Year 10 BTEC Tech award Engineering

Component 1

Component title	Exploring Engineering Sectors and Design Applications
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 engineering sectors, products and organisations, and how they interrelate **Teaching content A1: Engineering sectors, engineered products and interconnections**			
1	What is engineering? [Component 1, A1, Engineering definition in context]	**Introductory activities:** ● **Paired activity:** students consider the meaning of the term 'engineering' and how they think engineering affects them in everyday life. In pairs, students discuss what they think engineering means. ● **Teacher-led presentation:** teacher introduces Component 1, Learning aim A1 and explains that students will learn about engineering, its sectors and products, and how these interrelate. **Main session activities:** ● **Teacher-led discussion:** teacher leads a discussion on the definition of engineering and then explains the four main engineering disciplines. ● **Whole class activity:** students watch a video clip and make notes on how engineering is used in everyday life. ● **Group activity:** students discuss the video clip and compare their notes. ● **Teacher-led presentation:** teacher introduces how engineering achievements can help people, including specific groups, such as in sports successes. ● **Group activity:** students watch another video clip showing how engineering can be innovative and then discuss how they think engineering ideas can be used to transform the future. **Plenary activities:**	Short video clip from the internet that illustrates engineering, e.g. 'What is engineering?', https://www.youtube.com/watch?v=bipTWWHya8A Short video clip from the internet that illustrates engineering innovation, e.g. 'What is engineering?', https://www.youtube.com/watch?v=FAJGx3zP-Eo Short video clip from the internet that illustrates bad engineering, e.g. 'World's funniest engineering fails', https://www.youtube.com/watch?v=qPhVZExcGXg&t=14s Internet access Interactive whiteboard

		● **Teacher-led presentation:** teacher explains that engineering can sometimes go wrong and shows a video clip with examples of bad engineering. ● **Teacher-led discussion:** teacher asks the group why such problems can arise and the difficulties they create.	
2	The need for engineers [Component 1, A1, The need for people who are qualified]	**Introductory activity:** ● **Paired activity**: students work in pairs to think about why engineers are needed and how many types of engineers they can think of. **Main session activities:** ● **Teacher-led presentation:** teacher explains the relationships between types of engineers and engineering disciplines and asks students for examples of types of engineers they have thought of. ● **Individual activity:** students use the internet to find as many types of engineers as they can and compare this with the number they had at the start of the lesson. ● **Teacher-led discussion:** teacher asks students if they know any friends or family who are engineers and, if yes, what they do. ● **Teacher-led presentation:** teacher explains the importance of interconnections in engineering, listing some examples. ● **Group activity:** working in small groups, students create a diagram showing the interconnections between types of engineers and engineering disciplines. ● **Whole class activity:** student groups present their diagrams to the whole class and then discuss what they came up with. ● **Teacher-led presentation:** teacher highlights the current shortage of engineers and describes why it is important that more engineers are recruited. **Plenary activity:**	Internet access Interactive whiteboard

		• **Individual activity:** Students search the internet to find job advertisements for engineering apprentices – how many are cross-discipline?	
3	The safe application of technical and practical knowledge [Component 1, A1, Engineering definition in context]	**Introductory activity:** • **Whole class activity:** students discuss why they think safety is critical in engineering. **Main session activities:** • **Teacher-led presentation:** teacher outlines the need for safety to be considered at all stages of designing and manufacturing an engineered product. • **Teacher-led presentation:** teacher explains why design safety and safety in practical working areas are essential. • **Teacher-led presentation:** teacher emphasises everyone's responsibility for safety while at work. • **Whole class activity:** students are asked to think about any safety issues they have come across, and then discuss these with the class. • **Whole class activity:** students watch videos that illustrate how accidents can occur. **Plenary activity:** • **Whole class activity:** students watch a video on safety in design.	Short video clip from the internet that illustrates how accidents are caused, e.g. 'What Causes Accidents - Safety Training Video - Preventing Accidents & Injuries', https://www.youtube.com/watch?v=dBf6BTX1bmM Internet access Interactive whiteboard Case study
4	Engineering sectors [Component 1, A1, Engineering sectors]	**Introductory activity:** • **Paired activity:** students use their knowledge of engineering disciplines and types of products they have heard of to help identify engineering sectors. **Main session activities:** • **Teacher-led presentation:** teacher lists the main engineering sectors – aerospace, automotive, communications, electrical/electronics, mechanical,	Interactive whiteboard Internet access Short video clips from the internet that illustrate more about the engineering sectors, e.g. 'Aerospace Engineers – What is it?', https://www.youtube.com/watch?v=STYw2OTOveY&list=PLTQHtld

		environmental, transport, rail and marine – then explains what each sector does. ● **Teacher-led discussion:** teacher asks students if they noticed that some companies work in more than one sector, and leads a class discussion on why. ● **Whole class activity:** students watch videos about one or two of the sectors covered. ● **Individual activity:** students carry out some research online to see if they can find any other engineering sectors and what they do. ● **Whole class activity:** students share their findings with the class and make a list. **Plenary activity:** ● **Individual activity:** students select four of the main engineering sectors and research and list two other companies for each.	EisnXVclVQHt7Bosd4xj-YQXpW&index=1 'Introduction to Civil and Environmental Engineering Design', https://www.youtube.com/watch?v=yZJbgimr5hg Case study
5	Engineered products [Component 1, A1, Engineered products from different sectors]	**Introductory activity:** ● **Individual activity:** students find (or are given) some photographs of products and are asked to write down against each which engineering sectors are involved. **Main session activities:** ● **Teacher-led presentation:** teacher explains engineered products and systems and how these relate to the different engineering sectors; gives examples of products from different sectors and a combination of sectors. ● **Individual activity:** students produce a table listing the main engineering sectors and add four more products for each sector. ● **Individual activity:** students list engineered products used in a sports car and attribute these to the main engineering sectors, plus any other sectors involved. ● **Paired activity:** students discuss their list with a partner.	Internet access Interactive whiteboard

