



# **MATERIALS DESIGN AND TECHNOLOGY**

## **ATAR course examination 2017**

### **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% (21 Marks)**

**Question 1**

**(12 marks)**

In a project you designed this year, a range of communication techniques was used throughout the process. Define each of the following communication techniques and outline how it was used in your portfolio.

- (a) Rapid concept development (3 marks)

Description	Marks
Definition of rapid concept development	2
Limited definition of rapid concept development	1
Outline of how the technique was used in the portfolio	1
<b>Total</b>	<b>3</b>
<p>Answers could include:</p> <p><b>Definition</b> Rapid concept development is at the start of the designing process, these are usually made up of quickly drawn hand sketches that allow the designer to get the message across to their clients.</p> <p><b>Outlined example of use in portfolio</b> Rapid concept development is produced based on the clients' wants and needs that are found out during client interview, questionnaires or design brief.</p> <p>Note: List is not exhaustive.</p>	

- (b) Design development (3 marks)

Description	Marks
Definition of design development	2
Limited definition of design development	1
Outline of how the technique was used in the portfolio	1
<b>Total</b>	<b>3</b>
<p>Answers could include:</p> <p><b>Definition</b> Design development is the part in the design process when a chosen rapid concept development idea is developed towards the final solution.</p> <p><b>Outlined example of use in portfolio</b> The client was asked to give feedback on the rapid concept development ideas and using this information. One idea is developed or different features are merged from several concepts to develop the solution.</p> <p>Note: List is not exhaustive.</p>	

(c) 3D presentation drawings

(3 marks)

Description	Marks
Definition of 3D presentation drawings	2
Limited definition of 3D presentation drawings	1
Outline of how the technique was used in the portfolio	1
<b>Total</b>	<b>3</b>
<p>Answers could include:</p> <p><b>Definition</b> 3D presentation drawings shows what the final design will look like. These drawings are often rendered and show details such as design features and manufacturing techniques.</p> <p><b>Outlined example of use in portfolio</b> The drawings can be used in a portfolio to show the client what the final product would look like and annotations can be used to explain the finer details such as material and finishing choices.</p> <p>Note: List is not exhaustive.</p>	

(d) 2D working drawings/specification sheets

(3 marks)

Description	Marks
Definition of 2D working drawings/specification sheets	2
Limited definition of 2D working drawings/specification sheets	1
Outline of how the example was used in the portfolio	1
<b>Total</b>	<b>3</b>
<p>Answers could include:</p> <p><b>Definition</b> 2D working drawings/specification sheets can show assembled or individual parts of a product with their dimensions. This can also help designers calculate materials costs. Some specification sheets also give the measurement gradation between sizes and give detailed size gradation for the garment.</p> <p><b>Outlined example of use in portfolio</b> The 2D drawing/specification sheet shows an assembled drawing of the project to show the client what it would look like and can be used to give the client an idea of size. Individual parts can be included so that the drawings be read easily and used for reference during the manufacturing process.</p> <p>Specification sheets help to produce accurate samples which improve production time and simplifies communication during all stages of manufacturing. They include detailed technical diagrams, construction notes, finished garment measurements and fabric yields, material and trim details.</p> <p>Note: List is not exhaustive.</p>	

**Question 2**

**(5 marks)**

Social trends have been a driving force behind the development of innovative and emerging materials.

Identify **one** innovative and emerging material and use **two** examples to explain how social trends have influenced its development.

Description	Marks
1 mark for correctly identifying one innovative and emerging material	1
Maximum 2 marks x 2 examples	
Explanation of how social trends have influenced the material's development	2
Outline of how social trends have influenced the material's development	1
<b>subtotal</b>	<b>4</b>
<b>Total</b>	<b>5</b>
<p>Answers could include:</p> <p>Possible materials could include:</p> <ul style="list-style-type: none"> <li>• shape memory alloy</li> <li>• titanium (alloy)</li> <li>• bamboo (timber)</li> <li>• medium density fibreboard</li> <li>• bamboo (fabric)</li> <li>• seamless technology</li> <li>• Gore-tex.</li> </ul> <p>Social trends that could have influenced a materials development are:</p> <ul style="list-style-type: none"> <li>• cost</li> <li>• material sourcing</li> <li>• ergonomics</li> <li>• function</li> <li>• aesthetics</li> <li>• trends</li> <li>• environment</li> <li>• durability</li> <li>• accept other relevant social trends as there are too many to list.</li> </ul> <p>Note: List is not exhaustive.</p>	

## Question 3

(4 marks)

The designer of the activity tracker considered **three** materials for the strap. Using the information given and the data in the diagram above explain, with reference to the properties, which material would be most suitable for the strap.

Description	Marks
Detailed explanation supporting material C as the most suitable material for the tracker	4
Explanation supporting material C as the most suitable material for the tracker	3
Limited explanation supporting material C as the most suitable material for the tracker	2
Superficial explanation supporting either material C as the most suitable material for the tracker	1
<b>Total</b>	<b>4</b>
<p>Answers could include:</p> <p>Material C would be the material most suited for the strap because once one compares its properties against the other materials, it is overall the best material. Its durability is slightly lower than materials A and B, only rating 8 against 9 and 10, but when you compare their impact resistance ratings, material C is better. Being worn on the wrist and during activities, personal fitness trackers are going to be exposed to many impacts so it's important to have a material that has high impact ratings. It also out-scores the other materials with tear resistance, this is important as this means the materials won't fail over a prolonged period of wear. Its water resistance doesn't score as high as material B, but with the device not being waterproof it does not have to have a high rating. The high strength rating also works in the material's favour allowing it to be bent around the wrist again and again without material failure occurring. It's for these reasons that material C would be the better choice.</p> <p>Note: B is also accepted for full marks with the appropriate justification.</p>	
<p>Note: List is not exhaustive – explanation may vary.</p>	

**Section Two: Extended answer**

**25% (31 Marks)**

**Question 4**

**(6 marks)**

Identify and compare how **two** different elements of design have been used in these two can openers.

Description	Marks
2 marks for identifying elements of design	1–2
2 comparisons x 2 marks each	
Accurate comparison of can opener	2
No comparison but limited description of can opener	1
<b>subtotal</b>	<b>2</b>
<b>Total</b>	<b>6</b>

Answers could include any two of the following elements:

**Line**

There has been a strong use of line in Image 1, this is due to the use of a material that looks like a flat bar. This gives it a lot of straight edges. There isn't as strong a use of straight line in Image 2, being a newer design there is a lot more use of free flowing line that would make it easier to hold.

**Shape**

The shape of the can opener in Image 1 is very linear and doesn't allow it to be easily seen in a cluttered kitchen drawer. The can opener in Image 2 is much the opposite that its shape allows it to stand out from the more traditional kitchen utensils and to be used safely.

**Form**

Image 1 has a very geometric form as the can opener was designed for its purpose with little thought of its design. Image 2 shows great form with the sweeping design and rounded edges, this gives the can opener the feeling that it would be comfortable to use.

**Texture**

Image 1 has little texture, other than the slight bends that are in the handle that would be there to help the user get a better grip. Image 2 seems to use two different materials, the green looks to be a rubber type material that would give the user a lot more grip and make it safer to use the can opener.

**Colour**

In Image 1 there is no contrast in colour – the shine on the silver does create some tone. By comparison Image 2 has made use of a bright green colour on the handle and the wheel that turns the cutters. Other relevant working parts are marked by red which is in stark contrast to the white body of the can opener, making it far more eye-catching than the dull silver tones of Image 1.

Note: List is not exhaustive.

## Question 5

(10 marks)

With reference to **five** design fundamentals, outline how each has contributed to the success of the ride-on hand luggage.

Description	Marks
5 design fundamentals x 2 marks each	
Outlines a successful design fundamental	2
Identifies a design fundamental with minimal explanation	1
<b>subtotal</b>	<b>2</b>
<b>Total</b>	<b>10</b>
<p>Answers could include:</p> <p><b>Aesthetics</b> The use of bright colours makes the product appealing to its younger audience; with there being multiple colour options it means it is appealing to both boys and girls.</p> <p><b>Function</b> The product has two functions, the main one being somewhere to store a child's toys or clothes, but the main one is that it allows the parents to drag their suitcase along if the child becomes tired and no longer wants to walk.</p> <p><b>Safety</b> The large indent on the top of the case allows the child to sit comfortably and steadily while being pulled along. The two purple shapes on the front of the case also act as handles for the child when being pulled along, meaning there is less chance that the child will fall off.</p> <p><b>Cost</b> Affordability will have been considered in the design of the product, to ensure a large range of parents could purchase the item.</p> <p><b>Environmental impact and consideration</b> It's made of plastic so it can be recycled.</p> <p><b>Sustainability</b> Whilst the product appears to be made of some kind of plastic, it seems to be durable, meaning it might not need to be replaced often.</p> <p><b>Ergonomics</b> The positioning of the wheels allows the case to be steady when sat on and the wheels rotate freely so that it can be easily transported.</p> <p><b>Anthropometric</b> The designer would have had to consider the overall sitting height for different children to ensure he got the correct positioning for the children. There would also have been thought put into how big the handles would need to be, as well as how long to make the strap so that the parents could pull the suitcase along easily.</p> <p>Note: List is not exhaustive.</p>	

**Question 6**

**(7 marks)**

- (a) Designers use modern technology to communicate their ideas to their design teams, clients and manufacturers more easily than in the past. Give **four** examples of how this can be done. (4 marks)

Description	Marks
1 mark for each relevant example relating to communication	1–4
<b>Total</b>	<b>4</b>
Answers could include: <ul style="list-style-type: none"> <li>• files can be emailed and shared</li> <li>• multiple people can work on the same file</li> <li>• drawings can be rendered to look like the real thing</li> <li>• drawings can be broken up to show individual parts</li> <li>• prototyping.</li> </ul>	
Note: List is not exhaustive.	

