Scheme of work – R014 Principles of engineering manufacture

## About this scheme of work

**Our redeveloped Cambridge National in Engineering Manufacture J823 is for first teaching from September 2022.**

This qualification provides lots of flexibility, allowing you to find the best route to suit your centre’s needs.Our curriculum planner shows you at a high level how you could teach the course over two or three years. Our schemes of work provide examples of how you could deliver each unit, integrating the knowledge and understanding learned in the externally assessed unit.

All schemes of work should provide an opportunity for integrating the knowledge and understanding learned from the externally assessed unit content alongside the NEA assessment content. This scheme of work provides one example for delivery of this unit. You may find that a different approach would work better in your centre. We have provided a blank template should you wish to create your own or adapt one of the approaches provided.

You’ve given us lots of feedback on what you need from a scheme of work, so we’ve made sure this resource features:

* a **unit-specific** and **lesson by lesson** approach
* **simple** and **editable** Word format – or you can use our [blank template](https://www.ocr.org.uk/Images/639549-scheme-of-work-template.docx) to create your own version
* links to our [curriculum planner’s first model](https://ocr.org.uk/Images/619713-curriculum-planner.docx) which is one teacher teaching the qualification over two years, broken down into half terms
* each lesson’s **key terms**
* **ideas** for teaching and learning with useful **links**
* some ‘warm up’ teaching ideas if you’re teaching over three years.

## Units and guided learning hours

**Our redeveloped Cambridge Nationals can be tailored to suit your needs – so this scheme of work and the lesson ideas are only suggestions.**

Here is a reminder of the **three mandatory units** in the redeveloped Cambridge National in Engineering Manufacture:

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| **Unit** | **Unit title** | **Guided learning hours (GLH)** | **How are they assessed?** | **Mandatory or optional?** |
| **R014** | **Principles of engineering manufacture** | **48** | **E** | **M** |
| R015 | Manufacturing a one-off product | 36 | NEA | M |
| R016 | Manufacturing in quantity | 36 | NEA | M |

## Assumptions

* You will adapt the SOW and lesson content to match your own timetabling arrangements and will choose how to spread the 48 GLH over the two years as best fits your needs. We have worked on the basis that the average lesson time is around 45 minutes.
* Students can access some resources outside of lessons for any online homework or extension tasks.
* You will refer to the [specification](https://www.ocr.org.uk/Images/610947-specification-cambridge-nationals-engineering-manufacture-j823.pdf) as the key document for detailed insight into the qualification’s content and assessment requirements.

## **Summary of software/other equipment in this scheme of work**

* Engineering drawings of parts/components.
* Basic drawing equipment (e.g. rule, pencils, paper etc.) to produce or complete engineering drawings.
* Engineering material samples to show form and properties (if available).
* Suitable physical parts/components to illustrate processes used in their manufacture (if available).
* Practical tools and machines to demonstrate manufacturing processes (if available).

## First year of teaching

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|  Autumn 1 |
| **Summary of what you will cover from the** [curriculum planner](https://www.ocr.org.uk/Images/619713-curriculum-planner.docx)**:** | **Reading engineering drawings** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA3Manufacturing requirements3.1 Interpreting orthographic third angle projection drawings | You could begin the unit with an introduction to how engineering drawings communicate the information required to manufacture components and products.In the first lesson you could:* show engineering drawings of parts/components and provide a summary of the key features being communicated
* explain third angle orthographic projection drawings
* focus on engineering line types, and what they represent
* provide example drawings which illustrate different line types for students to identify.

Students are required to use engineering drawings in both Units R015 and R016 and so this theoretical section on engineering drawing could complement their interpretation in these other units. | **Engineering drawings****Line types** | Recall and explain the meaning of different drawing line types.Identify different line types on drawings. | [Working drawings - Designing](https://www.bbc.co.uk/bitesize/guides/zvgvgdm/revision/6) - GCSE Design and Technology Revision - BBC Bitesize (bbc.co.uk) | R015/R016Students are required to interpret engineering drawings in both units. |
| 2 | TA3Manufacturing requirements3.1 Interpreting orthographic third angle projection drawings | Following on from the previous lesson you could continue to explore engineering drawings. You could:* illustrate how standard drawing conventions are used to communicate dimensions
* provide drawings with dimensions in different formats for students to interpret
* provide drawings with incomplete dimensioning for students to add missing dimensions to
* task students to calculate maximum and minimum acceptable dimensions from stated tolerances.
 | **Engineering drawings****Standard conventions** | Recall and explain drawing conventions used for adding dimensions.Interpret dimensions from a drawing; calculate upper and lower limits of a tolerance.Add dimensions to a drawing. | [Introduction to Orthographic Projection](https://static.sdcpublications.com/multimedia/9781630570521-sample/ege/ortho/ortho_page1.htm) (sdcpublications.com)[Guide to Engineering drawing conventions (design-technology.info)](http://www.design-technology.info/IndProd/drawings/) | R015/R016Students are required to interpret engineering drawings in both units. |
| 3 | TA3Manufacturing requirements3.1 Interpreting orthographic third angle projection drawings | In this lesson you could continue to explore engineering drawings by:* explaining, using drawings, abbreviations used and their meaning
* developing and using flashcards with parts of engineering drawings with abbreviations for students to identify
* providing more complex and complete engineering drawings with abbreviations for students to identify working in small groups.
 | **Engineering drawings****Abbreviations** | Recall and identify abbreviations used on engineering drawings. | [TES Engineering Drawing resource](https://www.tes.com/teaching-resource/engineering-drawing-resource-11420865) (tes.com)[note – some resources have download fee][Acronyms and Abbreviations in Engineering](https://blog.draftsperson.net/acronyms-and-abbreviations-in-engineering/) (draftsperson.net) | R015/R016Students are required to interpret engineering drawings in both units. |
| 4 | TA3Manufacturing requirements3.1 Interpreting orthographic third angle projection drawings | For this lesson on engineering drawings, you could:* show how mechanical features are communicated on drawings
* relate the mechanical features shown to how they translate to actual features on component, using actual components if available (e.g. how a knurl is represented on a drawing, and how it is appears on a physical part/component)
* provide engineering drawings showing mechanical features for students to interpret.
 | **Engineering drawings****Mechanical features** | Recall and explain how mechanical features are represented on a drawing.Interpret mechanical features from a drawing. | [TES Engineering Drawing resource](https://www.tes.com/teaching-resource/engineering-drawing-resource-11420865) (tes.com) [note – some resources have download fee][Graphic communication](http://www.duncanrig.s-lanark.sch.uk/pupil-zone/technical-education/technical-education-bge-s2-elective/technical-education-bge-s2-elective-course-outline/)  (duncanrig.s-lanark.sch.uk)[How to use a Knurling Tool](https://technologystudent.com/equip1/knurl1.htm) (technologystudent.com) | R015/R016Students are required to interpret engineering drawings in both units. |
| 5 | TA3Manufacturing requirements3.1 Interpreting orthographic third angle projection drawings | In this final lesson on engineering drawings, you could consolidate knowledge from the previous series of lessons by:* developing a quiz for students to identify line types, abbreviations, and mechanical features
* providing more detailed engineering drawings including different line types, abbreviations, and mechanical features for students working in small groups to interpret.