		Plenary activities: ● **Whole class discussion:** students find one other engineering sector and the engineered products it produces and discuss with the class. ● **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 engineering sectors, products and organisations, and how they interrelate **Teaching content A2: Engineering organisations, functions, job roles and career progression**			
6	Engineering organisations: large [Component 1, A2, Examples of engineering organisations – global/large]	**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. ● **Individual activity:** students are prompted to think about engineering organisations and how they are categorised by size. **Main session activities:** ● **Teacher-led presentation:** teacher explains how engineering organisations are classified as either large organisations or small and medium-sized enterprises (SMEs). ● **Teacher-led presentation:** teacher provides information showing how some large organisations operate internationally with facilities across the world. ● **Teacher-led discussion:** teacher leads a class discussion on why large organisations operate this way. ● **Individual activity:** students carry out research on two large international engineering companies – what do they produce, where are they based, do they move products globally, do they have more than one factory/facility and, if so, does each make a different product?	Internet access Interactive whiteboard Case study

		Plenary activity: ● **Individual activity:** students research three UK engineering companies that are large/global, establishing how many employees they have in the UK and worldwide.	
7	Engineering organisations [Component 1, A2, Examples of engineering organisations – SMEs and small jobbing companies]	**Introductory activity:** ● **Teacher-led discussion:** teacher leads an open discussion on why students think SMEs might be important. **Main session activities:** ● **Teacher-led presentation:** teacher explains what SMEs are and their three categories. ● **Teacher-led presentation:** teacher explains what small jobbing companies are and how they work. ● **Teacher-led presentation:** teacher prompts a recap of large companies and SMEs by listing the differences between them, including pros/cons of each. ● **Individual activity:** students carry out research on two SMEs in the local region of the UK – where are they based and what do they produce? ● **Individual activity:** students then do the same for two small jobbing companies in the same area. **Plenary activity:** ● **Whole class activity**: students combine their research from the main session activities to produce a list of SMEs/small jobbing companies in the region. The locations are plotted on a local map with coloured pins/flags; students discuss if there is a pattern in the proximity of small jobbing companies to SMEs.	Internet access Interactive whiteboard Map of the local region, with coloured pins/flags Case studies
8	Engineering organisations: specialist functions [Component 1, A2, Examples of engineering organisations covering the sectors]	**Introductory activity:** ● **Teacher-led presentation then paired activity:** teacher explains that there are some engineering functions that are carried out by third-party specialists. Students work in pairs to think and discuss why this is necessary.	Internet access Interactive whiteboard Case study

		Main session activities: ● **Teacher-led presentation:** teacher outlines what the following functions involve and why some organisations decide to outsource them: o R&D o manufacturing o service (customer support). ● **Individual activity:** students search online after each function is covered to find an example of a specialist organisation for that function – what do they do and who are their customers? **Plenary activity:** ● **Individual activity:** students discuss the types and purposes of the organisations they found for each function, also considering the types of engineers the organisations employ.	
9	Specialist organisations in sectors [Component 1, A2, Specialist organisations in sectors]	**Introductory activity:** ● **Individual activity:** students are asked to consider if any organisations they have looked at are seen as performing very highly specialist functions. **Main session activities:** ● **Teacher-led presentation:** teacher introduces students to specialist organisations and uses the examples of aircraft and aircraft parts manufacturers and manufacturers of hydraulic and pneumatic systems. ● **Whole class activity:** students watch videos on aircraft wing testing – model and fatigue testing. ● **Individual activity:** students are asked to find out, by researching online, what radar is and what an auxiliary power unit is. ● **Individual activity:** students are then asked to find out which hydraulic systems are used in motor vehicles, making notes and using sketches to help explain.	Internet access Interactive whiteboard Short video clips from the internet that illustrate more about specialist engineering organisations, e.g. 'Boeing 737 MAX winglets in the wind', https://www.youtube.com/watch?v=vD828p9Nt0U 'Boeing 787 conducts fatigue testing', https://www.youtube.com/watch?v=TH9k9fWaFrs Case study