- (b) Outline **three** advantages of CAD software for a designer. (3 marks)

Description	Marks
1 mark for each relevant advantage	1–3
<b>Total</b>	<b>3</b>
Answers could include: <ul style="list-style-type: none"> <li>• increased productivity</li> <li>• improved quality of designs</li> <li>• standardisation of drawings made by different designers working in teams</li> <li>• designs can be modified easily</li> <li>• ability to visualise the product better, in some cases with 3D animation</li> <li>• ability to handle costing and ordering of resources</li> <li>• creation of databases</li> <li>• communication is possible directly between CAD and CNC machinery</li> <li>• sustainability.</li> </ul>	
Note: List is not exhaustive.	



## Question 7

(8 marks)

Explain the processes that take place during production planning and production management and describe the differences between the two.

Description	Marks
2 processes (production planning and production management) x 3 marks each	
Detailed explanation of production planning/management	3
Explanation of production planning/management	2
Outline of production planning/management	1
<b>subtotal</b>	<b>6</b>
Detailed description of the difference between production planning and production management	2
Limited description of the difference between production planning and production management	1
<b>subtotal</b>	<b>2</b>
<b>Total</b>	<b>8</b>
<p>Answers could include:</p> <p>Answers should include an explanation of most of the dot points for production planning and production management processes.</p> <p>The description should clearly show the planning process is used at the start and lists overall structure/concepts but that it is linked to the management part. Production management is about the management of the production of the project and can result in the planning having to be reassessed/evaluated on occasions.</p> <p>Production planning processes:</p> <ul style="list-style-type: none"> <li>• materials list/costing</li> <li>• working drawings</li> <li>• steps</li> <li>• timeline</li> <li>• safety/risk management procedure.</li> </ul> <p>Production management processes:</p> <ul style="list-style-type: none"> <li>• materials/budget analysis</li> <li>• analysing the developing project versus the working drawings and presentation sketches</li> <li>• checking steps are being followed and noting if changes/modifications took place and why they took place</li> <li>• addressing time management</li> <li>• quality control - evaluating the quality of the developing product</li> <li>• risk management - ensuring safety procedures are being followed and identified</li> <li>• consider client feedback</li> <li>• hazard at every stage.</li> </ul> <p>Note: List is not exhaustive.</p>	

**Section Three: Wood context**

**60% (82 Marks)**

**Question 8**

**(12 marks)**

- (a) With reference to a project you designed this year, outline **three** environmental impacts you had to consider during and following production and give **one** example of how you might have reduced each impact. (6 marks)

Description	Marks
One mark for each environmental impact outlined	1–3
<b>subtotal</b>	<b>3</b>
One mark for each suitable example given on how to reduce the environmental impact	1–3
<b>subtotal</b>	<b>3</b>
<b>Total</b>	<b>6</b>
<p>Answers could include:</p> <p><b>Waste materials</b></p> <ul style="list-style-type: none"> <li>• that the waste materials were correctly disposed of</li> <li>• that waste materials that could be reused were stored away so that they could be used for another project</li> <li>• ensure that scrap material was used for practice etc.</li> </ul> <p><b>Fumes from finishing</b></p> <ul style="list-style-type: none"> <li>• check that the extraction fan/unit was on during the process to ensure all harmful toxins are removed from the area/air during the process of applying the finish.</li> </ul> <p><b>Finish application and disposal</b></p> <ul style="list-style-type: none"> <li>• use VAC free finishes</li> <li>• applied finish in a spray room/booth.</li> </ul> <p><b>Energy usage</b></p> <ul style="list-style-type: none"> <li>• ensure that after using each machine they were correctly turned off</li> <li>• ensure that parts match properly by test fitting before joining things together.</li> </ul> <p>Note: List is not exhaustive.</p>	

- (b) Identify and outline **three** factors that could have affected the sustainability of the materials you have sourced for the project. (6 marks)

Description	Marks
3 factors x 2 marks each	
Identifies and outlines a factor that could have affected the sustainability of the materials sourced	2
Identifies a factor that could have affected the sustainability of the materials sourced	1
<b>subtotal</b>	<b>2</b>
<b>Total</b>	<b>6</b>
<p>Answers could include:</p> <p><b>Origin</b> The origin of the material will determine if it is appropriate for the task. Choosing a material that is cleaner, that can be easily recycled or easier to work with.</p> <p><b>Availability</b> If the material is not available locally, it has to be transported meaning more fuel is used. Choosing an alternative that is available locally or choosing environmentally friendly transport methods might be an option.</p> <p><b>Treatment/finishes</b> Staining techniques and finishes all impact the biodegradability of a product if they introduce non-organic chemicals to it. Choosing timbers in their raw form then finishing them with biodegradable products.</p> <p><b>Cost</b> The cost of the material will affect the final selection due to budget constraints. If a project's budget is limited, an alternative material that has similar properties will need to be sourced.</p> <p><b>Sustainability</b> The growth time and long term availability of the material. Is the material renewable? Is the material recyclable? Does it have a limited life span?</p> <p><b>Environmental considerations</b> Is there a lasting effect on the environment from where the material was sourced? Has the material been sourced locally, reducing the need for lengthy deliveries, reducing the CO<sub>2</sub> emissions from transport? Does the extraction of the material have a lasting effect on the local environment?</p> <p><b>Environment</b> Where will the product be used? Will it be exposed to certain elements, such as ultra violet rays, rain and other conditions? Will it be used indoors?</p> <p>Note: List is not exhaustive.</p>	

**Question 9**

**(14 marks)**

- (a) Identify **two** timber conversion methods and describe how each alters the characteristics of the timber.

**(6 marks)**

Description	Marks
2 conversion methods x 3 marks each	
Detailed description of how the conversion process alters the characteristics of the timber	3
Describes how the conversion processes alters the characteristics of the timber	2
Limited description of how the different conversion processes alters the characteristics of the timber	1
<b>subtotal</b>	<b>3</b>
<b>Total</b>	<b>6</b>
<p>Answers could include:</p> <p><b>Quarter sawn</b></p> <div style="border: 1px dashed gray; padding: 5px; margin: 10px 0;"> <p>For copyright reasons this text cannot be reproduced in the online version of this document, but may be viewed at <a href="http://www.hardwooddistributors.org/blog/postings/what-is-the-difference-between-quarter-sawn-rift-sawn-and-plain-sawn-lumber/">http://www.hardwooddistributors.org/blog/postings/what-is-the-difference-between-quarter-sawn-rift-sawn-and-plain-sawn-lumber/</a></p> </div> <p>Characteristics:</p> <ul style="list-style-type: none"> <li>• produces radial boards</li> <li>• more expensive</li> <li>• more waste</li> <li>• more decorative</li> <li>• less prone to distortion and cupping</li> <li>• provides a straighter face grain.</li> </ul> <p><b>Live sawn</b></p> <div style="border: 1px dashed gray; padding: 5px; margin: 10px 0;"> <p>For copyright reasons this text cannot be reproduced in the online version of this document, but may be viewed at <a href="http://www.hardwooddistributors.org/blog/postings/what-is-the-difference-between-quarter-sawn-rift-sawn-and-plain-sawn-lumber/">http://www.hardwooddistributors.org/blog/postings/what-is-the-difference-between-quarter-sawn-rift-sawn-and-plain-sawn-lumber/</a></p> </div> <p>Characteristics:</p> <ul style="list-style-type: none"> <li>• less waste</li> <li>• wider boards available</li> <li>• cheaper to produce</li> <li>• can absorb more moisture</li> <li>• more prone to cupping, warping etc.</li> </ul> <p><b>Back sawn</b></p> <div style="border: 1px dashed gray; padding: 5px; margin: 10px 0;"> <p>For copyright reasons this text cannot be reproduced in the online version of this document, but may be viewed at <a href="http://www.hardwooddistributors.org/blog/postings/what-is-the-difference-between-quarter-sawn-rift-sawn-and-plain-sawn-lumber/">http://www.hardwooddistributors.org/blog/postings/what-is-the-difference-between-quarter-sawn-rift-sawn-and-plain-sawn-lumber/</a></p> </div> <p>Characteristics:</p> <ul style="list-style-type: none"> <li>• expensive to produce</li> <li>• large amount of waste</li> <li>• very stable.</li> </ul>	
<p>Note: List is not exhaustive.</p>	

- (b) Identify and discuss the application and use of **two** different adhesives. (8 marks)