Note that students will need to interpret engineering drawings in both R015 and R016. | **Engineering drawings** | Consolidate knowledge of how to interpret engineering drawings through practice examples. | [TES Engineering Drawing resource](https://www.tes.com/teaching-resource/engineering-drawing-resource-11420865) (tes.com)[note – some resources have download fee][Guide to Engineering drawing conventions (design-technology.info)](http://www.design-technology.info/IndProd/drawings/) | R015/R016Students are required to interpret engineering drawings in both units. |

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| Autumn 2 |
| **Summary of what you will cover from the** [**curriculum planner**](https://www.ocr.org.uk/Images/619713-curriculum-planner.docx)**:** | **Engineering materials** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA2Engineering materials2.3 Types of engineering materials and how they are processed2.3.1 Metals | You could begin the next series of lessons on engineering materials by providing an overview of materials and their role in manufacturing components and products. In this first lesson you could:* explain the difference between pure metals and alloys
* introduce ferrous and non-ferrous metals and their properties
* use samples or videos to show forms of supply of metals
* use examples or videos to show typical applications of different metals.

Students could work in small groups to prepare a summary or short presentation about metals.Note that students are required to use engineering materials in Units R015 and R016. | **Metals** | Recall and explain the properties, typical forms of supply and processes that can be used with metals.Give at least one common application of metals. | [Alloys - Metals and alloys](https://www.bbc.co.uk/bitesize/guides/ztgy6yc/revision/2) - GCSE Combined Science Revision - BBC Bitesize(bbc.co.uk)[Ferrous and non-ferrous metals - Material categories and properties](https://www.bbc.co.uk/bitesize/guides/z74bcj6/revision/3) - GCSE Design and Technology Revision - BBC Bitesize(bbc.co.uk) | R015/R016Students are required to process materials in both units when performing manufacturing operations. |
| 2  | TA2Engineering materials2.3 Types of engineering materials and how they are processed2.3.2 Polymers | In this lesson, you could continue exploring engineering materials, looking at polymers. You could:* explain the difference between thermoplastics and thermosetting polymers
* introduce the types of polymer under each category, and their properties.
* use samples or videos to show forms of supply of polymers
* use examples or videos to show typical applications of different types of polymers.

Students could work in small groups to prepare a summary or short presentation about polymers. | **Polymers** | Recall and explain the properties, typical forms of supply and processes that can be used with polymers.Give at least one common application of polymers. | [Thermoplastics](https://plasticseurope.org/plastics-explained/a-large-family/thermoplastics/) (placticseurope.org)[Education Kits](https://bpf.co.uk/polymer-zone/resources/education-kits/default.aspx) (bpf.co.uk) | R015/R016Students are required to process materials in both units when performing manufacturing operations. |
| 3 | TA2Engineering materials2.3 Types of engineering materials and how they are processed2.3.3 Engineering ceramics2.3.4 Composite materials | Following on from the previous lesson, you could focus this lesson on ceramics and composite. You could:* explain the properties of ceramics and composites
* use samples or videos to show forms of supply
* use examples or videos to show typical applications
* task students with investigating different ceramics and composites including their key properties and applications.
 | **Ceramics****Composites** | Recall and explain the properties, typical forms of supply and processes that can be used with ceramics and composites.Give at least one common application of ceramics and composites. | [Ceramics - their properties, manufacture, and everyday uses](https://www.explainthatstuff.com/ceramics.html) (explainthatstuff.com)[10 Surprising Examples of Composite Materials –](https://smicomposites.com/10-surprising-examples-of-composite-materials/)(smicomposites.com) |  |
| 4 | TA2Engineering materials2.3 Types of engineering materials and how they are processed2.3.5 Smart materials | You could begin this lesson by using sample materials or videos to illustrate different types of smart materials, including their properties.You could ask students to investigate the properties, forms of supply and typical applications of the following smart materials:* shape memory alloy (SMA)
* thermochromic pigment
* photochromic pigment
* Quantum Tunnelling Composite (QTC).

They could summarise their findings in a short presentation or poster. | **Smart materials** | Recall and explain the properties, typical forms of supply and processes that can be used with smart materials.Give at least one common application of smart materials. | [Smart materials - Nanoscience and smart materials](https://www.bbc.co.uk/bitesize/guides/z6r7xfr/revision/3) (bbc.co.uk)GCSE Chemistry Revision - BBC Bitesize (bbc.co.uk) |  |
| 5 | TA2Engineering materials2.1 Mechanical properties of materials | In this lesson you could introduce the mechanical properties of materials, including:* strength
	+ yield/tensile
	+ compressive
* elasticity
* ductility
* hardness.

You could provide a definition for each of the mechanical properties.* illustrate each of the properties practically using suitable materials or using photographs or videos.
 | **Materials (mechanical properties of)** | Recall and define each of the mechanical properties associates with engineering materials. | [Material Properties 101 - YouTube](https://www.youtube.com/watch?v=BHZALtqAjeM) | R015/R016Students are required to process materials in both units when performing manufacturing operations. |

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| Spring 1 |
| **Summary of what you will cover from the** [**curriculum planner**](https://www.ocr.org.uk/Images/619713-curriculum-planner.docx)**:** | **Engineering materials/manufacturing processes** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA2Engineering materials2.2 Other properties influencing manufacturing | In the final lesson in the series covering materials, you could introduce:* malleability
* machinability
* cost
	+ material
	+ manufacturing
* sustainability.

You could do this by:* providing a definition for each of the mechanical properties
* illustrating malleability and machinability practically using suitable materials or using photographs or videos
* using suitable examples to relate to cost and sustainability.
 | **Materials (other properties of)** | Recall and define other properties associates with materials. | [Malleability and Ductility-Physical Properties - YouTube](https://www.youtube.com/watch?v=CIBXoYaM7Fw)[Social and ecological issues - Metals –](https://www.bbc.co.uk/bitesize/guides/zv4g4qt/revision/3) GCSE Design and Technology Revision - BBC Bitesize (bbc.co.uk) | R015/R016Students are required to process materials in both units when performing manufacturing operations. |
| 2  | TA1Manufacturing processes1.1 Types of manufacturing process1.1.1 The types of manufacturing processes | In the following series of lessons students will briefly focus on types of manufacturing processes, including how to recommend and justify the most appropriate process to create a manufactured form. Specific processes under each type is covered in more depth in later lessons in the unit. In the first lesson you could:* provide a brief overview of the following manufacturing processes:
* wasting
* shaping
* forming
* additive processes
* joining
* finishing
* illustrate with practical examples or videos showing wasting and shaping
* explain how wasting and shaping processes are related to creating a desired manufactured form.