		Plenary activity: ● **Teacher-led discussion:** teacher leads a class discussion where students describe/show their research into motor vehicle hydraulics, including the names of any specialist organisations.	
10	Functions in organisations [Component 1, A2, Functions in organisations – research, design, planning, making]	**Introductory activity:** ● **Paired activity:** students consider the functions required in engineering organisations. (Students should keep their list – some of the functions may be covered in lesson 11.) **Main session activities:** ● **Teacher-led discussion:** teacher leads class discussion on what could go wrong if a product idea is not communicated correctly and the need for engineering functions to be well organised. ● **Teacher-led presentation then class discussion:** teacher introduces and describes the four functions of R&D, design, planning and making. Class discussion as each is covered. ● **Paired activity:** students draw a 'flow chart' showing how the four functions are interconnected, with notes to explain their reasoning. (Students will continue the flow chart in the next lesson.) **Plenary activity:** ● **Teacher-led discussion:** teacher leads a summary discussion of what each student pair found in the activity.	Interactive whiteboard Large sheets of paper and marker pens
11	Functions in organisations [Component 1, A2, Functions in organisations – quality, marketing, selling, customer service, installation]	**Introductory activity:** ● **Paired activity:** working in the same pairs as in the previous lesson, students consider additional functions required in engineering organisations. (Students to check their list from lesson 10 – they may have already thought of some of these.) **Main session activities:**	Interactive whiteboard Large sheets of paper and marker pens

		● **Teacher-led presentation then class discussion:** teacher introduces and explains the five functions of quality, marketing, selling, customer service and installation. Class discussion as each is covered. ● **Paired activity:** working in the same pairs as in the previous lesson, students complete their 'flow chart', adding the five additional functions and how these are connected to each other and to the other four functions, with notes to explain their reasoning. **Plenary activities:** ● **Teacher-led discussion:** teacher leads a summary discussion of what each student pair found in the activity. ● **Homework task:** students create a table to show which of the total of nine functions a global/large organisation, SME and small jobbing company might each employ.	
12	Engineering job roles 1 [Component 1, A2, Engineering job roles – maintenance technician, machine operator, aircraft fitter, design engineer]	**Introductory activity:** ● **Paired activity:** students think of and make a list of different engineering job roles that are required within engineering organisations. (Students may think of some that will be covered in lesson 13.) **Main session activities:** ● **Teacher-led presentation:** teacher introduces and describes the four job roles of maintenance technician, machine operator, aircraft fitter and design engineer. ● **Individual activity:** students carry out some online research into the four job roles, taking notes of the skills required for each. ● **Paired activity:** students discuss the skills required. ● **Paired activity:** in the same pairs, students create a poster for a vacancy for one of the job roles. ● **Whole class activity:** each pair of students presents their poster for class discussion.	Internet access Interactive whiteboard Poster paper and pens

		Plenary activity: ● **Individual then whole class activity:** students use their notes to create a mind map including the skills required for each role. Students check if there are any similarities between the different job roles and discuss with the class.	
13	Engineering job roles 2 [Component 1, A2, Engineering job roles – manufacturing engineer, installation engineer, process engineer, telecommunications engineer]	**Introductory activity:** ● **Teacher-led discussion:** teacher asks the class whether they know what the job role of a process engineer is. **Main session activities:** ● **Teacher-led presentation:** teacher introduces and describes the four job roles of manufacturing engineer, installation engineer, process engineer and telecommunications engineer. ● **Individual activity:** students carry out some online research into the four job roles, taking notes on the skills required for each. ● **Paired activity:** students discuss the skills required. ● **Paired activity:** students compare the list of job roles they made at the start of lesson 12 with the eight job roles covered in lessons 12 and 13. ● **Whole class activity:** students discuss the job roles that are different with the rest of the class, as well as those jobs on their list that are not covered by the eight job roles in lessons 12 and 13. **Plenary activities:** ● **Individual activity:** students use their notes to update their mind map with the four job roles from this lesson, including the skills required. Students check if there are any similarities between the different job roles and discuss with the class. ● **Teacher-led discussion:** teacher leads a class discussion on what industry sectors a manufacturing engineer could work in.	Internet access Interactive whiteboard

14	Career progression opportunities [Component 1, A2, Career progression opportunities]	**Introductory activity:** ● **Individual activity:** students consider the sectors, functions and job roles that interest them so far. Students should note down their reasons for future reference. **Main session activities:** ● **Paired activity:** students research online advertisements for a job they are interested in, taking notes on any qualifications, training and experience required and any training and qualifications the job would offer them. ● **Teacher-led discussion:** teacher leads a class discussion, explaining that career path progression is important and that students should consider the implications of this. ● **Teacher-led presentation:** teacher lists the classifications – apprentice, operator, technician; technical, professional, management. ● **Teacher-led discussion:** teacher asks students if they have a level they currently aspire to. ● **Teacher-led presentation:** teacher then explains each classification level and the career paths possible. ● **Paired activity:** students work in the same pairs to research online job advertisements for a global/large organisation, SME and small jobbing company – one job for each type – again taking notes on any qualifications, training and experience required and any training and qualifications the job would offer them. ● **Teacher-led discussion:** teacher leads a discussion on what the students have found. **Plenary activity:** ● **Paired activity:** in the same pairs, students review the notes they made at the start of the lesson and compare with those they made from researching the job advertisements, then discuss with the teacher and class.	Internet access Interactive whiteboard Case study

