Year 10 BTEC Tech award Engineering

Component 2

Component title	Investigating an Engineering Project
Guided learning hours	36
Number of lessons	36
Duration of lessons	1 hour

Lesson	Topic from specification	Suggested activities	Classroom resources
Learning aim A: Understand materials, components and processes for a given engineering product **Teaching content A1: Materials**			
1	Engineering materials: ferrous metals [Component 2, A1, Engineering material categories: ferrous metals]	**Introductory activity:** ● **Paired activity:** students discuss the question 'Why is there a need for different materials to be used for different component parts when manufacturing a skateboard?' **Main session activities:** ● **Whole class activity:** students feed back on their paired work to compile a list of reasons why it is not always the best idea to use the same material to make certain engineered products. ● **Teacher-led discussion:** teacher-led discussion covering the following points: o Identify the range of engineering sectors. o Describe the engineering products manufactured. o Explain why there is a need for different materials. ● **Teacher-led presentation:** teacher covers the main engineering material categories (ferrous metals, non-ferrous metals, thermosetting polymers, thermoforming polymers), using an online video to illustrate points. ● **Individual activity:** students research and make a list of as many ferrous and non-ferrous metals as they can. If possible, they should give an example of an engineered product made from the metals they list. ● **Individual activity:** students look up the properties of medium carbon steel, high carbon steel and stainless steel and answer the following questions: o What would they manufacture a chisel from? Why?	Short video clip from the internet that illustrates ferrous and non-ferrous metals, e.g. 'The difference between ferrous and non-ferrous metals', https://www.youtube.com/watch?v=UgmlmDUhR6A Internet access

		o Why does the food preparation industry use stainless steel instead of a low carbon steel for their equipment? **Plenary activity:** ● **Group activity**: students select an engineered product to examine and list the different metals involved in its manufacture. How many different metals can they recognise? List these. Students discuss their list within a small group and see if they can divide the metals into different categories. For example, iron is a ferrous material.	
2	Engineering materials: non-ferrous metals [Component 2, A1, Engineering material categories: non-ferrous metals]	**Introductory activities:** ● **Whole class activity**: key terms check. Teacher asks individual students to write down the definitions of the following words on paper or a whiteboard, and then share their answers with the class – ferrous, non-ferrous, malleability, ductility, wrought, alloys, electroplating. ● **Whole class activity**: students discuss why an engineered product made from a malleable material would be preferable to one that is not. **Main session activities:** ● **Teacher-led presentation:** teacher covers the different types of non-ferrous metals and their properties. ● **Individual activity:** students answer the following questions, using their own research. o Why would a manufacturer choose brass rather than copper for the pins on a three-pin plug? o What percentages of materials are used in the alloy composition of brass? o What are the major uses of the various brass alloys with different percentages of brass? **Plenary activities:**	Examples of engineered products made from more than one type of metal.

		• **Individual activity:** students find a metallic engineered product to study. They must identify as many individual metals as they can in the product, and then think about what alternative engineered products the metals could be used for. • **Individual activity:** students answer the following questions. o How are non-ferrous metals different from ferrous metals? o Why does the food preparation industry use stainless steel instead of a low carbon steel?	
3	Engineering materials: thermosetting polymers [Component 2, A1, Engineering material categories: thermosetting polymers]	**Introductory activities:** • **Teacher-led presentation:** teacher introduces polymers, using an online video resource to illustrate their properties. • **Whole class activity:** students consider their surroundings at home, at school and in leisure environments and identify products made from polymers. Can they explain why polymers have been used to make these items? **Main session activities:** • **Teacher-led presentation:** teacher gives an introduction to the different thermosetting polymers, referencing phenol-formaldehyde, polyimides and polyurethane, all with examples. • **Whole class activity**: teacher makes available a variety of plastic/rubber objects for students to inspect and then answer the following questions. o How many polymers can be identified? o What alternative uses can you suggest for the materials? • **Individual activity:** students look up the properties of melamine. o Why is it used for the bodies of electrical sockets? o Why is it used for kitchen utensils?	Short video clip from the internet that illustrates polymers, e.g. 'Thermosets and thermoplastics', https://www.youtube.com/watch?v=lNS7TwWmlrg&t=11s A variety of plastic/rubber objects Internet access

