

A Level Design and Technology



Specification

Pearson Edexcel Level 3 Advanced GCE in Design and Technology

(Product Design) (9DT0)

First teaching from September 2017

First certification from 2019

Issue 1

Qualification at a glance

Content and assessment overview

The Pearson Edexcel Level 3 Advanced GCE in Design and Technology (Product Design) consists of one externally-examined paper and one non-examined assessment component. Students must complete all assessment in May/June in any single year.

Component 1: Principles of Design and Technology (Paper code: 9DT0/01)*
<p>Written examination: 2 hours 30 minutes</p> <p>50% of the qualification</p> <p>120 marks</p>
<p>Content overview</p> <p>Topic 1: Materials</p> <p>Topic 2: Performance characteristics of materials</p> <p>Topic 3: Processes and techniques</p> <p>Topic 4: Digital technologies</p> <p>Topic 5: Factors influencing the development of products</p> <p>Topic 6: Effects of technological developments</p> <p>Topic 7: Potential hazards and risk assessment</p> <p>Topic 8: Features of manufacturing industries</p> <p>Topic 9: Designing for maintenance and the cleaner environment</p> <p>Topic 10: Current legislation</p> <p>Topic 11: Information handling, Modelling and forward planning</p> <p>Topic 12: Further processes and techniques.</p>
<p>Assessment overview</p> <ul style="list-style-type: none">• The paper includes calculations, short-open and open-response questions, as well as extended-writing questions focused on:<ul style="list-style-type: none">○ analysis and evaluation of design decisions and outcomes, against a technical principle, for prototypes made by others○ analysis and evaluation of wider issues in design technology, including social, moral, ethical and environmental impacts.• Students must answer all questions.• Students must have calculators and rulers in the examination. <p>Calculators may be used in the examination. Information on the use of calculators during the examinations for this qualification can be found in <i>Appendix 2: Calculators</i>.</p>

*See *Appendix 9: Codes* for a description of this code and all other codes relevant to this qualification.

Content

Topic	What students need to learn:												
1 Materials	<p>To apply a knowledge and understanding of working properties, characteristics, applications, advantages and disadvantages of the following types of materials in order to discriminate between them and select appropriately.</p> <table border="1" data-bbox="496 481 1369 1832"> <tbody> <tr> <td data-bbox="496 481 592 633">1.1</td> <td data-bbox="592 481 1369 633"> Woods: a) hardwoods – oak, mahogany, beech, jelutong, balsa b) softwoods – pine, cedar, larch, redwood. </td> </tr> <tr> <td data-bbox="496 633 592 875">1.2</td> <td data-bbox="592 633 1369 875"> Metals: a) ferrous metals – mild steel, carbon steels, cast iron b) non-ferrous metals – aluminium, copper, zinc, tin c) alloys (ferrous and non-ferrous) – stainless steel, duralumin, brass. </td> </tr> <tr> <td data-bbox="496 875 592 1182">1.3</td> <td data-bbox="592 875 1369 1182"> Polymers: a) thermoplastics – acrylic, polyethylene, polyethylene terephthalate (PET), polyvinyl chloride (PVC), polypropylene (PP), acrylonitrile butadiene styrene (ABS) b) thermosetting plastics – epoxy resins (ER), urea formaldehyde (UF), polyester resin (PR). c) elastomers – rubber. </td> </tr> <tr> <td data-bbox="496 1182 592 1357">1.4</td> <td data-bbox="592 1182 1369 1357"> Composites: a) composites – carbon fibre (CFRP), glass fibre (GRP), Medium Density Fibre Board (MDF), hardboard, chipboard, plywood. </td> </tr> <tr> <td data-bbox="496 1357 592 1599">1.5</td> <td data-bbox="592 1357 1369 1599"> Papers and boards: a) drawing papers – layout, tracing, copier, cartridge b) commercial printing papers – bond, coated c) boards – mounting board, corrugated board, foam board, folding box board, foil-lined board. </td> </tr> <tr> <td data-bbox="496 1599 592 1832">1.6</td> <td data-bbox="592 1599 1369 1832"> Textiles: a) natural fibres – cotton, linen, wool b) manmade fibres – nylon, polypropylene, polyester c) textile treatments – flame resistant, polytetrafluoroethylene (PTFE). </td> </tr> </tbody> </table>	1.1	Woods: a) hardwoods – oak, mahogany, beech, jelutong, balsa b) softwoods – pine, cedar, larch, redwood.	1.2	Metals: a) ferrous metals – mild steel, carbon steels, cast iron b) non-ferrous metals – aluminium, copper, zinc, tin c) alloys (ferrous and non-ferrous) – stainless steel, duralumin, brass.	1.3	Polymers: a) thermoplastics – acrylic, polyethylene, polyethylene terephthalate (PET), polyvinyl chloride (PVC), polypropylene (PP), acrylonitrile butadiene styrene (ABS) b) thermosetting plastics – epoxy resins (ER), urea formaldehyde (UF), polyester resin (PR). c) elastomers – rubber.	1.4	Composites: a) composites – carbon fibre (CFRP), glass fibre (GRP), Medium Density Fibre Board (MDF), hardboard, chipboard, plywood.	1.5	Papers and boards: a) drawing papers – layout, tracing, copier, cartridge b) commercial printing papers – bond, coated c) boards – mounting board, corrugated board, foam board, folding box board, foil-lined board.	1.6	Textiles: a) natural fibres – cotton, linen, wool b) manmade fibres – nylon, polypropylene, polyester c) textile treatments – flame resistant, polytetrafluoroethylene (PTFE).
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Topic	What students need to learn:	
	1.7	Smart and modern materials: <ul style="list-style-type: none"> a) thermo-ceramics b) shape memory alloys (SMA) c) reactive glass d) liquid crystal displays (LCD) e) photo-chromic materials f) thermo-chromic materials g) quantum tunnelling composites.