15	Role definitions [Component 1, A2, Role definitions]	**Introductory activity:** ● **Teacher-led discussion:** teacher asks students if they have heard of 'skilled' and 'unskilled' and if they know what these terms mean. **Main session activities:** ● **Teacher-led presentation:** teacher introduces the four role definitions – unskilled, skilled, technical and managerial. ● **Teacher-led presentation:** teacher then explains each definition and the jobs that typically fall within each 'category'. ● **Teacher-led discussion:** teacher leads a discussion to answer any student questions about these definitions. ● **Individual activity:** students research a global/large engineering company and create a table to define which 'categories' specific job roles fall into. ● **Individual activity:** students, using their notes from lesson 14, plot a simple flow chart showing a sequence of job roles that would help them work up from apprentice to company managing director (MD). **Plenary activity:** ● **Individual activity:** students identify, from a list of topics from Learning aims A1 and A2, those topics they are unsure about and any topics they do not understand.	Internet access Interactive whiteboard Case study
16	Learning aim A: assessment practice Revision of Learning aims A1 and A2 [Component 1, A1, A2, Understand engineering sectors, products and organisations, and how they interrelate]	**Introductory activity:** ● **Teacher-led discussion:** teacher leads a Q&A session based on Learning aims A1 and A2. **Main session activities:** ● **Teacher-led presentation:** teacher recaps topics covered in Learning aims A1 and A2, and explains that students will be expected to: o know the definition of engineering in context, and understand how the safe application of technical and	Pearson authorised assignment brief or brief produced and verified by school

		practical knowledge can turn ideas into engineered products o know the different engineering sectors, and which products are manufactured within each sector o understand the differences in engineering organisations (how they are structured, the range of functions in each organisation) and the different engineering job roles available. ● **Individual activity:** students complete the following tasks. o Students ensure that they can recognise the different engineering sectors. They must list as many as they can, with examples of products that each manufactures. o Students identify and describe different job roles and link these to the correct engineering sectors. o Students identify and describe different engineered products and link these to the correct engineering organisations. **Plenary activity:** ● **Teacher-led presentation then individual activity:** teacher introduces final assignment brief for Learning aims A1 and A2 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: Explore engineering skills through the design process **Teaching content B1: The design process**			
17	The engineering design and make process [Component 1, B1, The engineering design and make process]	**Introductory activities:** ● **Teacher-led presentation:** students are introduced to Learning aim B1. ● **Teacher-led discussion:** what is design and why it is important?	Internet access Interactive whiteboard Case study

		● **Teacher-led discussion:** students are asked if they can identify / already know / have heard of the five steps associated with the engineering design and make process. **Main session activities:** ● **Teacher-led presentation:** teacher introduces and explains the five-step process, with a short class discussion for each step. ● **Teacher-led discussion:** teacher leads a class discussion on the importance and benefits of working as a team when solving engineering problems. ● **Group activity:** students work in small teams to identify an idea for an engineered product and apply the five-step process, recording notes for each step. (One example would be a new design or redesign of a device to crush plastic bottles for recycling bins.) ● **Whole class activity:** each student team presents their idea and solution(s) to the class group. **Plenary activity:** ● **Individual activity:** students consider an innovation/idea for a new product (could use an idea they have thought about in previous lessons) or for improvements to an existing product. Students work though the five-step process to establish what would need to be done. Teacher asks students if they now see any potential problems they had not originally considered.	
18	The engineering brief [Component 1, B1, Interpreting an engineering brief]	**Introductory activity:** ● **Paired activity:** teacher asks students working in pairs if they know what an engineering brief is and why engineering briefs are important in the design process. **Main session activities:** ● **Teacher-led presentation:** teacher explains what an engineering brief is and introduces students to the what, why, who criteria.	Internet access Interactive whiteboard Case study

		● **Teacher-led presentation:** teacher describes the importance of interpreting customer requirements to ensure that an engineering brief is correct. ● **Teacher-led presentation:** teacher uses an example of a simple outline engineering specification to show what information is normally included, e.g. portable wind-powered device. ● **Paired activity:** students work in pairs to consider a new design problem, e.g. add/subtract device for small children, and produce an outline engineering specification using the lesson example as a guide. **Plenary activity:** ● **Individual activity:** students write a simple engineering brief for the product innovations/ideas they had thought about in previous lessons.	
19	Criteria for an engineering brief [Component 1, B1, Interpreting an engineering brief – physical requirements, aesthetics, size, function, performance requirements]	**Introductory activity:** ● **Group activity:** students work in small groups to make a list of the types of information that they think will be needed for a more complex engineering design brief. **Main session activities:** ● **Teacher-led presentation:** teacher introduces students to the five factors of an engineering brief: physical requirements, aesthetics, size, function and performance requirements. ● **Teacher-led discussion:** teachers leads a class discussion on each of the factors, getting feedback from the students on their thoughts about each factor. ● **Teacher-led presentation:** teacher emphasises the importance of checking and asking if information is unclear or missing. ● **Paired activity:** students work in pairs to design a pro forma sheet for a typical engineering brief, using the five factors and including any standard questions/criteria the students think are important.	Internet access Interactive whiteboard Case study

