Year 10 BTEC Tech award Engineering

Component 3

Component title	Responding to an Engineering Brief
Guided learning hours	48
Number of lessons	48
Duration of lessons	1 hour

Lesson	Topic from specification	Suggested activities	Classroom resources
Learning aim A: Carry out a process to meet the needs of an engineering brief **Essential content A1: Carry out a process**			
1	Carry out a process [Component 3, A1, Carry out a process]	**Introductory activities:** ● **Teacher-led presentation:** teacher introduces students to Component 3, drawing their attention to the fact that this is synoptic and therefore draws on their learning from Components 1 and 2. ● **Paired activity:** students discuss how useful they think instructions are and why these are used in engineering processes. **Main session activities:** ● **Teacher-led discussion:** teacher leads a class discussion on the importance of following processes in engineering and the types of work instructions that are used in engineering industries. ● **Individual activity:** students think about whether they have ever assembled a model construction kit or if they helped or watched someone assemble some flat-pack furniture. ● **Paired activity:** working with their original partners, students list any advantages/disadvantages of working to clear instructions. ● **Whole class activity:** students compare their ideas with the rest of the class. ● **Teacher-led discussion:** Teacher leads a discussion in which students consider the benefits of the different types of work instructions. ● **Individual activity:** students produce a plan using a flow chart or sequential drawing for a simple engineering activity.	Internet access Interactive whiteboard

		● **Teacher-led discussion:** teacher asks for feedback on the types of information the students included in their plans, listing these on the whiteboard. **Plenary activities:** ● **Teacher-led discussion:** teacher leads a summary discussion in which students consider the reasons for using instructions. ● **Individual activity:** students research some examples of work instructions and procedures used in engineering.	
2	Following planned procedures [Component 3, A1, Following planned procedures]	**Introductory activity:** ● **Group activity:** students work in small groups to discuss what could happen if instructions are not followed correctly, e.g. when repairing a bicycle. **Main session activities:** ● **Paired activity:** students exchange copies of production plans that they have written in previous lessons with a partner and prepare to carry out the operations in the plan they received. ● **Individual then paired activity:** students record on the copy of the plan both what was easy and what was difficult to understand, and then discuss with their partners. ● **Teacher-led discussion:** teacher leads a class discussion on ways to improve a production plan. ● **Individual activity:** students take their production plans and apply the suggested ways of improvement, highlighting any stages that could be simplified, removed or combined and other opportunities to reduce the number of components, tools and pieces of equipment. ● **Teacher-led discussion:** teacher leads a class discussion on the benefits of keeping the number of tools to a minimum by standardising component design. **Plenary activity:**	Internet access Interactive whiteboard Production planning documents Hand tools Workshop facilities

		● **Paired activity:** students compare the original and improved production plans and discuss the reasons why they think the improved plans are better.	
3	Prototypes and models [Component 3, A1, Using and testing a prototype/model]	**Introductory activity:** ● **Paired activity:** students discuss what they think a prototype is and why they are used by engineers. **Main session activities:** ● **Teacher-led presentation:** teacher outlines why prototypes and models are important during the design of an engineered product. ● **Individual activity:** students research an example of a prototype for an engineered product that they are interested in; they should make notes on any associated research carried out, find out how many prototypes were necessary, and compare the final design with the original prototype. ● **Teacher-led presentation:** teacher explains the benefits of carrying out prototype testing and describes the basis of functional, ergonomic and destructive testing. **Plenary activity:** ● **Paired activity:** students consider a specific engineered product, such as a car engine or a digital camera, and discuss what could happen if these products were not tested at the prototype stage.	Internet access Interactive whiteboard Case studies – prototypes
4	Understanding how a product is assembled [Component 3, A1, Assembling, handling and using materials, equipment and machinery]	**Introductory activity:** ● **Teacher-led discussion then paired activity:** teacher asks students if they have heard of reverse engineering. Working in pairs, students think about and discuss reasons why design engineers might disassemble a product to find ways of improving it. **Main session activities:** ● **Teacher-led presentation:** teacher explains reverse engineering and what it means.	Internet access Interactive whiteboard Products to be disassembled/reassembled (or just dismantled) Hand tools Workshop equipment Measuring equipment

		● **Teacher-led presentation:** teacher explains disassembly of a product and outlines what is seen as good practice. ● **Individual activity:** students practise disassembly of a product that has at least six components (perhaps an old unwanted product). The process should result in the students being able to produce a plan for reassembly. As part of this, students should consider why and how a reassembled product should be tested. (Critical: a disassembled product could be unsafe and out of warranty/liability removed.) **Plenary activity:** ● **Paired activity:** students think about the tools that they will use when disassembling an engineered product.	
5	Handling and using materials, equipment and machinery [Component 3, A1, Assembling, handling and using materials, equipment and machinery]	**Introductory activity:** ● **Teacher-led discussion:** teacher leads a class discussion and asks students to list the types of metals used in engineering products. **Main session activities:** ● **Teacher-led presentation:** teacher recaps what has been learned in Component 2 about metals and polymers, composites and smart materials. ● **Teacher-led discussion:** teacher leads a class discussion covering the safe handling of materials and the types of PPE that should be used. ● **Individual activity:** students research handling methods for a range of materials and material forms. ● **Individual activity:** students investigate safe working practices for handling various materials. ● **Individual activity:** students research and list the PPE that should be used and the reasons for its use. ● **Teacher-led presentation:** teacher explains how the form and shape of materials impacts on safe handling procedures.	Internet access Interactive whiteboard