Description	Marks
One mark for each correctly identified suitable adhesive	1–2
<b>subtotal</b>	<b>2</b>
2 adhesives x 3 marks each	
Detailed discussion of an adhesive's application and use	3
Discussion of an adhesive's application and use	2
Limited discussion of an adhesive's application and use	1
<b>subtotal</b>	<b>3</b>
<b>Total</b>	<b>8</b>
<p>Answers could include: PVA and Epoxy</p> <p><b>Epoxy</b> Application:</p> <ul style="list-style-type: none"> <li>• needs the two parts to be mixed to set off the chemical reaction and has a limited working life before it starts to set</li> <li>• is not water based so is difficult to clean and can be messy to work with</li> <li>• takes 24 hours to set</li> <li>• requires clamping or force to hold the materials together while the glue sets.</li> </ul> <p>Use:</p> <ul style="list-style-type: none"> <li>• epoxy based glues are waterproof</li> <li>• sets very hard</li> <li>• has a longer working time but there are some epoxy glues designed to set very quickly (5 minutes) which can reduce clamping time but can be difficult to work with.</li> </ul> <p><b>PVA</b> Application:</p> <ul style="list-style-type: none"> <li>• does not have to be mixed and is able to be stored ready for use</li> <li>• is water based so easy to clean after use and cleaner to use</li> <li>• begins to set after 20 minutes</li> <li>• requires clamping or force to hold the materials together while the glue sets.</li> </ul> <p>Use:</p> <ul style="list-style-type: none"> <li>• is usually not waterproof and is not durable when exposed to moisture</li> <li>• is an elastic polymer and does not perform well when under tension</li> <li>• have to work quickly before it begins to set.</li> </ul> <p>Note: List is not exhaustive.</p>	

**Question 10**

**(34 marks)**

- (a) Using the image and the information in the tables above, complete each row of the table below and calculate the total cost of producing a single rocking horse. Round the costs to the nearest cent. (8 marks)

Description	Marks
One mark for each part total. Maximum of 7 marks	1–7
One mark for total cost	1
<b>Total</b>	<b>8</b>

Part	Material	Size: (L x W x T)	No Req.	Cost: (\$/m)	Cost: subtotal
Rocker	pine	900 x 145 x 35	2	\$7.40	\$13.32
Slats	pine	300 x 90 x 19	2	\$5.40	\$3.24
Centre slat	pine	300 x 120 x 19	1	\$6.12	\$1.84
Legs	pine	330 x 70 x 35	4	\$2.43	\$3.21
Seat	pine	600 x 240 x 45	1	\$16.20	\$9.72
Head	pine	320 x 290 x 45	1	\$17.86	\$5.71
Handle	dowel	240 x 25	1	\$9.60	\$2.30
<b>Total cost</b>					<b>\$39.34</b>

- (b) The horse's head was made using a template and router table. Explain in detail, using the correct terminology, how you would undertake this process. (4 marks)

Description	Marks
Comprehensive explanation of the processes needed to shape the head with the correct use of terminology	4
Detailed explanation of the processes needed to shape the head with the correct use of terminology	3
Satisfactory explanation of the processes needed to shape the head with the use of some correct terminology	2
Limited explanation of the processes needed to shape the head with little or no use of correct terminology	1
<b>Total</b>	<b>4</b>
<p>Answers could include:</p> <ul style="list-style-type: none"> <li>• if CNC is not available, the template can be done by hand</li> <li>• using a CAD drawing program, create the shape of the head</li> <li>• using a laser cutter or CNC router cut out a template from 7 mm ply</li> <li>• trace around the template onto the timber</li> <li>• using a band saw cut around the shape close to the line</li> <li>• using a hot glue join the template to the roughly cut out head</li> <li>• set up a pattern router bit or flush cutting bit with the bearing on top into the table router</li> <li>• ensure that the bearing is in line with the template by adjusting the height</li> <li>• route around the template removing waste material from the horse's head.</li> </ul> <p>Note: List is not exhaustive.</p>	

- (c) The horse's head will be attached to the seat using screws. Explain how this will be done and identify **three** benefits of this joining method over others. (5 marks)

Description	Marks
Explanation of the processes needed to attach the head to the seat with use of correct terminology – minimum of 3 to 4 steps required	2
Limited explanation of the processes needed to attach the head to the seat with little to no use of correct terminology	1
<b>subtotal</b>	<b>2</b>
Identifies one to three suitable benefits	1–3
<b>subtotal</b>	<b>3</b>
<b>Total</b>	<b>5</b>
<p>Answers could include:</p> <p>Process of how to attach the head to the seat:</p> <ul style="list-style-type: none"> <li>• mark the centre line on the body</li> <li>• measure the base of the horse's head and divide it by three to work out the spacing for the screws</li> <li>• mark the centre points for the holes on the body</li> <li>• centre punch the markings</li> <li>• using a drill bit which is the same diameter as the outside of the screw thread; drill the two clearance holes</li> <li>• using a countersink drill bit, drill the underside of the seat so that the screws sit flush with the surface</li> <li>• place the head in the correct location on the body</li> <li>• using a drill bit the same diameter as the screw shaft drill up into the horse's head</li> <li>• using a driver bit screw the head to the body.</li> </ul> <p>Benefits:</p> <ul style="list-style-type: none"> <li>• fast construction</li> <li>• allows the parts to be disassembled/reassembled</li> <li>• no waiting for glue to dry</li> <li>• can be assembled with little user skill required</li> <li>• cheaper</li> <li>• product can be flat packed.</li> </ul> <p>Note: List is not exhaustive.</p>	

**Question 10** (continued)

- (d) Identify a suitable finish and explain how to prepare the material and apply the finish to it. (5 marks)

<b>Description</b>	<b>Marks</b>
One mark for correctly identifying a suitable finish.	1
Detailed explanation of how to prepare the material for application of a finish	2
Limited explanation of how to prepare the material for application of a finish	1
<b>subtotal</b>	<b>2</b>
Detailed explanation of how the finish would be applied.	2
Limited explanation of how the finish would be applied.	1
<b>subtotal</b>	<b>2</b>
<b>Total</b>	<b>5</b>
<p>Answers could include:</p> <p><b>Examples of finish</b></p> <ul style="list-style-type: none"> <li>• polyurethane varnish</li> <li>• danish oil</li> <li>• tung oil</li> <li>• wax</li> <li>• paint.</li> </ul> <p>Preparation of material: All surfaces should be cabinet scraped to remove machine marks and then sanded with a variety of abrasive papers, starting with rough and gradually working towards the smoother grits. Before applying a finish you need to ensure that all surfaces are smooth and free of any marks.</p> <p>Application of finish: Danish oil should be applied using a rag and worked into the grain until the timber stops absorbing the oil. All excess oil should be removed using a clean rag to ensure the finish dries evenly. This process should be repeated another two times to ensure an even coat.</p> <p>Note: List is not exhaustive.</p>	



- (e) Using the risk assessment table below, outline **two** potential hazards for each tool used during the production process described and **two** control measures that relate to the hazards for each. (12 marks)

Description		Marks
1 mark for each appropriate potential hazard for each tool. Maximum 2 marks per tool x 3 stages in the production process		1–6
<b>subtotal</b>		<b>6</b>
1 mark for each appropriate control measure that relates to the hazard for each tool. Maximum 2 marks per tool x 3 stages		1–6
<b>subtotal</b>		<b>6</b>
<b>Total</b>		<b>12</b>
Answers could include:		
Tool	Potential hazards	Control measures
Using drop saw to cut timber to length.	<ul style="list-style-type: none"> <li>timber getting jammed or pinched in the blade</li> <li>sharp edges on blade</li> <li>debris such as dust and timber pieces</li> <li>amputation of fingers</li> <li>hearing damage</li> </ul>	<ul style="list-style-type: none"> <li>ensure timber is not twisted or bowed</li> <li>only cut across the grain</li> <li>ensure fingers are away from cutting edges before cutting</li> <li>wear protective glasses</li> <li>wear a dust mask or use extraction</li> <li>only cut across the grain</li> <li>ensure timber is not twisted or bowed</li> <li>work piece is securely held prior to cutting</li> <li>tuck thumb under palm of hand and ensure hand is clear of blade</li> <li>wear earmuffs or protection</li> </ul>
Using a router to shape the head.	<ul style="list-style-type: none"> <li>timber grabbing on router bit</li> <li>wood chips or dust in eyes</li> <li>dust inhalation</li> <li>finger getting in contact with fingers</li> <li>hearing damage</li> <li>clothing getting caught</li> </ul>	<ul style="list-style-type: none"> <li>ensure you are going against the direction of the router bit</li> <li>wear safety glasses</li> <li>extraction/dust mask</li> <li>keep fingers clear of router bit</li> <li>wear hearing protection</li> <li>tie loose clothing back</li> </ul>
Using a bandsaw to cut the tapers on each of the rockers.	<ul style="list-style-type: none"> <li>cutting injury</li> <li>blade snapping</li> <li>fingers jamming under timber</li> <li>eye injury</li> </ul>	<ul style="list-style-type: none"> <li>keep hands clear of blade</li> <li>ensure guards are in place</li> <li>don't turn the timber too much when cutting</li> <li>keep the table clear and ensure timber is flat</li> <li>safety glasses to protect from flying offcuts</li> </ul>
No marks for PPE, unless it is explained.		
Note: List is not exhaustive.		

**Question 11**

**(10 marks)**

- (a) Describe the cellular structure of **one** timber. Use an annotated drawing to support your answer. (4 marks)

Description	Marks
Description/drawing is comprehensive and includes annotations	4
Description/drawing is detailed and includes some annotations	3
Description/drawing and one of two annotations	2
Limited description/drawing and/or annotations	1
<b>Total</b>	<b>4</b>

Answers should include the following features – annotations may vary:

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<http://www.boeingconsult.com/tafe/mat/Timber/HowTreeGrows-OH.htm>

Description of the cellular structure of one of the following:

**Hardwood**  
 Hardwoods have vessel elements that transport water throughout the wood; under a microscope, these elements appear as pores. The pores in hardwoods are a lot of what gives hardwood its prominent grain, which is quite different from softwood's light grain.

**Softwood**  
 In softwoods, medullary rays and tracheids transport water and produce sap. When viewed under a microscope, softwoods have no visible pores because tracheids do not have pores.