		Plenary activity: ● **Paired activity:** students use the pro forma they have developed to look again at the example of a portable wind-powered device in lesson 18, discussing with their partners if they think a standard pro forma approach would help.	
20	Interpreting an engineering brief [Component 1, B1, Interpreting an engineering brief]	**Introductory activities:** ● **Paired activity:** students swap copies of engineering briefs they prepared in the previous lesson with another pair of students and review the document, making notes. ● **Paired activity:** students discuss the benefits of reviewing each other's briefs. **Main session activities:** ● **Teacher-led presentation:** teacher explains how the information in an engineering brief can be used by, and therefore affects, a number of people in an engineering process, from the customer to design engineers and production operators. ● **Teacher-led discussion:** students consider, in a quick class discussion, the definition of 'interpretation'. ● **Individual activity:** students work individually to complete the class activity, producing an engineering brief for a set task. ● **Group activity:** students split into teams of three to discuss the engineering briefs, taking the roles of brief creator, customer and brief receiver. ● **Teacher-led discussion:** teacher leads a class discussion on what the groups found. ● **Individual activity:** students think of a small product (mobile phone) and write a specification for the features and functions they want the product to have. ● **Paired activity:** students swap their specifications with a partner and each writes an engineering brief against the	Internet access Interactive whiteboard

		specification received. Once finished, students discuss with their partners. **Plenary activity:** ● **Homework task/research:** students ask a friend or family member who has purchased a large product, such as a car, TV or laptop, if they can see a copy of the documentation received with the product. Is this another form of engineering brief?	
21	Organising your design [Component 1, B1, Producing initial design proposals – researching existing products]	**Introductory activity:** ● **Paired activity:** students work in pairs to consider why engineering design should be an organised activity. **Main session activities:** ● **Teacher-led discussion:** teacher leads a class discussion on how and why the engineering design process is iterative. ● **Teacher-led presentation:** teacher outlines the benefits of an engineering design file and shows an example of a design file based on the five steps of the engineering design and make process. ● **Paired activity:** students work with a partner to create a design file structure on their computer's file management system, one they can use in the future for a design project. **Plenary activity:** ● **Paired activity:** students research 'engineering design file organisation' on the internet and make notes, including on how engineering files are named.	Internet access Interactive whiteboard Computer system access
22	Initial design using existing products [Component 1, B1, Producing initial design proposals – researching existing products]	**Introductory activity:** ● **Teacher-led discussion:** teacher leads a class discussion about where to begin an initial design – start by researching existing products. **Main session activities:** ● **Teacher-led presentation:** teacher reminds students that it is important to know that they may not be permitted to copy an	Internet access Interactive whiteboard

		existing design if it has a patent, but on the other hand it's best if they don't reinvent the wheel. ● **Teacher-led presentation:** teacher describes useful resources for researching information. ● **Individual activity:** students then research and gain experience of what information sources they have access to and can find online, in textbooks and in their nearest library. ● **Teacher-led presentation:** teacher mentions that many companies have subject matter experts (SMEs) – trying not to confuse students with the previously given SME abbreviation – who may be happy to help. ● **Paired activity:** students consider some products that have developed over the years – e.g. bicycles, mobile phones – and list the similarities and differences between them. **Plenary activity:** ● **Individual activity:** students check if they know an engineer and, if so, whether the engineer has any old textbooks they could look through.	
23	Researching your initial design proposal [Component 1, B1, Producing initial design proposals – researching existing products]	**Introductory activity:** ● **Paired activity:** students consider what they need to research to develop a product design. **Main session activities:** ● **Teacher-led discussion:** teacher asks students if they have heard of the acronym KISS. ● **Teacher-led presentation:** teacher outlines three areas of research: o materials for the product o manufacturing processes to be used o manufacturing skills needed. ● **Whole class activity:** students discuss each of the above research areas.	Internet access Interactive whiteboard

		● **Group activity:** working in small groups, students consider two products – a wind turbine on a wind farm and a skateboard. For each, students research (i) the materials used and why, (ii) how the materials are joined together, and (iii) what manufacturing processes and skills are required, including for on-site installation of the wind turbine; for example, why are the rotors bolted on? **Plenary activity:** ● **Paired activity:** students research manufacturing processes and manufacturing skills and find out what these are.	
24	Producing initial design sketches in 2D and 3D [Component 1, B1, Producing initial design proposals – producing design sketches in 2D and 3D]	**Introductory activity:** ● **Teacher-led discussion:** teacher leads a class discussion on the benefits of producing visual designs through making initial design sketches. **Main session activities:** ● **Individual activity:** students review a design sketch, reasonably complex, and try to write down what is required, as if they had to produce a written specification instead of a drawing. ● **Whole class activity:** students then discuss this with the class. ● **Teacher-led presentation:** teacher explains engineering technical drawing standards and their purpose. ● **Teacher-led presentation:** teacher introduces students to 2D and 3D sketching. ● **Individual activity:** students practise sketching in both 2D and 3D. **Plenary activity:** ● **Individual then whole class activity:** students sketch a new product, perhaps their innovative idea from previous lessons, in both 2D and 3D, and discuss with the class.	Internet access Interactive whiteboard Drawing/sketching equipment