		• **Individual activity**: students write down the properties, forms and examples of use of the thermosetting polymers they have studied. **Plenary activity:** • **Whole class activity:** class discussion on why thermosetting polymers are preferred for some engineered products.	
4	Engineering materials: thermoforming polymers [Component 2, A1, Engineering material categories: thermoforming polymers]	**Introductory activities:** • **Individual activity:** students find one example each of a thermoforming polymer and a thermosetting polymer. What differences between them can they identify? • **Whole class activity:** students watch a video on polymers, making notes on what they learn. **Main session activities:** • **Teacher-led presentation:** teacher gives an introduction to the different thermoforming polymers, referencing polyethylene, polypropylene and acrylic, all with examples. • **Whole class activity:** teacher makes available acrylic sheeting and students use a line bender to bend this to 90 degrees. Students then try to bend the sheeting back flat and evaluate their efforts. • **Whole class activity:** students research the industrial recycling and recovery process for the manufacture of products from recycled materials. An online video could be shown to illustrate the information. o What different products can be manufactured in this way? o What initial polymers can be used? • **Individual activity:** students write down the properties, forms and examples of use of the thermoforming polymers they have studied. **Plenary activity:**	Short video clip from the internet. e.g. 'Polymers – Crash Course Chemistry #45' https://www.youtube.com/watch?v=rHxxLYzJ8Sw&spfreload=10 Line bender Acrylic strips/pieces PPE for use with line bender Second short video clip, e.g. 'What is thermoforming?' https://www.youtube.com/watch?v=_z6RgDJxZSsBe Internet access

		• **Whole class activity:** students review the properties of and uses for polyethylene, polypropylene and acrylic; class discussion on the advantages and disadvantages of using thermoforming polymers to make a reusable plastic bottle.	
5	Properties of engineering materials [Component 2, A1, Properties of engineering materials]	**Introductory activity:** • **Whole class activity**: the properties of a material determine how it reacts when a force is applied to it. Students discuss what they think is the hardest material. **Main session activities:** • **Teacher-led presentation**: teacher explains the different properties of engineering materials, perhaps using an online video resource on the physical properties of metals. • **Paired then whole class activity:** students discuss the following questions in pairs and then write a short summary of their answers, before feeding back to the class. o What are the different strength properties of metallic materials and polymers? Explain your answer. o Is diamond both hard and tough? Explain your answer. • **Individual activity**: students research different types of metals and determine which is the: o toughest o strongest o hardest. **Plenary activity**: • **Group activity**: working in small groups, students examine the chairs they have been sitting on and see if they can work out why the designer has selected the materials in it. Students should also try to identify: o the toughest material o the strongest material	Short clip from the internet, e.g. 'Physical Properties of Metals' https://www.youtube.com/watch?v=NHWcwAijMvk Classroom chairs Internet access

		○ the hardest material.	
6	Characteristics of engineering materials [Component 2, A1, Characteristics of engineering materials]	**Introductory activities:** ● **Whole class activity**: students discuss what factors should be considered when designing a product to last. ● **Paired activity**: students discuss the link between the characteristics and properties of engineered materials. **Main session activities:** ● **Teacher-led presentation**: teacher explains the different characteristics of engineering materials. ● **Individual activity**: students investigate the characteristics of engineering materials and describe how these make certain materials suitable for use in engineering products. ● **Individual activity:** students think of something they have bought where one part did not last the product's lifespan – for example, the handle fell off a door. Which of the characteristics of engineering materials was the prime reason for this? ● **Individual activity:** students research the following materials and note the machinability, workability and durability of each: ○ copper ○ low carbon steel ○ polystyrene ○ acrylic. **Plenary activities:** ● **Individual activity:** students write down definitions for the terms machinability, workability and durability. ● **Individual activity:** students answer the following question: why is it important for an engineered product to be made from a durable metal or polymer?	Examples of copper, low carbon steel, polystyrene and acrylic (either components or materials)

		• **Homework task:** From a list of teacher-suggested topics related to Learning aim A1, students identify those topics they are unsure about and any topics they do not understand.	
Learning aim A: Understand materials, components and processes for a given engineering product **Teaching content A2: Components**			
7	Components: types and characteristics [Component 2, A2, Types of components]	**Introductory activities:** • **Teacher-led discussion:** teacher uses a Q&A-style session to review Learning aim A1 content that students are unsure about. • **Whole class activity:** students are prompted to think about the types of components used in the production of engineered products. **Main session activities:** • **Teacher-led presentation**: teacher gives an overview of the different types and characteristics of engineering components. • **Individual activity**: students examine an image of a bicycle and list the proprietary engineered products on it. Students should also list the product-specific engineered products on the bicycle. • **Paired activity**: students look around their workshop environment and find as many fasteners as they can. They then classify these into permanent and semi-permanent. • **Individual activity:** students answer the following questions regarding the outside diameter of an engineering shaft that is 50 mm ± 0.25 mm. o What is the largest permissible size? o What is the smallest permissible size? o What is the size of the hole it needs to fit into? **Plenary activities:**	Images of bicycles Examples of fasteners, e.g. nuts, bolts, machine screws, snap rivets, pop-rivets

