



# **MATERIALS DESIGN AND TECHNOLOGY**

## **ATAR course examination 2022**

### **Marking key**

Marking keys are an explicit statement about what the examining panel expect of candidates when they respond to particular examination items. They help ensure a consistent interpretation of the criteria that guide the awarding of marks.

**Section One: Short answer**

**15% (31 Marks)**

**Question 1**

**(9 marks)**

- (a) In the table below, state **one** purpose and **one** characteristic of each drawing technique listed. (6 marks)

Description		Marks
For each purpose of drawing technique (3 x 1 mark)		
States a purpose of each drawing technique.		1
<b>Subtotal</b>		<b>3</b>
For each characteristic of drawing technique (3 x 1 mark)		
States a characteristic of each drawing technique.		1
<b>Subtotal</b>		<b>3</b>
<b>Total</b>		<b>6</b>
Drawing technique	Purpose	Characteristic
Rapid concept sketching	To generate ideas to solve the design brief	<ul style="list-style-type: none"> <li>• Rapidly drawn</li> <li>• Line drawings</li> <li>• Black and white</li> <li>• Show a range of options</li> <li>• Show initial ideas</li> <li>• Can be 2D</li> <li>• Limited detail</li> </ul>
3D presentation drawings	To show client final chosen design	Rendered, detailed/developed drawing of final design
2D working/technical drawings	<ul style="list-style-type: none"> <li>• To record specifications of product</li> <li>• To give specification information to manufacturer</li> </ul>	<ul style="list-style-type: none"> <li>• Line drawing, no rendering</li> <li>• Detailed information of features</li> <li>• Has dimensions/measurements</li> </ul>
Accept other relevant answers.		

- (b) Identify **three** ways in which information and communication technology (ICT) has changed drawing techniques. (3 marks)

Description	Marks
For each way ICT has changed drawing techniques (3 x 1 marks)	
Identifies a way information and communication technology (ICT) has changed drawing techniques.	1
<b>Total</b>	<b>3</b>
Answers could include: <ul style="list-style-type: none"> <li>• designers can use CAD to produce more accurate, higher quality drawings</li> <li>• designers can reuse and easily change designs</li> <li>• drawings may be easier to read with better layout</li> <li>• the skill of the designer does not impact the quality of the drawing</li> <li>• easier for the designer to draw to scale</li> <li>• designers can make changes easily and reduce risk of error</li> <li>• features, such as designing physical objects in a virtual workspace, are easier for the client to understand</li> <li>• may save time and money.</li> </ul>	
Accept other relevant answers.	

Question 2

(14 marks)

- (a) Name a machine that you have used this year and outline **four** safety checks to be performed before using the machine, in order to reduce risks. (8 marks)

Description	Marks
For each safety check (4 x 2 marks)	
Outlines a safety check to do before using the machine to reduce risks.	2
Identifies a safety check to do before using the machine to reduce risks.	1
<b>Total</b>	<b>8</b>
Answers could include:  Textiles: <ul style="list-style-type: none"> <li>Sewing machines: check electric cords are not damaged, no water nearby, condition of machine needles, area is free of clutter, needle threaded correctly, bobbin is inserted correctly.</li> </ul> Metal: <ul style="list-style-type: none"> <li>Coldsaw: check guards are in place, check blade for wear, check vice is secure, table is clean of debris, check workpiece is secure.</li> </ul> Wood: <ul style="list-style-type: none"> <li>Drill press: check guards are in place, check drill bit is sharp, check drill piece is in straight, check chuck is tight, table is clean of debris, check workpiece is secure, check drill speed is correct</li> <li>Dropsaw: check guards are in place, check blade for wear, check table is secure, table is clean of debris.</li> </ul> Accept other relevant answers. Note: Do not accept personal protective equipment (PPE) as a safety check.	

- (b) Identify **three** steps to be followed in carrying out a risk management plan. (3 marks)

Description	Marks
For each step (3 x 1 mark)	
Identifies step in risk management plan.	1
<b>Total</b>	<b>3</b>
Answers could include: <ul style="list-style-type: none"> <li>identify risks</li> <li>assess the risks</li> <li>minimise or eliminate risks.</li> </ul> Accept other relevant answers.	

**Question 2** (continued)

- (c) List **three** legal implications for designers when designing material products for the consumer market. (3 marks)

Description	Marks
For each legal implication (3 x 1 mark)	
Lists a legal implication for designers when designing material products for consumers.	1
<b>Total</b>	<b>3</b>
Answers could include: <ul style="list-style-type: none"> <li>• copyright</li> <li>• intellectual property right</li> <li>• licencing</li> <li>• product liability</li> <li>• patents.</li> </ul>	
Accept other relevant answers.	

## Question 3

(8 marks)

With reference to the image above, outline **two** principles and **two** elements of design used in the design of the building.

Description	Marks
For each principle of design (2 x 2 marks)	
Outlines principle of design used, with reference to the image.	2
Outlines principle of design used.	1
<b>Subtotal</b>	<b>4</b>
For each element of design (2 x 2 marks)	
Outlines element of design used, with reference to the image.	2
Outlines element of design used.	1
<b>Subtotal</b>	<b>4</b>
<b>Total</b>	<b>8</b>
<p>Answers could include:</p> <ul style="list-style-type: none"> <li>Principles: rhythm, dominance, radiation, proportion, repetition, harmony, balance, gradation, contrast, unity</li> <li>Elements: line, colour, shape, form, tone, texture</li> </ul> <p>Outline:</p> <ul style="list-style-type: none"> <li>to create the visual impact of the building, line has been used in the overall shape of the structure that looks like a large cube. There are lines of holes in the outer walls leading the eye around the space. A grid of lines around the curved centre of the building breaks the large area into smaller shapes</li> <li>the main shapes of the structure are a large cube and cylinder, broken up with the use of smaller curves and circles forming patterns in the structure</li> <li>there are many contrasts in the shapes and colours of the structure that create a feeling of strength and beauty. There is a strong contrast between the solid outer walls and the blue glass centre. There is a contrast in the glossy texture of the glass and the matte walls</li> <li>the size of the building is enhanced by the rhythm and proportional size of the patterns in the walls that lead the eye to the outer edges of the walls</li> <li>the 3D form of the building is emphasized by the range of lines, patterns, shapes and textures used.</li> </ul>	
Accept other relevant answers.	

**Section Two: Extended answer**

**25% (42 Marks)**

**Question 4**

**(18 marks)**

- (a) Using **five** design fundamentals, compare the features of the water bottles shown below. (10 marks)

Description	Marks
For each comparison of design fundamentals (5 x 2 marks)	
Compares a feature of the two water bottles using a design fundamental.	2
Outlines a feature of the two water bottles using a design fundamental.	1
<b>Total</b>	<b>10</b>
<p>Answers could include:</p> <p>Comparisons:</p> <ul style="list-style-type: none"> <li>• Aesthetics – the colours used on the bottles are very different. Black is a neutral colour that will be appealing to a bigger group, the light blue of the second bottle could limit the market.</li> <li>• Function – both bottles are designed to hold liquids securely and offer the user ways of carrying them. The first has a hook on the lid that allows the user to carry it using their finger; you could do this with the second bottle, but it looks like the carabiner could break. The second bottle also offers the ability to be collapsed to a smaller size for when you aren't using it, making it easier to store.</li> <li>• Safety – the first bottle is made from metal, which is much heavier than the silicone bottle, but it has a bigger sturdier looking handle on the lid which would make it safer for the user to carry. The silicone bottle looks flimsy and the clip looks like it could break off.</li> <li>• Cost – the first bottle is made from stainless steel, the second bottle from silicone. The stainless steel will be more durable and cost more than the silicone.</li> <li>• Environmental impact – the materials of both bottles can be reused and recycled at end of use. The collapsible bottle may use more energy to produce with the complex design.</li> <li>• Sustainability – the metal bottle is a harder wearing material which means it will last for a lot longer period. The silicone bottle looks lesser quality and easier to damage.</li> <li>• Ergonomics – the materials used will give a different feel to the user's hand. The metal bottle looks smooth, which means the bottle could slip out of the user's hand. The Silicone on the other hand will give a better grip and won't slip as easily.</li> <li>• Anthropometric data – would have to have been considered in how the user can grip the bottle. The circumference on the second bottle varies with indents to improve the grip.</li> </ul> <p>Accept other relevant answers.</p>	

- (b) Using a cultural inspiration, draw a rapid concept sketch to illustrate how Bottle One in part (a) could be adapted to appeal to a niche market. (4 marks)

Description	Marks
Names a niche market.	1
Names a cultural inspiration.	1
Draws a competent rapid concept sketch to illustrate how Bottle One in part (a) could be adapted to appeal to a niche market.	1–2
<b>Total</b>	<b>4</b>
Answers could include: <ul style="list-style-type: none"> <li>• Niche market – children, teenage girls/boys, people who are into health and beauty, food, lifestyle and wellness, the environment, technology users, pet lovers, nature lovers, etc.</li> <li>• Cultural inspirations – Aboriginal, art, literary and music figures, sporting clubs, television shows, epochs, sub-cultures (e.g. punk, goth, cosplay, etc.)</li> <li>• Rapid concept sketch – showing a cultural inspiration, may be coloured or black and white, annotated or not.</li> </ul>	
Accept other relevant answers.	