25	Creative thinking and evaluation techniques [Component 1, B1, Producing initial design proposals – using creative thinking and evaluation techniques]	**Introductory activity:** ● **Teacher-led discussion:** teacher leads a class discussion on creative thinking and whether the students think it can help the design process. **Main session activities:** ● **Teacher-led presentation:** teacher outlines some of the creative thinking and evaluation techniques, including: o rewording the problem o brainstorming o mind maps o challenging assumptions o thinking in reverse o rich pictures o de Bono's Six Thinking Hats® ● **Paired activity:** students research and make notes about mind maps and rich pictures. ● **Teacher-led presentation:** teacher explains the importance of constant evaluation, examples being formative and summative evaluation techniques. ● **Whole class activity:** students watch a video on de Bono's Six Thinking Hats® and then discuss as a group what they think about it. **Plenary activity:** ● **Teacher-led discussion:** teacher leads a class discussion to sum up the students' understanding of creative thinking and evaluation.	Internet access Interactive whiteboard Short video clip from the internet that illustrates more about de Bono's Six Hats, e.g. 'What Is Six Thinking Hats?' https://www.youtube.com/watch?v=UZ8vF8HRWE4
26	Computer-aided design (CAD) drawings [Component 1, B1, Computer-aided design (CAD) drawings]	**Introductory activity:** ● **Teacher-led discussion:** teacher asks students if they are familiar with the term CAD and whether they know that engineering designs are produced using CAD software.	Internet access Interactive whiteboard CAD software Document/drawing printer

		Main session activities: ● **Teacher-led presentation:** teacher describes how all technical draughtspersons used to work at drawing boards, creating paper drawings using pencils and pens, and how paper drawings were then copied and stored. ● **Teacher-led presentation:** teacher introduces students to CAD packages and their benefits. Most companies now use CAD to create drawings electronically, but can still print the drawings off for manufacture. ● **Teacher-led presentation:** teacher outlines some of the typical and common CAD commands, using AutoCAD® as an example – the draw and modify commands. ● **Paired activity:** students try the CAD software they will have access to. Students try simple commands such as draw, erase, copy and move, and then research online to find other commands and see what they do. **Plenary activity:** ● **Paired activity:** students work in the same pairs to discuss their experience of trying CAD and what benefits they think CAD offers compared with manual sketching and drawing.	
27	Final design solutions using 2D drawing techniques [Component 1, B1, Generating final design solutions – 2D drawing techniques]	**Introductory activity:** ● **Paired activity:** students discuss with a partner whether they should start practising CAD drawing using 2D or 3D CAD packages. **Main session activities:** ● **Teacher-led presentation:** teacher outlines the use of 2D and 3D CAD, explaining that it is best to start with 2D CAD to learn the basics first. ● **Teacher-led presentation:** teacher runs through some of the basic activities and commands that the students will need to become familiar with. ● **Teacher-led presentation:** teacher reminds students of the importance of always keeping passwords safe and saving	Internet access Interactive whiteboard CAD software Document/drawing printer Short video clip from the internet that illustrates more about converting 2D designs into 3D, e.g. 'Converting 2D to 3D in SOLIDWORKS', https://www.youtube.com/watch?v=QPYLPxfYPB0

		work regularly so that no work is lost if a computer crashes or there is a power cut. ● **Individual activity:** students practise the basic activities and commands for 2D CAD design. ● **Individual activity:** students then move on to making a 2D design drawing of a product or component, e.g. a dice, or producing a drawing from the sketch of the innovative idea they have been working on in previous lessons. ● **Individual activity:** students learn how to print out a drawing and then discuss any problems with the teacher. **Plenary activities:** ● **Whole class activity:** students watch a video showing how some CAD packages can convert 2D drawings into 3D. ● **Paired activity:** students try creating a simple 3D design, e.g. a cube, and discuss with a partner.	
28	Generating final design drawings [Component 1, B1, Generating final design solutions – detailed drawings, circuit diagrams]	**Introductory activity:** ● **Paired activity:** students work in pairs to think about the types of drawings used in engineering and what information each type provides. **Main session activities:** ● **Teacher-led presentation:** teacher introduces students to engineering working drawings used for final design solutions, i.e. sketches, component drawings, assembly drawings, parts lists/drawings, and circuit diagrams. ● **Individual activity:** students carry out some research on oblique and isometric projections and perspective drawings. ● **Individual activity:** students research exploded view diagrams, what information this type of drawing provides, and how this is useful. Have they come across this type of drawing before, in everyday life, perhaps? ● **Individual activity:** students use available CAD software to produce final design drawings of the product or component	Internet access Interactive whiteboard CAD software Document/drawing printer

		they have been working on. Students should assess which types of 2D and 3D drawings are required. **Plenary activity:** ● **Teacher-led discussion:** teacher leads a class discussion, including a Q&A session, on each student's basic understanding of the engineering working drawings for a final design solution of an engineered product.	
29	Final design solutions using 3D printing [Component 1, B1, Generating final design solutions – 3D printing]	**Introductory activities:** ● **Paired activity:** students research some products that are produced using 3D printing. ● **Teacher-led discussion:** teacher leads a class discussion on what students discovered. **Main session activities:** ● **Teacher-led presentation:** teacher explains the subject of additive manufacturing (AM), including fused deposition modelling (FDM). ● **Individual then whole class activity:** students research the different types of materials that can be used in 3D printing, and then discuss as a class. ● **Teacher-led presentation:** teacher explains the effects of 3D printer resolution on a final product. ● **Teacher-led discussion:** teacher leads a class discussion on some of the considerations associated with FDM 3D printing. ● **Group activity:** working in small groups, students consider a simple product they could make on a 3D printer – they need to think about materials, support structures and time to make the product. **Plenary activity:** ● **Paired activity:** students list and sketch three engineered products that could be produced on a 3D printer.	Internet access Interactive whiteboard CAD software Document/drawing printer 3D printer