		● **Individual activity**: students answer the following questions. o What does the term proprietary mean in an engineering context? o When are proprietary engineered products classed as product-specific? ● **Homework task:** From a list of teacher-suggested topics related to Learning aim A2, students identify those topics they are unsure about and any topics they do not understand.	
Learning aim A: Understand materials, components and processes for a given engineering product **Teaching content A3: Processes**			
8	Engineering processes: shaping [Component 2, A3, Types of engineering processes: shaping]	**Introductory activities:** ● **Teacher-led discussion:** teacher uses a Q&A-style session to review Learning aim A2 content that students are unsure about. ● **Group activity:** students think about a disc brake that might be used on a bicycle and discuss in a small group how such a disc brake would be produced from a large-diameter steel bar. ● **Individual activity:** students note down which features would be required to make a disc brake (they may need to do some research) and draw an annotated sketch referring to the features the disc brake must have. **Main session activities:** ● **Teacher-led presentation**: teacher gives an overview of the different types of shaping processes. Teacher may wish to demonstrate these as they go along. ● **Individual activity**: students research the different shaping processes that can be carried out using a lathe in order to produce complex shapes.	Bolts Machine screws Internet access

		● **Individual activity:** students investigate an engineering component, e.g. a bolt. Students need to: o write a plan for machining the component part, listing the processes they would use in the correct order o select a material to use and explain why they have chosen that material o research methods that could be used to cut the screw thread of the bolt. ● **Paired activity:** students research horizontal and vertical milling machines and their uses in engineering. **Plenary activity:** ● **Individual activity**: students summarise the differences and similarities between turning and milling.	
9	Engineering processes: cutting [Component 2, A3, Types of engineering processes: cutting]	**Introductory activity:** ● **Individual activity**: students choose one of the types of cutting (drilling, sawing, filing or shearing) and think of one advantage and one disadvantage of that process. **Main session activities:** ● **Teacher-led presentation**: teacher introduces the different types of cutting processes. Teacher may wish to demonstrate these as they go along. ● **Individual activity**: students answer the following questions. o A low carbon steel bar is turned in a lathe. Calculate the correct RPM if the cutting speed is 27 metres per minute and the diameter is 25 mm. o Check the RPM on the lathes in your workshop. What is the nearest RPM that you can select? ● **Paired activity:** students practise shearing skills. They must find a piece of thin steel, mark a centre point and draw a circle with a diameter of 100 mm, and then cut	Range of different files and hacksaws Tin snips Pillar/bench drill and bits Centre punch Hammer Steel block/swage block Marking-out equipment Thin sheet steel (max 1 mm thickness suggested)

		around the circle. Pairs then evaluate each other's work. How accurate was their cutting? ● **Individual activity**: with teacher facilitation, students obtain three different files and three different hacksaws from the workshop. They then fill in the table provided, or produce their own. **Plenary activities**: ● **Individual activity:** students give definitions for each of the different types of cutting they have learned about. ● **Whole class activity:** students discuss the need for different types of files and the reasons why hacksaw blades have different numbers of teeth.	
10	Engineering processes: joining [Component 2, A3, Types of engineering processes: joining]	**Introductory activity:** ● **Paired activity**: with a partner, students examine the chair that they are sitting on and make a list of the types of joining processes that they think have been used to make it, and the reasons why these processes have been chosen. **Main session activities:** ● **Teacher-led presentation**: teacher introduces the different types of joining processes. ● **Individual activity:** students research the different methods used to prevent oxidation in the welding process. ● **Individual activity:** students research the best joining techniques to use in the following examples and give reasons for their answers: o mounting electronic components on a printed circuit board o joining two mild steel pipes o joining different component parts of a bike frame o joining different component parts of a car windscreen. **Plenary activity:**	Examples of soldered, welded and brazed joints (physical or images) Internet access

		• **Paired activity:** students create a short presentation on the different ways in which metals can be joined, using real-life examples to explain each process.	
11	Engineering processes: forming polymers [Component 2, A3, Types of engineering processes: forming – extruding, moulding]	**Introductory activity:** • **Whole class activity**: students look at some everyday products and write down a list of processes they think were used to make each product – e.g. how is a jelly made or a chocolate bar shaped? Many of the processes may be applicable to the engineering of metal and polymer products. **Main session activities:** • **Teacher-led presentation**: teacher explains the different types of forming processes used for polymer materials. • **Teacher-led presentation**: teacher demonstrates the process of extrusion, using video clips as appropriate (could also be demonstrated using a hot glue gun). • **Individual activity:** students research examples of components that have been manufactured using injection moulding, then answer the following questions. o What is the component, and what is its function? o What type of polymer is the component made of, and why? o What are the advantages of using injection moulding to produce the component? **Plenary activity:** • **Individual activity:** students write a step-by-step process for how they would form something using both extrusion and moulding techniques.	Short video clip from the internet, e.g. 'Plastic Extrusion' https://www.youtube.com/watch?v=Tp2Rdx69SSo Glue gun and die Internet access
12	Engineering processes: forming metals [Component 2, A3, Types of engineering processes: forming – forging, casting, folding, bending	**Introductory activity:** • **Paired or small group activity:** students discuss how metals might behave differently from polymers while they are being formed, linking this to their knowledge of how polymers behave when being formed.	Internet access