If access to practical resources is possible, students could undertake safe wasting and shaping activities. Note that students are required to use wasting processes in units R015 and R016, so these practical skills could complement the theoretical knowledge taught in this unit. | **Wasting processes****Shaping processes** | Describe how wasting and shaping changes the form of material.Recommend and justify what these processes are most suited to when creating a manufactured form.  | [Section A: Fact Files - Method of Processing Materials Part 1.pdf (ccea.org.uk)](https://ccea.org.uk/downloads/docs/Support/AS%201%20Support/2019/Section%20A%3A%20Fact%20Files%20-%20Method%20of%20Processing%20Materials%20Part%201.pdf)[How to use a hacksaw - YouTube](https://www.youtube.com/watch?v=G0NGoPF3Q6A)[Skillbuilder: 5 Tips for Using Files - YouTube](https://www.youtube.com/watch?v=32FUysj-Lu4)[Metal Shaping: EXTREME Shrinking and Stretching Aluminum - YouTube](https://www.youtube.com/watch?v=uh5W4QZxYRA)(note use of the term Aluminum for Aluminium) | R015Students are required to manually process materials when performing manufacturing operations. |
| 3 | TA1Manufacturing processes* 1. Types of manufacturing process

1.1.1 The types of manufacturing processes | In this lesson you could continue to show manufacturing processes, looking at forming processes. You could:* illustrate with practical examples or videos forming different processes
* explain how forming processes are related to creating a desired manufactured form.

Again, if access to practical resources is possible, students could practise a forming process. | **Forming processes** | Describe how each of the following processes changes the form of material.Recommend and justify what this process is most suited to when creating a manufactured form. | [How It's Made - Car Doors - YouTube](https://www.youtube.com/watch?v=r9byGJtbCws)(shows pressing – which is a forming process) | R015Students are required to manually process materials when performing manufacturing operations. |
| 4 | TA1Manufacturing processes* 1. Types of manufacturing process

1.1.1 The types of manufacturing processes | This lesson continues manufacturing processes by looking at additive manufacturing. You could:* with access to suitable 3D printing resources, show additive manufacturing in action
* alternatively, illustrate additive manufacturing using videos
* explain how additive manufacturing is related to creating a desired manufactured form.
 | **Additive processes** | Describe how additive processes changes the form of material.Recommend and justify what these processes are most suited to when creating a manufactured form. | [What Is Additive Manufacturing? - YouTube](https://www.youtube.com/watch?v=t4S0mKjXtT4) | R015Students are required to manually process materials when performing manufacturing operations. |
| 5 | TA1Manufacturing processes* 1. Types of manufacturing process

1.1.1 The types of manufacturing processes | For this lesson you could look at joining processes, and how they are used in manufacturing by:* explaining different joining processes
* illustrating joining processes practically or with videos
* explaining how joining processes are related to creating a desired manufactured form.
 | **Joining processes** | Describe how joining changes the form of material.Recommend and justify what these processes are most suited to when creating a manufactured form. | [Joining methods – Metals GCSE Design and Technology Revision - BBC Bitesize](https://www.bbc.co.uk/bitesize/guides/zn2w7p3/revision/9) (bbc.co.uk) | R015Students are required to manually process materials when performing manufacturing operations. |

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| Spring 2 |
| **Summary of what you will cover from the** [**curriculum planner**](https://www.ocr.org.uk/Images/619713-curriculum-planner.docx)**:** | **Manufacturing processes** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA1Manufacturing processes* 1. Types of manufacturing process

1.1.1 The types of manufacturing processes | In this final lesson summarising manufacturing processes, you could focus on finishing processes by:* explaining different finishing processes
* illustrating finishing processes practically or with videos
* explaining how finishing processes are related to creating a desired manufactured form.
 | **Finishing processes** | Describe how finishing changes the form of material.Recommend and justify what this process is most suited to when creating a manufactured form. | [Metal Finishing–What Types of Finishes Are There?](https://www.thomasnet.com/articles/custom-manufacturing-fabricating/types-metal-finishing/) (thomasnet.com)[CMA Robotics Spa - Automotive painting - YouTube](https://www.youtube.com/watch?v=gUWCljX7oa0) | R015Students are required to manually process materials when performing manufacturing operations. |
| 2  | TA1Manufacturing processes1.2 Details of different manufacturing processes | The following series of lessons looks in more depth at the details of different manufacturing processes which fall under the headings covered in the previous lessons. Throughout the next series of lessons on wasting processes students will learn, for each process, about:* tools and equipment required
* steps carried out to manufacture a part/component
* safety measures
* characteristics or limitations of the process.

In this first lesson you could be begin by providing an overview of the format of the following series of lessons, focusing in this lesson on the wasting processes: sawing, filing, and shearing. You could:* explain what is meant by a wasting process (compared to additive processes)
* explain and illustrate practically or using videos sawing, filing, and shearing (using a manual guillotine and tin snips).

If access to practical resources is possible, students could undertake safe sawing, filing and shearing activities.Note that students will use manual processes and manually controlled machines in unit R015 and so this could complement the theory taught in this unit. | **Wasting processes****Sawing****Filing****Shearing** | Identify and explain the tools and equipment used, and describe the steps involved including safety considerations when sawing, shearing (using a guillotine and tin snips) and filing. | [Cutting Metal With a Hacksaw - YouTube](https://www.youtube.com/watch?v=v5TqhTpKDeQ)[8 Old School Tips For Better Hand Filing - YouTube](https://www.youtube.com/watch?v=h4KaiG7CpSQ)[Sheet Metal Guillotine Introduction - Design at Loughborough University - YouTube](https://www.youtube.com/watch?v=hiSc_SgC2zA) | R015Students are required to manually process materials when performing manufacturing operations. |
| 3 | TA1Manufacturing processes* 1. Details of different manufacturing processes

1.2.1 Wasting processes | In this lesson students will continue to learn about manufacturing processes by looking at threading (using manual taps and dies). You could:* explain how taps and dies are used to create internal and external thread, including the tools required
* illustrate practically or with videos the steps involved
* highlight the safety measures that must be taken.

As previously, students could undertake practical work with access to suitable resources. | **Wasting processes****Threading** | Identify and explain the tools and equipment used, and describe the steps involved including safety considerations when threading using a tap and die. | [Everything You Need to Know About Taps & Dies - Gear Up With Gregg's - YouTube](https://www.youtube.com/watch?v=CWCQ-hlQvdY) | R015Students are required to manually process materials when performing manufacturing operations. |
| 4 | TA1Manufacturing processes1.2 Details of different manufacturing processes1.2.1 Wasting processes | Like previous lessons, this lesson could introduce students to routing.You could:* explain how routing is used to process materials, including the equipment and tools required
* illustrating practically or with videos the steps involved with routing
* highlighting the safety measures that must be taken.