		● **Teacher-led presentation:** teacher reminds students that they should operate only equipment and machinery they have been instructed to use and should always get permission first. **Plenary activities:** ● **Small group activity:** students discuss in small groups why specific equipment is used with certain 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: Carry out a process to meet the needs of an engineering brief **Essential content A2: Recording the process**			
6	Recording the process [Component 3, A2, Measuring and recording data with accuracy and precision; Tabulating appropriate data in the correct format accurately and to a suitable degree of precision]	**Introductory activities:** ● **Teacher-led discussion:** teacher uses a question and answer (Q&A) session to review Learning aim A1 content that students are unsure about. ● **Group activity:** working in small groups, students discuss and list the values they think are important when collecting data for engineered components. **Main session activities:** ● **Teacher-led discussion:** teacher prompts students to think about how and why it is important to measure and record process data. ● **Teacher-led presentation:** teacher defines accuracy, precision and units of measurement. ● **Teacher-led presentation:** teacher shows examples of how to tabulate data, using tally charts and data collection charts. ● **Paired activity:** students collect a random selection of mechanical fixings or electrical components and carry out investigations, recording data in tabular form. Students discuss their results and what they show. **Plenary activity:**	Internet access Interactive whiteboard Sets of components (electronic or mechanical) to measure and tabulate Case study – set of data for analysis Calculators

		● **Paired activity:** students are given a set of data related to either mechanical or electronic components, which they individually categorise and analyse. Then, with their partners, they discuss the accuracy of the results and whether the process could be improved.	
7	Displaying data using charts and graphs [Component 3, A2, Displaying appropriate data graphically with accuracy – chart/graph, axis, scaling]	**Introductory activity:** ● **Paired activity:** students think about any trends or patterns they can see in the data from lesson 6. **Main session activities:** ● **Teacher-led presentation:** teacher explains why it is important to think about the type of graph or chart to use to display data. ● **Teacher-led presentation:** teacher describes types of charts and asks students for any feedback/comments. ● **Paired activity:** students are provided with data and produce three types of charts to display the data – pie chart, bar chart and pictograph. At the end, students write a review and conclude which method is the most effective for the data, then discuss with their partners. ● **Teacher-led presentation:** teacher describes types of graphs, again asking students for any feedback/comments. **Plenary activity:** ● **Teacher-led discussion:** students are provided with some examples of charts and graphs and teacher leads a class discussion on what decisions were made to use the specific type of chart/graph and which types were, or would be, the most effective.	Internet access Interactive whiteboard Graph/squared paper Calculator
8	Displaying data using lines of best fit [Component 3, A2, Displaying appropriate data graphically with accuracy – line/curve of best fit, labelling; Observation skills]	**Introductory activity:** ● **Teacher-led discussion:** teacher leads a class discussion on what students know about lines of best fit. **Main session activities:**	Internet access Interactive whiteboard Graph/squared paper Scientific calculator

		● **Teacher-led presentation:** teacher describes scatter graphs, using the example from lesson 6 of the load–extension of a spring with tabulated data and a scatter graph. ● **Individual activity:** students carry out a practical activity to measure the extension of a spring with different loadings, plotting points on a chart to produce a scatter graph. ● **Teacher-led presentation:** teacher explains lines of best fit and how they can be used effectively to show straight-line relationships for data. ● **Teacher-led presentation:** teacher reminds students of the importance of using their observational skills whenever investigating data. **Plenary activities:** ● **Individual then paired activity:** students take the scatter graphs they produced in the main session activity and try to plot a line of best fit. With a partner, students think about and discuss the reasons why tabulated data and scatter graphs can be useful. ● **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.	Springs Weights Measuring tape/ruler
Learning aim A: Carry out a process to meet the needs of an engineering brief **Essential content A3: Interpretation of data**			
9	Interpretation of data [Component 3, A3, Identifying anomalous results; Comparison of trends/patterns]	**Introductory activities:** ● **Teacher-led discussion:** teacher leads Q&A session to review Learning aim A2 content that students are unsure about. ● **Paired activity:** students are prompted to think about how to interpret tabulated data, and compare their interpretation of a set of tabulated data with that of a partner. **Main session activities:**	Internet access Interactive whiteboard Examples of tabulated data Examples of scatter graphs Scientific calculator

		● **Teacher-led presentation:** teacher explains basic approaches to interpreting data, starting with the comparison of trends and patterns – linear relationships, lines/curves of best fit. ● **Individual activity:** students examine an example of tabulated data (table with around ten rows) and see if they can identify a trend/pattern. ● **Individual activity:** students plot the tabulated data on a scatter graph and draw a best line of fit. ● **Teacher-led presentation:** teacher asks students to compare the result with their initial thoughts and to say if they were able to notice the trend from the initial table. ● **Teacher-led presentation:** teacher explains anomalous results and sources of error, using an example scatter graph to show what these mean. **Plenary activity:** ● **Paired activity:** students examine some scatter graphs and see if they can identify any anomalous results.	
10	Evaluating processes, drawing conclusions and making recommendations [Component 3, A3, Evaluating the process, including testing process used, recording/processing results; Drawing valid conclusions; Making recommendations related to engineering briefs]	**Introductory activity:** ● **Paired activity:** students consider how testing can help evaluate and improve engineered components, products and processes. **Main session activities:** ● **Teacher-led presentation:** teacher recaps the previous lesson on collecting and presenting data. ● **Teacher-led presentation:** teacher outlines the types of measuring equipment that could be used, depending on which measurements are being taken. ● **Teacher-led presentation:** teacher explains the use of gauges, such go/no-go gauges. ● **Paired activity:** students check the accuracy of the lengths of a sample of engineered components and parts using a go/no-	Internet access Interactive whiteboard Scientific calculator Gauges Machined components Case studies Measuring and testing equipment Workshop access Hand tools Drawing equipment, including drawing boards, set squares and compasses/CAD

