstration of methods to meet the design and manufacturing requirements for 100 polymer laptop shelves. Comprehensive understanding of the <b>four aspects</b> specified in question. Information in RB is used effectively to fully exemplify the points being made. Sketches will be clear and supported with relevant notes. The methods will be technically accurate and clear in the way they are explained.</p> <p><b>Level 3 [7-9 marks]</b>  A <b>good</b> demonstration of methods to meet the design and manufacturing requirements for 100 polymer laptop shelves. Good understanding of <b>at least three</b> aspects specified in question. Information in RB is used</p>
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	 <ul style="list-style-type: none"> <li>• Neoprene / EVA sheet could be applied to the top of the shelf, bonded with a synthetic resin.</li> </ul> <p>2. Provide structural reinforcement</p> <ul style="list-style-type: none"> <li>• Ribs moulded into the base to reinforce the vertical 'sheet' and prevent fracture.</li> <li>• Vertical 'sheet' widened at base to increase rigidity</li> </ul> <p>General example:</p> 		<p>Candidates can draw on practical experience to support responses.</p> <p>Candidates are expected to demonstrate understanding of the processes through annotated sketches and/or notes.</p>	<p>for the most part effectively to exemplify points being made although one or two opportunities are missed. Sketches will for the most part be clear and supported with relevant notes. The methods will be technically accurate and for the most part be clear in the way they are explained.</p> <p><b>Level 2 [4-6 marks]</b>  A <b>sufficient</b> demonstration of methods to meet the design and manufacturing requirements for 100 polymer laptop shelves. Sufficient understanding of <b>at least two</b> aspects specified in question. Information in RB is used to exemplify some points being made although much more could have been done to exploit the stimulus material available. Sketches will be adequate and</p>
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- Ribs moulded into the base of the shelf to increase rigidity, reduce deflection and thus eliminate fracture within normal loading.

General example – PP swing-out tray:

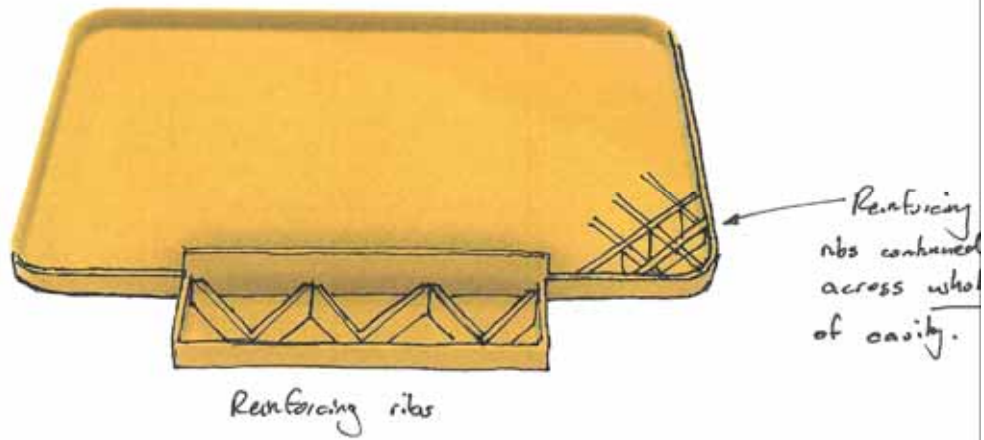
supported with notes. The methods will not always be technically accurate with some knowledge gaps evident.

### Level 1 [1-3 marks]

A **limited** demonstration of methods to meet the design and manufacturing requirements for 100 polymer laptop shelves. Limited understanding of **one** aspect specified in question.

Use of information from the RB is used in a simplistic way and adds limited value to the points being made. Sketches if used will be unclear with only basic notes to accompany them. The methods may lack technical detail and be basic in nature.

**0 marks – No answer or answer not worthy of credit.**



- V – Grooves
- Corrugation



General examples:

**DESIGN FEATURES**

**Ribs**– these are most commonly used. For a part that may bend ribs should be perpendicular to the point of bending. For parts under tension, diagonal ribs are the most effective at increasing stiffness. In all instances deep ribs are more efficient than thick ribs.



**Rib Forms** - For a straight beam loaded in the middle corrugation is the stiffest followed by ribs then V-grooves assuming the same amount of material is used in each case. However, for panel that could be loaded in different directions, say at right angles to each other, a rib form would then be the stiffest option.



**V-Grooves** - These are incorporated where significant increases in stiffness are required. However, they are not often used because they give uneven top and bottom surfaces. V-grooves should be perpendicular to the bend.