- (c) Explain the relationship between product innovation, lifestyle choices and consumer demand. (4 marks)

Description	Marks
Explains the relationship between product innovation, lifestyle choices and consumer demand.	4
Describes the relationship between product innovation, lifestyle choices and consumer demand.	3
Outlines the relationship between product innovation, lifestyle choices and consumer demand.	2
Makes a general statement about product innovation, lifestyle choices and/or consumer demand.	1
<b>Total</b>	<b>4</b>
Answers could include: <ul style="list-style-type: none"> <li>• innovative products can make consumers change the way they do things in their life. They may see a product, such as a dishwasher, that saves them time in the kitchen and makes a boring, repetitive task easier, so they buy that product to have more recreation time</li> <li>• consumers may have a need, such as more choice in size, price and functions of smart phones, so designers create more models to meet consumer demand.</li> </ul>	
Accept other relevant answers.	

**Question 5**

**(10 marks)**

- (a) Describe **two** construction techniques or processes that can be carried out with computer numerically-controlled (CNC) technologies. (4 marks)

Description	Marks
For each construction technique or process (2 x 2 marks)	
Describes a construction technique or process that can be carried out with CNC technologies.	2
Makes a general statement about a technique or process that can be carried out with CNC technologies.	1
<b>Total</b>	<b>4</b>
<p>Answers could include:</p> <p>Textiles:</p> <ul style="list-style-type: none"> <li>• the process of knitting seamless garments all in one piece to eliminate joining pieces</li> <li>• using CNC sewing machines for sewing seams, hems etc. reduces errors, improves quality and reduces waste</li> <li>• cutting out garments with automated machines and robots increases quantities, reduces time, errors, wastage and handling.</li> </ul> <p>Metal:</p> <ul style="list-style-type: none"> <li>• the process of cutting and shaping can be completed using CNC technology in the workshop. CNC Lathes can be used to shape parts for mass production. CNC Plasma Cutter and Water Jet Cutting Technologies can cut through different material thickness to produce parts that are designed to go together accurately</li> <li>• cutting materials with automated machines increases quantities, reduces time, errors, wastage and handling.</li> </ul> <p>Wood:</p> <ul style="list-style-type: none"> <li>• through the use of a CNC router parts can be mass produced, the exact same profile can be cut out an infinite number of times</li> <li>• joints such as knock down fittings can be drilled or bored with accuracy and consistency.</li> </ul> <p>Accept other relevant answers.</p>	



- (b) Outline **three** ways in which CNC processes are effective in managing the environmental impacts of production. (6 marks)

Description	Marks
For each CNC process (3 x 2 marks)	
Outlines a way that CNC processes are effective in managing the environmental impact of production.	2
Makes a general statement about CNC processes.	1
<b>Total</b>	<b>6</b>
<p>Answers could include:</p> <ul style="list-style-type: none"> <li>• more precise machining and processes means less production errors, minimises waste and creates less landfill</li> <li>• greater efficiency and faster processing may use less energy and produce less land, air and water pollution</li> <li>• processes may use less materials, requiring less resources, less transport and creating less waste</li> <li>• manufacturing can be done locally/onsite rather than offshore, which reduces transportation and can ensure safe environmental practices are being adhered to</li> <li>• the process is more precise than manual machining and can be repeated in exactly the same manner over and over again</li> <li>• faster production speed and increased efficiency uses less energy</li> <li>• waste is managed through efficient placement of templates and patterns, so less off-cuts are created</li> <li>• greater accuracy and less wastage mean less product dumping and resources going to landfill</li> <li>• improved processes use less water.</li> </ul>	
Accept other relevant answers.	

**Question 6**

**(8 marks)**

- (a) Discuss the difference between production planning and production management by identifying the components of each stage. (5 marks)

Description	Marks
Discusses the difference between production planning and production management, identifying components within each stage.	5
Explains the difference between production planning and production management, identifying components within each stage.	4
Describes production planning and production management, identifying components within each stage.	3
Outlines some features of production planning and/or production management.	2
Makes a general statement about production planning or production management.	1
<b>Total</b>	<b>5</b>
<p>Answers could include:</p> <p>The production planning stage is carried out pre-manufacturing and is started after the final concept has been decided. The designer would produce a working drawing and cutting and costing list for the project. A designer will need to ensure they consider the client's anthropometric and ergonomic requirements when doing this. From here a production plan is made detailing the requirements for each step of production.</p> <p>Production planning components:</p> <ul style="list-style-type: none"> <li>• produce scaled working drawings</li> <li>• specification sheets</li> <li>• material and costing lists</li> <li>• produce production plans detailing processes, equipment, time and OHS to be considered.</li> </ul> <p>The production management is carried out during the production stage with the working drawing, cutting list and production plan being a point of reference. During this process the manufacturer should keep a detailed production journal that documents their progress and noting any issues they have had to overcome. Any changes to the design or process should be recorded in an updated production plan, working drawings and cutting list.</p> <p>Production management components:</p> <ul style="list-style-type: none"> <li>• record a daily journal of steps and process that were carried out, noting any issues/changes done</li> <li>• update working drawings if needed</li> <li>• alter cutting and costings lists.</li> </ul> <p>Accept other relevant answers.</p>	

- (b) Describe how production planning is linked to the final evaluation of the product. (3 marks)

Description	Marks
Describes how production planning is linked to the final evaluation of the product.	3
Outlines how production planning is linked to the final evaluation of the product.	2
Makes a general statement about production planning.	1
<b>Total</b>	<b>3</b>
Answers could include:	
<ul style="list-style-type: none"><li>• When planning the manufacture of a product the designer works out the details to make the product based on the client's needs and the requirements of the design. They document the choice of materials, working drawings, specification sheets, the budget for the project, the timeline and the steps to manufacture the product.</li><li>• In the final evaluation the designer will use the documents set up during production planning to assess if they have met the needs, values and beliefs of the client and the design brief. After the evaluation the designer will update and revise the plans for future use.</li></ul>	
Accept other relevant answers.	

**Question 7**

**(6 marks)**

Discuss how this problem could influence globalisation for local, national **and** international industries.

<b>Description</b>	<b>Marks</b>
Discusses in detail how this problem could influence globalisation for local, national and international industries.	6
Discusses how this problem could influence globalisation for local, national and international industries.	5
Explains some ways this problem could influence globalisation for local, national and/or international industries.	4
Describes ways this problem could influence globalisation for local, national and/or international industries.	3
Outlines ways this problem could influence globalisation for local, national and/or international industries.	2
Makes a general statement about this problem.	1
<b>Total</b>	<b>6</b>
<p>Answers could include:</p> <p>Local and National:</p> <ul style="list-style-type: none"> <li>• competition is reduced for local and national products</li> <li>• smaller independent companies could see an increase in business as consumers find it hard to get imported items</li> <li>• less availability and choice of materials</li> <li>• retailers won't have access to usual international products causing supply issues</li> <li>• small businesses selling local products may flourish due to increased demand to fill gaps</li> <li>• competition from the online market will be altered as supply is interrupted</li> <li>• consumers wanting cheaper retail prices may have to pay more for products</li> <li>• reduction in overseas manufacturing as transport interruptions cause delays in materials and parts deliveries</li> <li>• transport and supply chains will be put under pressure as local and national production increases, and then improve to meet new demands</li> <li>• employment can increase as production increases.</li> </ul> <p>International/Global:</p> <ul style="list-style-type: none"> <li>• consumers will source products from other countries and cultures not affected by the Canal blockage</li> <li>• businesses that rely on materials being shipped through the Canal will struggle to get materials, affecting manufacturing times</li> <li>• materials and parts may be held in containers for a prolonged period of time</li> <li>• shipping and port schedules will be impacted causing further delays when ships do arrive at their destinations</li> <li>• countries that rely on international trade could have to find alternative buyers or suppliers</li> <li>• markets develop for alternative products and materials that are accessible.</li> </ul> <p>Accept other relevant answers.</p>	

## Section Three: Wood context

60% (80 Marks)

## Question 8

(15 marks)

- (a) Using relevant terminology, identify **three** sources of inspiration that designers might use when designing a product. (3 marks)

Description	Marks
For each (3 x 1 mark)	
Identifies source of inspiration, using relevant terminology.	1
<b>Total</b>	<b>3</b>
Answers could include:	
Sources of inspiration may include:	
<ul style="list-style-type: none"> <li>• social, cultural, historical, and political sources</li> <li>• the characteristics of the material(s)</li> <li>• existing products (online research, instore research, magazines and social media).</li> </ul>	
Accept other relevant answers.	

- (b) Describe how the functional and aesthetic properties of materials influence the selection of materials for a product. (4 marks)

Description	Marks
<b>Functional properties</b>	
Describes how the functional properties of materials influence the selection of materials for a product.	2
Identifies how the functional properties of materials influence the selection of materials for a product.	1
<b>Subtotal</b>	<b>2</b>
<b>Aesthetic properties</b>	
Describes how the aesthetic properties of materials influence the selection of materials for a product.	2
Identifies how the aesthetic properties of materials influence the selection of materials for a product.	1
<b>Subtotal</b>	<b>2</b>
<b>Total</b>	<b>4</b>
Answers could include:	
<ul style="list-style-type: none"> <li>• Functional properties: strength, workability, stain resistance, density, directional stability</li> <li>• Aesthetic properties: lustre, colour and texture</li> </ul>	
Description:	
<ul style="list-style-type: none"> <li>• designers try to match the properties of materials to the design needs of their product. They need to match the functional properties, such as strength, so that their product will be strong enough to work correctly and safely for consumers</li> <li>• designers will try to use materials with desirable aesthetic properties of lustre and colour to appeal to their target market and improve their sales. Properties determine performance of the product and suitability to the end user.</li> </ul>	
Accept other relevant answers.	