		go gauge. Students group the components into ‘too small’, ‘too big’ and ‘within tolerance’ and write notes on why some components were not within tolerance. **Plenary activities:** ● **Paired activity:** working in the same pairs, students think about how useful measured data can be in recommending improvements to manufacturing processes. ● **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.	
11	Learning aim A: assessment practice Revision of Learning aims A1, A2 and A3 [Component 3, A1, A2, A3, Carry out a process to meet the needs of an engineering brief]	**Introductory activity:** ● **Teacher-led discussion:** 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 carry out an engineering investigation. ● **Individual activity:** students access and read through the SAMs for Learning aim A. ● **Individual activity:** students follow teacher’s given instructions to carry out an engineering investigation and record their findings in tabular and graphical formats. ● **Group activity:** students are grouped depending on revision needs and given support activities depending on their responses to the plenary activity of lesson 10. **Plenary activity:** ● **Teacher-led presentation:** teacher reviews the format of the final assignment brief for Learning aims A1, A2 and A3 and discusses the assessment criteria, explaining the command words.	Pearson published SAMs Practice investigations set by school
Learning aim B: Provide a design solution for an engineered product against the needs of an engineering brief			

Essential content B1: Interpretation of a given brief for an engineered product			
12	Interpretation of a given design brief for an engineered product [Component 3, B1, Analysing the existing product with reference to the design brief]	**Introductory activities:** ● **Teacher-led presentation:** students are introduced to Learning aim B1. ● **Group activity:** students work in small groups to discuss and make a list of information needed in a design brief (previously covered in Component 1). **Main session activities:** ● **Teacher-led discussion:** teacher leads a class discussion considering the information contained within an engineering design brief and the analysis of an existing product, covering physical requirements, aesthetics, size, function and performance requirements. ● **Individual activity:** students carry out an investigation into a simple engineered product, using the research to produce a design brief for the product. ● **Paired activity:** students exchange their design briefs with a partner to see if they can identify what the product is, based only on the description in the written brief. **Plenary activity:** ● **Paired activity:** students analyse one product in the workshop or classroom and write a design brief for the product.	Internet access Interactive whiteboard Case studies/engineered products Drawing equipment/CAD software
13	Features of engineered products [Component 3, B1, Dimensions and tolerances; Physical form; Attributes]	**Introductory activity:** ● **Paired activity:** students examine a given product and make a list of what they think are the features of the product. **Main session activities:** ● **Teacher-led presentation:** teacher outlines the features associated with dimensions, surface finishes and physical forms, also mentioning physical attributes. ● **Paired activity:** in the same pairs as in the introductory activity, students research and analyse a fabricated	Internet access Interactive whiteboard Example products Hand tools Measuring equipment Workshop facilities Drawing equipment/CAD software

		component, sketching the component, labelling the features and highlighting which features are important and why. ● **Teacher-led discussion:** teacher leads a class discussion on dimensions (and how to measure them), types of surface finishes (with examples if possible) and how to describe physical form. **Plenary activity:** ● **Teacher-led discussion:** students discuss tolerances and the relative importance of these for engineered products.	
14	Selecting engineering materials [Component 3, B1, Materials]	**Introductory activity:** ● **Individual activity:** students write down examples of the four categories of materials – ferrous and non-ferrous metals, and thermosetting and thermoforming polymers. **Main session activities:** ● **Teacher-led presentation:** teacher leads a class review of the four categories of materials used in most engineered products and components, describing their properties. ● **Individual activity:** students examine an engineered product and list the materials used for the various parts/components of the product, research the properties of the materials and then suggest alternative materials with similar properties. **Plenary activity:** ● **Group activity:** working in small groups, students discuss the reasons for their selections of alternative materials.	Internet access Interactive whiteboard Example products
15	Manufacturing processes [Component 3, B1, Processes]	**Introductory activity:** ● **Group activity:** students investigate the processes used in the manufacture of an engineered product, starting by disassembling the product and making a list of the processes they think have been used. **Main session activities:** ● **Teacher-led presentation:** teacher leads a class review of the four categories of manufacturing processes used in most	Internet access Interactive whiteboard Example products Hand tools PowerPoint® software

		engineered products and components – cutting, shaping, forming, and joining and fabrication – describing examples of their use. ● **Individual activity:** students examine an engineered product and list the manufacturing processes used for the various parts/components of the product. ● **Individual activity:** students then research two contrasting processes from the four process groups. ● **Whole class activity:** students share their research information by creating a short presentation and presenting it to the class group. **Plenary activities:** ● **Group activity:** students work in small groups to discuss the different options that can be used to manufacture an engineered product. ● **Homework task:** From a list of teacher-suggested topics related to Learning aim B1, students identify those topics they are unsure about and any topics they do not understand.	
Learning aim B: Provide a design solution for an engineered product against the needs of an engineering brief **Essential content B2: Redesign**			
16	Redesign [Component 3, B2, Identifying relevant issues with existing design; Design sketching – 2D, annotation]	**Introductory activities:** ● **Teacher-led discussion:** teacher uses Q&A session to review Learning aim B1 content that students are unsure about. ● **Individual then paired activity:** students select some objects from their classroom or workshop, e.g. a pencil sharpener or plastic chair, and sketch the objects using a single view; then they compare their sketch with that drawn by a partner. **Main session activities:** ● **Individual activity:** students are prompted to think about the use of redesign and how to identify relevant issues with existing designs.	Internet access Interactive whiteboard Example components Example design sketches Drawing equipment/CAD software