		Main session activities: ● **Individual activity**: students research and note down the correct definition of the term 'forging'. ● **Teacher-led presentation**: teacher introduces different types of forming processes for metals. ● **Individual activity:** students research folding and bending processes in the manufacture of common, everyday items, and then make notes and sketches to illustrate the processes. **Plenary activities:** ● **Individual activity:** students list similarities and differences between the forming processes for metals and polymers, giving specific examples where possible. ● **Homework task:** students identify, from a list of topics from Learning aim A3, those topics they are unsure about and any topics they do not understand.	
13	Learning aim A: assessment practice Revision of Learning aims A1, A2 and A3 [Component 2, A1, A2 and A3, Understand materials, components and processes for a given engineered product]	**Introductory activity:** ● **Whole class activity**: teacher leads a Q&A session based on Learning aims A1, A2 and A3. **Main session activities:** ● **Teacher-led presentation:** teacher recaps topics covered in Learning aims A1, A2 and A3 and explains that students will be expected to: o identify different engineering material categories, and understand the uses for these materials o Identify the properties of different engineering materials, and how these can be used effectively for different engineered products o identify the types of components they will be using to make engineered products, and the characteristics of these	Pearson authorised assignment brief or brief produced and verified by school

		○ demonstrate their knowledge and ability to carry out different types of engineering processes, such as cutting, shaping and forming. ● **Individual activity**: students are given an engineered product to investigate; they identify the proprietary and specialist components used to make the product and then investigate the materials used to make the components. ● **Individual activity**: students complete the following tasks. ○ Students write down the differences between ferrous and non-ferrous metals. What are the primary uses for each type? ○ Students list the properties, forms and an example of use of acrylic. ○ Students identify and describe the different engineering processes used to form polymers and metals. **Plenary activity:** ● **Teacher-led presentation then individual activity**: teacher introduces final assignment brief for Learning aims A1, A2 and A3 and discusses the assessment criteria, explaining the command words. Students conduct the assessment independently and produce an outline plan for their assessment.	
Learning aim B: Investigate a given engineered product using disassembly techniques **Teaching content B1: Practical engineering skills**			
14	Practical engineering skills 1 [Component 2, B1, Practical engineering skills – Observing and recording skills]	**Introductory activities:** ● **Individual activity:** students make a list of all the practical engineering skills they can think of. ● **Group activity:** working in a small group, students discuss and compare their list with others to see what they can add to their list. They then evaluate their strengths and any areas needing development.	

		Main session activity: ● **Individual activity:** students make a list of all the tools and equipment that they have been shown how to use safely. For each item, they write down what it is used for and any safety precautions they need to follow. Then, they make a list of the tools and equipment in their engineering workshop that they do not know the purpose of or how to use. Students then carry out research to find out what these tools are for. **Plenary activity:** ● **Paired activity:** students discuss with a partner the advantages of keeping a logbook of all of the engineering activities that they complete on their course.	
15	Practical engineering skills 2 [Component 2, B1, Practical engineering skills – Observing and recording skills]	**Introductory activity:** ● **Paired activity:** students think about all the pieces of information that they would need to know about an engineering component to be able to make it. How would they find out this information? **Main session activities:** ● **Individual activity:** students are given one of a number of engineered products (such as a hand tool from an engineering workshop) and then observe and record its various parameters: o visual features o surface features o mass o colour o degradation o identification marks. For their notes, it might be useful to take a picture of the product.	A variety of engineered products Camera/smartphone to take pictures

		Plenary activity: ● **Paired or small group activity:** students compare their observations of the product that they have examined with those of another student who observed the same or a similar product. What are the similarities and differences in the descriptions and observations?	
16	Practical engineering skills 3 [Component 2, B1, Practical engineering skills – Measurement skills; Appraisal/interpretation skills]	**Introductory activity:** ● **Whole class activity:** students come up with examples of what could go wrong when making an engineered product if things are not measured correctly. **Main session activities:** ● **Individual activity:** teacher asks students if they can order a bolt or a nut via the internet. Students list some of the information that would be required to place an accurate order. ● **Paired activity:** students obtain some nuts and bolts and measure and record their: o length o diameter o thread size. ● **Paired then whole class activity:** students compare their results with those of their partner. They then swap their items with another pair and repeat the exercise. Compare all of the measurements across the class. What differences are there? Why might that be? **Plenary activities:** ● **Individual activity:** students answer the following question: why do bolts and nuts have standard across flats (AF) features? Students revisit the initial evaluation of practical engineering skills and re-evaluate their own skills.	A selection of nuts and bolts of various lengths, diameters and thread sizes Measuring instruments: rule, Vernier callipers, micrometer