**Question 8** (continued)

- (c) Explain how a designer would use anthropometric data to meet the ergonomic requirements of a product. (4 marks)

<b>Description</b>	<b>Marks</b>
Explains how a designer would use anthropometric data to meet the ergonomic requirements of a product.	4
Describes how a designer would use anthropometric data to meet the ergonomic requirements of a product.	3
Outlines some features of anthropometric data or the ergonomic requirements of a product.	2
Makes a general statement about anthropometric data or the ergonomic requirements of a product.	1
<b>Total</b>	<b>4</b>
<p>Answers could include:</p> <p>Anthropometric data are measurements of the human body. In products designed for use by humans the data or measurements are essential for a designer to meet the ergonomic requirements of a product. Ergonomics ensure that products are safe, comfortable and can function correctly when used. The designer would research or gather the particular measurements of the body that relate to their product, and use them to design the parts of their product to get the best fit for optimal end use. A product with sound ergonomics will be more successful in the market.</p> <p>Accept other relevant answers.</p>	

(d) Explain how sustainability issues affect the design and production of products. (4 marks)

Description	Marks
Explains how sustainability issues affect the design and production of products.	4
Describes how sustainability issues affect the design and production of product(s).	3
Outlines a way sustainability affects the design and/or production of product(s).	2
Makes a general statement about sustainability in the design or production of product(s).	1
<b>Total</b>	<b>4</b>
<p>Answers could include:</p> <p>Sustainability issues may have negative and positive impacts upon design and production, including timing and speed of production, cost of manufacturing, process efficiency, type of materials used, amount of labour or mechanisation required, resource usage and waste management.</p> <p>Design:</p> <ul style="list-style-type: none"> <li>• use recycled materials where possible</li> <li>• use eco-friendly materials</li> <li>• make designs durable to increase lifespan</li> <li>• design for multi-use to be used repeatedly</li> <li>• draw and measure carefully and accurately so that correct quantities are purchased</li> <li>• use leftover materials before purchasing new supplies.</li> </ul> <p>Production:</p> <ul style="list-style-type: none"> <li>• use correct quantities to reduce wastage</li> <li>• materials are correctly disposed of</li> <li>• reusable materials are stored correctly</li> <li>• scrap material is used for practice etc.</li> <li>• minimise the use of water for clean-up</li> <li>• turn off machinery, lights and extraction when not in use</li> <li>• use low energy lighting</li> <li>• use renewable energy sources</li> <li>• purchase materials with minimal trips to suppliers</li> <li>• source locally if possible</li> <li>• manufacture locally rather than offshore.</li> </ul>	
Accept other relevant answers.	

**Question 9**

**(17 marks)**

(a) Label the **five** parts of the wood structure indicated with the red arrows below. (5 marks)

Description	Marks
For each label (5 x 1 mark)	
Identifies part of the wood structure.	1
<b>Total</b>	<b>5</b>
Accept other relevant answers.	

(b) Using an example, describe how the cellular structure of softwoods contributes to the properties of the timber. (3 marks)

Description	Marks
Describes how the cellular structure of softwoods contribute to the properties of timber, using an example.	3
Outlines how the cellular structure of softwoods contribute to the properties of timber, using an example.	2
Makes a general statement about the cellular structure of softwoods.	1
<b>Total</b>	<b>3</b>
<p>Answers could include:</p> <p>The main structural element is the cellulose which is very effective in transmitting tension and compression:</p> <ul style="list-style-type: none"> <li>• each cell has two main zones, a thin primary wall that forms first, followed by a three-layer secondary wall that provides most of the strength</li> <li>•</li> <li>•</li> </ul> <div style="border: 1px dashed gray; padding: 5px; text-align: center; margin: 10px 0;">                     For copyright reasons this text cannot be reproduced in the online version of this document.                 </div>	
Accept other relevant answers.	



(c) Identify **three** physical characteristics of hardwood trees. (3 marks)

Description	Marks
For each (3 x 1 mark)	
Identifies physical characteristic of hardwood trees.	1
<b>Total</b>	<b>3</b>
Answers could include: <ul style="list-style-type: none"> <li>• broad leaves</li> <li>• branches usually grow out at different levels</li> <li>• trees are generally evergreens</li> <li>• shed their leaves in certain times of the year</li> <li>• always have divided trunks</li> <li>• dense cellular structure</li> <li>• strength/stronger</li> <li>• darker appearance.</li> </ul> Accept other relevant answers.	

(d) Describe **three** defects that can be caused by seasoning timber. (6 marks)

Description	Marks
For each defect (3 x 2 marks)	
Describes defect that can be caused by seasoning timber.	2
Identifies defect that can be caused by seasoning timber.	1
<b>Total</b>	<b>6</b>
Answers could include: <ul style="list-style-type: none"> <li>• bowing – the curvature over the length of the sawn timber</li> <li>• checks – small separations of the wood fibres in longitudinal direction</li> <li>• cupping – the curvature of a piece of sawn timber across it's width</li> <li>• diamonding – distortion due to differential shrinkage in drying that causes a piece of timber to become diamond shaped across the cross section</li> <li>• split – a longitudinal separation of fibres</li> <li>• twisting – spiral distortion of a piece of sawn timber.</li> </ul> Accept other relevant answers.	

**Question 10**

**(16 marks)**

- (a) Using the space below draw, render and annotate a 3D presentation drawing that meets your client's needs. (8 marks)

Description	Marks
<b>Presentation drawing</b>	
Draws and renders a detailed 3D presentation drawing that meets all specified client needs.	4
Draws and renders a 3D presentation drawing that meets most specified client needs.	3
Draws and renders a 3D presentation drawing with limited client needs met.	2
Draws a sketch.	1
<b>Subtotal</b>	<b>4</b>
<b>Annotations</b>	
Clear, concise annotations of all specified client needs and design features.	4
Clear annotations of most specified client needs and design features.	3
Annotations of some specified client needs and design features.	2
Limited annotations of client needs or design features.	1
<b>Subtotal</b>	<b>4</b>
<b>Total</b>	<b>8</b>
<p>Answers could include:</p> <div style="text-align: center;"> </div>	
Accept other relevant answers.	

- (b) Identify a suitable joining method for the project and justify its suitability. (4 marks)

Description	Marks
Identifies a joining method.	1
<b>Subtotal</b>	<b>1</b>
<b>Justification</b>	
Justifies the suitability of the joining method.	3
Describes the suitability of the joining method.	2
Makes a general statement about the joining method.	1
<b>Subtotal</b>	<b>3</b>
<b>Total</b>	<b>4</b>
Answers could include:	
Domino joint: where the top joins the sides on the carcass a domino joint can be used. Being end grain to longitudinal grain the domino joint ensures adequate strength and increases the surface area for gluing. With the use of a tenon being cut into both timbers the shear strength is also increased and assembly of the frame is made easier. Domino joints are also fast to mark out and cut.	
Accept other relevant answers.	

- (c) Outline the production steps you would follow to make the join identified in part (b). (4 marks)

Description	Marks
Outlines the production steps to make the join.	4
Outlines some of the production steps to make the join.	3
Lists the production steps to make the join.	2
Lists a limited number of production steps.	1
<b>Total</b>	<b>4</b>
Answers could include:	
<ul style="list-style-type: none"> <li>• adjust the machine to ensure the cutter is centred on the face of the end grain</li> <li>• adjust the width of cut and the depth of cut based on the length of the dominos being used</li> <li>• evenly mark out 4 dominos along the face to be cut on both the top and side pieces</li> <li>• clamp the work to the bench</li> <li>• attach the extraction and plug the machine in</li> <li>• cut the domino slots ensuring the fence is flush with the material</li> <li>• check joints before gluing.</li> </ul>	
Accept other relevant answers.	

**Question 11**

**(9 marks)**

Using the drawings below, materials list and price list, complete the costing table for the parts of **one** chair. Round costs to the nearest cent. All sizes are in millimetres (mm).

<b>Description</b>					<b>Marks</b>
For each (9 x 1 mark)					
Correctly calculates total cost of parts.					1
<b>Total</b>					<b>9</b>
<b>Part</b>	<b>Material size</b>	<b>Number required</b>	<b>Total length required (m)</b>	<b>Cost per linear metre</b>	<b>Total cost of parts</b>
1	700x100x30	4	2.8	21.15	\$59.22
2	675x100x30	2	1.35	21.15	\$28.55
3	575x100x30	2	1.15	21.15	\$24.32
4	650x90x20	5	3.25	11.99	\$38.97
5	500x100x30	1	0.5	21.15	\$10.58
6	500x60x30	2	1	12.99	\$12.99
7	650x90x20	2	1.3	11.99	\$15.59
8	700x90x20	2	1.4	11.99	\$16.79
9	750x90x20	1	0.750	11.99	\$8.99
Accept other relevant answers.					