Students could undertake a practical routing activity if suitable resources are available. | **Wasting processes****Routing** | Identify and explain the tools and equipment used, and describe the steps involved including safety considerations when routing. | [How to Cut Aluminum with a Router - YouTube](https://www.youtube.com/watch?v=-gboj2XhuW0)(note use of the US term ‘Aluminum’ for Aluminium) | R015Students are required to manually process materials when performing manufacturing operations. |
| 5 | TA1Manufacturing processes1.2 Details of different manufacturing processes1.2.1 Wasting processes | For this lesson you could continue introducing wasting processes to students by looking at laser cutting. In the same style as previous lessons, this could include:* explaining how laser cutting is used to process materials, including the equipment required
* illustrating practically or with videos the steps involved with laser cutting
* highlighting the safety measures that must be taken when performing laser cutting.

You could use practical activities to support your delivery of this topic if you have access to suitable resources. | **Wasting processes****Laser cutting** | Identify and explain the tools and equipment used, and describe the steps involved including safety considerations when laser cutting. | [How does laser cutting work - Basics explained - YouTube](https://www.youtube.com/watch?v=SIjUVCho_xU) | R015Students are required to manually process materials when performing manufacturing operations.R016Students could program and use a CNC laser cutter. |

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| Summer 1 |
| **Summary of what you will cover from the** [**curriculum planner**](https://www.ocr.org.uk/Images/619713-curriculum-planner.docx)**:** | **Manufacturing processes** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA1Manufacturing processes1.2 Details of different manufacturing processes1.2.1 Wasting processes | In the penultimate lesson on wasting processes, you could concentrate on turning processes by:* identifying the key parts of a lathe
* explaining how a lathe is used to process materials, including the equipment and tooling required
* illustrating practically or with videos the steps involved with turning operations
* highlighting the safety measures that must be taken when using a lathe to turn materials.

Again, you could offer students the opportunity to perform practical turning operations with access to suitable resources. | **Wasting processes****Turning** | Identify and explain the tools and equipment used, and describe the steps involved including safety considerations when turning. | [The Centre Lathe](https://technologystudent.com/equip1/mlathe1.htm) (technologystudent.com)[Learning to Use a Lathe, Part 1: Basic operation and facing cut - YouTube](https://www.youtube.com/watch?v=_Vw48i30SN8) | R015Students are required to manually process materials using machines when performing manufacturing operations. |
| 2  | TA1Manufacturing processes1.2 Details of different manufacturing processes1.2.1 Wasting processes | In the final lesson on wasting processes, you could focus on milling by, for example: * identifying the key parts of a milling machine
* explaining how a milling machine is used to process materials, including the equipment and tooling required
* illustrating practically or with videos the steps involved with milling operations
* highlighting the safety measures that must be taken when using a milling machine to mill materials.

You could use practical activities to support students’ learning about milling. | **Wasting processes****Milling** | Identify and explain the tools and equipment used, and describe the steps involved including safety considerations when milling. | [The Vertical Miller](https://technologystudent.com/equip1/vert1.htm) (technologystudent.com)[Vertical Mill Tutorial 1: The Basics - YouTube](https://www.youtube.com/watch?v=FyuG-B95PQs) | R015Students are required to manually process materials using machines when performing manufacturing operations. |
| 3 | TA1Manufacturing processes1.2 Details of different manufacturing processes1.2.2 Shaping processes | The next two lessons could introduce shaping processes. In the first lesson this could include moulding processes:* injection moulding
* powder metallurgy for ceramic product.

You could:* explain the tools and equipment required
* illustrate the steps carried out with diagrams or videos
* highlight the safety measures to be taken.
 | **Shaping processes****Moulding** | Identify and explain the tools and equipment used, and describe the steps involved including safety considerations when shaping through moulding. | [Plastic Injection Moulding - YouTube](https://www.youtube.com/watch?v=RMjtmsr3CqA)[Powder Metallurgy Process - YouTube](https://www.youtube.com/watch?v=MgukjCT9o80) | R015Students are required to manually process materials when performing manufacturing operations. |
| 4 | TA1Manufacturing processes1.2 Details of different manufacturing processes1.2.2 Shaping processes | This lesson on shaping processes could focus on casting processes:* sand casting
* die casting.

You could do this by:* explaining the tools and equipment required
* illustrating the steps carried out with diagrams or videos
* highlighting the safety measures to be taken
* summarising the differences between sand and die casting, including the type of moulds used.
 | **Shaping processes****Casting** | Identify and explain the tools and equipment used, and describe the steps involved including safety considerations when shaping through casting.Explain the difference between sand and die casting, including types of mould used. | [Casting Metal: the Basics - YouTube](https://www.youtube.com/watch?v=2CIcvB72dmk)(shows sand casting)[What is the Die Casting Process? The High Pressure Die Casting Process - YouTube](https://www.youtube.com/watch?v=iSyBsdJkQu8) | R015Students are required to manually process materials when performing manufacturing operations. |
| 5 | TA1Manufacturing processes1.2 Details of different manufacturing processes1.2.3 Forming processes | The next two lessons could look at how forming processes are used to form materials. This lesson could explore:* forging
* press forming.

As in the style of previous lessons, you could do this by:* explaining the tools and equipment required for each moulding process
* illustrating the steps carried out for each process with diagrams or videos
* highlighting the safety measures to be taken.

Should access to practical resources be available, you could give students the opportunity to safely perform forging or pressing. | **Forming processes****Forging****Pressing** | Identify and explain the tools and equipment used, and describe the steps involved including safety considerations for different forming methods. | [Blacksmithing - Forging An Axe - YouTube](https://www.youtube.com/watch?v=ksDvJI3wav8)[Top 5 Amazing Forge Videos - YouTube](https://www.youtube.com/watch?v=GI9ePdzt-YI)[Factory to Forecourt - Press Shop - YouTube](https://www.youtube.com/watch?v=hPlcs4o_ibA) | R015Students are required to manually process materials when performing manufacturing operations. |

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| Summer 2 |
| **Summary of what you will cover from the** [**curriculum planner**](https://www.ocr.org.uk/Images/619713-curriculum-planner.docx)**:** | **Manufacturing processes** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA1Manufacturing processes1.2 Details of different manufacturing processes1.2.3 Forming processes | In this lesson on forming processes, you could introduce students to:* strip heating of polymers
* vacuum forming
* moulding of composite materials.

Again, you could do this by:* explaining the tools and equipment required for each moulding process
* illustrating the steps carried out for each process with diagrams or videos
* highlighting the safety measures to be taken.