- (b) Describe how the cellular structure contributes to **three** properties of this timber. (6 marks)

Description	Marks
3 properties x 2 marks each	
Identification of property with outline of how it relates to the timber's structure	2
Identification of property	1
<b>subtotal</b>	<b>2</b>
<b>Total</b>	<b>6</b>
<p>Answers could include:</p> <p><b>Properties</b></p> <ul style="list-style-type: none"> <li>the main structural element is the cellulose which is very effective in transmitting tension and compression</li> <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>the open cell structure of softwoods makes them generally more receptive than hardwoods to preservative treatments to enhance durability</li> </ul> <div style="border: 1px dashed gray; padding: 10px; margin: 10px 0;"> <p>For copyright reasons this text cannot be reproduced in the online version of this document, but may be viewed at  <a href="http://www.intad.asn.au/materials/wd_hrdsoft.asp">http://www.intad.asn.au/materials/wd_hrdsoft.asp</a></p> </div> <ul style="list-style-type: none"> <li>vessels which appear as pores on the end grain of hardwood determine the texture of the timber</li> <li>cavities of mature vessels in hardwood fill with crystallised gum, which add to the timbers durability by reducing fungal and insect attack</li> <li>fibres in hardwood provides the mechanical strength.</li> </ul>	
<p>Note: List is not exhaustive.</p>	

**Question 12**

**(12 marks)**

Discuss the influence that globalisation has on the local, national and international timber industries.

Description	Marks
<b>3 influences (local, national and international) x 4 marks each</b>	
Comprehensive discussion of influence on the impact globalisation has on the industry	4
Discussion of influence on the impact globalisation has on the industry	3
Outline of influence on the impact globalisation has on the industry	2
States an influence on the impact globalisation has on the industry	1
<b>subtotal</b>	<b>4</b>
<b>Total</b>	<b>12</b>
<p>Answers could include:</p> <p><b>Local</b></p> <ul style="list-style-type: none"> <li>• smaller independent companies are facing competition from outside their area</li> <li>• wider variety of products are available</li> <li>• independent retailers have better access to international products</li> <li>• local businesses can learn more about their clients through social media such as instagram</li> <li>• ability to create a home business selling designed or found products online</li> <li>• competition from cheaper, mass produced products from overseas</li> <li>• competition from the online market</li> <li>• consumers want cheaper retail prices</li> <li>• consumers are not concerned with sustainability of products over price.</li> </ul> <p><b>National</b></p> <ul style="list-style-type: none"> <li>• ease of communications between national branches</li> <li>• distribution is streamlined and more easily tracked</li> <li>• first world countries benefit due to bigger budgets and better access to resources</li> <li>• transport options such as express post are possible in emergency situations</li> <li>• reduction in manufacturing as companies go offshore to save money</li> <li>• in third world countries educated people move away to improve their quality of life</li> <li>• there are still discrepancies between countries regarding ethical working conditions.</li> </ul> <p><b>International</b></p> <ul style="list-style-type: none"> <li>• movement of workers around the globe</li> <li>• the internet allows us to access a wider variety products from other countries and cultures</li> <li>• businesses can easily access different markets</li> <li>• less travel is needed to conduct business with communication methods such as email and skype preferred</li> <li>• a global economy is emerging</li> <li>• countries can now exchange commodities</li> <li>• markets develop for international products such as jarrah, bamboo and iron-ore</li> <li>• the push for international trade has led to innovations in the handling and trade.</li> </ul>	
<p>Note: List is not exhaustive.</p>	

## Section Three: Metal Context

60% (82 Marks)

## Question 13

(12 marks)

- (a) With reference to a project you designed this year, outline **three** environmental impacts you had to consider during and following production and give **one** example of how you might have reduced each impact. (6 marks)

Description	Marks
One mark for each environmental impact outlined	1–3
<b>subtotal</b>	<b>3</b>
One mark for each suitable example given on how to reduce the environmental impact	1–3
<b>subtotal</b>	<b>3</b>
<b>Total</b>	<b>6</b>

Answers could include:

**Waste materials**

- were correctly disposed of
- materials that could be reused were stored so that they could be used for another project
- scrap material was used for welding practice etc.

**Fumes from welding**

- ensure extraction is on during the process to ensure all harmful toxins are removed from the area.

**Finish application and disposal**

- use VAC free finishes
- powder coating finish as there is little waste
- applied finish in a spray room/booth.

**Waste water**

- use a bucket of water to cool down welds/metals instead of using running tap water all of the time.

**Energy usage**

- ensure that after using each machine they were correctly turned off
- ensure that parts match properly by test fitting before welding things together.

Note: List is not exhaustive.

**Question 13** (continued)

- (b) Identify and outline **three** factors that could have affected the sustainability of the materials you have sourced for the project. (6 marks)

Description	Marks
3 factors x 2 marks each	
Identifies and outlines a factor that could have affected the sustainability of the materials sourced	2
Identifies a factor that could have affected the sustainability of the materials sourced	1
<b>subtotal</b>	<b>2</b>
<b>Total</b>	<b>6</b>

Answers could include:

**Origin:**

The origin of the material will determine if it is appropriate for the task. Choosing a material that is cleaner, that can be easily recycled or easier to work with.

**Availability:**

If the material is not available locally, it has to be transported meaning more fuel is used. Choosing an alternative that is available locally or choosing environmentally friendly transport methods might be an option.

**Treatment/finishes:**

Dyes, colouring techniques and finishes all impact the biodegradability of a product if they introduce non-organic chemicals to it. Choosing fabrics in their raw form then treating them with organic chemicals or purchasing them with organic treatments might be possible.

**Cost:**

The cost of the material will affect the final selection due to budget constraints. If a project's budget is limited you may have to look at an alternative material that has similar properties.

**Sustainability:**

The growth time and long term availability of the resource. Is the material renewable? Is the material recyclable? Does it have a limited life span?

**Environmental considerations:**

Is there a lasting effect on the environment from where the material was sourced? Has the material been sourced locally, reducing the need for lengthy deliveries, reducing the Co2 emissions from transport? Does the extraction of the material have a lasting effect on the local environment?

**Environment:**

Where will the product be used? Will it be exposed to certain elements, such as UV rays, rain and other conditions? Will it be used indoors?

Note: List is not exhaustive.

## Question 14

(14 marks)

- (a) Identify **two** types of heat treatments and describe how each alters the structure of a metal. (6 marks)

Description	Marks
2 x heat treatments x 3 marks each	
Detailed description of how the heat treatment alters the structure of a metal	3
Description of how the heat treatment alters the structure of a metal	2
Limited description of how the heat treatment alters the structure of a metal	1
<b>subtotal</b>	<b>3</b>
<b>Total</b>	<b>6</b>
<p>Answers could include:</p> <div style="border: 1px dashed gray; padding: 10px; margin: 10px auto; width: 80%;"> <p>For copyright reasons this text cannot be reproduced in the online version of this document, but may be viewed at  <a href="https://theroyalmechneers.wordpress.com/2015/05/30/heat-treatment-process/">https://theroyalmechneers.wordpress.com/2015/05/30/heat-treatment-process/</a></p> </div> <p><b>Annealing</b>            In ferrous alloys, annealing is usually accomplished by heating the metal beyond the upper critical temperature and then cooling very slowly, resulting in the formation of pearlite. In both pure metals and many alloys that cannot be heat treated, annealing is used to remove the hardness caused by cold working. The metal is heated to a temperature where recrystallisation can occur, thereby repairing the defects caused by plastic deformation. In these metals, the rate of cooling will usually have little effect.</p> <p><b>Quenching</b>            Quenching is a process of cooling a material that has been heated at a rapid rate using water or oil. Quenching ferrous metals will often result in the material becoming harder. But if you were to heat up a non-ferrous metal and then quench it the material would likely become softer.  <a href="https://knowledgetextile.wordpress.com/more/others/cotton-fiber-morphology/">https://knowledgetextile.wordpress.com/more/others/cotton-fiber-morphology/</a></p> <p>Note: List is not exhaustive.</p>	

**Question 14** (continued)

- (b) Discuss how hot and cold working processes affect the working/forming of metals. (8 marks)

Description	Marks
2 x working processes (hot and cold) x 4 marks each	
Comprehensive discussion of how the working process affects the working/forming of metals	4
Detailed discussion of how the working process affects the working/forming of metals	3
Satisfactory discussion of how the working process affects the working/forming of metals	2
Limited discussion of how the working process affects the working/forming of metals	1
<b>subtotal</b>	<b>4</b>
<b>Total</b>	<b>8</b>
<p>Answers could include:</p> <p><b>Hot working processes affecting properties examples</b></p> <div style="border: 1px dashed gray; padding: 5px; margin: 10px 0;"> <p>For copyright reasons this text cannot be reproduced in the online version of this document, but may be viewed at link: <a href="https://me-mechanicalengineering.com/comparison-of-hot-working-and-cold-working-processes/">https://me-mechanicalengineering.com/comparison-of-hot-working-and-cold-working-processes/</a></p> </div> <p><b>Cold working processes affecting the properties examples</b></p> <div style="border: 1px dashed gray; padding: 5px; margin: 10px 0;"> <p>For copyright reasons this text cannot be reproduced in the online version of this document, but may be viewed at link: <a href="https://me-mechanicalengineering.com/comparison-of-hot-working-and-cold-working-processes/">https://me-mechanicalengineering.com/comparison-of-hot-working-and-cold-working-processes/</a></p> </div>	
<p><b>Note:</b> List is not exhaustive.</p>	