		● **Teacher-led presentation:** teacher reminds students that 2D sketching is a first step to producing ideas for redesign of an existing product. ● **Individual activity:** students practise sketching some engineered components, adding annotations to explain any important features. **Plenary activity:** ● **Paired activity:** students evaluate how effective sketches are at representing given components.	
17	3D sketching [Component 3, B2, Design sketching – 3D]	**Introductory activity:** ● **Paired activity:** students discuss with a partner what they remember about the 3D sketching techniques (such as oblique and isometric projections and perspective drawings) they researched in Component 1, Learning aim B: Generating final design drawings. **Main session activities:** ● **Teacher-led discussion:** teacher leads a class discussion on the limitations of 2D sketching and why 3D sketching is more effective. ● **Teacher-led presentation:** teacher explains the three methods of 3D sketching and their advantages and disadvantages. ● **Individual activity:** students produce 3D sketches, using each 3D sketching method/technique, for a number of given engineered components. **Plenary activity:** ● **Group activity:** in small groups, students discuss the problems with each sketching method and which method they think gives the most realistic representation.	Internet access Interactive whiteboard Example components Drawing equipment/CAD software
18	Exploded diagrams [Component 3, B2, Design sketching – exploded diagrams, annotation]	**Introductory activity:** ● **Individual then whole class activity:** students sketch a fully assembled engineered product based on an exploded	Internet access Interactive whiteboard

		diagram. Students then compare their diagrams with the rest of the class. **Main session activities:** ● **Teacher-led presentation:** teacher explains exploded diagrams and what they are used for. ● **Teacher-led presentation:** teacher emphasises the importance of labels and annotations to show what the parts are. Alternatively, reference number systems can be used. ● **Individual activity:** students produce an exploded diagram of an engineered product that they have disassembled previously and for which they have sketched the component parts. The exploded diagram should be annotated to identify each individual part. ● **Teacher-led presentation:** teacher explains parts lists, what information they provide and what they are used for. **Plenary activity:** ● **Paired activity:** students produce a simple parts list based on an exploded diagram of an engineered product.	Example components Example exploded diagrams Drawing equipment/CAD software
19	Electronic circuit diagrams [Component 3, B2, Design sketching – circuit diagrams]	**Introductory activity:** ● **Paired activity:** students research images of electronic circuits, making lists of components that are either easy or more difficult to draw. **Main session activities:** ● **Teacher-led presentation:** teacher explains the advantages of circuit schematic diagrams, compared with pictorial circuit drawings, and introduces some electronic component symbols and why these are used. ● **Individual activity:** students research some other symbols used for electronic components, creating a table to include the description, an image and the standard schematic symbol of each component. **Plenary activity:**	Internet access Interactive whiteboard Examples of simple electronic circuits Drawing equipment/CAD software

		● **Individual activity:** students collect images of physical electronic circuits, draw the respective circuit schematic diagram, and produce a parts list of the circuit's components.	
20	Design for manufacture [Component 3, B2, Design for manufacture]	**Introductory activity:** ● **Individual activity:** students think about how important it was to carry out processes in a specific order or in a certain way in engineering activities and processes they have worked on previously. **Main session activities:** ● **Teacher-led presentation:** teacher shows examples of concepts for products where manufacture has not been considered fully and discusses the potential impacts. ● **Teacher-led presentation then discussion:** teacher describes design approaches that can be used when designing for manufacture and leads a class discussion on this subject. ● **Individual activity:** students examine and investigate an engineered product that can be disassembled so that one component can be identified as possibly requiring improvement. ● **Paired activity:** students compare and discuss their ideas with a partner. **Plenary activity:** ● **Group activity:** working in small groups, students investigate some engineered products, discussing ways that the product could be improved to make it easier to manufacture.	Internet access Interactive whiteboard Case studies: examples of products where manufacturing has not been fully considered Drawing equipment/CAD software
21	Variation in form to solve a problem [Component 3, B2, Design ideas – variation in form]	**Introductory activity:** ● **Individual activity:** students consider products in their classroom or workshop that have a variety of forms but perform the same function (e.g. mobile phones, chairs), and make a list of common product features. **Main session activities:**	Internet access Interactive whiteboard Presentation materials Case studies: examples of products that have different forms

		● **Teacher-led presentation:** teacher prompts students to think about the ways in which the form of a product can be changed. ● **Individual then whole class activity:** students undertake research into the design of a support for a portable hard disk drive and then discuss with their class. ● **Teacher-led discussion:** teacher leads a class discussion on some of the ways in which the form of a product can be varied. **Plenary activity:** ● **Group activity:** students produce a mind map to show the factors that engineers should consider when changing the form of a product.	(e.g. mobile phones, cars, chairs, boats, hooks)
22	Variation in approach to solve a problem [Component 3, B2, Design ideas – variation in approach, use of different methods]	**Introductory activity:** ● **Paired activity:** students find as many ways as possible of solving a particular problem, such as designing a device to control the lighting in a room. **Main session activities:** ● **Teacher-led presentation:** teacher explains how there are often different solutions to a design problem, with different results and effectiveness – taking the example of crossing a river, solutions include stepping stones and a suspension bridge. ● **Individual activity:** students find a range of engineered products that meet the same general design requirement but take a different approach, making notes to explain how the idea meets the design requirements and sketching the design parts that are most effective. Activity includes producing a mind map. ● **Teacher-led presentation:** teacher outlines the use of rating systems, such as the RAG rating system. ● **Individual activity:** students revisit the examples of engineered product examined earlier in the lesson and carry	Internet access Interactive whiteboard Presentation materials Case studies: examples of products that have the same function (e.g. mobile phones, classroom equipment, workshop equipment)