If you have access to strip heaters or vacuum forming equipment, you could also show this through practical demonstrations and student activities. | **Forming processes****Heating****Forming****Moulding composites** | Identify and explain the tools and equipment used, and describe the steps involved including safety considerations for different forming methods.Explain the characteristics of vacuum forming moulds. | [How to use the strip heater - YouTube](https://www.youtube.com/watch?v=u6JRELLcoXo)[Making Complex Carbon Fibre Tubes Using a Split-Mould - YouTube](https://www.youtube.com/watch?v=bBbOUDDJv4Q) | R015Students are required to manually process materials when performing manufacturing operations. |
| 2  | TA1Manufacturing processes1.2 Details of different manufacturing processes1.2.4 Additive manufacturing | This lesson could look at additive manufacturing using the fused deposition modelling (FDM) method by:* explaining that how additive manufacturing differs from wasting (or subtractive manufacturing)
* showing a practical demonstration or videos of a component being created using FDM
* identifying the equipment and tooling/materials required for FDM
* highlighting the safety measures to be taken with FDM.

You may have access to a 3D printer with FDM technology so you could demonstrate this practically to students.  | **Additive manufacturing** | Identify and explain the tools and equipment used, and describe the steps involved including safety considerations when additive manufacturing. | [Fused Deposition Modelling (FDM) Technology - YouTube](https://www.youtube.com/watch?v=WHO6G67GJbM) |  |
| 3 | TA1Manufacturing processes1.2 Details of different manufacturing processes1.2.5 Joining processes | Over the next two lessons you could focus on joining processes in detail including permanent and temporary fixing methods. You could do this by:* explaining the difference between permanent and temporary joining (fixing) methods including their applications
* categorising joining methods into permanent or temporary.

In this lesson you could focus on the following joining methods:* riveting
* hammered rivets
* pop rivets
* mechanical fastening
* nuts and bolts
* self-tapping screws.

For each process, you could do this by:* explaining the tools and equipment required
* showing the steps carried out to join materials together
* highlighting the safety measures to be taken.

Practical demonstrations or activities could further reinforce student understanding of these joining processes. | **Joining processes****Riveting****Mechanical fastening** | Identify and explain the tools and equipment used, and describe the steps involved including safety considerations for different joining methods. | [Common Metal Shop Tools: Riveting - YouTube](https://www.youtube.com/watch?v=7M0RsmR5d6M)[What is a Pop Rivet? | Design Squad - YouTube](https://www.youtube.com/watch?v=9aoXmzdSf_I)[Nuts and Bolts Sheet 1](https://technologystudent.com/joints/bolt1.htm) (technologystudent.com)[Types of Screws](https://technologystudent.com/joints/screws2.htm) (technologystudent.com) | R015Students are required to manually process materials when performing manufacturing operations. |
| 4 | TA1Manufacturing processes1.2 Details of different manufacturing processes1.2.5 Joining processes | In this lesson on joining processes, you could concentrate on the following methods:* brazing
* MIG/MAG welding.

Again, you could do this through:* explaining the tools and equipment required
* showing the steps carried out to join materials together
* highlighting the safety measures to be taken.

Videos could be used to show brazing and welding operations being performed, or even practical demonstrations if possible. | **Joining processes****Brazing****Welding** | Identify and explain the tools and equipment used, and describe the steps involved including safety considerations for different joining methods.Explain the relative characteristics of different joining methods. | [What is Brazing? | Skill-Lync - YouTube](https://www.youtube.com/watch?v=neL4CMdUpjg)[What is MIG Welding? (GMAW) - YouTube](https://www.youtube.com/watch?v=twUAa5LWUvk) | R015Students are required to manually process materials when performing manufacturing operations. |
| 5 | TA1Manufacturing processes1.2 Details of different manufacturing processes1.2.6 Finishing processes | In this final lesson on manufacturing processes, you could introduce:* painting
	+ brush
	+ spray
* powder coating.

As in previous lessons, you could do this for each process:* explaining the tools and equipment required
* showing the steps carried out to finish materials using each process
* highlighting the safety measures to be taken.
 | **Finishing processes****Painting****Powder coating** | Identify and explain the tools and equipment used, and describe the steps involved including safety considerations for different finishing processes. | [The Basics of How to Use an Automotive Paint Spray Gun - YouTube](https://www.youtube.com/watch?v=PnmJ1ywmvsU)[What Is Powder Coating? New Wheels For The S2000! - YouTube](https://www.youtube.com/watch?v=vCeJR7bQGEw) | R015Students are required to manually process materials when performing manufacturing operations. |

## Second year of teaching

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| Autumn 1 |
| **Summary of what you will cover from the** [**curriculum planner**](https://www.ocr.org.uk/Images/619713-curriculum-planner.docx)**:** | **Scales of manufacture** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA3Manufacturing requirements3.2 Influence of the scale of manufacture on the production method | The next series of lessons could focus on the influence of scale of manufacture on the chosen production methods. You could begin with a brief introduction to scale manufacture using videos and then:* introduce students to different scales of manufacture - one-off, batch, mass production
* highlight typical products manufactured under each of these scales.

Students could do some investigation to find out about the characteristics and products made under each scale of manufacturer and their advantages and disadvantages. They could work in small groups to summarise and present their findings. | **Scales of manufacture****One-off****Batch****Mass** | Recall and explain scales of production, identify at least one product under one-off, batch and mass. | [Scales of production](https://www.stem.org.uk/resources/collection/443805/scales-production)STEM Learning (stem.org.uk) | R016Students are required to use CNC machines to make parts/components in quantity. |
| 2 | TA3Manufacturing requirements3.2 Influence of the scale of manufacture on the production method | For this lesson you could introduce students to the following items, and how they are used to assist with scale production:* jigs
* fixtures
* templates
* moulds.

You could do this by:* showing real examples of each method, or alternatively using videos
* explaining how they are used to assist with scale production
* highlighting the advantages and limitations of each method.

Note that students are required to use jigs, fixtures, and templates in unit R016 and so knowledge gained in this unit could complement this practical activity. | **Jigs****Fixtures****Templates****Moulds** | Describe how jigs, fixtures, templates, and moulds are used including advantages and limitations of each. | [Templates, jigs and patterns - Making](https://www.bbc.co.uk/bitesize/guides/z6cbcj6/revision/2) –GCSE Design and Technology Revision - BBC Bitesize (bbc.co.uk)[Jigs and Fixtures for Machine Shops - Educational Video - YouTube](https://www.youtube.com/watch?v=CA3GnfImGmw)(video is dated but very useful)[Jigs & Fixtures - YouTube](https://www.youtube.com/watch?v=fcrbKURkWJQ) | R016Students are required to use manufacturing and production aids. |
| 3 | TA3Manufacturing requirements3.2 Influence of the scale of manufacture on the production method | In this lesson you could show students different levels of automation:* manual control
* CAM processes
* fully automated robotic control.