Topic	What students need to learn:	
2 Performance characteristics of materials	2.1	Performance characteristics of woods, metals, polymers, smart and modern materials, papers, boards, textiles and composites in order to discriminate between materials and select appropriately: <ul style="list-style-type: none"> a) conductivity b) strength c) elasticity d) plasticity e) malleability f) ductility g) hardness h) toughness i) durability j) biodegradability.

Topic	What students need to learn:	
3 Processes, techniques and specialist tools	3.1	<p>Processes, applications, characteristics, advantages and disadvantages of the following, in order to discriminate between them and select appropriately including the selection of specific and relevant tools to be used for domestic, commercial and industrial products and systems, and use safely when experimenting, improving and refining in order to realise a design:</p> <ul style="list-style-type: none"> a) heat treatments – hardening and tempering, case hardening, annealing, normalising (including use of specialist tools) b) alloying (including use of specialist tools) c) printing – offset lithology, flexography, screen-printing, gravure (including use of specialist tools) d) casting – sand (to include investment), die, resin, plaster of Paris (including use of specialist tools) e) machining – milling/routing, drilling, turning, stamping, pressing (including use of specialist tools) f) moulding – blow moulding, injection moulding, vacuum forming, extrusion, rotational moulding (including use of specialist tools) g) lamination (including use of specialist tools) h) marking out techniques – woods, metals, polymers, paper and boards (including use of specialist tools).
	3.2	<p>Application of specialist measuring tools and equipment to determine and apply the accuracy and precision required for products to perform as intended.</p> <ul style="list-style-type: none"> a) marking, cutting and mortise gauges b) odd leg, internal and external callipers c) squares (set, try, engineers and mitre) d) micrometer and vernier callipers e) densitometer f) dividers g) jigs and fixtures h) go and no-go gauges

Topic	What students need to learn:	
3 Processes, techniques and specialist tools <i>continued</i>	3.3	Use of media to convey design decisions, to record to recognised standards, explain and communicate information and ideas using the following methods and techniques: <ul style="list-style-type: none"> a) pictorial drawing methods for representing 3D forms – isometric, 2-point perspective b) working drawings for communicating 2D technical information – 3rd angle orthographic projection, triangulation c) nets (developments) for communicating information about 3D forms in a 2D format d) translation between working drawings, pictorial drawings and nets (developments) e) report writing.
	3.4	Uses, characteristics, advantages and disadvantages of the following permanent and semi-permanent joining techniques in order to discriminate between them, select appropriately and use safely: <ul style="list-style-type: none"> a) adhesives – contact adhesive, acrylic cement, epoxy resin, polyvinyl acetate (PVA), hot melt glue, cyanoacrylate (superglue), polystyrene cement (including use of specialist tools) b) mechanical – screws, nuts, bolts, washers, rivets, press (including use of specialist tools) c) heat – oxy-acetylene welding, MIG welding, brazing, hard soldering, soft soldering (including use of specialist tools) d) jointing – traditional wood joints, knock-down fittings (including use of specialist tools).
	3.5	Application, advantages and disadvantages of the following finishing techniques and methods of preservation in order to discriminate between them and select appropriately for use, including for the prevention of degradation: <ul style="list-style-type: none"> a) finishes – paints, varnishes, sealants, preservatives, anodising, electro-plating, powder coating, oil coating, galvanisation, cathodic protection (including use of specialist tools) b) paper and board finishing process – laminating, varnishing, hot foil blocking, embossing (including use of specialist tools).