## Question 15

(34 marks)

- (a) Using the image and the information in the tables above, complete each row of the table below and calculate the total cost of producing a single camping shovel. Round the costs to the nearest cent. (8 marks)

Description	Marks
One mark for each part total. Maximum of 7 marks	1–7
<b>subtotal</b>	<b>7</b>
One mark for total cost	1
<b>Total</b>	<b>8</b>

Part	Material	Size: (L × W × T)	Number required	Cost: (\$/m)	Cost: subtotal
Blade	MS plate	220 x 200 x 3	1	N/A	\$7.50
Handle	ERW tube	630 x 27	1	\$14.50	\$9.14
Bolt head	hexagonal bar	22 x 19	1	\$37.14	\$0.82
Bolt thread	threaded bar	65 x 12	1	\$9.92	\$0.64
Brackets	angle bar	25 x 25 x 25 x 3	2	\$3.06	\$0.15
Custom nut	round bar	25 x 27	1	\$11.39	\$0.28
Custom washer	flat bar	28 x 28 x 3	1	\$6.07	\$0.17
Pin	round bar	28 x 6	1	\$2.22	\$0.06
<b>Total cost</b>					<b>\$18.76</b>

- (b) The custom nut was made from one piece of round bar on the metalwork lathe. Explain in detail, using the correct terminology, how you would shape a roughly-cut piece of round bar to the finished size in preparation for the hole being threaded by hand. (4 marks)

Description	Marks
Comprehensive explanation of how you would shape a custom nut with the correct use of terminology	4
Detailed explanation of how you would shape a custom nut with the correct use of terminology	3
Satisfactory explanation of how you would shape a custom nut with some use of terminology	2
Limited explanation of how you would shape a custom nut with little or no use of terminology	1
<b>Total</b>	<b>4</b>
<p>Answers could include:</p> <ul style="list-style-type: none"> <li>place the material into the chuck with roughly 30 mm protruding</li> <li>face off one end of the MS rod</li> <li>using a centre drill, drill the centre of the face</li> <li>using a set of twist drills, drill in increments of 2 mm until you get to 10 mm</li> <li>parallel turn the first 20 mm down to 22 mm diameter</li> <li>using a parting tool to remove the custom nut from the other material.</li> </ul> <p>Note: List is not exhaustive.</p>	

**Question 15** (continued)

- (c) The MIG welding process will be used to attach the brackets to the blade. Explain the MIG welding process and identify **three** benefits of this joining method over others. (5 marks)

Description	Marks
Explanation of the MIG welding processes with use of subject terminology	2
Limited explanation of the MIG welding process with little to no use of subject terminology	1
<b>subtotal</b>	<b>2</b>
Identifies one to three suitable benefits	1–3
<b>subtotal</b>	<b>3</b>
<b>Total</b>	<b>5</b>
<p>Answers could include:</p> <div style="border: 1px dashed gray; padding: 10px; margin: 10px 0;"> <p>For copyright reasons this text cannot be reproduced in the online version of this document, but may be viewed at link: <a href="https://www.millerwelds.com/resources/article-library/mig-welding-the-basics-for-mild-steel">https://www.millerwelds.com/resources/article-library/mig-welding-the-basics-for-mild-steel</a></p> </div> <p>Benefits could include:</p> <ul style="list-style-type: none"> <li>• easy process to learn compared to other welding techniques</li> <li>• speed</li> <li>• high quality welds</li> <li>• minor weld spatter produced</li> <li>• can be used on a wide variety of metals and alloys</li> <li>• variable speeds and power means it can be used on different thicknesses of material.</li> </ul>	
<p>Note: List is not exhaustive.</p>	

- (d) Identify a suitable finish and explain how to prepare the material and apply the finish to it. (5 marks)

Description	Marks
One mark for correctly identifying a suitable finish	1
Detailed explanation of how to prepare the material	2
Limited explanation of how to prepare the material	1
<b>subtotal</b>	<b>2</b>
Detailed explanation of how the finish would be applied	2
Limited explanation of how the finish would be applied	1
<b>subtotal</b>	<b>2</b>
<b>Total</b>	<b>5</b>
<p>Answers could include:</p> <p><b>Examples of a suitable finish</b></p> <ul style="list-style-type: none"> <li>• powder coating</li> <li>• spray painting</li> <li>• galvanising.</li> </ul> <p><b>Preparation of material</b> Powder coating, spray painting and galvanising All weld areas should be filed and cleaned. All surfaces should be sanded and filed to remove any weld spatter, dirt, oil and grease as these can affect how a finish takes to the surface.</p> <p><b>Application of the finish</b> Powder coating and spray painting Before applying a top coat of paint you need to prime the surface. You should apply light even coats until all surfaces are evenly coated. Once dry the paint should be applied either a brush or can, the coats should be light and even and built up.</p> <p>Galvanising The material is dipped into molten zinc.</p> <p>Note: List is not exhaustive.</p>	

**Question 15** (continued)

- (e) Using the risk assessment table below, outline **two** potential hazards for each tool used during the production process described and **two** control measures that relate to the hazards for each. (12 marks)

Description		Marks
1 mark for each appropriate potential hazard for each tool. Maximum 2 marks per tool x 3 stages in the production process		1–6
<b>subtotal</b>		<b>6</b>
1 mark for each appropriate control measure that relates to the hazard for each tool. Maximum 2 marks per tool x 3 stages		1–6
<b>subtotal</b>		<b>6</b>
<b>Total</b>		<b>12</b>
Answers could include:		
Tool	Potential hazards	Control measures
Using bench shears remove the excess materials from the shovel blade.	<ul style="list-style-type: none"> <li>• closing movements between shearing surfaces and other parts can result in trapping</li> <li>• sharp edges on cutters, work pieces can cause cuts</li> <li>• squash/crush and pinch points</li> <li>• impact from handle</li> <li>• manual handling.</li> </ul>	<ul style="list-style-type: none"> <li>• ensure fingers are away from cutting edges before cutting</li> <li>• wear protective gloves to protect hand and fingers from sharp edges</li> <li>• ensure you are not standing directly in front of the handle</li> <li>• ensure no one is behind you when operating the tool</li> <li>• work piece is securely held prior to cutting.</li> </ul>
Using the MIG welder to attach the angle brackets onto the blade.	<ul style="list-style-type: none"> <li>• electric shock</li> <li>• fumes</li> <li>• fire</li> <li>• radiation burns to eyes or body</li> <li>• flying sparks</li> <li>• body burns</li> <li>• tripping hazards.</li> </ul>	<ul style="list-style-type: none"> <li>• ensure workplace is free of any potential hazards prior to starting</li> <li>• material and work area is free from oil and grease</li> <li>• fume extraction system is on</li> <li>• wear a welding mask, ensure it is in good working order</li> <li>• ensure others around you are protected</li> <li>• wear overalls to protect your skin</li> <li>• wear leather gloves to protect your hand from the heat</li> <li>• near lift hot material.</li> </ul>
Using a drill press to drill the 6 mm hole in the centre of the bracket.	<ul style="list-style-type: none"> <li>• eye injuries</li> <li>• entanglement in rotating parts</li> <li>• flying off cuts</li> <li>• hot drill bits and surfaces</li> <li>• sharp edges and burrs</li> <li>• material catching and spinning.</li> </ul>	<ul style="list-style-type: none"> <li>• ensure work is securely held in a machine vice</li> <li>• safety glasses to protect from flying off cuts</li> <li>• ensure speed is set correctly</li> <li>• if necessary use a cutting compound</li> <li>• ensure drill bit is sharp</li> <li>• no loose clothing.</li> </ul>
No marks for PPE, unless it is explained.		
Note: List is not exhaustive.		

Question 16

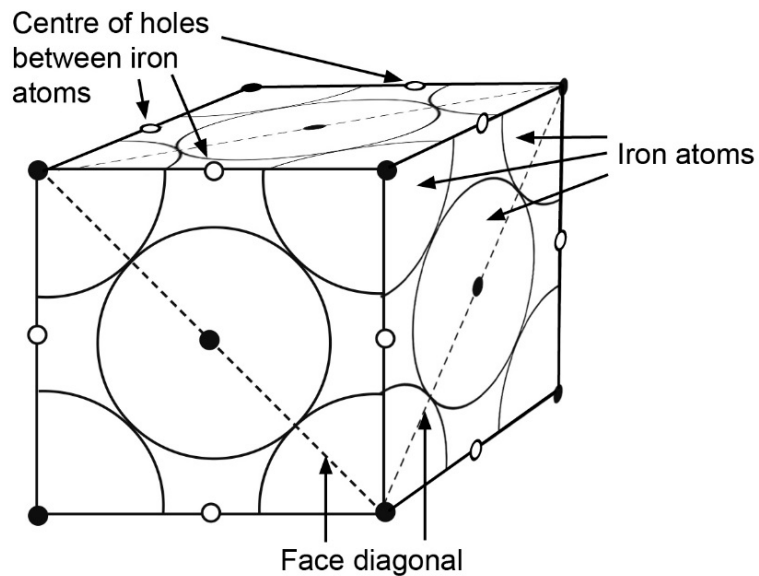
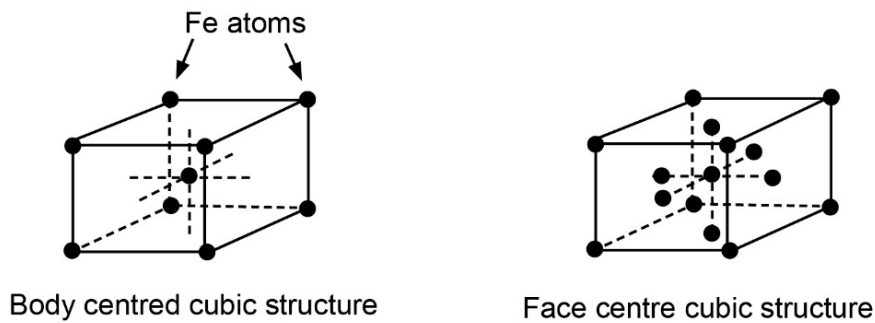
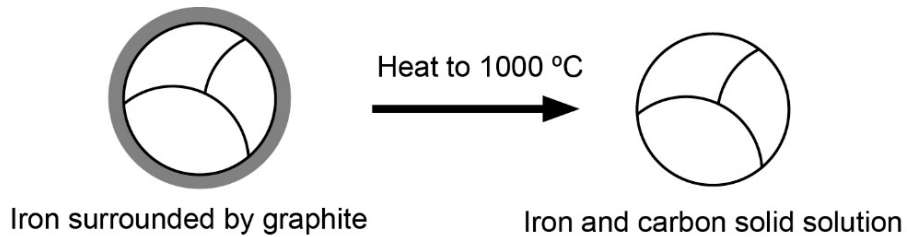
(10 marks)