		out a RAG rating for each of the design requirements for each of the product examples. **Plenary activity:** ● **Paired activity:** students carry out a RAG rating of two products in their classroom/workshop.	
23	Using different componentry [Component 3, B2, Design ideas – use of different componentry]	**Introductory activity:** ● **Individual activity:** students select an engineered product (possibly one they have examined in Components 1 and 2) and investigate parts or components that could be substituted. **Main session activities:** ● **Teacher-led presentation:** teacher explains ways of using different components to replace existing ones when redesigning and improving a product design, such as limiting the type/size of parts, using alternative materials, redesigning to reduce weight/volume, using common components and parts integration. ● **Individual activity:** students investigate the possible use of alternative components as part of a product's redesign. ● **Teacher-led discussion:** teacher leads a class discussion to recap the importance of standardisation of components, reducing tooling changes and common material choices. ● **Teacher-led presentation:** teacher also explains the alternative method of combining components. **Plenary activities:** ● **Paired activity:** students discuss the approaches that can be used to improve the componentry of an engineering problem. ● **Homework task:** from a list of teacher-suggested topics related to Learning aim B2, students identify those topics they are unsure about and any topics they do not understand.	Internet access Interactive whiteboard Case studies: examples of engineered products
Learning aim B: Provide a design solution for an engineered product against the needs of an engineering brief **Essential content B3: Evaluation**			

24	Evaluation [Component 3, B3, Reviewing the credibility of the design ideas given the needs of the brief]	**Introductory activities:** ● **Teacher-led discussion:** teacher uses a Q&A session to review Learning aim B2 content that students are unsure about. Students are prompted to think about how to evaluate a design and review design ideas. ● **Group activity:** students work in small groups to find examples of different engineered products that provide a solution to the same problem, e.g. provide the same functionality, and then compare the products and decide which one they think is the best solution. **Main session activities:** ● **Teacher-led presentation:** teacher introduces evaluation techniques and how these are used to review the credibility of design ideas. ● **Teacher-led discussion:** teacher leads a class discussion covering useful points about how to analyse and test proposed ideas. ● **Individual then paired activity:** students look at an example engineering problem, selecting solution ideas and sketching the ideas as mind maps to analyse and confirm how specific aspects of the design brief are met; they discuss their results with a partner. ● **Teacher-led presentation:** teacher explains that when evaluating design ideas, students should be honest, critical and thorough in their analysis. **Plenary activity:** ● **Group activity:** students carry out a peer review/evaluation of a design idea analysis and decide if they agree/disagree with the original designer's comments.	Internet access Interactive whiteboard Case studies: examples of design ideas/solutions A3 paper for sketching mind maps for presentation
25	Selecting and justifying the most appropriate design solution	**Introductory activity:** ● **Paired activity:** students discuss ways of justifying the appropriate design solutions for an engineering problem.	Internet access Interactive whiteboard

	[Component 3, B3, Selecting the most appropriate design solution; Justification of the design solution]	**Main session activities:** ● **Teacher-led presentation:** teacher outlines how to select and justify the best design solution for a given design brief and design specification. ● **Teacher-led presentation:** teacher leads a review of an example specification for an engineered product, e.g. a shelf bracket, reviewing and deciding on the most important points in order for the product to be termed fit-for-purpose. ● **Individual activity:** students carry out an exercise using RAG rating to help decide the selection and justification of the most effective solution out of a set of design ideas. This includes writing a short report to explain the selected outcome and the reason for that choice. **Plenary activity:** ● **Group activity:** students discuss the approaches that should be taken when justifying the selection of an effective solution.	Case studies: examples of design ideas/solutions
26	Justification of the processes to be used [Component 3, B3, Justification of the processes to be used]	**Introductory activity:** ● **Paired activity:** students examine an engineered product or component, making a list of the processes that have been used to make it, and then discuss why those processes were selected. **Main session activities:** ● **Teacher-led presentation:** teacher recaps the types of manufacturing processes covered in previous lessons. ● **Teacher-led presentation:** teacher explains why it is important that engineers understand processes in order to justify their choices and that research should always be carried out first if they have not used a specific process before. ● **Teacher-led presentation:** teacher covers some of the things that need to be considered when deciding on processes for manufacture – number of products, materials, features of the product, lead time and budget.	Internet access Interactive whiteboard Case studies: examples of design ideas/solutions

		● **Individual activity:** students look at an engineering problem and justify which materials and processes should be used for the solution, stating their reasons. **Plenary activities:** ● **Paired activity:** students work in the same pairs as previously to discuss alternative processes that could be used to manufacture a component, presenting their reasons. ● **Homework task:** from a list of teacher-suggested topics related to Learning aim B3, students identify those topics they are unsure about and any topics they do not understand.	
27	Learning aim B: assessment practice Revision of Learning aims B1, B2 and B3 [Component 3, B1, B2 and B3, Provide a design solution for an engineered product against the needs of an engineering brief]	**Introductory activity:** ● **Teacher-led discussion:** teacher leads a Q&A session based on Learning aims B1, B2 and B3. **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 evaluate an existing engineering design in preparation for producing an improved design. ● **Individual activity:** students access and read through the SAMs for Learning aim B. ● **Individual activity:** students analyse a given engineered product and related information to identify advantages/disadvantages and limitations/constraints of the existing design. ● **Group activity:** students are grouped depending on revision needs and given support activities depending on their responses in the plenary activity of lesson 26. **Plenary activity:** ● **Teacher-led presentation:** teacher introduces final assignment brief for Learning aims B1, B2 and B3, and discusses the assessment criteria, explaining the command	Pearson published SAMs Practice investigations set by school