Topic	What students need to learn:	
4 Digital technologies	4.1	<p>Set up, safe and accurate operation, advantages and disadvantages of the following digital technologies:</p> <ul style="list-style-type: none"> a) computer-aided design (CAD) – 2D and 3D design to create and modify designs and create simulations, 3D modelling for creating 'virtual' products b) computer-aided manufacture (CAM) and rapid prototyping – CNC lathes, CNC routers, CNC milling machine, CNC laser, CNC vinyl cutters, rapid prototyping.

Topic	What students need to learn:	
5 Factors influencing the development of products	5.1	<p>The importance and influence of user centred design in ensuring products are fit-for-purpose and meet the criteria of specifications when designing, making and evaluating in relation to:</p> <ul style="list-style-type: none"> a) user needs, wants and values b) purpose c) functionality d) innovation e) authenticity.
	5.2	<p>Principles, applications and the influence on design of anthropometrics and ergonomics:</p> <ul style="list-style-type: none"> a) sources and applications of anthropometric data b) ergonomic factors for a designer to consider when developing products and environments with which humans react.
	5.3	<p>The influence of aesthetics, ergonomics and anthropometrics on the design, development and manufacture of products:</p> <ul style="list-style-type: none"> a) form over function b) form follows function.
	5.4	<p>Design theory through the influences and methods of the following key historical movements and figures:</p> <ul style="list-style-type: none"> a) Arts and Crafts – William Morris b) Art Nouveau – Charles Rennie Mackintosh c) Bauhaus Modernist – Marianne Brandt d) Art Deco – Eileen Gray e) Post Modernism – Philippe Starck f) Streamlining – Raymond Lowey g) Memphis – Ettore Sottsass.

Topic	What students need to learn:	
6 Effects of technological developments	6.1	<p>Current and historical technological developments that have had an effect on the work of designers and technologists and their social, moral and ethical impacts:</p> <ul style="list-style-type: none"> a) mass production – the consumer society, built-in obsolescence, the effect mass production has on employment b) the 'new' industrial age of high-technology production – computers and the development and manufacture of products, miniaturisation of products and components, the use of smart materials, products from innovative applications c) the global marketplace – multinational companies in developed and developing countries, manufacturing 'offshore' in developing countries and local and global production.

Topic	What students need to learn:	
7 Safe working practices, potential hazards and risk assessment	7.1	<p>Adopting safe working practices, recognise and react to potential hazards:</p> <ul style="list-style-type: none"> a) understanding safe working practices for yourself and others when designing and making, including when selecting and safely using machinery, equipment and tools in order to ensure safe working environments b) understanding the need for risk assessments – identification of potential hazards, identification of people at risk, evaluation of risks, implement control measures, recording and storing of risk assessment documentation.

Topic	What students need to learn:	
8 Features of manufacturing industries	8.1	Characteristics and stages of the following methods of production when applied to products and materials: a) one-off production b) batch production c) high-volume production.
	8.2	Characteristics, application, advantages and disadvantages of the following types of quality monitoring systems: a) quality control – the monitoring and achieving of high standards and degree of tolerance by inspection and testing, computer-aided testing b) quality assurance – monitoring the quality of a product from its design and development stage, through its manufacture, to its end-use performance and degree of customer satisfaction c) Total Quality Management (TQM) – when applied to quality assurance procedures and its impact on employees at every stage of the production process, ISO 9000.
	8.3	Characteristics, processes, application, advantages and disadvantages and the importance of considering accuracy of production and efficiency of modern manufacturing methods and systems when designing for manufacture for small, medium and large scale production: a) production scheduling and production logistics b) robotics in production – robots on fully-automated production and assembly lines/cells c) materials handling systems – automated storage and retrieval systems (ASRS), automatic guided vehicles (AGVs) d) flexible manufacturing systems (FMS), modular/cell production systems e) lean manufacturing using just-in-time (JIT) systems f) standardised parts, bought-in components g) quick response manufacturing (QRM) h) data integration – product data management (PDM), enterprise resource planning (ERP) systems i) concurrent manufacturing.

