A-level

DESIGN AND TECHNOLOGY: PRODUCT DESIGN 7552/1

Paper 1 Technical Principles

Mark scheme

June 2019

Version: 1.0 Final

I96A7552/I/MS

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Glossary for maths

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

[a, b]	Accept values between a and b inclusive.
For π	Accept values in the range [3.14, 3.142]
Their	Accept an answer from the candidate if it has been inaccurately calculated but is subsequently used in a further stage of the question.

As a general principle, a correct response is awarded full marks.

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

Qu	Part	Marking Guidance	Total marks	AO
1		Explain why 'potatopak' is a suitable material for the manufacture of disposable cutlery. One mark per correct appropriate reason. **Indicative content:** • 'Potatopak' can be easily formed into the shape of cutlery using a heated compression mould • 'Potatopak' is a bio-polymer that will naturally decompose when disposed of • 'Potatopak' is a starch based material that is food safe • Disposable cutlery is a single use product and wont contribute to landfill waste when disposed of. • The use of 'Potatopak' reduces the demand for oil based polymers **Note:** This indicative content is not exhaustive: any other valid points should be credited.	3 marks	AO41b

<table>
<tr>
<td>2</td>
<td></td>
<td>
Explain how BSI certification impacts on the purchase of a child's car seat by a consumer.
<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>5-6 marks</td><td>A detailed explanation of BSI certification and how it impacts the purchasing decision of consumers and is clearly linked to the child's car seat context.</td></tr>
<tr><td>3-4 marks</td><td>Good explanation which demonstrates good understanding of BSI certification and makes reference to how it impacts the consumer purchase</td></tr>
<tr><td>1-2 marks</td><td>Basic explanation. The response shows basic understanding of BSI certification.</td></tr>
<tr><td>0 marks</td><td>No response worthy of credit.</td></tr>
</table>
Indicative content:

BSI certification shows that the car seat has been rigorously tested before being able to be sold.
Consumers will want to ensure that their child's seat is safe and fit for purpose.
BSI certification will increase a brand's reputation by it becoming synonymous with a company that invests in testing and produce high quality safe products for transporting children.
It will allow the company to display the kite mark on its seat and packaging, which consumers will associate with a safe and secure product and its presence is often a deciding factor when making a purchase over other car seat brands or models.
It reassures consumers that the child's seat will undergo ongoing tests and faulty products recalled providing piece of mind to parents.
It reassures the consumer that the seat will be up to date and meet current safety regulations such as rear facing requirements etc.
BSI standards are updated periodically, which will reassure parents that current legislation is being met and this in turn will ensure the child seat is fit for purpose.

Note: This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.
</td>
<td>6 marks</td>
<td>AO41b</td>
</tr>
</table>

3		Give **three** benefits of using stock forms of material for a manufacturer. One mark per correct benefit of stock forms to the manufacturer. **Indicative content:** • Uniformity of material sizes across countries and suppliers. • The use of a stock form reduces extra costs for manufacturers associated with machining to a specific size. • Less expensive than custom sizes due to the large quantity produced. • Allows for efficient planning of manufacture to minimise waste. • Allows manufacturers to plan for the efficient storage of raw materials. • Less likely to have any delays in manufacture than a custom size. **Note:** This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.	3 marks	AO41A

4		PAR is a stock form of timber. What does PAR stand for? One mark for the correct definition of PAR • Planed All Round (PAR)	1 mark	AO41A

<table>
<tr>
<td>5</td>
<td></td>
<td>
Figure 1 shows a children’s climbing frame. (Shown in Question Paper)

Explain why powder coating is an appropriate finish for the climbing frame shown in Figure 1.