		words. Students conduct assessment independently and produce an outline plan for their assessment.	
Learning aim C: Provide solutions to meet the needs of an engineering brief **Essential content C1: Analysing engineering information associated with the problem**			
28	Analysing engineering information associated with the problem [Component 3, C1, Types of engineering information – production data, job cards]	**Introductory activities:** ● **Teacher-led presentation:** students are introduced to Learning aim C1. ● **Group activity:** students think about and discuss why engineers use a range of engineering information as part of their quality control checks, when trying to solve an engineering problem. **Main session activities:** ● **Teacher-led presentation:** teacher outlines some of the types of engineering information, including work instructions, production data/plans, job cards, test reports and engineering drawings. ● **Individual activity:** students undertake a production task by following engineering information – listing materials, tools and equipment, obtaining the items, and then manufacturing a small engineered component. **Plenary activity:** ● **Paired activity:** students discuss what the range of engineering information is used for.	Internet access Interactive whiteboard Case studies: examples of work instructions, job cards, etc. Example of work instruction to be carried out Access to materials Access to tools and equipment
29	Types of engineering working drawings [Component 3, C1, Types of engineering information – engineering drawings]	**Introductory activity:** ● **Paired activity:** students list the types of engineering drawings they think are best for communicating designs for specific products, e.g. electronics. **Main session activities:** ● **Teacher-led presentation:** teacher explains some of the specific types of drawings used, e.g. component drawings,	Internet access Interactive whiteboard ICT facilities Presentation software/materials Examples of engineering drawings

		assembly drawings, repair and modification drawings, installation diagrams and wiring diagrams. ● **Individual activity:** students are asked to imagine that they have to design a prototype digital camera suitable for water sport activities. They research the types of drawings they should use. ● **Individual activity:** students then produce a short presentation that provides a brief overview of the drawings they would use, with an explanation of why each type of drawing is useful. **Plenary activity:** ● **Group activity:** students discuss what each type of engineering drawing shows and when each type is used.	
30	Drawings and information [Component 3, C1, Types of engineering information – engineering drawings]	**Introductory activity:** ● **Individual then paired activity:** students list the types of information needed to produce an engineered product in a workshop. Then, in pairs, they discuss why some engineering drawings could be difficult to interpret. **Main session activities:** ● **Teacher-led presentation:** teacher covers specific drawing conventions, such as those for materials, components and dimensions, highlighting important points to consider with male/female components and dimensions. ● **Paired activity:** students assemble an engineered product using only engineering drawings. They should note and discuss any problems encountered, and how these could be overcome, using photographs and annotations to show where problems occurred. **Plenary activity:** ● **Group activity:** in small groups, students think about and discuss why drawing conventions are important.	Internet access Interactive whiteboard Engineered product for assembly Incomplete/inaccurate engineering drawings Hand tools Photographic equipment, cameras

31	Identifying issues and causes associated with a problem [Component 3, C1, Interpreting patterns and trends related to the engineering information; Identifying issues and causes associated with the problem]	**Introductory activity:** ● **Group activity:** in small groups students think about and discuss the types of problems that could be encountered with the design and manufacture of an engineered product. **Main session activities:** ● **Individual activity:** students think about how to investigate a set of given data (e.g. presented in a scatter graph) and identify potential problems or faults. ● **Teacher-led presentation:** teacher explains random and systematic faults and what each type of fault covers. ● **Individual activity:** students investigate problems associated with an engineered product and identify which types of fault it has, as well as causes of and ways to prevent these problems. ● **Teacher-led presentation:** teacher explains how interpreting patterns and trends in engineering information can help engineers identify and solve problems. **Plenary activities:** ● **Individual activity:** students list random and systematic faults that can impact an engineering process. ● **Homework task:** from a list of teacher-suggested topics related to Learning aim C1, students identify those topics they are unsure about and any topics they do not understand.	Internet access Interactive whiteboard Production data Case studies
Learning aim C: Provide solutions to meet the needs of an engineering brief **Essential content C2: Selecting a solution**			
32	Selecting a solution [Component 3, C2, Possible solutions for current and/or potential issues, e.g. design, tooling, process]	**Introductory activities:** ● **Teacher-led discussion:** teacher uses a Q&A session to review Learning aim C1 content that students are unsure about. Students are prompted to think about how to select possible solutions for potential issues.	Job cards Workshop equipment Hand tools Drawing equipment

		● **Paired activity:** students are asked to imagine that they are to redesign a prototype torch design; they list all the factors that need to be considered for the redesign. **Main session activities:** ● **Teacher-led presentation:** teacher describes some of the approaches that can be taken when redesigning a product for an increased scale of production. ● **Teacher-led presentation:** teacher reviews the benefits of using standardised components and reducing the number of components. ● **Teacher-led presentation:** teacher explains how material choices can affect manufacturing processes. ● **Individual activity:** students find an image of a prototype engineered product; they sketch the existing design and annotate it with the materials used, then produce 2D/3D sketches to show how the product could be made in quantity, explaining their ideas in annotations. **Plenary activity:** ● **Paired activity:** students discuss the factors that need to be considered when they plan to use a metallic material for a product instead of the polymer material used in the prototype.	
33	Possible engineering solutions [Component 3, C2, Possible solutions for current and/or potential issues, e.g. design, tooling, process; Extent to which these solutions have fulfilled their primary purpose]	**Introductory activity:** ● **Individual activity:** students consider a simple everyday product, making a note of any flaws and problems they find with the design. **Main session activities:** ● **Teacher-led presentation:** teacher explains that when identifying potential improvements to a product, the design, tooling and manufacturing processes all need to be considered, and describes an example case study.	Internet access Interactive whiteboard Examples of designs Case studies