Topic	What students need to learn:	
9 Designing for maintenance and the cleaner environment	9.1	Characteristics, application, advantages and disadvantages of 'cleaner' design and technology – a product's life cycle in relation to the following sustainable development issues: <ul style="list-style-type: none"> a) material selection – source, quantity, quality, range, recyclability, biodegradability b) manufacture – minimising energy use, simplification of processes, achieving optimum use of materials and components, giving consideration to material form, cost and scale of production c) distribution – efficient use of packaging, reduction of transport, alternatives to fossil fuels d) use – repair versus replacement, energy efficiency, efficiency ratings e) repair and maintenance – standardisation, modular construction, bought in parts f) end of life – design for disassembly, recovered material collection, sorting and re-processing methods, energy recovery, environmental implications of disposal to landfill.
	9.2	The wider issues of using cleaner technologies: <ul style="list-style-type: none"> a) cost implications to the consumer and manufacturer b) sustainability – designing without jeopardising the potential for people in the future to meet their needs.

Topic	What students need to learn:	
10 Current legislation	10.1	From the consumer's point of view the implications of consumer rights legislation to consumers and manufacturers: a) Consumer Rights Act (2015) b) Sale of Goods Act (1979).
	10.2	The principles and applications of health and safety laws and regulations and their impact on the designing and making process, including the consequences of non-adherence: a) health and safety regulation – the Health and Safety Executive and an awareness of relevant regulations to manufacturing industries b) Health and Safety at Work etc Act (1974) – the procedures to safeguard the risk of injury to people: personal protective equipment (PPE), signage, warning symbols c) Control of Substances Hazardous to Health (COSHH) regulations – the storage and use of solvent-based substances containing volatile organic compounds (VOCs).

Topic	What students need to learn:	
11 Information handling, modelling and forward planning	11.1	Collection, collation and analysis of information and the use of this to make informed decisions: a) marketing – marketing analysis, research techniques, raw data/analysed data to enable enterprise to be encouraged b) innovation management – cooperation between management, designers and production engineers, the encouragement of creativity c) the use of feasibility studies on the practicability of proposed solutions.
	11.2	Modelling the costing of projects to achieve an optimum outcome: a) budgets – undertake financial forecasts b) planning for production – allocation of: o employees o materials o scale of production c) selection of appropriate tools, machines and manufacturing processes.
	11.3	The importance, implications and ways of protecting the intellectual property rights of designers, inventors and companies: a) patents b) copyrights c) design rights d) trademarks.
	11.4	Implication to designers, manufacturers and consumers of the following standards when developing designs and manufacturing products: a) British Standards (BSI and kite mark) b) European (CEN and CE) c) International Standards (ISO).

Topic	What students need to learn:	
12 Further processes and techniques	12.1	Strategies, techniques and approaches to explore, create and evaluate design ideas: a) user-centred design: <ul style="list-style-type: none"> ○ framework process ○ problem solving ○ user needs, wants and values ○ limitations of end user consideration b) circular economy – biologically-based systems and an understanding of how waste and pollution can be eliminated c) systems thinking – the influence of systems on commercial activity to enable all elements of a manufacturing enterprise to work together.
	12.2	Applications, characteristics, advantages and disadvantages of the following project management strategies: a) critical path analysis – the handling of complex and time sensitive operations b) scrum – how flexible, holistic product development is achieved c) Six Sigma – the improvement of output quality of a process by identifying and removing the causes of defects and setting value targets of: <ul style="list-style-type: none"> ○ reduce process cycle time ○ reduce pollution ○ reduce costs ○ increase customer satisfaction ○ increase profits.
	12.3	The cost, sales, profit and market implications to the designer and manufacturer of the stages of a product's life cycle: <ul style="list-style-type: none"> ● Introduction Stage ● Growth Stage ● Maturity Stage ● Decline Stage.