30	Final design solutions using physical modelling [Component 1, B1, Generating final design solutions – physical modelling]	**Introductory activity:** ● **Teacher-led presentation:** teacher asks students if they have made a physical model before, out of card, modelling compound or other materials. **Main session activities:** ● **Teacher-led discussion:** teacher explains and then leads a class discussion on why 3D physical models are used, and their benefits. ● **Whole class activity:** students watch a video showing how card can be used to create a prototype of a new product. ● **Teacher-led discussion:** teacher leads a class discussion about the advantages and disadvantages of modelling. ● **Teacher-led presentation:** teacher outlines the advantages/disadvantages of different modelling materials, e.g. card, plastics, wood, metals. ● **Individual activity:** students look at a photo of a corrugated card model of a car and then consider the differences between making the model from card and by 3D printing. What are the costs of materials? What is the time required, including CAD time to develop the design instead of making manual sketches? Students create a table of advantages and disadvantages. **Plenary activity:** ● **Individual activity:** students consider an earlier design sketch they have produced and decide which type of modelling would be best to use. If time permits, students could make a simple model of their design.	Internet access Interactive whiteboard Modelling materials, including card, adhesives, etc. Short video clip from the internet that shows how to model with card, e.g. 'How to make a cardboard prototype', https://www.youtube.com/watch?v=k_9Q-KDSb9o
31	Making final design solution decisions on materials [Component 1, B1, Making final design solution decisions – selection of materials]	**Introductory activity:** ● **Group activity:** in small groups, students think about and discuss making a decision on the selection of materials for the final design solution. **Main session activities:**	Internet access Interactive whiteboard

		● **Teacher-led presentation:** teacher explains the importance of correct material selection and outlines the four engineering material categories – ferrous metals, non-ferrous metals, thermosetting polymers and thermoforming polymers (these will be covered in more detail in Components 2 and 3). ● **Teacher-led presentation:** teacher talks through the process of assessing material options and performing an objective comparison of materials against set criteria. ● **Paired activity:** students think about material selection for a new engineered product that they have considered in previous lessons and for which they have worked on a design. **Plenary activity:** ● **Whole class activity:** students discuss what they have learned about the subject of material selection with the rest of the class.	
32	Making final design solution decisions on making techniques [Component 1, B1, Making final design solution decisions – selection of making techniques]	**Introductory activity:** ● **Group activity:** in small groups, students think about and discuss how to decide on the selection of making techniques for the final design solution. **Main session activities:** ● **Teacher-led presentation:** teacher explains the importance of the correct selection of making techniques and outlines the four engineering manufacturing process categories – cutting, shaping, forming and joining/fabrication processes (these will be discussed in more detail in Components 2 and 3). ● **Teacher-led presentation:** teacher talks through the process of assessing the options for making techniques and refers to the assessment of materials example in the previous lesson to illustrate how to judge what making technique would be the best option. ● **Paired activity:** students think about the selection of making techniques for a new engineered product that they have	Internet access Interactive whiteboard

		considered in previous lessons and for which they have worked on a design. **Plenary activities:** ● **Whole class activity:** students discuss what they have learned about the subject of making techniques selection with the rest of the class. ● **Whole class activity:** students consider whether it's viable to apply an objective comparison for the selection of making techniques and, again, discuss within the class.	
33	Considering quality requirements [Component 1, B1, Making final design solution decisions – considering quality requirements]	**Introductory activity:** ● **Paired then whole class activity:** students look up and make notes on the definitions of 'quality' and then discuss with the class. **Main session activities:** ● **Teacher-led discussion:** teacher leads a class discussion on meeting customer requirements – what are these? ● **Teacher-led presentation:** teacher explains the meanings of quality assurance and product conformance and non-conformance. ● **Teacher-led presentation:** teacher outlines the importance of quality control checks and the need to carry out inspections and tests, using the example checklist (Table 1.13 in the Student Book). ● **Paired activity:** students create a quality control checklist for the new engineered product that they have been considering in previous lessons. ● **Whole class activity:** students present their checklist to the class and then explain why they came up with specific checks. **Plenary activities:** ● **Teacher-led discussion:** teacher leads a class discussion on why quality control checks are essential for an engineering	Internet access Interactive whiteboard Dictionary

		company, and why it is important to carry out checks periodically during product manufacture. ● **Individual activity:** students select any product or object and write out a quality control checklist for it.	
34	Working in a team and peer review [Component 1, B1, How employees work in a team and peer review during the engineering design and make process with the customer as a focus]	**Introductory activity:** ● **Teacher-led discussion:** teacher leads a class discussion on how students like working alone, in pairs and in small/large groups. Which do they prefer? (Students need to consider how this relates to certain tasks.) **Main session activities:** ● **Teacher-led presentation:** teacher explains what teamwork is, why it is important and the benefits. ● **Teacher-led presentation:** teacher explains peer review and peer review methods. ● **Group activity:** students undertake an activity to try peer review. In groups of four, students consider an engineered product: one as a design engineer, one as a manufacturing engineer, one as a production/machine operator, one as a quality control engineer. Each role writes a brief about a common problem in each of their processes. ● **Group activity:** students swap briefs with another group and each student carries out a peer review of the brief related to their respective role/discipline. ● **Group activity:** students assigned alike roles get together and discuss the peer reviews. **Plenary activities:** ● **Teacher-led discussion:** teacher leads a class discussion on the peer review process. ● **Whole class activity:** students watch a video on peer reviews.	Internet access Interactive whiteboard Short video clip from the internet that shows how to write peer reviews, e.g. 'Writing Peer Review (Peer Critique) TOP 10 Mistakes' https://www.youtube.com/watch?v=iBuq4qgRhCc
35	Using generic skills at work	**Introductory activity:**	Internet access