		• **Homework task:** students identify, from a list of topics from Learning aim B1, those topics they are unsure about and any topics they do not understand.	
Learning aim B: Investigate a given engineered product using disassembly techniques **Teaching content B2: Disassembly techniques**			
17	Disassembly techniques [Component 2, B2, Safe use of disassembly techniques]	**Introductory activities:** • **Teacher-led discussion**: teacher leads Q&A session to review Learning aim B1 content that students are unsure about. • **Paired activity**: students think about and discuss what the term disassembly means and write out a definition of the word. • **Individual activity**: students are prompted to think about disassembly techniques and how these might be used to investigate an engineered product. **Main session activity:** • **Teacher-led presentation**: teacher reinforces the importance of safety when using disassembly techniques. • **Small group activity:** students are given a small, engineered assembly and complete the following tasks: o Identify the items needed for storing parts that are removed. o List the tools needed for disassembly. o Identify the semi-permanent and permanent fixings. o Identify which parts look difficult to remove. • **Teacher-led demonstration**: Teacher gives explanation/demonstration and students make notes on using a torque wrench correctly. **Plenary activity:**	A variety of materials, components, products and assemblies Documentation/sketching tools Appropriate PPE Short video clip from the internet, e.g. 'PPE: An Introduction - Safety Training Video Preview - Safetycare Personal Protective Equipment': https://www.youtube.com/watch?v=rg1GJluag6w

		● **Individual activity:** students list the steps needed when removing parts from an engineered assembly and laying them out.	
18	Disassembly tools [Component 2, B2, Safe use of tools and equipment]	**Introductory activity:** ● **Individual activity:** students research and list organisational and safety considerations when using disassembly techniques. **Main session activities:** ● **Teacher-led presentation**: teacher reinforces the importance of and demonstrates the safe use of correct tools and equipment – disassembly/assembly tools with settings. ● **Paired activity:** using what they have learned in the previous lesson, students think of examples where they would use a torque wrench. ● **Small group activity:** students are given a small, engineered assembly and then follow these steps: o Identify the PPE they will need. o List the tools that they will need. o List the documents they would need to refer to when disassembling and reassembling the product. o List the photographs they would take. o Sketch how they would lay out the various disassembled parts. o Identify the hazards. o Identify the risks. **Plenary activity:** ● **Individual activity:** students list the types of PPE needed in diassembly operations.	A variety of small products and assemblies A variety of disassembly and reassembly tools, such as screwdrivers, spanners, torque wrenches, drifts and feeler gauges Appropriate PPE

		● **Homework task:** students identify, from a list of topics from Learning aim B2, those topics they are unsure about and any topics they do not understand.	
Learning aim B: Investigate a given engineered product using disassembly techniques **Teaching content B3: Product design specification (PDS)**			
19	Product design specification (PDS) [Component 2, B3, Product design specification]	**Introductory activity:** ● **Teacher-led discussion:** teacher leads Q&A session to review Learning aim B2 content that students are unsure about. ● **Individual activity:** students examine a mobile phone. How many different functions does it have? How well does it perform these functions? How many functions do the students use? Compare their list with that of another student. What requirements do they have for a mobile phone? **Main session activities:** ● **Teacher-led presentation:** teacher gives a quick summary of the meaning of a PDS. ● **Group activity**: working in small groups, students search online for an example of a PDS; it must be for an electronic engineered product. Then, using the example PDS they found as a base, students create their own PDS for another engineered product, such as a digital music player. They should consider factors such as: o size o mass o measurements o product life o reliability o performance o function	Mobile phones Internet access

		○ service requirements ○ economic considerations ○ standards and legislation. ● **Individual activity**: students find a conversion table for SI and imperial units. **Plenary activities:** ● **Individual activity:** students explain the difference between function and performance. ● **Individual activity:** students list the different types of information needed for a PDS.	
20	Safe working [Component 2, B2, Safety and risk assessment]	**Introductory activity:** ● **Individual or whole class activity:** students think about what the main aims of a risk assessment are, and list as many as they can. **Main session activities:** ● **Individual activity:** students research companies that have failed the duty of care. What have been the consequences? ● **Paired activity:** students complete the following tasks for the disassembly of a small, engineered product (for example, a motor or a pump): ○ Identify the hazards that may be present. ○ Decide who might be harmed and how. ○ Evaluate the risks and adopt control measures. ○ Record their findings. ○ Review their assessment and update if necessary. ○ Complete a HSE risk assessment pro forma for this task. **Plenary activities:** ● **Individual activity:** students describe the five steps of a risk assessment.	Internet access Risk assessment pro forma