<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>5-6 marks</td><td>The response demonstrates a detailed and thorough understanding of why powder coating is a suitable finish for the climbing frame with reference to how performance characteristics make it appropriate for the climbing frame application.</td></tr>
<tr><td>3-4 marks</td><td>The response demonstrates a good understanding of why powder coating is a suitable finish for the climbing frame with some reference to how performance characteristics of the finish relate to the climbing frame application.</td></tr>
<tr><td>1-2 marks</td><td>The response offers a basic explanation of the benefits of powder coating with limited reference to the climbing frame application.</td></tr>
<tr><td>0 marks</td><td>No response worthy of credit.</td></tr>
</table>

Indicative content:

• Powder coating provides a hard, durable finish which will resist the wear from children’s shoes.
• Thicker coats can be achieved than feasible with liquid paint finishes.
• A wide range of colours are available, as pigments can be added.
• Powder coating will protect the frame from oxidising.
• Powder coating gives an even coat of material around cylindrical shapes.
• Overspray from the climbing frame can be recycled and reused.
• Powder coated finishes are less prone to fading from UV degradation due to the use of stabilisers.
• Powder coated finishes are less likely to chip than traditional paint finishes.
• Powder coated finishes are not affected by extremes of temperature found outdoors during summers and winters.

Note: This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.
</td>
<td>6 marks</td>
<td>AO41B</td>
</tr>
</table>

6		Define each of the following terms: • copyright • trademark • patent One mark per appropriate definition. **Indicative content:** Copyright • A legal right that provides protection for material such as books, computer code, photography, drama, music, films, television programmes etc. Trademark • A protected logo or series of words that is a unique identifier of a company or brand. Eg DuPont™ - Kevlar®. *Both registered and unregistered trademarks are acceptable responses.* Patent • A government issued protection order covering a new idea or invention. **Note:** This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.	3 marks	AO41A

7		**Figures 2** and **3** show rolls of adhesive tape. (shown in Question Paper) Compare the environmental impact of the materials used to manufacture the cores of the adhesive tapes shown.	6 marks 3 marks AO32A 3 marks AO32B	AO32A AO32B

Marks	**Description**
5-6 marks	The response demonstrates excellent analysis and compares the environmental impact of the materials used to manufacture both adhesive tape cores. Response provides detailed evaluation of the environmental impact of the materials used throughout their lifecycle, with reference to aspects such as source, manufacture, use and disposal.
3-4 marks	The response provides good analysis and compares the environmental impact of the material used for the adhesive tape cores. Response provides some evaluation of the environmental impact of the materials used at stages of their lifecycle, with reference to aspects such as source, manufacture, use and disposal.
1-2 marks	The response shows a basic evaluation of the environmental impact of the materials used to manufacture the adhesive tape cores, but tends to be descriptive rather than evaluative.
0 marks	No response worthy of credit.

Indicative content:

ABS core

- ABS comes from crude oil which is a non-renewable resource, once used it cannot be replaced or regrown.
- Risk of environmental damage to marine life when sourcing and transporting the crude oil to a refinery.
- At the end of its use the spool will be disposed of and may end up in landfill where it will take a considerable length of time to decompose.
- ABS is a thermoplastic and can be recycled depending on local recycling facilities.
- The core is injection moulded so minimal waste material is produced.

Cardboard core

- Cardboard is manufactured from renewable and sustainable materials.
- The trees used for corrugated cardboard come from managed woodland with some reference to FSC.
- Consideration of NAPM guidelines.
- Can be manufactured from 100% recycled material, but more

		commonly has a 70% – 90% recycled content. • Water and air pollution is greater when producing cardboard than when manufacturing a polymer. **Note:** This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.		

8		**Figure 4** shows the dimensions of a component to be made using 3D printing. (Shown in Question Paper) Calculate the material cost of manufacturing 50 units.	5 marks	AO41C

Cuboid Volume	30 × 30 × 10 = 9000 mm^3	1 mark (M1)
Cross Section of semi circle	½ × π × 15^2 – π × 3^2 = 103.5 π Or = 353.25 – 28.26 = [324.99, 325.197]	1 mark (M1)
Total Volume	Cross section × 20 + base Their [324.99, 325.197] × 20 + 9000 = [15499.8, 15503.94]	1 mark (A1)
Mass of Shape	Density × Volume 0.000448 × their [15499.8, 15503.94] mm^3 = [6.944, 6.946 g]	1 mark (M1)
Cost of 50 units	mass × 50 units their [6.944, 6.946g] × 50 =[347.26, 347.3] / 500g × 18 = £12.50	1 mark (A1)
Cost of 50 units Where no working has been shown but final answer is accurate	= £12.50	5 marks