	[Component 1, B1, How employees use generic skills – respect for others, professionalism, working relationships, collaborative skills]	• **Teacher-led discussion:** teacher asks students what they think about working with customers and whether they see any differences in how they should conduct themselves compared to working with colleagues. **Main session activities:** • **Teacher-led presentation:** teacher outlines some of the generic skills that employers look for, in terms of behaviour, attitude, limitations, respect for others, professionalism, working relationships and collaborative skills. • **Paired activity:** students research online some other generic skills, making notes on these. • **Small group activity:** students discuss any new skills they found through their research and list these on the whiteboard. • **Teacher-led discussion:** teacher leads a summary discussion on generic skills and asks students for feedback. **Plenary activities:** • **Individual activity:** students list which skills they think they are good at and which skills they need to improve. • **Individual activity:** students identify, from a list of topics from Learning aim B1, those topics they are unsure about and any topics they do not understand.	Interactive whiteboard
36	Learning aim B: assessment practice Revision of Learning aim B1 [Component 1, B1, Explore engineering skills through the design process]	**Introductory activity:** • **Teacher-led discussion:** teacher leads a Q&A session based on Learning aim B1. **Main session activities:** • **Teacher-led presentation:** teacher recaps topics covered in Learning aim B1, and explains that students will be expected to: o use engineering skills to produce solutions to engineering problems o design as part of the engineering design and make process	Pearson authorised assignment brief or brief produced and verified by school

		○ produce solutions to problems using different combinations of engineering skills, including designing as part of the engineering design and make process. ● **Individual activity:** students produce a set of design proposals, comparing the design proposals to the engineering brief when they have finished, and then use CAD to produce a final solution. ● **Whole class activity:** students work as a class to describe successful features of the design process. **Plenary activity:** ● **Teacher-led presentation then individual activity:** teacher introduces final assignment brief for Learning aim B1 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.

Websites

https://www.imeche.org/industry-sectors, *Institution of Mechanical Engineers, Industry Sectors* – latest news in various industry sectors

https://www.theiet.org/apprentices/area-engineering, *The Institution of Engineering and Technology, Which area of engineering?* – looking at the opportunities for different types of apprenticeships

https://www.eef.org.uk, *The manufacturers' organisation, We are EEF* – information on supporting manufacturing and engineering in the UK

https://www.bbc.co.uk/education/subjects/zmhg9j6, *BBC Bitesize Engineering* – learning resource information for engineering

https://www.careersadviceforparents.org, *Careers Advice for Parents, creating better futures* – information to help plan careers and the skills needed for employment

Videos

‘What is engineering?’ available from: https://www.youtube.com/watch?v=bipTWWHya8A – demonstrating what engineering is about and why it is important

‘What is Engineering?’ available from: https://www.youtube.com/watch?v=FAJGx3zP-Eo – demonstrating what engineering is about and what it could do

‘World’s Funniest Engineering Fails’, available from: https://www.youtube.com/watch?v=qPhVZExcGXg&t=14s – showing what can go wrong in engineering

‘What Causes Accidents - Safety Training Video - Preventing Accidents & Injuries’, available from: https://www.youtube.com/watch?v=dBf6BTX1bmM – safety training video showing that we need to prevent accidents and injuries

‘Aerospace Engineers – What is it?’ available from https://www.youtube.com/watch?v=STYw2OTOveY&list=PLTQHtldEisnXVclVQHt7Bosd4xj-YQXpW&index=1 – video describing the divisions of aerospace engineering

‘Introduction to Civil and Environmental Engineering Design’, available from: https://www.youtube.com/watch?v=yZJbgimr5hg – video providing introductory overview of aspects of civil engineering

‘Boeing 737 MAX winglets in the wind’, available from: https://www.youtube.com/watch?v=vD828p9Nt0U – video showing how Boeing conducts tests in its wind tunnel testing lab

‘Boeing 787 conducts fatigue testing’, available from: https://www.youtube.com/watch?v=TH9k9fWaFrs – video showing an example of how Boeing carries out fatigue testing

‘What Is Six Thinking Hats?’ available from: https://www.youtube.com/watch?v=UZ8vF8HRWE4 – what are the six thinking hats and what do they mean?

‘Converting 2D to 3D in SOLIDWORKS’, available from: https://www.youtube.com/watch?v=QPYLPxfYPB0 – how to import a 2D drawing file and convert it to 3D

‘How to make a cardboard prototype’, available from: https://www.youtube.com/watch?v=k_9Q-KDSb9o – using cardboard to make a prototype toaster

‘Writing Peer Review (Peer Critique) TOP 10 Mistakes’, available from: https://www.youtube.com/watch?v=iBuq4qgRhCc – students in a class show how NOT to conduct a peer review