		● **Teacher-led presentation:** teacher emphasises that it is important to keep things simple, referring to the acronym KISS ('Keep it simple, stupid'). ● **Individual activity:** students examine an engineered product (physical item or image) and make a note of any issues with the design, explaining any problems there could be with tooling and manufacturing processes. ● **Paired activity:** students discuss and come up with potential ways to improve the design and improve the product. ● **Teacher-led presentation:** teacher mentions the importance of keeping up with advances in technology, as this is often useful when improving the design of a product. **Plenary activity:** ● **Paired activity:** working in the same pairs as previously, students look at a standard product and consider the approaches that would lead to the greatest benefit in making the product more effective.	
34	Wider factors that need to be considered [Component 3, C2, Any wider factors that need to be considered in order to meet the brief]	**Introductory activities:** ● **Teacher-led discussion:** teacher asks students if they know what batch-produced means. ● **Paired activity:** students list engineered products which they think are batch-produced. **Main session activities:** ● **Teacher-led presentation:** teacher outlines one-off and batch production operations, describing the characteristics of each type. ● **Individual activity:** students analyse an existing batch-produced product, investigating the materials and processes used. ● **Individual activity:** students produce a short presentation containing information about resources, reasons for batch production, safety factors and environmental impacts.	Internet access Presentation software/materials Example batch-produced products Hand tools Measuring equipment Workshop facilities

		● **Teacher-led presentation:** teacher explains and leads a class discussion on environmental impacts – use of energy, use of resources and waste from production. **Plenary activity:** ● **Group activity:** in small groups, students discuss what they found during the investigation carried out in the main activity and how this impacts on the redesign of the product.	
35	Ways to improve the solution [Component 3, C2, Ways in which the solution might be improved on against its primary purpose and/or other factors]	**Introductory activity:** ● **Individual activity:** students think about the reasons why some products need to be redesigned. **Main session activities:** ● **Teacher-led discussion:** teacher leads a class discussion on the background to evaluating an existing design. ● **Individual activity:** students carry out research for a given batch-produced engineered product, e.g. an aluminium shelf bracket – customers have reported that the bracket is not strong enough and bends when loaded. Students evaluate the product and identify issues that could be causing it to fail. ● **Teacher-led presentation:** teacher explains what limitations and constraints with existing designs are and how to identify these. **Plenary activity:** ● **Paired activity:** students consider an everyday product, e.g. a watch or mobile phone, and identify the strengths and weaknesses of the product's design.	Internet access Interactive whiteboard Examples of batch-produced engineered products with faults
36	Producing an alternative design solution [Component 3, C2, Using the best-fit approach to select the best solution; Identifying advantages and disadvantages/limitations/constraints; Justifying the best solution]	**Introductory activity:** ● **Paired activity:** students use the example of the product they evaluated previously and think of ways to redesign the product to make it better. **Main session activities:**	Internet access Interactive whiteboard Example products

		● **Individual activity:** using the same example as in the introductory activity, students carry out a detailed review – what can be done about the performance of the product, what could be changed, can the materials be changed, and what alternative processes could be used? ● **Teacher-led presentation:** students are reminded that when investigating and evaluating a design, they should always refer to the design brief. ● **Teacher-led presentation:** teacher explains the reasons why it is important to justify a proposed solution. **Plenary activity:** ● **Paired activity:** students summarise the important factors to include when justifying a design solution – does the design meet the brief, why is the choice of material important, and can the design decisions be supported?	
37	Reflecting on your design solution [Component 3, C2, Reflecting on processes and making recommendations for improvements to the best solution]	**Introductory activity:** ● **Individual activity:** students refer to the example product they have been investigating, e.g. the shelf bracket from lesson 35, and make a list of the reasons why they think the materials and manufacturing processes were chosen originally. **Main session activities:** ● **Teacher-led presentation:** teacher explains the important factors to be considered when selecting materials for a redesigned product – material properties, material cost/availability, processes, the environment. ● **Teacher-led presentation:** teacher mentions the need to consider the advantages and disadvantages of processes when making recommendations. ● **Individual activity:** students review the engineered product design they have been working on and justify their choices of materials and manufacturing processes for an improved product design. **Plenary activities:**	Internet access Interactive whiteboard Example products

		● **Paired activity:** students discuss the importance of material properties, environmental impact and any other factors that can influence the choice of processes. ● **Homework task:** from a list of teacher-suggested topics related to Learning aim C2, students identify those topics they are unsure about and any topics they do not understand.	
Learning aim C: Provide solutions to meet the needs of an engineering brief **Essential content C3: Problem solution**			
38	Resources required and their use [Component 3, C3, Problem solution, resources required and their use, to include materials, tools, components, equipment, apparatus]	**Introductory activities:** ● **Teacher-led discussion:** teacher uses a Q&A session to review Learning aim C2 content that students are unsure about. Students are prompted to think about the resources required to solve engineering problems and how they are used. ● **Group activity:** Students examine equipment in the workshop/classroom and list the types of resources required to manufacture the equipment. **Main session activities:** ● **Teacher-led presentation:** teacher outlines why students need to consider resources required when planning the manufacture of a product – materials, tools and tooling, components, and equipment and apparatus. ● **Individual activity:** students plan the manufacture of an engineered component that requires features to be produced by specific machining operations. ● **Individual activity:** students carry out research into the tools and equipment and write a short report to explain and justify their choices. **Plenary activity:** ● **Paired activity:** for an engineered product, students make a list of materials, tools/tooling, components and	Internet access Interactive whiteboard Example products/equipment

		equipment/apparatus that they think will be required in its manufacture.	
39	Presenting your design solution [Component 3, C3, Designs of solution]	**Introductory activity:** ● **Individual activity:** students make a list of 2D and 3D presentation techniques that can be used to communicate a design solution. **Main session activities:** ● **Teacher-led presentation:** teacher runs through the types of sketches and formal drawings that can be used – including isometric and orthographic drawings – and explains the purpose and importance of annotations. ● **Individual activity:** using sketches of a shelf bracket from an earlier lesson, students produce both isometric and orthographic drawings, remembering to add annotations and dimensions to explain design features. **Plenary activity:** ● **Paired activity:** students look at ways in which they could improve their drawings, thinking about accuracy, amount of detail, size and scale of the drawings.	Internet access Interactive whiteboard Drawing equipment/CAD software Example drawings Examples of components
40	Make processes to create a prototype solution [Component 3, C3, Make processes; Processes too follow; Manufacturing processes to use]	**Introductory activity:** ● **Paired activity:** students discuss the advantages and disadvantages of producing prototype models for the development of new products. **Main session activities:** ● **Teacher-led presentation/demonstration:** teacher explains or demonstrates rapid prototyping using 3D printing (additive manufacturing) and traditional physical modelling. ● **Individual activity:** students make a small model of the design solution they have been working on in the previous lessons, i.e. a shelf bracket, using 3D printing or physical modelling.	Internet access Interactive whiteboard CAD software 3D printer if possible Modelling materials Examples of products