9		Name a specific application for each of the following compliant materials: • bleed proof paper • duplex card • moulded paper pulp. One mark per correct application. **Indicative content:** **Bleed proof paper** • Drawing and sketching • Rendering with marker pens • Using waterbased inks **Duplex card** • Food packaging (due to its waxy / glossy coating) • Disposable plates and cups • Applications where recycled board would be unsuitable **Moulded paper pulp** • Take away cup carriers • Protective packaging • Food packaging – egg boxes **Note:** This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.	3 marks	AO41A

10		Evaluate the following techniques for rendering a design: • using computer aided design (CAD) • hand generated	6 marks 3 marks AO32A 3 marks AO32B	AO32A AO32B

Marks	Description
5-6 marks	Response shows detailed analysis and compares the two processes in detail with reference to factors such as costs, ease of use and functionality. The response provides detailed evaluation of the suitability of each as a design communication technique.
3-4 marks	Response shows good analysis and evaluation of both methods for rendering a design. Responses provide some evaluation with reference to factors such as costs, ease of use and functionality.
1-2 marks	The response focuses on one rendering technique with basic evaluation. Response tends to be descriptive rather than evaluative.
0 marks	No response worthy of credit.

Indicative content:

CAD Rendering

- Costly software and powerful computer processors are needed which can make it prohibitive.
- A high degree of competency in the use of the CAD software is needed to fully exploit all functions which may require lengthy training.
- Software may require purchased credits to perform high quality renders adding to the cost of the technique.
- Photo realistic renders are feasible.
- A huge range of material textures are available.
- Light sources and shadow can be represented.
- Rendered images can be placed into scenarios.
- CAD can be emailed/shared for instant feedback from clients/focus groups.
- CAD renders can be easily edited.

Hand rendering

- A great deal of skill is needed to proficiently achieve a high quality render using markers, coloured pencils or inks etc.
- Specialist paper is needed to avoid the colours running.
- A hand rendered drawing can be time consuming to complete and takes longer than CAD.
- Tone and shadow can be achieved through a wide range of available colours.
- Flat smooth colours can be achieved with the use of a blender.

		• Minimal specialist equipment is needed making the process more affordable than CAD. • Hard to edit the render and usually would require restarting. **Note:** This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.		

11		**Figure 5** shows an aluminium seat clamp. **Figure 6** shows the dimensions of a block of aluminium. (Shown in the Question Paper) Compare the cost of each manufacturing process if 5000 units are to be produced. Show your working out.	6 marks	AO41C

The volume of the seat clamp	7280 mm^3
The cost of aluminium	£4 per 100 000 mm^3
The cost of manufacturing a mould for the redistribution process	£3000

Machined seat clamp		
Block volume	10 × 50 × 60 =30 000 mm^3	1 mark (M1)
Recognition of correct equation	Block volume ÷ cost of aluminium	1 mark (M1)
Cost for one machined seat clamp	Their 30 000 ÷ 100 000 × £4 = £1.20 per clamp	1 mark (M1)
Cost of 5000 machined seat clamps	Their 1.20 X 5000 = £6000	1 mark (A1)
Cost of 5000 machined seat clamps Where no working has been shown but final answer is accurate	£6000	4 marks

Redistribution seat clamp		
Cost for one redistribution seat clamp (without mould factored in)	7280 ÷ 100 000 × 4 = [£0.29, £0.292]	1 mark (A1)
Cost of 5000 redistribution seat clamps	Their [£0.29, £0.292] × 5000 + 3000 = [£4450, £4460]	1 mark (A1)
Cost of 5000 redistribution seat	= [£4450, £4460]	2 marks

		clamps where no working has been shown but final answer is accurate				

<table>
<tr>
<td>12</td>
<td></td>
<td>Explain the safe work practices necessary to protect workers when using solvent adhesives.