This could be done by:* using videos to show each of the different levels of automation
* setting an activity for students to find out about the types of product made under each level of automation.

Students could work in pairs or small groups to prepare a presentation of their findings. | **Automation (levels of)** | Describe different levels of automation with typical products manufactured using each.  | [The Future of Factory Automation - YouTube](https://www.youtube.com/watch?v=wZkZb9I-g3s)[Computer Aided Manufacturing (CAM) - YouTube](https://www.youtube.com/watch?v=FdipJNG_vV8)[Industrial Robots have Transformed the Manufacturing Industry - A Galco TV Tech Tip - YouTube](https://www.youtube.com/watch?v=Cndodc3X50s) | R016Students are required to use CNC machines to make products in quantity. |
| 4 | TA3Manufacturing requirements3.2 Influence of the scale of manufacture on the production method | For this lesson on CAM (Computer Aided Manufacturing) you could:* hold a class discussion to identify the advantages and limitations of CAM machines to highlight:
* improved consistency of products
* reduction in defects
* ability to accurately manufacture complex parts
* greater rate of production
* ability of automated systems to work in environments that would be hazardous to operators
* initial capital outlay
* influence on employment opportunities
* use flashcards for students, working in small groups, to sort into advantages or disadvantages.
 | **CAM (Computer Aided Manufacture)** | Recall and describe the advantages and limitations of CAM. | [Design and Technology KS3/4: Why is CAD/CAM essential in design?](https://www.bbc.co.uk/teach/class-clips-video/design-tech-ks3/zd7hy9q) - BBC Teach (bbc.co.uk)[Advantages and Disadvantages of CAD/CAM - Advantages and disadvantages table in All Levels Design & Technology: Resistant Materials (getrevising.co.uk)](https://getrevising.co.uk/grids/advantages_and_disadvantages_of_cadcam) | R016Students are required to program and use CNC machines to make parts/components in quantity. |
| 5 | TA3Manufacturing requirements3.2 Influence of the scale of manufacture on the production method | This lesson could be used to consolidate knowledge of influences of scale of manufacture on production methods. You could do this by:* holding a quiz on scales of manufacture and the products made under each scale
* developing a worksheet on the advantages and limitations of jigs, fixtures, templates, and moulds
* using flash cards to test knowledge of levels of automation (and the products made under each level), and the advantages/disadvantages of CAM (Computer Aided Manufacturing) machines.
 |  | Consolidate knowledge of the influences on scale of manufacture, solving example problems. | [Production methods test questions - Other](https://www.bbc.co.uk/bitesize/guides/z3fvcdm/test) - GCSE Business Revision - BBC Bitesize (bbc.co.uk)[CAD/CAM Teaching Resources](https://www.tes.com/teaching-resource/cad-cam-6410125) (tes.com)[note – some resources have download fee] | R016Students are required to program and use CNC machines to make parts/components in quantity. |

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| Autumn 2 |
| **Summary of what you will cover from the** [**curriculum planner**](https://www.ocr.org.uk/Images/619713-curriculum-planner.docx)**:** | **Quality** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA3Manufacturing requirements3.3 Quality | Over the next series of lessons, you could concentrate on quality in manufacturing. In this lesson you could:* begin with an introduction to quality and its role in manufacturing
* show videos of quality tools and techniques being used
* use examples to show what happens if quality is not addressed.

Note that students have to use quality control techniques in Unit R016 and so this series of lessons could complement this practical activity. | **Quality systems** | Explain some of the reasons for implementing quality systems. | [Audi Factory Quality Control - YouTube](https://www.youtube.com/watch?v=V5slnfLstUo)[FAA reviews Boeing Dreamliner quality control lapses after production - YouTube](https://www.youtube.com/watch?v=w29vcuvpF4w) | R016Students are required to apply quality control techniques.  |
| 2  | TA3Manufacturing requirements3.3 Quality | This lesson could build on the previous lesson and focus on the reasons for implementing quality systems in engineering:* early intercept of problems in production
* reducing waste and associated costs
* consistency of finished products
* conformity to industry standards and regulations
* reduce issues at customer and returns.

You could:* hold a class discussion to explore the reasons for implementing quality to see if students can identify these.
* use videos to illustrate some of these reasons.
 | **Quality systems** | Recall and explain the reasons for implementing quality systems. | [Quality Control In Manufacturing](https://www.graphicproducts.com/articles/quality-control-in-manufacturing/)(Graphicproducts.com)[Quality Management - Costs of Poor Quality - YouTube](https://www.youtube.com/watch?v=-GKlF6C06do)[The Cost of Poor Quality - YouTube](https://www.youtube.com/watch?v=ETP6PUunZ4Y) | R016Students are required to apply quality control techniques. |
| 3 | TA3Manufacturing requirements3.3 Quality | This lesson could look at the differences between quality control and quality assurance. In the lesson you could:* use examples to illustrate quality assurance and quality control
* use videos to show each in action
* use flash cards with key words for students to sort into either quality assurance methods or quality control techniques.
 | **Quality systems****Quality control****Quality assurance** | Recall and explain the difference between quality control and quality assurance. | [5 Major Differences between Quality Assurance and Quality Control Testing](https://rezaid.co.uk/differences-between-quality-assurance-and-quality-control/) (rezaid.co.uk)[Quality Management - Quality Assurance - YouTube](https://www.youtube.com/watch?v=0hzqHwu1i_I) | R016Students are required to apply quality control techniques. |
| 4 | TA3Manufacturing requirements3.3 Quality | For this lesson you could focus in more detail on quality control, and how it is a reactive approach.You could:* show examples of quality control
* relate the types of measuring equipment used for measuring the dimensions of parts
* recap on tolerance from previous work on interpreting engineering drawings and its relationship to quality control
* use practical examples of quality control for students to complete.

Note that students have to undertake quality control activities in Unit R016 and so this could complement this lesson. | **Quality systems****Quality (reactive)** | Explain how quality control is used as a reactive approach by measuring parts. | [Quality Control Process for QA1 Rod Ends - YouTube](https://www.youtube.com/watch?v=MbPQ5zDkons)[Top-10 Mechanical Measuring Instruments (Every Mechanical Engineer should know)) - YouTube](https://www.youtube.com/watch?v=lou9kAFGOjk) | R016Students are required to apply quality control techniques. |
| 5 | TA3Manufacturing requirements3.3 Quality | For the final lesson on quality, you could look at quality assurance and how it is used as a preventative approach.You could do this by:* using videos to show quality assurance being implemented in manufacturing
* showing how quality assurance systems can be used to react to manufacturing faults and so reduce occurrence of defects
* using real examples for students to complete.