Question 12

(13 marks)

- (a) Identify **one** innovation in the furniture/cabinet making industry. (1 mark)

Description	Marks
Identifies an innovation in the furniture/cabinet making industry.	1
<b>Total</b>	<b>1</b>
Answers could include: <ul style="list-style-type: none"> <li>• CNC router</li> <li>• CNC lathe</li> <li>• 3D Printing</li> <li>• Augmented reality</li> <li>• Artificial intelligence</li> <li>• 3D Modelling software</li> <li>• Innovative materials</li> <li>• Computer Aided Manufacture (CAM).</li> </ul> Accept other relevant answers.	

- (b) State **two** advantages and **two** disadvantages of the innovation identified in part (a). (4 marks)

Description	Marks
<b>Advantages</b>	
States two advantages of the innovation identified.	2
States one advantage of the innovation identified.	1
<b>Subtotal</b>	<b>2</b>
<b>Disadvantages</b>	
States two disadvantages of the innovation identified.	2
States one disadvantage of the innovation identified.	1
<b>Subtotal</b>	<b>2</b>
<b>Total</b>	<b>4</b>
Answers could include: <p>Advantages:</p> <ul style="list-style-type: none"> <li>• faster production times</li> <li>• increased accuracy</li> <li>• cheaper production costs</li> <li>• lower skill set required to operate machines</li> <li>• less workforce required</li> <li>• ability to see products in software before production</li> <li>• more designs possible</li> <li>• streamlined production</li> <li>• less negative environmental impacts</li> <li>• less human error</li> <li>• can operate 24 hours.</li> </ul> <p>Disadvantages:</p> <ul style="list-style-type: none"> <li>• less jobs available</li> <li>• the need to upskill</li> <li>• increase in 'disposable furniture'</li> <li>• technology costs, expensive to install</li> <li>• decrease in individual designs (greater mass production of a concept).</li> </ul> Accept other relevant answers.	

**Question 12** (continued)

- (c) Using the diagram below, outline **four** ways in which designers are using innovations in the furniture/cabinet making industry to improve the life cycle of products. (8 marks)

Description	Marks
For each designers use of innovation (4 x 2 marks)	
Outlines a way in which designers are using innovations in the furniture/cabinet making industry to improve the life cycle of products.	2
Identifies a way in which designers are using innovations in the furniture/cabinet making industry to improve products.	1
<b>Total</b>	<b>8</b>
<p>Answers could include:</p> <p>Extraction/conversion:</p> <ul style="list-style-type: none"> <li>• the use of recycled materials</li> <li>• the use of fast-growing timbers such as bamboo</li> <li>• geometric scanning is used to determine grade and the best ways to cut logs</li> <li>• automation in logging reducing the environmental impact of products</li> <li>• efficiencies in logging methods and technologies</li> <li>• reducing pollution (air/soil/sound) through better machinery and methods</li> <li>• reducing transportation.</li> </ul> <p>Design:</p> <ul style="list-style-type: none"> <li>• CAD to improve accuracy, reduce wastage of resources and product dumping</li> <li>• Artificial Intelligence to anticipate needs and wants and improve designs.</li> </ul> <p>Production:</p> <ul style="list-style-type: none"> <li>• automation in furniture manufacturing reducing the environmental impact of products</li> <li>• improving product quality</li> <li>• streamline processes to reduce time to market</li> <li>• using renewable energies</li> <li>• more efficient transportation with flat pack products.</li> </ul> <p>Use:</p> <ul style="list-style-type: none"> <li>• products having multiple uses</li> <li>• integration of technologies to improve the use of the item</li> <li>• greater energy efficiency in products</li> <li>• longer lasting products reducing the need to replace.</li> </ul> <p>Disposal:</p> <ul style="list-style-type: none"> <li>• use of biodegradable materials in products and packaging</li> <li>• finishes that do not contain harmful chemicals</li> <li>• longer life expectancy reducing the need to replace.</li> </ul> <p>Accept other relevant answers.</p>	

## Question 13

(10 marks)

Discuss the historical impact that the processing **and** use of timber has had on society.

Description	Marks
Discusses the historical impact that the processing and use of timber has had on society.	9–10
Explains the historical impact that the processing and use of timber has had on society.	7–8
Describes the historical impact that the processing and use of timber has had on society.	5–6
Outlines the historical impact that the processing and/or use of timber has had on society.	3–4
Makes a general statement about the processing and/or use of timber.	1–2
<b>Total</b>	<b>10</b>
<p>Answers could include:</p> <ul style="list-style-type: none"> <li>• throughout history the processing and use of timber has solved many problems, addressed many needs and created economic wealth. From early human times timber has provided building materials for shelter and for the manufacture of tools, weapons and furniture. It has been used in the cultivation, harvesting and packaging of food, but perhaps most importantly it was an important source of fuel to make fire</li> <li>• throughout history, timber has played a key role in the transportation of people and their possessions with inventions such as the wheel, carts, sailing ships and railroads</li> <li>• other inventions made of timber, such as the first printing press, have changed humankind. During the first Industrial Revolution timber machines were used in textile factories. At the beginning of the machine age most machines were made of timber. The invention and use of these machines continuously improved standards of living, moulding the course of history</li> <li>• for millennia timber has promoted cultural exchange through trade, both as a raw material and in products. Exploration for new minerals, plants, spices, lands and peoples was enabled by the use of timber ships. In an upward spiral timber has created more industry, more products and more innovation throughout the history of humankind.</li> <li>• improved standard of living: <ul style="list-style-type: none"> <li>▪ invention of products to make life easier and more efficient e.g. cars/vehicles, household appliances, medical equipment etc.</li> <li>▪ increased food production in quantities and efficiency</li> <li>▪ improved housing</li> <li>▪ time for education</li> <li>▪ time for recreation and improved health</li> <li>▪ new toys for fun</li> <li>▪ new weapons for warfare</li> </ul> </li> <li>• improved standard of working: <ul style="list-style-type: none"> <li>▪ more efficiency of work/labour</li> </ul> </li> <li>• greater impact on the environment</li> <li>• negative and positive impacts.</li> </ul> <p>Accept other relevant answers.</p>	

**Section Three: Metal context**

**60% (80 Marks)**

**Question 14**

**(15 marks)**

- (a) Using relevant terminology, identify **three** sources of inspiration that designers might use when designing a product. (3 marks)

Description	Marks
For each (3 x 1 mark)	
Identifies source of inspiration, using relevant terminology.	1
<b>Total</b>	<b>3</b>
Answers could include:  Sources of inspiration may include: <ul style="list-style-type: none"> <li>• social, cultural, historical, and political sources</li> <li>• the characteristics of the material(s)</li> <li>• existing products (online research, instore research, magazines and social media)</li> </ul> Accept other relevant answers.	

- (b) Describe how the functional and aesthetic properties of materials influence the selection of materials for a product. (4 marks)

Description	Marks
<b>Functional properties</b>	
Describes how the functional properties of materials influence the selection of materials for a product.	2
Identifies how the functional properties of materials influence the selection of materials for a product.	1
<b>Subtotal</b>	<b>2</b>
<b>Aesthetic properties</b>	
Describes how the aesthetic properties of materials influence the selection of materials for a product.	2
Identifies how the aesthetic properties of materials influence the selection of materials for a product.	1
<b>Subtotal</b>	<b>2</b>
<b>Total</b>	<b>4</b>
Answers could include: <ul style="list-style-type: none"> <li>• Functional properties: strength, weldability, workability, corrosion resistance</li> <li>• Aesthetic properties: lustre, colour and texture</li> </ul> Description: <ul style="list-style-type: none"> <li>• designers try to match the properties of materials to the design needs of their product. They need to match the functional properties, such as strength, so that their product will be strong enough to work correctly and safely for consumers</li> <li>• designers will try to use materials with desirable aesthetic properties of lustre and colour to appeal to their target market and improve their sales. Properties determine performance of the product and suitability to the end user.</li> </ul> Accept other relevant answers.	



- (c) Explain how a designer would use anthropometric data to meet the ergonomic requirements of a product. (4 marks)

Description	Marks
Explains how a designer would use anthropometric data to meet the ergonomic requirements of a product.	4
Describes how a designer would use anthropometric data to meet the ergonomic requirements of a product.	3
Outlines some features of anthropometric data or the ergonomic requirements of a product.	2
Makes a general statement about anthropometric data or the ergonomic requirements of a product.	1
<b>Total</b>	<b>4</b>
<p>Answers could include:</p> <p>Anthropometric data are measurements of the human body. In products designed for use by humans the data or measurements are essential for a designer to meet the ergonomic requirements of a product. Ergonomics ensure that products are safe, comfortable and can function correctly when used. The designer would research or gather the particular measurements of the body that relate to their product, and use them to design the parts of their product to get the best fit for optimal end use. A product with sound ergonomics will be more successful in the market.</p> <p>Accept other relevant answers.</p>	

- (d) Explain how sustainability issues affect the design and production of products. (4 marks)

Description	Marks
Explains how sustainability issues affect the design and production of products.	4
Describes how sustainability issues affect the design and production of product(s).	3
Outlines a way sustainability affects the design and/or production of product(s).	2
Makes a general statement about sustainability in the design or production of product(s).	1
<b>Total</b>	<b>4</b>
<p>Answers could include:</p> <p>Sustainability issues may have negative and positive impacts upon design and production, including timing and speed of production, cost of manufacturing, process efficiency, type of materials used, amount of labour or mechanisation required, resource usage and waste management.</p> <p>Design:</p> <ul style="list-style-type: none"> <li>• use recycled materials where possible</li> <li>• use eco-friendly materials</li> <li>• make designs durable to increase lifespan</li> <li>• design for multi-use to be used repeatedly</li> <li>• draw and measure carefully and accurately so that correct quantities are purchased</li> <li>• use leftover materials before purchasing new supplies.</li> </ul> <p>Production:</p> <ul style="list-style-type: none"> <li>• use correct quantities to reduce wastage</li> <li>• materials are correctly disposed of</li> <li>• reusable materials are stored correctly</li> </ul>	

- scrap material is used for practice etc.
- minimise the use of water for clean-up
- turn off machinery, lights and extraction when not in use
- use low energy lighting
- use renewable energy sources
- purchase materials with minimal trips to suppliers
- source locally if possible
- manufacture locally rather than offshore.