<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>5-6 marks</td><td>The response demonstrates a detailed and thorough understanding of the safety requirements needed to protect the user of solvent adhesive such as COSHH guidance, and key considerations for safe working practice.</td></tr>
<tr><td>3-4 marks</td><td>The response demonstrates a good understanding of the safety requirements associated with the use of solvent adhesives with an awareness of safe working practice.</td></tr>
<tr><td>1-2 marks</td><td>The response offers a basic understanding of the safety requirements associated with solvent adhesives.</td></tr>
<tr><td>0 marks</td><td>No response worthy of credit.</td></tr>
</table>

Indicative content:

• Users should be aware of the COSHH guidance that governs their use, storage and disposal.
• Users must store the adhesive in a COSHH cupboard when not in use.
• The adhesive may be irritant to skin so correct PPE should be worn eg gloves.
• The adhesive may be a liquid so correct PPE such as goggles should be worn.
• Vapours that can be released can be highly flammable so no naked flames should be present when using the adhesive.
• Users must ensure that instructions have been read and guidance is followed.
• Vapours can be released therefore the adhesive should be used in a well ventilated area.
• Users must identify and understand the COSHH symbol present which will both govern its use and disposal.

Note: This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.</td>
<td>6 marks</td>
<td>AO41B</td>
</tr>
</table>

<table>
<tr>
<td>13</td>
<td></td>
<td>
Explain why neoprene is a suitable material to manufacture a case to carry a laptop.
<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>7-8 marks</td><td>Detailed understanding of why neoprene is used in the manufacture of a laptop case. Response may make reference to the material properties, the manufacture and suitability for the laptop case application.</td></tr>
<tr><td>5-6 marks</td><td>Good understanding of why neoprene is used in the manufacture of a laptop case. Response may make some reference to aspects such as material properties, the manufacture or suitability for the laptop case application.</td></tr>
<tr><td>3-4 marks</td><td>Limited understanding why neoprene is used for a laptop carry case</td></tr>
<tr><td>1-2 marks</td><td>Basic understanding of why neoprene is used for a laptop carry case, the points made are generic.</td></tr>
<tr><td>0 marks</td><td>No response worthy of credit.</td></tr>
</table>
Indicative content:

Neoprene is an elastomer and will stretch around the laptop holding it securely.
Neoprene is soft so will not scratch the screen or casing of the laptop.
It is thin and lightweight so does not add unnecessary bulk when being used.
It is available in a wide range of colours.
It is available in a range of thicknesses for different applications.
The neoprene can be printed on and logos or branding applied.
Fixings such as zips and poppers can be stitched into the fabric.
Neoprene is water repellent, protecting the product from small spillages.
Laptops are often carried and are fragile devices that require a protective sleeve to prevent damage. Neoprene will help prevent damage from impact if dropped.
The case can be used as a protective surface to rest the laptop on when not in use

Note: This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.
</td>
<td>8 marks</td>
<td>AO41C</td>
</tr>
</table>

14		**Figure 7** shows a lift interface. (Shown in Question Paper) Evaluate how well the lift interface has been designed to be inclusive to all users.	6 marks	AO32A AO32B

Marks	**Description**
5-6 marks	Excellent understanding of how well the lift interface has been designed to be inclusive for a wide range of users. Response provides detailed analysis of the majority of key features and evaluates how successfully their design impacts on the function and usability of the lift interface.
3-4 marks	Good understanding of how well the lift interface has been designed to be inclusive for a wide range of users. Response provides good analysis of some key features and evaluates how successfully their design impacts on the function and usability of the lift interface.
1-2 marks	The response provides a basic understanding of how well the lift interface has been designed to be inclusive. The response evaluates some features of the lift interface but tends to be descriptive rather than evaluative.
0 marks	No response worthy of credit.

Indicative content:

Current inclusive features

- The digital screen has green figures providing contrast with the black background making it easy to read.
- The buttons are clearly placed next to the figure for the relevant floor and well-spaced out making it easy to locate and press the desired floor.
- The buttons all feature a braille pattern to help blind or partially sighted users correctly identify the button to press but doesn't obscure the floor number for sighted users.
- The emergency stop and emergency phone are denoted by the use of red making them stand out from the other buttons.