- (a) Describe the atomic (crystalline/grain) structure of steel. Use an annotated drawing to support your answer. (4 marks)

Description	Marks
Description/drawing is comprehensive and includes detailed annotations	4
Description/drawing is detailed and includes some annotations	3
Description/drawing or annotations and one or two annotations	2
Limited description/drawing and/or annotations	1
<b>Total</b>	<b>4</b>

Answers must include the following features – annotations may vary:

**Example of an annotated drawing**



**Possible description of the atomic (crystalline/grain) structure of steel**

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**Question 16** (continued)

- (b) Describe how the atomic (crystalline/grain) structure of steel contributes to **three** physical properties. (6 marks)

Description	Marks
3 physical properties x 2 marks each	
Identification of a physical property with description of how the structure contributes to the physical property	2
Identification of a physical property	1
<b>subtotal</b>	<b>2</b>
<b>Total</b>	<b>6</b>

**Crystalline/grain structure and physical properties**

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[www.materials.ac.uk/resources/fe/ferrousmetallurgy.ppt](http://www.materials.ac.uk/resources/fe/ferrousmetallurgy.ppt)

**Grain Structure**

Before cold working the grains are all of a similar size, but during the cold working process the grains are elongated and this increases the hardness and strength of the material.

During the hot working process new grains can be formed above 350 °C and these replace the old grains. This is known as recrystallisation and this process softens and lowers the material's strength, while also increasing the material's ductility. Excessive temperatures during recrystallisation can cause the material to develop poor mechanical properties.

As the **grain size** is reduced hardness (and yield stress) increases. As yield/hardness increase, usually **ductility** decreases, since dislocations have a higher number of boundaries to pile up into and the volume available for their movement is greatly reduced.

Note: List is not exhaustive.

## Question 17

(12 marks)

Discuss the influence that globalisation has on the local, national and international metal industries.

Description	Marks
3 influences (local, national and international) x 4 marks each	
Comprehensive discussion of influence on the impact globalisation has on the industry	4
Discussion of influence on the impact globalisation has on the industry	3
Outline of influence on the impact globalisation has on the industry	2
States an influence on the impact globalisation has on the industry	1
<b>subtotal</b>	<b>4</b>
<b>Total</b>	<b>12</b>
<p>Answers could include:</p> <p><b>Local</b></p> <ul style="list-style-type: none"> <li>• smaller independent companies are facing competition from outside their area</li> <li>• wider variety of products are available</li> <li>• independent retailers have better access to international products</li> <li>• local businesses can learn more about their clients through social media such as instagram</li> <li>• ability to create a home business selling designed or found products online</li> <li>• competition from cheaper, mass produced products from overseas</li> <li>• competition from the online market</li> <li>• consumers want cheaper retail prices</li> <li>• consumers are not concerned with sustainability of products over price.</li> </ul> <p><b>National</b></p> <ul style="list-style-type: none"> <li>• ease of communications between national branches</li> <li>• distribution is streamlined and more easily tracked</li> <li>• first world countries benefit due to bigger budgets and better access to resources</li> <li>• transport options such as express post are possible in emergency situations</li> <li>• reduction in manufacturing as companies go offshore to save money</li> <li>• in third world countries educated people move away to improve their quality of life</li> <li>• there are still discrepancies between countries regarding ethical working conditions.</li> </ul> <p><b>International</b></p> <ul style="list-style-type: none"> <li>• movement of workers around the globe</li> <li>• the internet allows us to access a wider variety products from other countries and cultures</li> <li>• businesses can easily access different markets</li> <li>• less travel is needed to conduct business with communication methods such as email and skype preferred</li> <li>• a global economy is emerging</li> <li>• countries can now exchange commodities</li> <li>• markets develop for international products such as jarrah, bamboo and iron-ore</li> <li>• the push for international trade has led to innovations in the handling and trade.</li> </ul>	
Note: List is not exhaustive.	

**Section Three: Textiles context**

**60% (82 Marks)**

**Question 18**

**(12 marks)**

- (a) With reference to a project you designed this year, outline **three** environmental impacts you had to consider during and following production and give **one** example of how you might have reduced each impact. (6 marks)

Description	Marks
One mark for each environmental impact	1–3
<b>subtotal</b>	<b>3</b>
One mark for each suitable example given on how to reduce them	1–3
<b>subtotal</b>	<b>3</b>
<b>Total</b>	<b>6</b>
<p>Answers could include:</p> <p><b>Material waste</b></p> <ul style="list-style-type: none"> <li>by using off cuts to create pockets and add embellishments.</li> </ul> <p><b>Chemical waste</b></p> <ul style="list-style-type: none"> <li>by using vegetable dyes or organic paints.</li> </ul> <p><b>Landfill</b></p> <ul style="list-style-type: none"> <li>by considering using materials that biodegrade such as cotton or that can be recycled such as polyester.</li> </ul> <p><b>Finish application</b></p> <ul style="list-style-type: none"> <li>by sourcing locally grown materials and locally made embellishments such as beads therefore no transportation required.</li> </ul> <p><b>Energy usage</b></p> <ul style="list-style-type: none"> <li>by turning off all machinery when not in use and consideration of alternatives such as constructing a blind hem by hand.</li> </ul> <p>Note: List is not exhaustive.</p>	



- (b) Identify and outline **three** factors that could have affected the sustainability of the materials you have sourced for the project. (6 marks)

Description	Marks
3 factors x 2 marks each	
Identifies and outlines a factor that could have affected the sustainability of the materials sourced	2
Identifies a factor that that could have affected the sustainability of the materials sourced	1
<b>subtotal</b>	<b>2</b>
<b>Total</b>	<b>6</b>
<p>Answers could include:</p> <p><b>Origin/classification</b> The origin/classification of the material will determine if it is biodegradable. Choosing a version of the material that is cleaner or that can be more easily recycled or choosing a different material that is more easily biodegraded.</p> <p><b>Availability</b> If the material is not available locally, it has to be transported meaning more fuel is used. Choosing an alternative that is available locally or choosing environmentally friendly transport methods might be an option.</p> <p><b>Treatment/finishes</b> Dyes, colouring techniques and finishes all impact the biodegradability of a product if they introduce non-organic chemicals to it. Choosing fabrics in their raw form then treating them with organic chemicals or purchasing them with organic treatments might be possible.</p> <p><b>Cost</b> The cost of the material will affect the final selection due to budget constraints. If a project's budget is limited you may have to look at an alternative material that has similar properties.</p> <p><b>Sustainability</b> The growth time and long term availability of the resource. Is the material renewable? Is the material recyclable? Does it have a limited life span?</p> <p><b>Environmental considerations</b> Is there a lasting effect on the environment from where the material was sourced? Has the material been sourced locally, reducing the need for lengthy deliveries, reducing the CO<sub>2</sub> emissions from transport? Does the extraction of the material have a lasting effect on the local environment?</p> <p><b>Environment</b> Where will the product be used? Will it be exposed to certain elements, such as UV Rays, rain and other conditions? Will it be used indoors?</p> <p><b>Properties</b> The aesthetic, chemical and physical properties of a fabric will determine if it meets the requirements of the design brief. These properties must be taken into account when selecting a material.</p> <p>Note: fibres and fabrics accepted.</p> <p>Note: List is not exhaustive.</p>	

Question 19

(14 marks)

- (a) Identify and describe the characteristics of **two** different yarn structures that are available. (6 marks)

Description	Marks
2 yarn structures x 3 marks each	
Identifies and gives a detailed description of the characteristics of a yarn structure	3
Identifies and describes the characteristics of a yarn structure	2
Limited description of a characteristic of a yarn structure	1
<b>subtotal</b>	<b>3</b>
<b>Total</b>	<b>6</b>
<p>Answers could include:</p> <p><b>Staple spun yarn:</b> short staple fibres spun together in a twisted manner</p> <ul style="list-style-type: none"> <li>• single staple spun yarn</li> <li>• ply spun yarn.</li> </ul> <p><b>Filament yarn:</b> one or more continuous filament strands</p> <ul style="list-style-type: none"> <li>• monofilament</li> <li>• multifilament.</li> </ul> <p><b>Novelty yarn:</b> yarns constructed with features added during the yarn construction process</p> <ul style="list-style-type: none"> <li>• flocked yarn</li> <li>• chenille yarn.</li> </ul> <p>Note: List is not exhaustive.</p>	