Accept other relevant answers.

## Question 15

(17 marks)

- (a) (i) Identify the **two** types of metal that have been used in the construction of the kitchen knife shown below. (2 marks)

Description	Marks
For each type (2 x 1 mark)	
Identifies correctly the type of metal.	1
<b>Total</b>	<b>2</b>
Answer could include:	
<ul style="list-style-type: none"> <li>• Blade – High Carbon Steel or Damascus Steel</li> <li>• Handle – Brass</li> </ul>	
Accept other relevant answers.	

- (ii) Identify **three** benefits of using the blade material identified in part (a)(i). (3 marks)

Description	Marks
For each benefit (3 x 1 mark)	
Identifies a benefit of using this material.	1
<b>Total</b>	<b>3</b>
Answers could include:	
High carbon steel:	
<ul style="list-style-type: none"> <li>• wear resistant, will stay sharper longer</li> <li>• high hardness, for resisting abrasion and retaining shape</li> <li>• can withstand significant force before deforming.</li> </ul>	
Accept other relevant answers.	

- (b) Describe the atomic (crystalline/grain) structure of steel. (3 marks)

Description	Marks
Describes the atomic (crystalline/grain) structure of steel.	3
Outlines the atomic (crystalline/grain) structure of steel.	2
Makes a general statement about the atomic (crystalline/grain) structure of steel.	1
<b>Total</b>	<b>3</b>
Answers could include:	
<p>For copyright reasons this text cannot be reproduced in the online version of this document, but may be viewed under at the following link <a href="https://sciencing.com/atomic-structure-steel-6638014.html">https://sciencing.com/atomic-structure-steel-6638014.html</a> (Paragraph under 'The Crystal Lattice')</p>	
Accept other relevant answers.	

**Question 15** (continued)

- (c) Describe how the atomic (crystalline/grain) structure contributes to the properties of steel. (3 marks)

<b>Description</b>	<b>Marks</b>
Describes how the atomic (crystalline/grain) structure contributes to the properties of steel.	3
Outlines how the atomic (crystalline/grain) structure contributes to the properties of steel.	2
Makes a general statement about the atomic (crystalline/grain) structure of steel.	1
<b>Total</b>	<b>3</b>
<p>Answers could include:</p> <p>Atomic structure of steel can include:</p> <ul style="list-style-type: none"> <li>• hardness</li> <li>• toughness</li> <li>• tensile strength</li> <li>• yield strength</li> <li>• corrosion resistance</li> <li>• malleability.</li> </ul>	
Accept other relevant answers.	



**Question 16**

**(16 marks)**

- (a) Using the space below draw, render and annotate a 3D presentation drawing that meets your client's needs. (8 marks)

Description	Marks
<b>Presentation drawing</b>	
Draws and renders a detailed 3D presentation drawing that meets all specified client needs.	4
Draws and renders a 3D presentation drawing that meets most specified client needs.	3
Draws and renders a 3D presentation drawing with limited client needs.	2
Draws a sketch.	1
<b>Subtotal</b>	<b>4</b>
<b>Annotations</b>	
Clear, concise annotations of all specified client needs and design features.	4
Clear annotations of most specified client needs and design features.	3
Annotations of some specified client needs and design features.	2
Limited annotations of client needs or design features.	1
<b>Subtotal</b>	<b>4</b>
<b>Total</b>	<b>8</b>
<p>Answers could include:</p> <ul style="list-style-type: none"> <li>• <b>Materials:</b> Mild Steel has been used for the frame as it's easy to work with and widely available in different forms.</li> <li>• <b>Alternative Materials:</b> Timber has been used for the top as it's a good contrast against the metal surface.</li> <li>• <b>Joining Methods:</b> Parts assembled using a MIG Welder as it's a versatile technique.</li> <li>• <b>Finish:</b> Powder coated finish provides a tough, durable skin that is easy to maintain. Oil has been used to seal the timber parts and enhance the grain.</li> <li>• <b>Storage:</b> The addition of a long drawer under the table top provides a large space for storage of everyday items.</li> <li>• <b>Style:</b> The clean straight lines of the frame and minimalistic use of materials creates a modern style.</li> </ul>	
Accept other relevant answers.	

- (b) Identify a suitable joining method for the project and justify its suitability. (4 marks)

Description	Marks
Identifies a joining method.	1
<b>Subtotal</b>	<b>1</b>
<b>Justification</b>	
Justifies the suitability of the joining method.	3
Describes the suitability of the joining method.	2
Makes a general statement about the joining method.	1
<b>Subtotal</b>	<b>3</b>
<b>Total</b>	<b>4</b>
<p>Answers could include:</p> <p>Joining methods:</p> <ul style="list-style-type: none"> <li>• fusion e.g. MIG welding, TIG welding, oxyacetylene welding, stick welding</li> <li>• adhesion e.g. brazing, silver soldering</li> <li>• mechanical fasteners e.g. rivets, screws, nuts and bolts</li> </ul> <p>Justification for MIG welding:</p> <ul style="list-style-type: none"> <li>• Higher productivity: due to time saved by not having to constantly change rods or chip away slag and not having to brush the weld repeatedly, thus able to work faster and cleaner.</li> <li>• Simple to learn: one advantage of MIG welding is its simplicity. Welders can learn how to MIG weld in a few hours, with basic training in twenty minutes, with the majority of the time spent cleaning the weld.</li> <li>• Simple to use: MIG provides better weld pool visibility. Add this to the simplicity of the process and better control offered by the auto-feed wire and MIG makes it simple to produce a good-looking weld.</li> <li>• Clean and efficient: since MIG uses a shielding gas to protect the arc, there is very little loss of alloying elements as the metal transfers across the arc. There is no slag to remove, which is typical for stick welding, and only minor weld spatter is produced. After a brief clean up, MIG welders will be back on the job in a fraction of the time.</li> <li>• Versatile: MIG welding is extremely versatile and can weld a wide variety of metals and alloys, while operating in a variety of ways, such as semi and fully automatic. While MIG welding is useful for many home welding projects, it is also used by a large number of industries. MIG is used for the following metals: aluminium, copper, stainless steel, mild steel, magnesium, nickel and many of their alloys, as well as iron and most of its alloys.</li> <li>• Faster welding speed: the continuously fed wire keeps both hands free for MIG welding, which improves the welding speed, quality of the weld and overall control.</li> </ul> <p>Accept other relevant answers.</p>	

**Question 16** (continued)

- (c) Outline the production steps you would follow to make the join identified in part (b).  
(4 marks)

<b>Description</b>	<b>Marks</b>
Outlines the production steps to make the join.	4
Outlines some of the production steps to make the join.	3
Lists the production steps to make the join.	2
Lists a limited number of production steps.	1
<b>Total</b>	<b>4</b>
<p>Answers could include:</p> <ul style="list-style-type: none"> <li>• measure and mark parts to be cut</li> <li>• cut joins/remove waste materials using suitable equipment (Grinders, Hacksaw, Cold Saw etc.)</li> <li>• clean cuts to remove burrs</li> <li>• lay out piece and check they fit together</li> <li>• tac weld frame</li> <li>• check that all parts fit together as planned and frame is square</li> <li>• fully weld frame together.</li> </ul>	
Accept other relevant answers.	



## Question 17

(9 marks)

Using the drawings below, materials list and price list, complete the costing table for making **one** rocket stove. Round costs to the nearest cent. All sizes are in millimetres (mm).

Description					Marks
For each (9 x 1 mark)					
Correctly calculates cost subtotal and total.					1
<b>Total</b>					<b>9</b>
Part	Name of material	Material size	Number required	Cost per linear metre	Cost subtotal
Body A	Mild Steel Square Hollow Section	300 x 100 x 100 x 3	1	\$44.50	\$13.35
Body B	Mild Steel Square Hollow Section	158 x 100 x 100 x 3	1	\$44.50	\$7.03
Body C	Mild Steel Square Hollow Section	140 x 100 x 100 x 3	1	\$44.50	\$6.23
Feet	Mild Steel Flat Bar	180 x 50 x 5	2	\$10.45	\$3.76
Insert	Mild Steel Flat Bar	120 x 100 x 5	1	\$20.90	\$2.51
Handle	Mild Steel Flat Bar	232 x 25 x 3	1	\$3.80	\$0.88
Grips	Timber	90 x 25 x 12	2	\$1.90	\$0.34
Grill	Mild Steel Flat Bar	65 x 40 x 3	4	\$6.28	\$1.63
<b>Total</b>					<b>\$35.73</b>
Accept other relevant answers.					