Areas of poor inclusivity

- The numbers are not in a common order or format which may reduce instinctive operation.
- The panel doesn't provide information about each floor, such as departments in a shop or exits etc.
- It is not immediately clear if the square elements or the circle are the buttons.
- The location of the lift panel is not ideally suited to smaller users

<table>
<tr><td></td><td></td><td>or users in a wheelchair.
• The panel could have an audio feature that provides floor information.

Note: This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.</td><td></td><td></td></tr>
</table>

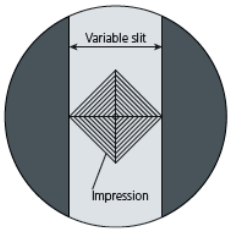
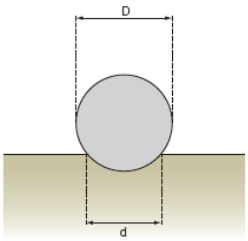
<table>
<tr><td>15</td><td></td><td>A manufacturer is producing a glass reinforced plastic (GRP) moulding.

Calculate the volume of hardener needed.

Show all of your working.

<table>
<tr><td>Size of GRP mat needed for moulding</td><td>2 metres × 5 metres</td></tr>
<tr><td>Ratio of resin to hardener</td><td>3 : 2</td></tr>
<tr><td>Total volume of liquid (resin and hardener) needed per m^2 of GRP matting</td><td>3 litres per m^2</td></tr>
</table>
<table>
<tr><td>Area of Matting</td><td>2 × 5
= 10m^2</td><td>1 mark
(M1)</td></tr>
<tr><td>Total volume of liquid needed</td><td>10 × 3
= 30 litres</td><td>1 mark
(A1)</td></tr>
<tr><td>Ratio factor</td><td>3 + 2 = 5 parts
30 ÷ 5
= 6 litres</td><td>1 mark
(M1)</td></tr>
<tr><td>Hardener needed</td><td>6l × 2
=12 litres of hardener</td><td>1 mark
(A1)</td></tr>
<tr><td>Volume of hardener needed
Where no working has been shown but final answer is accurate</td><td>= 12 litres of hardener</td><td>4 marks</td></tr>
</table>
</td><td>4 marks</td><td>AO41C</td></tr>
</table>

16		Explain why industrial tests are more accurate than workshop tests when testing material properties. One mark for a simple statement Two marks for a justified explanation **Indicative content:** • Workshop tests are comparative and harder to ensure that controlled variables are accurate. • Industrial tests are more reliable and compared against a set scale or standardised test piece or material. • Industrial testing machines are regularly calibrated to ensure accurate comparable results. Accept other correct responses.	2 marks	AO41B

17		Describe how a specific industrial test is undertaken to measure material hardness. **Award 1 mark for each of the following:** • **A named test** • **Reference to how the indentation is made** • **Reference to measuring the indentation** • **Reference to comparison against a controlled sample or table of data** Candidates may include a relevant diagram in their response. Award correct responses. **Indicative content:** **Named test** • Named test – Rockwell / Brinell / Vickers **Reference to how the indentation is made** • Indenter could be a steel ball, diamond or pyramid • Shaped indenter is preloaded on the test pieces surface • Addition load is applied for a given time (dwell time)  Figure 1.1.31 Vickers pyramid test.  Figure 1.1.30 Brinell test. **Reference to measuring the indentation** • Load is removed and indentation measured • The smaller the indentation the harder the material **Reference to comparison against a controlled sample or table of data** • The measurement of the sample indentation is compared to a controlled sample • The measurement of the sample indentation is compared to a predetermined table of data. Accept other correct responses. **Note: Do not reward reference to workshop based tests.**	4 marks	AO41B

18		**Figure 8** and **Figure 9** show two bicycle frames. (Shown in Question Paper) Evaluate the suitability of the materials and manufacturing methods used for each of the bicycle frames shown.	12 marks	AO32A AO32B