Note that students have to perform a SPS activity in Unit R016 which could complement the content of this lesson. | **Quality systems****Quality - preventative** | Explain how quality assurance is used as a preventative approach to reduce occurrence of defects. | [Quality Assurance](https://technologystudent.com/prddes1/qual1.html) (technologystudent.com)[What to know about quality assurance](https://monday.com/blog/project-management/quality-assurance/)(Monday.com blog)[Factory to Forecourt - Quality Assurance - YouTube](https://www.youtube.com/watch?v=3t3Pa6WXr0w) | R016Students are required to apply quality control techniques. |

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| Spring 1 |
| **Summary of what you will cover from the** [curriculum planner](https://www.ocr.org.uk/Images/619713-curriculum-planner.docx)**:** |  **Inventory management/lean manufacturing** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA4Developments in engineering manufacture | The next series of lessons in this unit could focus on developments in engineering manufacture.In this first lesson you could:* introduce inventory management and lean manufacturing
* use video examples to show inventory management and lean manufacturing in real settings
* hold a class discussion to explore student perceptions of the importance of these developments.
 | **Inventory management****Lean manufacturing** | Recall and briefly explain the meaning behind inventory management and lean manufacturing.  | [How Toyota Changed The Way We Make Things - YouTube](https://www.youtube.com/watch?v=F5vtCRFRAK0)[Introduction to Lean Manufacturing - YouTube](https://www.youtube.com/watch?v=ZdHGTCXcJQU) |  |
| 2  | TA4Developments in engineering manufacture4.1 Inventory management | In this lesson you could look at the JIT (Just In Time) philosophy of inventory management by:* providing a definition of JIT
* using case study examples of JIT being used
* exploring, through class discussion, the advantages, and disadvantages of this technique of inventory management.
 | **JIT (Just In Time)** | Recall the definition of JIT.Explain JIT including its advantages and disadvantages. | [Just in Time by Toyota: The Smartest Production System in The World - YouTube](https://www.youtube.com/watch?v=cAUXHJBB5CM) |  |
| 3 | TA4Developments in engineering manufacture4.1 Inventory management | This lesson could complement the previous lesson by looking at the MRP (Material Requirements Planning) method of inventory management.You could:* provide a definition of MRP
* used case studies of companies who use MRP in their manufacturing operations
* develop a simple MRP worksheet or activity for students to complete, working in small groups
* summarise the advantages and disadvantages of this method.
 | **Material Requirements Planning (MRP)** | Recall the definition of MRP.Explain MRP including its advantages and disadvantages. | [What is MRP (Material Requirements Planning)? Why is it Important? - YouTube](https://www.youtube.com/watch?v=Dis3UYcEXVw)[What is Material Requirements Planning? - YouTube](https://www.youtube.com/watch?v=eoLSZh35_LY) |  |
| 4 | TA4Developments in engineering manufacture4.2 Lean manufacturing | This lesson could look at lean manufacturing and the seven categories of waste:* transportation
* inventory
* movement
* waiting
* over-processing
* over-production
* defects.

The lesson could comprise:* an introduction to lean manufacturing along with examples of companies who use this technique
* introduction to each of the seven lean wastes
* a worksheet for students to complete to match a description for each of the seven wastes.
 | **Lean manufacturing****Seven categories of waste** | Recall and describe the seven categories of waste. | [The seven wastes of lean](https://leanmanufacturingtools.org/wp-content/uploads/2016/11/seven-wastes.pdf) (leanmanufacturingtools.org)[The 7 wastes of lean - YouTube](https://www.youtube.com/watch?v=Ygf3g8fKXZQ) |  |
| 5 | TA4Developments in engineering manufacture4.2 Lean manufacturing | In this lesson you could continue to explore the seven categories of waste by considering how reducing waste improves the performance of manufacturing.In the lesson you could:* use case studies of companies who use lean manufacturing to reduce waste
* hold a class discussion to examine how reducing waste improves the performance of a manufacturer, and how this can be achieved
* provide simple case studies for students to discuss working in small groups.
 | **Lean manufacturing****Waste (reduction**) | Explain how reducing waste improves the performance of manufacturing. | [[The seven wastes of lean](https://leanmanufacturingtools.org/wp-content/uploads/2016/11/seven-wastes.pdf) (leanmanufacturingtools.org)](https://leanmanufacturingtools.org/wp-content/uploads/2016/11/seven-wastes.pdf)[The 7 wastes of lean - YouTube](https://www.youtube.com/watch?v=Ygf3g8fKXZQ) |  |

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| Spring 2 |
| **Summary of what you will cover from the** [**curriculum planner**](https://www.ocr.org.uk/Images/619713-curriculum-planner.docx)**:** | **Globalisation** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA4Developments in engineering manufacture4.3 Globalisation | In this final series of lessons, you could look at how globalisation influences manufacturing.In this first lesson you could:* introduce global manufacturing.
* use case studies or video examples to show how companies approach global manufacturing
* hold a class discussion to explore student perceptions of global manufacturing, and to see if they can identify advantages and disadvantages.
 | **Globalisation** | Recall and briefly explain the meaning behind globalisation in a manufacturing context. | [Effects of Economic Globalization](https://www.nationalgeographic.org/article/effects-economic-globalization/9th-grade/)National Geographic Society (nationalgeographic.org)[Globalization and its effects on developing countries. - YouTube](https://www.youtube.com/watch?v=BaJnlMYNDvk) |  |
| 2  | TA4Developments in engineering manufacture4.3 Globalisation | For this lesson you could focus on transport and international standards as part of global manufacturing by:* using examples of transport requirements as part of global manufacturing
* highlighting how products are designed and manufactured to standards and how these work internationally
* using case studies or video examples of companies who manufacture globally and how they use transportation or international standards in their operations.
 | **Globalisation****Transport****International standards** | Explain how transportation and international standards impact global manufacturing. | [International Trade and Supply Chains - YouTube](https://www.youtube.com/watch?v=Bblo8_B32Co)[DHL Inbound to Manufacturing - Overview - YouTube](https://www.youtube.com/watch?v=AAN2wPxPFm0) |  |
| 3 | TA4Developments in engineering manufacture4.3 Globalisation | In this lesson you could look at how employment opportunities and conditions are impacted by global manufacturing.You could do this by:* introducing the topic area
* holding a class discussion to explore student perceptions of the influence of employment opportunities and differences in employment conditions
* tasking students to investigate and summarise the positive and negative effects relating to employment of global manufacturing.
 | **Globalisation****Employment** | Explain the significance of employment to global manufacturing including opportunities and conditions. | [Why Chinese Manufacturing Wins - YouTube](https://www.youtube.com/watch?v=E7Jfrzkmzyc)[Inside Apple's iPhone Factory In China - YouTube](https://www.youtube.com/watch?v=9XkX6EGk_CA) |  |
| 4 | TA4Developments in engineering manufacture4.3 Globalisation | This lesson on global manufacturing could examine the influences on product cost.You could:* introduce the reasons why product cost is often lowered by globalisation of manufacturing
* hold a class discussion to explore the benefits of lower product costs for consumers, and the negative aspects to this cost reduction
* task students to investigate the positive and negative impacts of globalisation on product cost.
 | **Globalisation****Product cost** | Explain the impact of global manufacturing on product cost. | [Costs and benefits of globalisation](https://www.economicshelp.org/blog/81/trade/costs-and-benefits-of-globalisation/) (Economics Help) |  |
| 5 | TA4Developments in engineering manufacture4.3 Globalisation | In this final lesson on globalisation, you could focus on the implications on sustainability and consider the economic, social, ethical, and environmental implications.You could do this by:* introducing sustainability and its association with global manufacturing
* exploring the impact of global manufacturing on economics, society, ethics, and the environment
* using case studies and videos to illustrate this
* looking at the CSR (Corporate Social Responsibility) statements of companies who manufacture globally
* holding a class discussion to examine the positive and negative aspects of these aspects to global manufacturing.
 | **Globalisation****Sustainability****Economic, social, ethical, environment** | Explain the impact of globalisation on sustainability, economics, social, ethical, and environmental considerations. | [Globalisation and product manufacture](https://www.stem.org.uk/resources/elibrary/resource/450579/globalisation-and-product-manufacture)(stem.org.uk) |  |