		● **Teacher-led presentation:** teacher emphasises the importance of following the correct processes, especially working safely, by using only equipment that students have permission to use and have been shown how to use, and always wearing the correct PPE. **Plenary activity:** ● **Individual activity:** students think about the advantages and disadvantages of additive manufacturing and physical modelling.	
41	Collecting and analysing data [Component 3, C3, Data collection requirements, to include what quantitative and qualitative data must be recorded, resource material, data sources; Data analysis and quality, to include trends, meeting specifications, possible solutions]	**Introductory activity:** ● **Paired activity:** students make a list of data types that could be collected and analysed with engineered products. **Main session activities:** ● **Teacher-led presentation:** teacher outlines the background to collecting data. ● **Individual activity:** students collect a range of components or products (at least ten that are the same type and have nominally the same dimensions), and then measure and record the exact dimensions. ● **Individual activity:** students plot the data on a line graph and write a short summary report to explain what they found. ● **Teacher-led presentation:** teacher shows how data can be displayed in different ways – in order of inspection or in rank order – and what information each method provides. ● **Teacher-led presentation:** teacher explains the difference between quantitative and qualitative data. ● **Teacher-led presentation:** teacher explains the uses of analysing data and how to spot trends or patterns in data, which can be used to find reasons for differences in measured values and thus identify faults in production. **Plenary activity:**	Internet access Interactive whiteboard Workshop access A range of components/products of similar size and dimensions Measuring equipment

		● **Individual activity:** students are given some examples of data and asked to think about the best way to present the data.	
42	Safety considerations [Component 3, C3, Safety considerations, to include COSHH]	**Introductory activity:** ● **Individual activity:** students are asked if they remember what the main aims of risk assessments are (as covered in Component 2: Learning aim B). **Main session activities:** ● **Teacher-led presentation:** teacher reiterates the importance of being aware of hazards and risks and runs through the elements of risk assessments, giving an example of the five steps normally taken. ● **Teacher-led presentation:** teacher mentions the importance of COSHH (Control of Substances Hazardous to Health) Regulations. ● **Individual activity:** students investigate the materials and processes they have chosen previously for their design solution. ● **Individual activity:** students then carry out a risk assessment, using a pro forma, to identify hazards and risks and decide which control measures would be suitable. **Plenary activities:** ● **Paired then whole class activity:** in pairs, students write out an example risk assessment of an engineering process, such as a turning operation on a lathe. The risk assessment is then compared with those of other pairs in the class and any differences discussed. ● **Individual activity:** students identify, from a list of topics from Learning aim C3, those topics they are unsure about and any topics they do not understand.	Internet access Interactive whiteboard Exemplar risk assessments Risk assessment pro-formas Examples of PPE
43	Learning aim C: assessment practice Revision of Learning aims C1, C2 and C3	**Introductory activity:**	Practice assessment information

	[Component 3, C1, C2 and C3, Provide solutions to meet the needs of an engineering brief]	● **Teacher-led discussion:** teacher leads a Q&A session based on Learning aims C1, C2 and C3. **Main session activities:** ● **Teacher-led presentation:** teacher recaps topics covered in Learning aims C1, C2 and C3 and explains what students will be expected to demonstrate when they produce their improved designs for Part 2 of the set task. **Plenary activity:** ● **Group activity:** students are grouped depending on revision needs and given support activities depending on their responses in the plenary activity of lesson 42.	
44	Component 3: assessment practice Preparation for assessment	**Introductory activity:** ● **Teacher-led discussion:** teacher leads a Q&A session based on Learning aims A, B and C of Component 3. **Main session activities:** ● **Individual activity:** students complete a redesign activity for a given engineering problem, producing a new design proposal that offers some improvement over the original design. **Plenary activity:** ● **Teacher-led presentation then individual activity:** teacher introduces external assessment for Component 3 and discusses the assessment criteria, explaining the command words. Students complete the assessment independently.	Pearson authorised assignment brief or brief produced and verified by the school
Synoptic assessment			
45	Sessions 45–48 to be used to complete the final supervised assessment		
46	Sessions 45–48 to be used to complete the final supervised assessment		
47	Sessions 45–48 to be used to complete the final supervised assessment		

48	Sessions 45–48 to be used to complete the final supervised 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.

Websites

https://www.bbc.co.uk/schools/gcsebitesize/design/resistantmaterials 'GCSE Bitesize on Design & Technology: Resistant materials', BBC – provides information on materials, processes and joining methods, along with product analysis and health and safety

https://engineeringtoolbox.com – descriptions of technical design, engineering and construction terms

http://www.hse.gov.uk/risk/controlling-risks.htm – Health and Safety Executive guidance for risk assessments

http://matweb.com – database of material properties

https://npdbook.com/engineering-specifications – descriptions of engineering specifications

https://science.howstuffworks.com/plastic4 – descriptions of types of polymers, including examples

http://www.technologystudent.com – materials, processes and joining methods are described, along with presentation techniques, product analysis and health and safety

https://tutor2u.net/business/production/quality_control.htm – includes use of data for quality control

http://thelibraryofmanufacturing.com/index.html – wide range of engineering processes are described fully