Marks	**Description**
9-12 marks	The response shows a detailed analysis and evaluation of the suitability of the chosen material and manufacturing process of **both** frames. The response clearly evaluates how the properties of the material and the way in which they are manufactured effect the suitability of choice for the manufacture of the bicycle frame and the performance of the frame in use.
5-8 marks	The response shows good evaluation and analysis of the suitability of the chosen material and manufacturing process of both frames with reference to the specific application of the bicycle frame.
1-4 marks	Basic evaluation of the suitability of the chosen material and manufacturing process of each of the frames, but tends to be descriptive rather than evaluative or focuses on one frame only.
0 marks	No response worthy of credit.

Indicative content:

Aluminium

- Lightweight material making the bike easy to pedal or carry
- Aluminium has good resistance to corrosion, increasing the lifespan of the frame.
- Ductile material that allows for tubes to be shaped, bent or fluid formed
- Easily powder coated
- Low melting point making it easy to recycle at the end of its life

TIG welded

- TIG welding provides a reliable joint with the use of a filler rod, producing a strong frame
- Argon or helium gas shield protect the joint from oxidising
- Aluminium with a thin wall thickness can be successfully joined
- TIG welding allows the accuracy needed to weld complex cylindrical shapes
- Frames can be tempered after welding

Carbon Fibre Reinforced Polymer

- Creates a stiff rigid structure allowing the cyclist to transfer power

		effectively • Lightweight material reducing the effort needed from the cyclist • Excellent absorption of shock and vibration • Has a reasonable level of impact resistance to resist chips from stones etc • Composite material that is hard to recycle if damaged or when it has reached the end of its life **Lay up** • Organic shapes can be easily achieved • Areas of high stress can be reinforced • Inserts such as threads or internal cable routing can be incorporated in to the frame • Hollow monocoque designs can be achieved • Can be painted or have company decals applied under the protective lacquer **Note:** This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.		

19		**Figure 10** shows a component to be cut on a computer numerically controlled (CNC) router. (Shown in Question Paper) Calculate how long it would take to machine the shape in each of the materials.	6 marks	AO41C

Circumference of circles	Outer tool path - πd π × 1208 = [3793.12mm , 3795.54mm] Inner tool path - πd π × 792 =[2486.88mm, 2488.46mm] Total distance of travel [3793.12mm , 3795.54mm] + =[2486.88mm, 2488.46mm] =[6280mm, 6284mm]	1 mark (M1) 1 mark (A1)
Distance of travel in MDF	Total distance × passes [6280mm, 6284mm] × 2 =[125 60mm, 125 68mm] / 1000 =12.56 meters	1 mark (M1) 1 mark (A1)
Distance of travel in Ply	Total distance × passes [6280mm, 6284 mm] × 3 =[188 40 mm,188 52] / 1000 =[18.84 meters, 18.85 meters]	
Time taken in MDF	[125 60mm, 125 68mm] ÷ 6 =2.09 minutes **or** =2 minutes 5 secs	1 mark (M1) 1 mark (A1)
Time taken in Ply	[18.84 metres, 18.85 meters]÷ 4.5 =[4.18 minutes,4.19 minutes] **or** =4 minutes 11 secs	

Time taken in MDF where no working has been shown but final answer is accurate	=2.09 minutes **or** =2 minutes 5 secs	3 marks

		Time taken in Ply where no working has been shown but final answer is accurate | =[4.18 minutes, 4.19 minutes] **or** =4 minutes 11 secs | 3 marks		

20		Explain why the knock down fittings named above are appropriate for each of the specific applications. One mark for a simple response. Two marks for a qualified explanation. **Maximum of two marks per knock down fitting described.** **Indicative content:** **Barrel nut and Bolt** • The barrel nut and bolt provide a secure joint suitable for a bed frame as it has a metal thread • The Allen Key head is easily accessible and an allen key can be easily rotated to tighten the bolt • The large head of the bolt helps spread the load of the joint • The barrel nut and bolt provide a secure joint suitable for a cot frame as it has a metal thread. • The barrel and nut can be undone and reassembled frequently to allow the cot to be adjusted, stored or disassembled. **Cam lock** • The fixings are hidden from the outside and top surface • The CAM lock provides a tight secure joint • When rotated the CAM lock pulls the two pieces of material together tightly • The CAM lock is easily accessible from beneath the frame **Dowel** • The joint has no visible fixings • Glue can be used to provide additional strength • The joint will only be subjected to small amounts of force making a dowel joint suitable • The dowels will help locate the shelf during assembly **Note:** This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.	3 × 2 marks	AO41C