**Question 18**

**(13 marks)**

(a) Identify **one** innovation in the metal fabrication industry.

(1 mark)

Description	Marks
Identifies an innovation in the metal fabrication industry.	1
<b>Total</b>	<b>1</b>
Answers could include: <ul style="list-style-type: none"> <li>• laser cutting</li> <li>• CNC technologies</li> <li>• plasma cutter</li> <li>• Computer aided manufacture (CAM).</li> </ul> Accept other relevant answers.	

(b) State **two** advantages and **two** disadvantages of the innovation identified in part (a).

(4 marks)

Description	Marks
<b>Advantages</b>	
States two advantages of the innovation identified.	2
States one advantage of the innovation identified.	1
<b>Subtotal</b>	<b>2</b>
<b>Disadvantages</b>	
States two disadvantages of the innovation identified.	2
States one disadvantage of the innovation identified.	1
<b>Subtotal</b>	<b>2</b>
<b>Total</b>	<b>4</b>
Answers could include: <p><b>Advantages:</b></p> <ul style="list-style-type: none"> <li>• faster production times</li> <li>• increased accuracy</li> <li>• cheaper production costs</li> <li>• lower skill set required to operate machines</li> <li>• less workforce required</li> <li>• ability to see products in software before production</li> <li>• more designs possible</li> <li>• streamlined production</li> <li>• less negative environmental impacts</li> <li>• less human error</li> <li>• can operate 24 hours.</li> </ul> <p><b>Disadvantages:</b></p> <ul style="list-style-type: none"> <li>• less jobs available</li> <li>• the need to upskill</li> <li>• increase in 'disposable furniture'</li> <li>• technology costs, expensive to install</li> <li>• decrease in individual designs (greater mass production of a concept).</li> </ul> Accept other relevant answers.	

(c) Using the diagram below, outline **four** ways in which designers are using innovations in the metal fabrication industry to improve the life cycle of products. (8 marks)

Description	Marks
For each designers use of innovation (4 x 2 marks)	
Outlines a way in which designers are using innovations in the metal fabrication industry to improve the life cycle of products.	2
Identifies a way in which designers are using innovations in the metal fabrication industry to improve products.	1
<b>Total</b>	<b>8</b>
<p>Answers could include:</p> <p>Extraction/conversion:</p> <ul style="list-style-type: none"> <li>• more efficient machinery and processes to extract raw materials</li> <li>• better ways of assessing potential risks to the environment</li> <li>• reducing pollution (Air/Soil/Sound) through better machinery and methods</li> <li>• converting raw material into usable materials.</li> </ul> <p>Design:</p> <ul style="list-style-type: none"> <li>• using sustainable materials, practices and processes in product design</li> <li>• designing in ways to minimise waste at all stages of the process</li> <li>• minimising the number of materials, elements and parts used</li> <li>• CAD to improve accuracy, reduce wastage of resources and product dumping</li> <li>• Artificial Intelligence to anticipate needs and wants and improve designs.</li> </ul> <p>Production:</p> <ul style="list-style-type: none"> <li>• improved energy consumption in products, processes and facilities</li> <li>• using renewable energy sources</li> <li>• conservation of materials through minimising waste and efficient processing</li> <li>• recycling</li> <li>• prevention of pollution e.g. through filtration systems</li> <li>• improving product quality</li> <li>• streamlining processes to reduce time to market</li> <li>• finishes that do not contain harmful chemicals.</li> </ul> <p>Use:</p> <ul style="list-style-type: none"> <li>• better design and materials for products that have multiple uses</li> <li>• making products easy to use and highly functional</li> <li>• making products safe to use</li> <li>• making products energy saving/efficient for users</li> <li>• making products reusable and recyclable</li> <li>• making products that are easy to repair if damaged</li> <li>• reducing need for product recalls.</li> </ul> <p>Disposal:</p> <ul style="list-style-type: none"> <li>• easier to recycle</li> <li>• new processes reduce harmful substances in products</li> <li>• using biodegradable materials for packaging</li> <li>• products can be broken down to salvage parts and reduce landfill</li> <li>• making products easy to disassemble</li> <li>• making durable, long-life products.</li> </ul>	
Accept other relevant answers.	

**Question 19**

**(10 marks)**

Discuss the historical impact that the processing **and** use of metals has had on society.

Description	Marks
Discusses the historical impact that the processing and use of timber has had on society.	9–10
Explains the historical impact that the processing and use of timber has had on society.	7–8
Describes the historical impact that the processing and use of timber has had on society.	5–6
Outlines the historical impact that the processing and/or use of timber has had on society.	3–4
Makes a general statement about the processing and/or use of timber.	1–2
<b>Total</b>	<b>10</b>
<p>Answers could include:</p> <ul style="list-style-type: none"> <li>• throughout history the processing and use of metals has solved many problems, addressed many needs and created economic wealth. From early human times metals have provided materials for the manufacture of tools, weapons, and jewellery. They have been used to make building materials and in the cultivation, harvesting and storage of food</li> <li>• throughout history, metals have played a key role in the transportation of people and their possessions with inventions such as ships, railroads and aircraft. During each Industrial Revolution metals have played a role through materials such as steel. The invention and use of metals continuously improved standards of living, moulding the course of history</li> <li>• for millennia metals have promoted cultural exchange through trade, both as a raw material and in products. From early exploration for new minerals, plants, spices and lands to the invention of motherboards for computers metals have created more industry, more products and more innovation throughout the history of humankind</li> <li>• improved standard of living:             <ul style="list-style-type: none"> <li>▪ invention of products to make life easier and more efficient e.g. cars/vehicles, household appliances, medical equipment etc.</li> <li>▪ increased food production in quantities and efficiency</li> <li>▪ improved housing</li> <li>▪ time for education</li> <li>▪ time for recreation and improved health</li> <li>▪ new toys for fun</li> <li>▪ new weapons for warfare</li> </ul> </li> <li>• improved standard of working:             <ul style="list-style-type: none"> <li>▪ more efficiency of work/labour</li> </ul> </li> <li>• greater impact on the environment</li> <li>• negative and positive impacts.</li> </ul>	
Accept other relevant answers.	

## Section Three: Textiles context

60% (80 Marks)

## Question 20

(15 marks)

- (a) Using relevant terminology, identify **three** sources of inspiration that designers might use when designing a product. (3 marks)

Description	Marks
For each (3 x 1 mark)	
Identifies source of inspiration, using relevant terminology.	1
<b>Total</b>	<b>3</b>
Answers could include:	
Sources of inspiration may include:	
<ul style="list-style-type: none"> <li>• social, cultural, historical, and political sources</li> <li>• the characteristics of the material(s)</li> <li>• existing products (online research, instore research, magazines and social media)</li> </ul>	
Accept other relevant answers.	

- (b) Describe how the functional and aesthetic properties of materials influence the selection of materials for a product. (4 marks)

Description	Marks
<b>Functional properties</b>	
Describes how the functional properties of materials influence the selection of materials for a product.	2
Identifies how the functional properties of materials influence the selection of materials for a product.	1
<b>Subtotal</b>	<b>2</b>
<b>Aesthetic properties</b>	
Describes how the aesthetic properties of materials influence the selection of materials for a product.	2
Identifies how the aesthetic properties of materials influence the selection of materials for a product.	1
<b>Subtotal</b>	<b>2</b>
<b>Total</b>	<b>4</b>
Answers could include:	
<ul style="list-style-type: none"> <li>• Functional properties: care, comfort, strength</li> <li>• Aesthetic properties: lustre, drape, handle, colour</li> </ul>	
Description:	
<ul style="list-style-type: none"> <li>• designers try to match the properties of materials to the design needs of their product. They need to match the functional properties, such as strength, so that their product will have durability for consumers</li> <li>• designers will try to use materials with desirable aesthetic properties of lustre and colour to appeal to their target market and improve their sales. Properties determine performance of the product and suitability to the end user.</li> </ul>	
Accept other relevant answers.	