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| Summer 1 |
| **Summary of what you will cover from the** [**curriculum planner**](https://www.ocr.org.uk/Images/619713-curriculum-planner.docx)**:** | **Examination revision (revision of Topic Areas)** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | Revision TA3 | The final series of lessons covers revision across the topic areas. You could use worksheets and quizzes to test student knowledge and understanding across selected topics from each area.The first revision session covers the key aspects of engineering drawings:* line types
* standard drawing conventions for dimensions, including 3rd angle orthographic projection
* abbreviations
* mechanical features.
 | Revision TA3 | Recall how to interpret engineering drawings including meaning of line types, standard drawing conventions for dimensions, abbreviations, and mechanical features. | [Guide to Engineering drawing conventions](http://www.design-technology.info/IndProd/drawings/) (design-technology.info) |  |
| 2  | Revision TA2 | This revision session could focus on engineering materials:* metals
* polymers
* ceramics
* composites
* smart materials
 | Revision TA2 | Recall the properties, forms of supply and common applications of selected engineering materials. | [Engineering Materials](https://mechanicalc.com/reference/engineering-materials) MechaniCalc(mechanical.com) |  |
| 3 | Revision TA2 | In this revision session you could use a worksheet to recap on:* mechanical properties of materials
* other properties influencing manufacturing
 | Revision TA2 | Recall the mechanical and other properties of materials. | [Mechanical Properties of Engineering Materials](https://www.electrical4u.com/mechanical-properties-of-engineering-materials/) (Electrical4u.com) |  |
| 4 | Revision TA1 | For this revision session you could use a worksheet to revisit manufacturing processes:* types of manufacturing processes
 | Revision TA1 | Recall, recommend and justify the most appropriate process required to manufacture a form. | [Materials & Industrial Processes](https://technologystudent.com/equip1/equipex1.htm)(technologystudent.com) |  |
| 5 | Revision TA1 | This final revision session on manufacturing processes could continue with worksheets covering the following:* wasting processes
* shaping processes
* forming processes
* additive manufacturing
* joining processes
* finishing processes.
 | Revision TA1 | Recall and explain the tools and equipment used, and describe the steps involved including safety considerations for selected manufacturing processes. | [Equipment and Processes Index Page](https://technologystudent.com/equip1/equipex1.htm) (technologystudent.com) |  |

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| Summer 2 |
| **Summary of what you will cover from the** [**curriculum planner**](https://www.ocr.org.uk/Images/619713-curriculum-planner.docx)**:** | **Examination revision (practice questions)** Note: this could occur in parallel with revision work of Summer 1. |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 onwards | Exam revision | You could reserve the final series of lessons for examination revision using practice questions:* give students different types and styles of questions to practise answering, including short and long answer questions
* show students how to analyse and decompose the requirements of question, including how command verbs are used
* show how marks are allocated across questions, and what is required to achieve the marks indicated on the exam paper: get students to attempt questions, peer mark others’ answers and discuss.
 | Exam revision | Analyse and practise exam style questions. Be able to provide responses to a selection of different types of exam question. Use teacher and peer review to inform further revision. | [OCR’s guide to understanding the assessment – examined and moderated](https://www.ocr.org.uk/Images/612302-understanding-the-assessment-examined-and-moderated.pdf):* p 9 command words
* pp 12-18 exam question types

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## Teaching over three years

Some centres may choose to start their delivery of the qualification earlier in Year 9, and so deliver over three years. The following topic areas are suggestions of what could form part of early delivery.

| Topic area | Warm up/introductory activities | Length of time activity may take |
| --- | --- | --- |
| TA3 Manufacturing requirements3.1 Interpreting orthographic third angle projection drawings | Students could start to become familiar with interpreting engineering drawings. This will be useful for all three Units R014, R015 and R016. They could practise producing or completing third angle orthographic drawings. They could also interpret engineering drawings having different line types, representation of dimensions, abbreviations and mechanical features. | 4-5 hours with additional time to practise producing third angle orthographic drawings. |
| TA2 Engineering materials2.3 Types of engineering materials and how they are processed | You could begin to introduce students to engineering materials, their properties and their typical applications. This could include metals, polymers, ceramics, composites and smart materials. Students could undertake simple experiments with materials to discover their mechanical properties such as testing their hardness, elasticity, ductility etc. Low cost kits of materials along with pre-prepared experiments (e.g. smart materials) are available, and could be useful. | 5-6 hours with additional time to complete a series of experiments with materials. |
| TA1 Manufacturing processes1.2 Details of different manufacturing processes | You could introduce the engineering workshop setting to student and show them how to safely use basic tools and machines (e.g. saws, files, cutters, pillar drill) and be set a task to manufacture a simple item. Examples could be a mobile phone holder, key holder, clock etc. This activity will also be useful for Unit R015. | 5-6 hours workshop practice with additional time for manufacturing a simple item. |
| TA4 Developments in engineering manufacture4.3 Globalisation | Students could do a set activity, working in small groups, to investigate the global manufacturing of engineered products. They could identify the key issues to global manufacturing (e.g. transportation, employment, cost, sustainability, social and ethical implications etc.) along with positive and negative impact for each. They could create a poster illustrating their findings. | 5-6 hours with additional time for working in small groups to create a poster. |

Please note – web links are correct at date of publication but other websites may change over time. If you have any problems with a link you may want to navigate to that organisation’s website for a direct search.



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