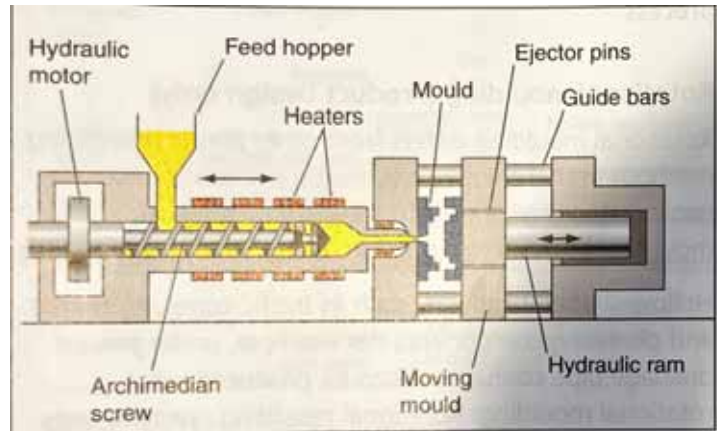


Corrugation – Similar to V-grooves



3. Batch manufacture 100 polymer laptop shelves

- Injection moulding - process to suit the laptop shelf to include appropriate tooling and mould design.
- Accept 3D printing.

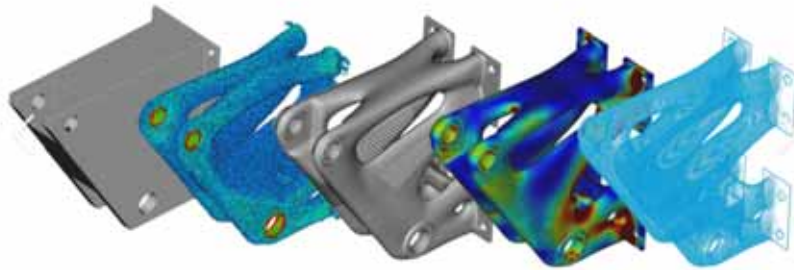


4. Take account of Design for manufacture and assembly (DFMA)

Possible aspects of DFMA for consideration:

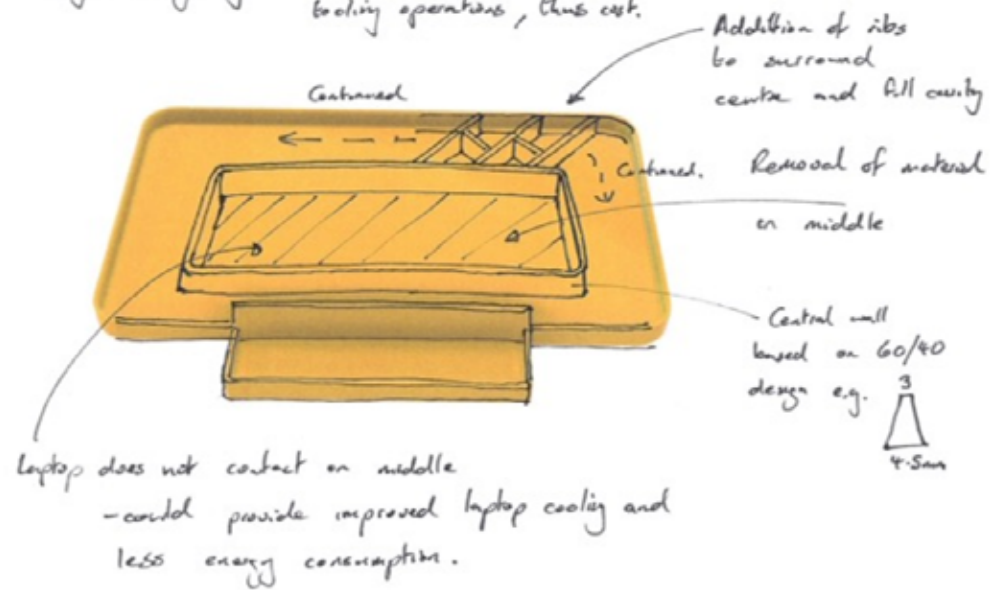
- Reduction in material – use of rib reinforcing structure to minimise the amount of polymer required whilst providing structural reinforcement.
- FEA simulations can be undertaken to reduce material further and lightweight the existing design whilst providing structural integrity for the key load bearing features.

General example – bracket:



Design optimization:

- Light weighting - reduction of material and tooling operations, thus cost.



Award credit for any other valid suggestion.

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