**Question 20** (continued)

- (c) Explain how a designer would use anthropometric data to meet the ergonomic requirements of a product. (4 marks)

<b>Description</b>	<b>Marks</b>
Explains how a designer would use anthropometric data to meet the ergonomic requirements of a product.	4
Describes how a designer would use anthropometric data to meet the ergonomic requirements of a product.	3
Outlines some features of anthropometric data or the ergonomic requirements of a product.	2
Makes a general statement about anthropometric data or the ergonomic requirements of a product.	1
<b>Total</b>	<b>4</b>
<p>Answers could include:</p> <p>Anthropometric data are measurements of the human body. In products designed for use by humans the data or measurements are essential for a designer to meet the ergonomic requirements of a product. Ergonomics ensure that products are safe, comfortable and can function correctly when used. The designer would research or gather the particular measurements of the body that relate to their product, and use them to design the parts of their product to get the best fit for optimal end use. A product with sound ergonomics will be more successful in the market.</p> <p>Accept other relevant answers.</p>	

(d) Explain how sustainability issues affect the design and production of products. (4 marks)

Description	Marks
Explains how sustainability issues affect the design and production of products.	4
Describes how sustainability issues affect the design and production of product(s).	3
Outlines a way sustainability affects the design and/or production of product(s).	2
Makes a general statement about sustainability in the design or production of product(s).	1
<b>Total</b>	<b>4</b>
<p>Answers could include:</p> <p>Sustainability issues may have negative and positive impacts upon design and production, including timing and speed of production, cost of manufacturing, process efficiency, type of materials used, amount of labour or mechanisation required, resource usage and waste management.</p> <p>Design:</p> <ul style="list-style-type: none"> <li>• use recycled materials where possible</li> <li>• use eco-friendly materials</li> <li>• make designs durable to increase lifespan</li> <li>• design for multi-use to be used repeatedly</li> <li>• draw and measure carefully and accurately so that correct quantities are purchased</li> <li>• use leftover materials before purchasing new supplies.</li> </ul> <p>Production:</p> <ul style="list-style-type: none"> <li>• use correct quantities to reduce wastage</li> <li>• materials are correctly disposed of</li> <li>• reusable materials are stored correctly</li> <li>• scrap material is used for practice etc.</li> <li>• minimise the use of water for clean-up</li> <li>• turn off machinery, lights and extraction when not in use</li> <li>• use low energy lighting</li> <li>• use renewable energy sources</li> <li>• purchase materials with minimal trips to suppliers</li> <li>• source locally if possible</li> <li>• manufacture locally rather than offshore.</li> </ul> <p>Accept other relevant answers.</p>	

**Question 21**

**(17 marks)**

- (a) Identify the **three** woven fabrics shown below. (3 marks)

Description	Marks
Fabric one: Plain weave	1
Fabric two: Twill weave	1
Fabric three: Satin weave	1
<b>Total</b>	<b>3</b>

- (b) (i) Describe why the straight grain of a woven fabric is important when laying out pattern pieces. (3 marks)

Description	Marks
Describes why the straight grain of a woven fabric is important when laying out pattern pieces.	3
Outlines why the straight grain of a woven fabric is important when laying out pattern pieces.	2
Makes a general statement about the straight grain of a woven fabric.	1
<b>Total</b>	<b>3</b>
<p>Answers could include:</p> <p>The straight grain arrow shows the direction to lay the pattern on the fabric so that the pieces sew and wear correctly. Placed off-grain the garment will not drape and hang correctly. It will feel uncomfortable to wear. It will be difficult to join the pieces so that the seams sit flat. These faults can lead to the garment being discarded and the resources wasted.</p> <p>Accept other relevant answers.</p>	

- (ii) Using an arrow, draw the straight grain of the woven fabric below. (1 mark)

Description	Marks
Draws accurately the straight grain arrow parallel to the selvage.	1
<b>Total</b>	<b>1</b>
<p>The diagram shows a rectangular piece of fabric. On the left side, there is a vertical double-headed arrow labeled 'Weft'. At the top, there is a horizontal double-headed arrow labeled 'Warp'. At the bottom, there is a horizontal line labeled 'Selvage'. In the center, there is a horizontal double-headed arrow labeled 'Straight grain'.</p> <p>Accept other relevant answers.</p>	



- (c) (i) Explain the difference between crystalline and amorphous structures of fibres. (4 marks)

Description	Marks
Explains the difference between crystalline and amorphous structures of fibres in detail.	4
Describes the difference between crystalline and amorphous structures of fibres.	3
Outlines the difference between crystalline and amorphous structures of fibres.	2
Makes a general statement about the crystalline and/or amorphous structures of fibres.	1
<b>Total</b>	<b>4</b>
Answers could include: <ul style="list-style-type: none"> <li>• crystalline structures in a fibre are created by the polymers laying parallel with each other in an orderly chain. This makes them strong, stiff and less absorbent of water</li> <li>• in amorphous areas of fibres, the polymers are not orderly, but placed in random ways. The amorphous sections have more air spaces within them which alters the properties of the fibre, making them flexible, weaker and absorbent.</li> </ul> Accept other relevant answers.	

- (ii) Wool has a high percentage of amorphous regions. Identify **two** properties of wool that result from this. (2 marks)

Description	Marks
Identifies two properties of wool.	2
Identifies a property of wool.	1
<b>Total</b>	<b>2</b>
Answers could include: <ul style="list-style-type: none"> <li>• high absorbency</li> <li>• weak strength</li> <li>• high elasticity.</li> </ul> Accept other relevant answers.	

**Question 21** (continued)

(d) Describe **two** chemical properties of fabric. (4 marks)

Description	Marks
For each chemical property (2 x 2 marks)	
Describes a chemical property of fabric.	2
Identifies a chemical property of fabric.	1
<b>Total</b>	<b>4</b>
<p>Answers could include:</p> <ul style="list-style-type: none"> <li>• effect of chemicals: resistant to effects of detergents, acids and alkalis</li> <li>• absorbency: amount of time it takes fabric to absorb a fixed amount of water</li> <li>• thermal properties: porosity and air permeability of fabric</li> <li>• flammability: the ease with which a material is ignited and the intensity with which it burns</li> <li>• sun resistance: resistance to UV light</li> <li>• colourfastness: the resistance of a material to change in any of its colour characteristics.</li> </ul>	
Accept other relevant answers.	

## Question 22

(16 marks)

- (a) Using the space below draw, render and annotate a 3D presentation drawing which meets your client's needs. (8 marks)

Description	Marks
<b>Presentation drawing</b>	
Draws and renders a detailed 3D presentation drawing which meets all specified client needs.	4
Draws and renders a 3D presentation drawing which meets most specified client needs.	3
Draws and renders a 3D presentation drawing with limited client needs.	2
Draws a sketch.	1
<b>Subtotal</b>	<b>4</b>
<b>Annotations</b>	
Clear, concise annotations of all specified client needs and design features.	4
Clear annotations of most specified client needs and design features.	3
Annotations of some specified client needs and design features.	2
Limited annotations of client needs or design features.	1
<b>Subtotal</b>	<b>4</b>
<b>Total</b>	<b>8</b>
<p>Answers could include:</p> <ul style="list-style-type: none"> <li>the event theme is Earth and Sky: colours of the garment, fabrics chosen, fabric patterns</li> <li>the event is held indoors: does not need to be warm, thin straps, light-weight fabrics etc.</li> <li>the gown should incorporate eco-friendly materials: organic cotton, hemp, bamboo</li> <li>must have one pocket for carrying a phone</li> <li>must be multi-use to increase sustainability: detachable overskirt, removable jacket, fabrics suited to day and evening, short or midi length etc.</li> </ul>	
Accept other relevant answers.	

**Question 22** (continued)

- (b) Identify a suitable joining method for the garment seams and justify its suitability. (4 marks)

Description	Marks
Identifies a joining method.	1
<b>Subtotal</b>	<b>1</b>
<b>Justification</b>	
Justifies the suitability of the joining method.	3
Describes the suitability of the joining method.	2
Makes a general statement about the joining method.	1
<b>Subtotal</b>	<b>3</b>
<b>Total</b>	<b>4</b>
<p>Answers could include:</p> <p>Joining methods: open seam, closed seam, French seam, flat-felled seam.</p> <p>Justification: open seam</p> <ul style="list-style-type: none"> <li>The open seam is necessary in the seam of the garment where the zip, a split or a pocket is placed. For example, for the zip to function correctly and allow the wearer to put on the garment the seam must open to the full length of the zip, giving maximum space to step into the garment or pull it over the head and shoulders. This is the only seam type that can fulfil this function. The seam is not the quickest seam to construct, but it is essential for this purpose.</li> </ul> <p>Justification: closed seam</p> <ul style="list-style-type: none"> <li>A closed seam would be used for most seams in the garment. It is the quickest seam to make as it has the least number of processes. It is completed in two steps, making it time efficient and cheaper to sew than more complex methods. The seam is stitched once to join the two pieces of the garment and then it is overlocked/neatened with one row of stitching. The seam is neat and not bulky, making it suitable for most fabrics and styles.</li> </ul> <p>Accept other relevant answers.</p>	

- (c) Outline the production steps you would follow to make the join identified in part (b). (4 marks)

Description	Marks
Outlines the production steps to make the join.	4
Outlines some of the production steps to make the join.	3
Lists the production steps to make the join.	2
Lists a limited number of production steps.	1
<b>Total</b>	<b>4</b>
<p>Answers could include:</p> <p>Open seam:</p> <ul style="list-style-type: none"> <li>lay the two garment pieces together, right-sides facing in</li> <li>pin down the seam line to the length of the pieces</li> <li>sew along the stitch line using a firm stitch and a reverse stitch at the beginning and end of the row</li> <li>overlock/neaten the edge of seam allowances on both garment pieces as separate pieces. Do not sew them together</li> <li>press the seam open up the seamline laying one seam allowance to each side of the stitching</li> <li>the seam will lay flat with one seam allowance on either side of the stitching line.</li> </ul> <p>Accept other relevant answers.</p>	

## Question 23

(9 marks)

Using the drawing, materials list and price list, complete the costing table for making the dress below. Round costs to the nearest cent.