- (b) Identify **two** fabric types, outline the structure of each type and compare both by describing their physical characteristics and uses. (8 marks)

Description	Marks
1 mark for correctly identifying each fabric type	1–2
<b>subtotal</b>	<b>2</b>
1 mark for outline of the structure of each fabric type	1–2
<b>subtotal</b>	<b>2</b>
Detailed comparative description of physical characteristics and uses	4
Comparative description of physical characteristics and uses	3
Describes physical characteristics and/or uses of both types but has no comparison	2
Limited description of fabric types	1
<b>subtotal</b>	<b>4</b>
<b>Total</b>	<b>8</b>
<p>Answers could include:</p> <p><b>Woven fabrics:</b> fabrics constructed in a geometrical pattern, traditionally on a flat loom. All weaves unravel and generally hold no stretch, unless they have a lycra/elastane blend to the fibre</p> <ul style="list-style-type: none"> <li>• <b>Plain weave</b> - traditional alternating over and under technique, looks and feels the same on both sides. Can be tightly or loosely woven (used in sheets, shirts and nylon tracksuits/windcheaters).</li> <li>• <b>Twill weave</b> - the weave technique is offset, resulting in a raised diagonal pattern on only the right side of the fabric. Tends to be more stain-and water-resistant (used in jeans, heavy duty workwear).</li> </ul> <p><b>Knit fabrics:</b> fabrics constructed in a looped pattern, generally on a flat bed and/or increasingly now on circular knitting machines. Knits do not unravel and are all stretchy to different extents</p> <ul style="list-style-type: none"> <li>• <b>Weft knit</b> - in weft knit fabrics the loops are formed horizontally, in a similar fashion to traditional hand knitted technique. Weft knits can be formed on a circular knitting machine. Weft knits traditionally drape well and are stretchier than warp knits. (for example jersey used in t-shirts)</li> <li>• <b>Warp knit</b> - in warp knits the loops are formed vertically. This is usually done on a knitting machine that is always a flatbed machine. It can be done by hand using the crochet technique but this is very time consuming. (Lace and tricot are created on warp knitting machines as well as netting and curtain fabrics).</li> </ul> <p><b>Non-woven fabrics:</b> these are fabrics constructed with the bonding of loose fibres with either a gluing agent or in the case of felt, friction and detergents. Bonded fabrics tend not to hold any stretch, are not always comfortable and are difficult to wash, particularly as hot water can either break down the bonds or shrink the fabric</p> <ul style="list-style-type: none"> <li>• <b>Felt</b> - felt is made by matting and pressing fibres together with the aid of detergents (used in hats, coats and other items such as boots).</li> </ul> <p>Note: List is not exhaustive.</p>	

**Question 20**

**(34 marks)**

- (a) Using the photograph, pattern and information in the tables below, complete each row of the table and calculate the total cost of producing a single shark pencil case. Select a zipper type and enter the type in the shaded area. Round the costs to the nearest cent. (8 marks)

Description	Marks
One mark for each part total. Maximum of 7 marks	1–7
One mark for total cost	1
<b>Total</b>	<b>8</b>
See below for working: <ul style="list-style-type: none"> <li>• 1 mark for selecting a standard zipper</li> <li>• 1 mark for total cost</li> <li>• 3 marks for material quantity calculations</li> <li>• 3 marks for material costing calculations</li> </ul> Note: costings that assume 12 cm width for body and wadding also accepted.	

Item	Quantity	Cost/m	Cost
Body fabric	0.24m	\$2.99/m	\$0.72
Fin and tail fabric	0.07m	\$5.60/m	\$0.39
Polyester iron on wadding liner (for body, tail, mouth and fins)	0.24m	\$6.00/m	\$1.44
Thread	1	\$2.99	\$2.99
Zipper type: standard zipper	1	\$1.99	\$1.99
Eyes (2 pk)	1	\$1.99	\$1.99
<b>Total cost</b>			<b>\$9.52</b>

- (b) To add a zipper to any product, the sewing machine must first be prepared. Explain in detail, using the correct terminology, the steps in the process followed to prepare the machine and placement of the fabric and zipper in the machine before you begin. (4 marks)

Description	Marks
Detailed explanation of the steps in the process needed to prepare for the placement of the fabric and zipper with the correct use of terminology	4
Explanation of the steps in the process needed to prepare for the placement of the fabric and zipper with the correct use of terminology	3
Description of the steps in the process needed to prepare for the placement of the fabric and zipper with the some use of terminology	2
Outline of the process needed to prepare for addition of a zipper with little to no use of correct terminology	1
<b>Total</b>	<b>4</b>
Answers could include: <ul style="list-style-type: none"> <li>• turn off the sewing machine</li> <li>• unscrew or unclip universal foot and replace with zipper foot</li> <li>• replace with zipper foot, aligning to left if zipper teeth are to sit on the right of the machine (and vice versa)</li> <li>• turn on machine and align the needle so that it will not make contact with the zipper foot</li> <li>• place fabric in the machine with zipper to the side of the zipper foot</li> <li>• manually drive needle into fabric slowly to ensure zipper foot, fabric and zipper and needle are correctly aligned.</li> </ul>	

Note: List is not exhaustive.

- (c) The belly of the shark must be attached to the body using a joining technique that can be integrated with a zipper. Identify this technique and explain how it works, giving reasons why you would use it over another technique. (5 marks)

Description	Marks
Identifies a joining technique with reasons and identification of other technique	2
Identifies a joining technique with weak or no reason	1
<b>subtotal</b>	<b>2</b>
Detailed explanation of the process needed to attach the belly to the body with some use of subject terminology	3
Explanation of the process needed to attach the belly to the body with some use of subject terminology	2
Limited description of the process needed to attach the belly to the body with little to no use of subject terminology	1
<b>subtotal</b>	<b>3</b>
<b>Total</b>	<b>5</b>
<p>Answers could include:</p> <p><b>Open seam</b></p> <ul style="list-style-type: none"> <li>• pin belly to body, with side fins and tail inside</li> <li>• stitch seam 1.5 cm from edge leaving mouth open for zipper</li> <li>• overlock seam edges separately.</li> </ul> <p>Justification: This seam allows the seam edges to sit flat in line with the zipper.</p> <p><b>Closed seam</b></p> <ul style="list-style-type: none"> <li>• pin belly to body, with side fins and tail inside</li> <li>• stitch seam 1.5 cm from edge leaving mouth open for zipper</li> <li>• sew zipper in, then overlock seam edges together.</li> </ul> <p>Justification: This seam is much stronger than the open seam, making the product more durable.</p> <p>Note: List is not exhaustive.</p>	

**Question 20** (continued)

- (d) Identify a decorative technique that could be added to the pencil case. Describe what materials and equipment would be needed and how the technique would be applied. (5 marks)

Description	Marks
One mark for correctly identifying a suitable decorative technique	1
Description of the materials and equipment need	2
Limited detailed description of the materials and equipment need	1
<b>subtotal</b>	<b>2</b>
Description of how the decorative technique would be applied	2
Limited description of how the decorative technique would be applied	1
<b>subtotal</b>	<b>2</b>
<b>Total</b>	<b>5</b>
<p>Answers could include:</p> <p><b>Decorative technique:</b></p> <ul style="list-style-type: none"> <li>• application of gems</li> <li>• application of embroidery</li> <li>• sequencing</li> <li>• lacing.</li> </ul> <p><b>Equipment and materials needed:</b>                      To carry out the application of embroidery you would need embroidery threads, needles and chalk. You could also use an embroidery hoop, embroidery machine, embroidery feet and interfacing to add structure to the back.</p> <p><b>Application:</b>                      Draw pattern onto fabric with chalk. Thread embroidery needle. Using selected embroidery technique, embroider over the pattern onto the fabric, changing threads as necessary.</p> <p>Note: List is not exhaustive.</p>	

- (e) Using the risk assessment table below, outline **two** potential hazards for each tool used during the production process described and **two** control measures that relate to the hazards for each. (12 marks)

Description		Marks
1 mark for each appropriate potential hazard for each tool. Maximum 2 marks per tool x 3 stages in the production process		1–6
<b>subtotal</b>		<b>6</b>
1 mark for each appropriate control measure that relates to the hazard for each tool. Maximum 2 marks per tool x 3 stages		1–6
<b>subtotal</b>		<b>6</b>
<b>Total</b>		<b>12</b>
Answers could include:		
Tool	Potential hazards	Control measures
Using the sewing machine to attach the zipper.	<ul style="list-style-type: none"> <li>• electric shock</li> <li>• risk of eye injury from the needle if it breaks</li> <li>• risk of piercing hand or fingers with the needle.</li> </ul>	<ul style="list-style-type: none"> <li>• ensure workplace is free of any potential hazards prior to starting</li> <li>• ensure machine is not turned on unless in use</li> <li>• ensure hands are clear of the needle</li> <li>• ensure the needle does not cross the teeth of the zipper.</li> </ul>
Using the overlocker.	<ul style="list-style-type: none"> <li>• electric shock</li> <li>• risk of injury from the cutter</li> <li>• risk of unintentionally cutting fabric with the cutter.</li> </ul>	<ul style="list-style-type: none"> <li>• ensure workplace is free of any potential hazards prior to starting</li> <li>• ensure machine is not turned on unless in use</li> <li>• ensure hands are clear of the cutter</li> <li>• ensure extra fabric does not creep under the blade.</li> </ul>
Ironing on the wadding.	<ul style="list-style-type: none"> <li>• electric shock</li> <li>• burns to skin</li> <li>• burns to the fabric</li> <li>• melting of the wadding.</li> </ul>	<ul style="list-style-type: none"> <li>• ensure iron has been safety tagged and the cord is not damaged</li> <li>• ensure iron is not turned on unless in use</li> <li>• ensure heat is set correctly so fabric and wadding do not burn</li> <li>• no loose clothing to avoid getting it caught.</li> </ul>
No marks for PPE, unless it is explained.		
Note: List is not exhaustive.		