		● **Homework task:** students identify, from a list of topics from Learning aim B3, those topics they are unsure about and any topics they do not understand.	
21, 22	Learning aim B: assessment practice Revision of Learning aims B1, B2 and B3 [Component 2, B1, B2 and B3, Investigate a given engineered product using disassembly techniques]	**Introductory activity:** ● **Teacher-led discussion**: teacher leads Q&A session based on learning aims B1, B2 and B3. ● **Individual activity:** students answer the following questions to check their learning. o What is the definition of a risk assessment? o What are four main things a PDS will cover? o Why do bolts and nuts have standard across flats features? **Main session activities:** ● **Teacher-led presentation**: teacher recaps topics covered in Learning aims B1, B2 and B3 and explains that students will be expected to: o show knowledge of disassembly tools and techniques and be able to disassemble an engineered product safely o demonstrate knowledge of how to remove semi-permanent fixings, and how to replace non-reusable consumables or fixings. o demonstrate their ability to observe and record the different features of an engineered product, including measurements, and use these to give an appraisal of a product, with justifications and reasoning o understand the requirements of a product design specification (PDS). ● **Paired activity**: working with a partner, students prepare a product design specification (PDS) for an engineered product by investigating its construction and manufacture. They must select an engineered product and investigate its purpose/function, using hand tools and working safely to dismantle the product. Once finished, students lay out the	Pearson authorised assignment brief or brief produced and verified by school

		parts, label them and identify the function of each one. For parts that have been machined/formed, students measure their dimensions and record these on simple sketches. ● **Individual activity:** students obtain an engineered product and answer/carry out the following tasks. o Write down all items of PPE required to safely strip (disassemble) and rebuild this product. o Make a list of the risks there are when stripping or reassembling the product. o Make a list of all the tools needed to strip or reassemble the product, ensuring that the correct sizes are noted for the tooling. o List the documents needed for disassembling or reassembling the product. o List the photographs they would take. o Sketch how they will lay out the various components. o Use hand tools and work safely to dismantle the product. o Lay out the parts, label them and identify the function of each one. o For parts that have been machined/formed, measure their dimensions and record on simple sketches. **Plenary activities:** ● **Whole class activity:** students discuss and give feedback on each other's PDS prepared in the paired activity. ● **Teacher-led presentation then individual activity**: teacher introduces final assignment brief for Learning aims B1, B2 and B3 and discusses the assessment criteria, explaining the command words. Students conduct assessment independently and produce an outline plan for their assessment.	
Learning aim C: Plan the manufacture and safely reproduce/inspect/test an engineered component			

Teaching content C1: Engineering make process			
23	Engineering make process 1 [Component 2, C1, Engineering make process – defining the problem, developing possible solutions, choosing a solution]	**Introductory activities:** ● **Teacher-led presentation:** teacher introduces students to Learning aim C1 – the engineering make process. ● **Individual activity:** students consider problems that could arise if they were working with a designer to create a child's bicycle. They list potential problems they might have to overcome when designing this product. **Main session activities:** ● **Individual activity:** students use the information gathered from their disassembly activity in Learning aim B to: o prepare a plan for the safe making of a reproduction of a component from the product previously dismantled o prepare a list of the tools and materials needed to make the component o conduct a risk assessment of the processes to be used o make the component o perform a quality inspection of the component. ● **Individual activity:** students examine the components from their disassembled engineering product and eliminate the ones that they cannot make due to lack of skills or lack of resources, tools or materials. Students write out a list of the components they can make. ● **Individual activity:** students examine the products they looked at in Learning aim B and prepare a document to show which of the following points can be ticked off for each product. o Check that they have the processes in the workshop to make the engineered product. o Check that they have the materials available. o Check that they have the measuring tools available.	Risk assessment pro forma Selection of components, products and assemblies investigated in Learning aim B

		o Ensure that they have the skills to make the engineered product. o Check that they have identified the possible problems and solutions for making the product. o Check if they can justify their solutions. **Plenary activity:** ● **Individual activity:** students produce a statement to describe an engineering component and what the component is used for.	
24	Engineering make process 2 [Component 2, C1, Engineering make process – making using engineering processes]	**Introductory activity:** ● **Group activity**: students discuss the following question in small groups: what do they need to do to ensure they are fully prepared to make an engineering product using engineering processes? Students share their thoughts with other groups to add to their answers. **Main session activities:** ● **Individual activity**: students go to the workshop and see what materials, tooling and equipment are available to support their assessment. ● **Individual activity:** students make a bolt to the specification detailed in lesson 23. ● **Paired activity:** in pairs, students evaluate how each performed in making the bolt in the main session activity. Is there anything they did wrong? Could anything be improved? **Plenary activity:** ● **Individual activity:** students answer the following question: what size would they turn the diameter of the bar to take a 10 mm thread?	Workshop materials, tooling and equipment needed to make a small component such as a bolt Appropriate PPE
25	Engineering make process 3	**Introductory activity:**	Internet access