Description			Marks
For each (9 x 1 mark)			
Correctly calculates the cost and total.			1
<b>Total</b>			<b>9</b>
Materials	Quantity required	Price per metre or each	Cost
Green rayon fabric	4.25 m	\$15.60	\$66.30
Green acetate lining	2.4 m	\$10.75	\$25.80
Interfacing	0.9	\$2.85	\$2.57
Buttons 10 mm	6	\$1.20	\$7.20
Buttons 6 mm	6	90c each	\$5.40
50 cm nylon zip	1	\$5.25 each	\$5.25
Thread	4 cones	\$3.40 each	\$13.60
Belt buckle	1	\$6.20 each	\$6.20
<b>Total</b>			<b>\$132.32</b>
Accept other relevant answers.			

**Question 24**

**(13 marks)**

- (a) Identify **one** innovation in the textile industry. (1 mark)

Description	Marks
Identifies an innovation in the textiles industry.	1
<b>Total</b>	<b>1</b>
Answers could include: <ul style="list-style-type: none"> <li>• CNC sewing machines</li> <li>• seamless technology</li> <li>• nanotechnology</li> <li>• microfibre fabrics</li> <li>• 3D printing</li> <li>• laser cutting</li> <li>• Computer Aided Manufacture (CAM).</li> </ul> Accept other relevant answers.	

- (b) State **two** advantages and **two** disadvantages of the innovation identified in part (a). (4 marks)

Description	Marks
<b>Advantages</b>	
States two advantages of the innovation identified.	2
States one advantage of the innovation identified.	1
<b>Subtotal</b>	<b>2</b>
<b>Disadvantages</b>	
States two disadvantages of the innovation identified.	2
States one disadvantage of the innovation identified.	1
<b>Subtotal</b>	<b>2</b>
<b>Total</b>	<b>4</b>
Answers could include: <p><b>Advantages:</b></p> <ul style="list-style-type: none"> <li>• faster production times</li> <li>• increased accuracy</li> <li>• cheaper production costs</li> <li>• lower skill set required to operate machines</li> <li>• less workforce required</li> <li>• ability to see products in software before production</li> <li>• more designs possible</li> <li>• streamlined production</li> <li>• less negative environmental impacts</li> <li>• less human error</li> <li>• can operate 24 hours.</li> </ul> <p><b>Disadvantages:</b></p> <ul style="list-style-type: none"> <li>• less jobs available</li> <li>• the need to upskill</li> <li>• increase in fast fashion</li> <li>• technology costs, expensive to install</li> <li>• decrease in individual designs (greater mass production of a concept).</li> </ul> Accept other relevant answers.	

- (c) Using the diagram below, outline **four** ways in which designers are using innovations in the textile industry to improve the life cycle of products. (8 marks)

Description	Marks
For each designers use of innovation (4 x 2 marks)	
Outlines a way in which designers are using innovations in the textile industry to improve the life cycle of products.	2
Identifies a way in which designers are using innovations in the textile industry to improve products.	1
<b>Total</b>	<b>8</b>
<p>Answers could include:</p> <p>Harvesting/conversion:</p> <ul style="list-style-type: none"> <li>innovations in fibre growing such as organic cotton and hemp are improving impacts on the environment by reducing pesticides</li> <li>developing production of fast-growing plants such as bamboo reduces the amount of land and water needed for crops</li> <li>reducing pollution (Air/Soil/Sound) through better machinery and methods.</li> </ul> <p>Design:</p> <ul style="list-style-type: none"> <li>CAD to improve accuracy, reduce wastage of resources and product dumping</li> <li>Artificial Intelligence to anticipate needs and wants and improve designs</li> <li>opti scanning technology improves accuracy of body measurements and reduces wasteful errors</li> <li>recycled materials (paper) can be used and recycled.</li> </ul> <p>Production:</p> <ul style="list-style-type: none"> <li>automated layout and cutting means less wastage, less product dumping and resources going to landfill</li> <li>using CNC technology techniques and designs can be done by the most efficient methods using less time, energy, water and materials</li> <li>improving product quality to reduce the need to replace</li> <li>seamless technology reduces the number of construction processes, saves energy and streamlines production to reduce time to market</li> <li>using renewable energies means less carbon emissions</li> <li>CNC sewing machines means less human error and wastage</li> <li>CNC sewing machines enables manufacturing locally rather than offshore, which reduces transportation and increases employment.</li> </ul> <p>Use:</p> <ul style="list-style-type: none"> <li>synthetic fabrics and applied finishes reduce the need for cleaning and ironing, so water and energy consumption are reduced</li> <li>better quality products may have multiple uses</li> <li>longer lasting products reduce the need to replace so often.</li> </ul> <p>Disposal:</p> <ul style="list-style-type: none"> <li>use of biodegradable materials in products and packaging</li> <li>new finishes such as Fluro-chemistry and anti-bacterials give a longer life span reducing the need to replace</li> <li>greater access to recycling and reusing materials and products.</li> </ul>	
Accept other relevant answers.	

**Question 25**

**(10 marks)**

Discuss the historical impact that the processing **and** use of textiles has had on society.

Description	Marks
Discusses the historical impact that the processing and use of textiles has had on society.	9–10
Explains the historical impact that the processing and use of textiles has had on society.	7–8
Describes the historical impact that the processing and use of textiles has had on society.	5–6
Outlines the historical impact that the processing and/or use of textiles has had on society.	3–4
Makes a general statement about the processing and/or use of textiles.	1–2
<b>Total</b>	<b>10</b>
<p>Answers could include:</p> <ul style="list-style-type: none"> <li>• throughout history the processing and use of textiles has solved many problems, addressed many needs and created economic wealth. In early human evolution woven cloth changed the course of humankind. Since then, textiles have provided clothing for protection from the environment and specific climatic conditions, shelter and comfort in homes, and been used for harvesting, processing and packaging food. Textiles have also contributed to art, culture and the pursuit of beauty throughout history</li> <li>• production of textiles started the first Industrial Revolution, driving innovation and inventions such as the Spinning Jenny. This changed populations from agricultural to industrial living. Changes occurred with increased production, building of factories, increased employment, development of larger towns and cities, increased pollution and use of detrimental child labour. Increased production drove importing and exporting with new materials and designs developed to meet demand and drive wealth creation for individuals and nations</li> <li>• textiles have been used as a measure of wealth in European and Asian cultures. Prior to the establishment of banking systems and gold standards highly prized silks were accumulated to harbour wealth. For millennia silk, cotton and woollens have promoted cultural exchange through trade, such as along the Silk Road and through the Americas. Exploration for new minerals, plants, spices, lands and peoples was enabled by the use of textiles for sails</li> <li>• now, in the 21<sup>st</sup> Century textiles are supporting innovation by improving communication through smart textiles. In an upward spiral textiles have created more industry, more products and more innovation throughout the history of humankind</li> <li>• improved standard of living: <ul style="list-style-type: none"> <li>▪ invention of products to make life easier and more efficient e.g. vehicles, household appliances, medical equipment etc.</li> <li>▪ increased food production in quantities and efficiency</li> <li>▪ improved housing</li> <li>▪ time for education</li> <li>▪ time for recreation and improved health</li> <li>▪ new toys for fun</li> <li>▪ new weapons for warfare</li> </ul> </li> <li>• improved standard of working: <ul style="list-style-type: none"> <li>▪ more efficiency of work/labour.</li> </ul> </li> <li>• greater impact on the environment: <ul style="list-style-type: none"> <li>▪ negative and positive impacts.</li> </ul> </li> </ul> <p>Accept other relevant answers.</p>	



## ACKNOWLEDGEMENTS

- Question 9(a)** Adapted from: Harrison, S. (2016). [Graphic of the cellular structure of softwood]. Retrieved April, 2022, from [https://www.furniturelinkca.com/images/softwood\\_1.png](https://www.furniturelinkca.com/images/softwood_1.png)
- Question 9(b)** Dot point 1 from: Canadian Wood Council. (2013). *Structure and Properties of Wood* [Presentation]. Retrieved October, 2022, from [https://www.paperonweb.com/Documents/Wood\\_Structure\\_and\\_Prop\\_2013.pdf](https://www.paperonweb.com/Documents/Wood_Structure_and_Prop_2013.pdf)
- Dot point 2 from: *Tree Wuchs - Hardwood/Softwood*. (n.d.). Retrieved October, 2022, from <http://www.boeingconsult.com/tafe/mat/Timber/HowTreeGrows-OH.htm>
- Dot point 3 adapted from: Industrial Technology and Design Teachers' Association of Queensland. (n.d.). *Wood's Importance*. Retrieved prior to October, 2022, from [http://www.intad.asn.au/materials/wd\\_hrdsft.asp](http://www.intad.asn.au/materials/wd_hrdsft.asp)
- Question 15(a)(ii)** Dot points 2–3 adapted from: Metro Steel. (2017). *Stainless Steel vs Carbon Steel – Which do you Choose?* Retrieved October, 2022, from <https://www.metrosteel.com.au/stainless-steel-vs-carbon-steel-which-do-you-choose/>
- Question 15(b)** Answer from: Crystal, M. (2017). *Atomic Structure of Steel*. Retrieved October, 2022, from <https://sciencing.com/atomic-structure-steel-6638014.html>
- Question 15(d)** Answer adapted from: Singh, R. (2006). *Introduction to Basic Manufacturing Processes and Workshop Technology*. New Age International Publishers, pp. 295–296, table 16.1.
- Question 16(b)** Dot points 4–9 adapted from: Baker's Gas. (n.d.). *The Pros & Cons of MIG Welding*. Retrieved October, 2022, from <https://bakersgas.com/pages/the-pros-cons-of-mig-welding>

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