**Question 21**

**(10 marks)**

- (a) Describe the molecular and morphological structure of **one** fibre. Use an annotated drawing to support your answer. (4 marks)

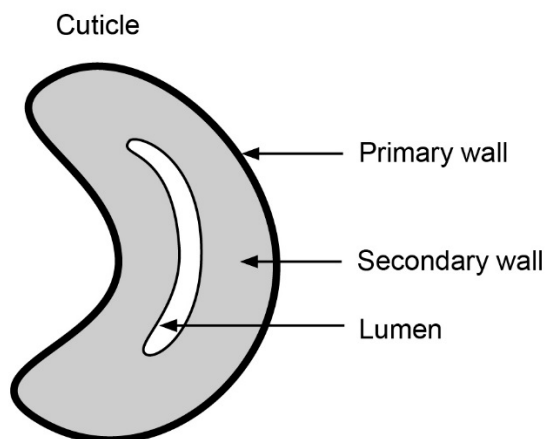
Description	Marks
Description/drawing is comprehensive and includes detailed annotations.	4
Description/drawing is satisfactory and includes some annotations.	3
Description/drawing or annotations are satisfactory	2
Limited description/drawing and/or annotations	1
<b>Total</b>	<b>4</b>

Answers must include the following features – annotations and answers may vary:

Example of images for a fibre below:

**Cotton fibre**

For copyright reasons this image cannot be reproduced in the online version of this document, but may be viewed at <https://knowledgetextile.wordpress.com/more/others/cotton-fiber-morphology/>



Description of the molecular and morphological structure of a cotton fibre:

**Cross-section view**

- annotated cross section drawing
- indication of whether the fibre is hollow or solid
- indication of whether the cell wall(s) are porous or solid.

**Longitudinal view**

- annotated longitudinal view (closed, open or partially open accepted)
- indication of any physical and/or aesthetic features
- description of the overall shape (accepted on either drawing).



- (b) Describe how the molecular and morphological structure contributes to **three** properties of this fibre. (6 marks)

Description	Marks
3 x properties x 2 marks each	
Identification of property with description of how the molecular and morphological structure contributes to the properties	2
Identification of property	1
<b>subtotal</b>	<b>2</b>
<b>Total</b>	<b>6</b>
<p>Answers could include:</p> <p><b>Discussion of properties - suggested answers to cotton example might include</b></p> <ul style="list-style-type: none"> <li>• discussion of likely shrinkage based on longitudinal views</li> <li>• discussion of likely absorption based on cross sectional/longitudinal annotations</li> <li>• discussion of likely lustre based on longitudinal view</li> <li>• discussion of molecular structure and relationship to properties.</li> </ul> <p><b>Natural cotton fibre properties</b></p> <ul style="list-style-type: none"> <li>• length of cotton fibre - physically the individual cotton fibres consist of a single long tubular cell. The length of a cotton fibre varies depending on the type of cotton</li> <li>• cotton is a soft and absorbent natural fibre which makes it suitable for undergarments</li> <li>• cotton conducts heat so keeps the body cool in summer and warm in winter</li> <li>• cotton is non-allergenic and, unlike synthetic fibres, cotton fibre is a natural product that contains no chemicals</li> <li>• cotton is considered to be a 'breathable fibre' which is healthier and comfortable which is because of its unique structure</li> <li>• cotton is one of the easiest fabrics to dye due to its natural whiteness and high rate of absorbency</li> <li>• Australian cotton may be dyed easily and does not break in looms easily</li> <li>• cotton becomes stronger when wet and holds up to 27 times its own weight in water</li> <li>• cotton does not have any static cling as it cannot retain an electric charge</li> <li>• elastic properties of cotton – there is relatively little elasticity and if deformation occurs it often cannot be returned to its original form.</li> </ul> <p>Note: Complete list of examples not supplied as the responses will be too varied.</p>	

**Question 22**

**(12 marks)**

Discuss the influence that globalisation has on the local, national and international textile industries.

Description	Marks
<b>3 x types of influences (local, national and international)</b>	
Comprehensive description of influences on the impacts globalisation has had on the industry	4
Detailed description of influences on the impacts globalisation has had on the industry	3
Satisfactory description of influences on the impacts globalisation has had on the industry	2
Limited description of influences on the impacts globalisation has had on the industry	1
<b>subtotal</b>	<b>4</b>
<b>Total</b>	<b>12</b>

Answers could include:

**Local**

- smaller independent companies are facing competition from outside their area
- wider variety of products are available
- independent retailers have better access to international products
- local businesses can learn more about their clients through social media such as instagram
- ability to create a home business selling designed or found products online
- competition from cheaper, mass produced products from overseas
- competition from the online market
- consumers want cheaper retail prices
- consumers are not concerned with sustainability of products over price.

**National**

- ease of communications between national branches
- distribution is streamlined and more easily tracked
- first world countries benefit due to bigger budgets and better access to resources
- transport options such as express post are possible in emergency situations
- reduction in manufacturing as companies go offshore to save money
- in third world countries educated people move away to improve their quality of life
- there are still discrepancies between countries regarding ethical working conditions.

**International**

- movement of workers around the globe
- the internet allows us to access a wider variety products from other countries and cultures
- businesses can easily access different markets
- less travel is needed to conduct business with communication methods such as email and skype preferred
- a global economy is emerging
- countries can now exchange commodities
- markets develop for international products such as jarrah, bamboo and iron-ore
- the push for international trade has led to innovations in the handling and trade.

Note: List is not exhaustive.

## ACKNOWLEDGEMENTS

- Question 9(a)** Text under 'Answers could include' adapted from: Hardwood Distributor's Association. (2017). *What is the difference between quarter sawn, rift sawn and plain sawn lumber?* Retrieved November, 2017, from <http://www.hardwooddistributors.org/blog/postings/what-is-the-difference-between-quarter-sawn-rift-sawn-and-plain-sawn-lumber/>
- Question 11(a)** Diagrams from: *Tree wuchs – hardwood/softwood* (Fig. 2). (n.d.). Retrieved November, 2017, from <http://www.boeingconsult.com/tafe/mat/Timber/HowTreeGrows-OH.htm>
- Question 11(b)** Text under 'Answers could include' from:  
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2nd dot point: Skates, L. (2012). *CE 479: Design of Building Components and Systems Fall 2012 – J. Liu* [PowerPoint slides]. Retrieved November, 2017, from <http://slideplayer.com/slide/3907826/>  
3rd dot point: *Tree wuchs – hardwood/softwood* (Cell structure of softwood and hardwood). (n.d.). Retrieved November, 2017, from <http://www.boeingconsult.com/tafe/mat/Timber/HowTreeGrows-OH.htm>  
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- Question 14(a)** Hardening (1st sentence), tempering and normalising text from: *Heat treatment process* [Blog post]. (2015, May 30). Retrieved November, 2017, from <https://theroyalmechneers.wordpress.com/2015/05/30/heat-treatment-process/>  
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- Question 14(b)** Hot working processes and cold working processes text from: ME Mechanical Team. (2016). *Comparison of hot working and cold working processes*. Retrieved November, 2017, from <https://me-mechanicalengineering.com/comparison-of-hot-working-and-cold-working-processes/>
- Question 15(c)** MIG welding definition from: Miller Electric Manufacturing Co. (n.d.). *MIG welding: The basics for mild steel*. Retrieved November, 2017, from <https://www.millerwelds.com/resources/article-library/mig-welding-the-basics-for-mild-steel>
- Question 16(a)** Diagram from: Sarna, S. K. (2016, March 6). Carbon steels and the iron-carbon phase diagram (Fig. 1). *Ispat Digest*. Retrieved November, 2017, from <http://ispatguru.com/carbon-steels-and-the-iron-carbon-phase-diagram/>  
Description of atomic structure of steel from: Crystal, M. (2017). *Atomic structure of steel* (The crystal lattice). Retrieved November, 2017, from <https://sciencing.com/atomic-structure-steel-6638014.html>

- Question 16(b)** Ferrite, cementite and pearlite text from: *Ferrous metallurgy: The chemistry and structure of iron and steel* [PowerPoint slides]. (n.d.). [Originally available on UK Centre for Materials Education website]
- Question 21(a)** First diagram adapted from: [Cotton fibre structure drawing]. (n.d.). Retrieved November, 2017, from <https://knowledgetextile.wordpress.com/more/others/cotton-fiber-morphology/>
- Second diagram adapted from: Arafa, A. S. (2014, November 24). Alternate relationship between single fiber properties and both of fiber microscopic and physical properties (Fig. 2). *Journal of Textile Science & Engineering*, 4(6). Retrieved November, 2017, from <https://www.omicsonline.org/open-access/alternate-relationship-between-single-fiber-properties-and-both-of-fiber-microscopic-and-physical-properties-2165-8064.1000175.php?aid=36830>  
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