	[Component 2, C1, Engineering make process – inspecting and testing chosen solution, evaluating outcome of project]	• **Individual activity:** students search online for a definition of an inspection sheet record. What types of information need to be recorded, and at what stage in the process should the inspection sheet be filled in? **Main session activities:** • **Individual then paired activity:** students practise measuring some 10 mm bar stock with: o Vernier callipers o a micrometer o callipers and rule. Students record their findings and compare them with those of a partner. Do their readings agree? Are there any major discrepancies? • **Teacher-led activity:** teacher gives students a suitable engineered product; students inspect the product and complete an inspection sheet provided by the teacher. **Plenary activities:** • **Individual activity:** students create inspection tables including all headings. • **Individual activity:** students list three things that they could report on when evaluating the outcome of their project. • **Homework task:** from a list of teacher-suggested topics related to Learning aim C1, students identify those they are unsure about and any topics they do not understand.	A selection of components or products for students to inspect
Learning aim C: Plan the manufacture and safely reproduce/inspect/test an engineered component **Teaching content C2: Develop a production plan**			
26	Developing a production plan [Component 2, C2, Developing a production plan]	**Introductory activities:** • **Teacher-led discussion:** teacher leads Q&A session to review Learning aim C1 content that students are unsure about.	

		• **Group activity**: working in small groups, students make a list of all of the features they think should be in a production plan. They then share their thoughts with other groups to add to their list. **Main session activity:** • **Paired activity:** students complete a production plan for the making of a bolt. **Plenary activity:** • **Whole class activity:** each student pair swaps production plans with another pair and gives feedback on the other pair's production plan. Based on the feedback they receive, students update their plan with any information they have missed. Teacher facilitates the comparison of production plans produced by different pairs of students and discussion regarding differences in the plans.	
27	Awareness of risks and hazards for making processes [Component 2, C2, Awareness of risks and hazards for making processes]	**Introductory activity:** • **Individual activity:** students answer the question: what is the difference between a risk and a hazard? Students write down as many examples of each as they can think of. **Main session activities:** • **Teacher-led presentation:** teacher explains the need for full awareness of risks and hazards, and methods of prevention. • **Individual activity:** students go to the HSE website and study the sample risk assessment for the motor vehicle mechanical repair workshop. They then complete a risk assessment for production of the bolt. • **Individual activity:** students visit the engineering workshop in their centre and locate the drilling machines, lathes and milling machines. They make a plan of the workshop to show the positions of different machines,	Internet access Risk assessment pro forma Access to workshop

		emergency stops, fire doors, first aid box, etc., and annotate it with the following information: o the guards that are on each machine o whether each machine has an emergency stop o where the emergency stop is located o how the tools are stored o what information is available about the cutting fluids o the PPE required for each machine. **Plenary activity:** ● **Teacher-led presentation:** teacher emphasises that students must be aware of any risks and hazards in their workshop – it is important to stay safe when they are working. Do they know: o how to isolate a machine in the workshop? o where the emergency stop is on a lathe?	
28	Safe preparation, good housekeeping and close down of the work area [Component 2, C2, Safe preparation, good housekeeping and close down of the work area; Making skills associated with the product to be produced – appropriate set-up of the work area/machine, adaptation according to inspected outcomes]	**Introductory activity:** ● **Individual activity:** students research basic lathe, milling and drilling processes, and list the safe working practices that would be needed for each process. They should consider every step of each process. **Main session activities:** ● **Teacher-led demonstration:** teacher sets up a work area for an engineering activity, including demonstrating the selection of tools and equipment. ● **Teacher-led presentation:** teacher reviews safety procedures that should be followed when using machinery. Students note the safety precautions that should be followed. ● **Individual activity:** students take notes about and/or sketch safe working practices that need to be followed in a workshop.	Internet access A selection of workshop materials, tools and equipment to demonstrate the set-up of a work area

		Plenary activity: ● **Paired then whole class activity:** students discuss the safety rules that should be followed when milling, drilling and turning. Pairs compare their thoughts and discuss any differences.	
29, 30	Choosing suitable tools [Component 2, C2, Making skills associated with the product to be produced – choosing suitable tools]	**Introductory activity:** ● **Group activity:** working in small groups, students write down the tools that need to be used to complete a simple engineering activity, and discuss why these tools are suitable for the task. **Main session activities:** ● **Teacher-led demonstration:** teacher shows and explains the use of tools for drilling, lathe tools and tools for milling; students take notes or make sketches. ● **Individual activity:** students list the correct tools to use for producing a bar: o with a 45 degree chamfer o with a 10 mm radius o that is parted off o that is faced off. ● **Individual activity:** students are asked to drill a hole of 10 mm diameter and explain the sequence of steps to take using the correct tools. **Plenary activity:** ● **Paired activity:** in pairs, students evaluate	A selection of tools used for milling, drilling and turning operations
30	C2, Choosing suitable tools	**Introductory activity:** ● **Group activity:** working in small groups, students write down the tools that need to be used to complete a simple engineering activity, and discuss why these tools are suitable for the task. **Main session activity:**	