<table>
<tr>
<td>21</td>
<td></td>
<td>
Explain the importance of the efficient supply of materials and components in a Just In Time (JIT) manufacturing process.
<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>7-9 marks</td><td>A detailed explanation of the importance of efficient supply of materials and components in JIT. Response demonstrates excellent knowledge of how aspects such as how the delivery, organisation and management of materials and components affect a JIT manufacturing process.</td></tr>
<tr><td>4-6 marks</td><td>The response demonstrates a good understanding of the importance of the efficient supply of materials and components in JIT and makes reference to aspects that can affect a JIT manufacturing process.</td></tr>
<tr><td>1-3 marks</td><td>The response offers a basic description of the importance of the efficient supply of materials and components in JIT.</td></tr>
<tr><td>0 marks</td><td>No response worthy of credit.</td></tr>
</table>
Indicative content:

Components are not stockpiled so scheduled deliveries must be on time to minimise disruption to manufacture
Delay in deliveries will affect the productivity of the manufacture, in severe cases
Limited storage is available so stock piles must be regularly topped up and maintained
JIT manufacture allows for flexibility on the production line so customers’ orders must arrive on time and consistently in order to prevent down time
Suppliers can be selected by proximity to the assembly plant to reduce travel time and disruption
Machinery and layout in the factory should be optimised to allow for efficient delivery of components
Stock is managed by computer systems
RFID identification is used to track products through the factory and automatically select the correct parts to install and order stock when necessary

Note: This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.
</td>
<td>9 marks</td>
<td>AO41B</td>
</tr>
</table>

22		Give **three** reasons why a kitchen work surface may have a melamine formaldehyde layer applied. **1 mark for each appropriate reason** **Indicative content:** • Hardwearing and durable which means it resists scratching and abrasion • Heat resistant with a high melting point so not affected by hot pans or dishes • Can be pigmented or a printed pattern laminated beneath the surface • Has good chemical resistance which allows it to be cleaned with detergents. **Note:** This indicative content is not exhaustive: other creditworthy responses or applications described should be awarded marks as appropriate.	3 marks	AO41A

<table>
<tr>
<td>23</td>
<td></td>
<td>Describe the process of forming a timber product using lamination.

<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>5-6 marks</td><td>The response shows a detailed knowledge of the process of laminating timber. Reference is made to a suitable moulding method with clear understanding of how the appropriate timber and adhesive is combined and moulded to produce the desired shape.</td></tr>
<tr><td>3-4 marks</td><td>The response shows a good level of knowledge of the process of laminating timber. The response describes an appropriate process that would achieve a successful laminated product.</td></tr>
<tr><td>1-2 marks</td><td>The response shows basic understanding of the process of laminating timber.</td></tr>
<tr><td>0 marks</td><td>No response worthy of credit.</td></tr>
</table>

Indicative content:

• Several thin layers of veneer or thin plywood (1.2 mm – 3 mm thickness) can successfully be combined to the required thickness
• Adhesive is placed between each layer
• A two part former is used and pressure applied with clamps or a press while the lamination dries
• Excess adhesive from the moulding process can be removed
• A bag press or vacuum bag could be used with a styrofoam mould or equivalent former
• Simple curved shapes can be achieved
• Cross linked adhesive or ‘cascamite’ can be used to create a stronger glued joint
• Lamination can be trimmed to size once formed
• Laminated products can also be achieved by combining several sheets of kerfed flexible MDF.

Note: This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.</td>
<td>6 marks</td>
<td>AO41A</td>
</tr>
</table>