		● Teacher-led demonstration:1 o lathe tools o student note-taking/sketching. ● **Paired activity:** working in pairs, use a lathe to cut a piece of 25mm diameter bar, 100 mm long down to 23mm diameter for a length of 25mm. ● Students must think about any safety considerations before they begin. ● What tools will they need to complete this task? **Plenary activity:** ● **Individual activity:** students list three tools used for drilling, milling and turning. For each tool, write down what it is used for and produce a labelled sketch.	
31	Skills in observing and recording techniques [Component 2, C2, Skills in observing and recording techniques]	**Introductory activity:** ● **Individual activity:** students examine an engineered product that they are familiar with and think about the checks that would need to be done to make sure that it works as it was designed to do. **Main session activities:** ● **Teacher-led presentation:** teacher explains the reasons for monitoring and observing engineering activities while they are being completed. ● **Individual activity:** students research methods of observing engineering processes, using both manual and automated techniques. ● **Teacher-led demonstration:** teacher shows how to make accurate measurements using a range of measuring instruments. ● **Individual activity:** students measure and record the dimensions of engineering components, considering the differences in measurements and the reasons for these.	Internet access A selection of bolts with the same specification (e.g. all M6 × 30 mm from the same supplier) Measuring instruments – rule, Vernier callipers, micrometer

		Plenary activities: ● **Teacher-led discussion:** teacher leads a discussion on why measurements should always be checked, and why it is important to ensure that measuring equipment is accurate. ● **Homework task:** students identify, from a list of topics from Learning aim C2, those topics they are unsure about and any topics they do not understand.	
32–36	Learning aim C: assessment practice Revision of Learning aims C1 and C2 [Component 2, C1, C2, Plan the manufacture and safely reproduce/inspect/test a given engineered component]	**Introductory activity:** ● **Teacher-led discussion:** teacher leads a Q&A session based on Learning aims C1 and C2. **Main session activities:** ● **Teacher-led presentation:** teacher recaps topics covered in Learning aims C1 and C2 and explains that students will be expected to o understand the planning stages of the engineering make process, including knowing how to define a problem, develop possible solutions for the problem and choose a suitable solution o understand how to make components and products using engineering processes, with the correct inspections and testing o know how to evaluate whether their project has been a success or not o be able to develop a comprehensive production plan o be aware of any risks and hazards associated with the make process, and how to safely work in workshop. ● **Individual activity:** students answer the following questions to check their learning. o What are the six main things that need to be covered in a production plan?	

		o Why do you need to inspect components once you have made them? o Why should you make notes on your production plan as you work through the different steps? ● **Individual activity:** students answer the following questions to check their learning. o Why is it important that you select the most suitable materials for the component? Think about what the component is designed to do and how you plan to make it. o Why is it important to close down a work area on completion of practical tasks? What could happen if it is not closed down correctly? ● **Individual activity:** students reproduce a component from the product they dismantled in Learning aim B, using the same materials and making processes. Using the information they gathered for the assessment practice in Learning aim B, students prepare a plan for the safe making of a reproduction of a component from the product previously dismantled. Students must: o prepare a list of the tools and materials to make the component o conduct a risk assessment of the processes to be used o make the component o perform a quality inspection of the component o show evidence of their work, which must fully meet the requirements of the assessment criteria and could include a portfolio of notes, photographs of different stages of production, a logbook and a process chart. ● **Paired activity:** students write down the good points and bad points of both their plan and the practical making activities. What went well and what could be improved? Students use these reflections to suggest some ways in	

		which both the planning and the making processes could be improved when they complete another similar activity **Plenary activity:** ● **Teacher-led presentation then individual activity:** teacher introduces the final assignment brief for Learning aims C1 and C2 and discusses the assessment criteria, explaining the command words. Students conduct assessment independently and produce an outline plan for their assessment.	

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this qualification. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Website

http://www.hse.gov.uk/, *Health and Safety Executive* website – information on health and safety within the engineering sector

Videos

'The difference between Ferrous and non-ferrous metals', available from https://www.youtube.com/watch?v=UgmlmDUhR6A

'Thermosets and thermoplastics', available from https://www.youtube.com/watch?v=INS7TwWmlrg&t=11s

'Polymers – Crash Course Chemistry #45', available from https://www.youtube.com/watch?v=rHxxLYzJ8Sw&spfreload=10

'What is thermoforming?', available from https://www.youtube.com/watch?v=_z6RgDJxZSsBe

'Physical Properties of Metals', available from https://www.youtube.com/watch?v=NHWcwAijMvk

'Plastic Extrusion', available from https://www.youtube.com/watch?v=Tp2Rdx69SSo

'PPE: An Introduction - Safety Training Video Preview - Safetycare Personal Protective Equipment', available from https://www.youtube.com/watch?v=rg1GJluag6w