

Mark Scheme (Results)

June 2011

GCSE Engineering/Manufacturing
(5EM03) Paper 3E

Electrical & Electronics, Process Control,
Computers, Telecommunications

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General Marking Guidance

- All learners must receive the same treatment. Examiners must mark the first learner in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Learners must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the learner's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a learner's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the learner has replaced it with an alternative response.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

i) Ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear

ii) Select and use a form and style of writing appropriate to purpose and to complex subject matter

iii) Organise information clearly and coherently, using specialist vocabulary when appropriate.

Question Number	Answer	Mark
1(a)	<ul style="list-style-type: none"> • DAB radio • Personal video recorder <p><i>If 3 boxes or more ticked - no marks.</i></p> <p style="text-align: right;">(2 x 1)</p>	(2)

Question Number	Answer	Mark
1(b)	<ul style="list-style-type: none"> • Wireless router • USB dongle <p><i>If 3 boxes or more ticked - no marks.</i></p> <p style="text-align: right;">(2 x 1)</p>	(2)

Question Number	Answer	Mark
2(a)	<ul style="list-style-type: none"> • LED • Light Emitting Diode <p><i>Accept any recognisable spelling (phonetic) of the answer above. Do not accept 'diode' on its own</i></p> <p style="text-align: right;">(1 x 1)</p> <hr/> <ul style="list-style-type: none"> • Transistor • NPN • PNP <p><i>Accept any recognisable spelling (phonetic) of the answer above.</i></p> <p style="text-align: right;">(1 x 1)</p>	(2)

Question Number	Answer	Mark
2(b)	<p>An answer that makes reference to two of the following points:</p> <ul style="list-style-type: none"> • To restrict current (1) • Allows variation from low value to high value (1) • Adjust potential difference in a circuit (1) • To adjust volume, tone, brightness etc (1) • Any other appropriate answer <p>e.g. To restrict current (1) so volume can be adjusted (1)</p> <p style="text-align: right;">(2 x 1)</p> <hr/> <p>An answer that makes reference to two of the following points:</p> <ul style="list-style-type: none"> • To store charge (1) • Charge up and slow release (1) • To create a time delay (1) • Part of a smoothing / filter circuit (1) • Any other appropriate answer <p>e.g. to store charge (1) and create a time delay (1)</p> <p style="text-align: right;">(2 x 1)</p>	(4)

Question Number	Answer	Mark
3	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Term</p> <div style="border: 1px solid black; padding: 5px; width: 150px; margin-bottom: 10px;">Blue tooth</div> <div style="border: 1px solid black; padding: 5px; width: 150px; margin-bottom: 10px;">Robotics</div> <div style="border: 1px solid black; padding: 5px; width: 150px; margin-bottom: 10px;">Polypropylene (PP)</div> <div style="border: 1px solid black; padding: 5px; width: 150px; margin-bottom: 10px;">Silicon</div> <div style="border: 1px solid black; padding: 5px; width: 150px; margin-bottom: 10px;">Video conferencing</div> <div style="border: 1px solid black; padding: 5px; width: 150px; margin-bottom: 10px;">Computer aided manufacture (CAM)</div> <div style="border: 1px solid black; padding: 5px; width: 150px; margin-bottom: 10px;">Polyvinyl chloride (PVC)</div> </div> <div style="text-align: center;"> <p>Key Area</p> <div style="border: 1px solid black; border-radius: 50%; padding: 10px; width: 150px; margin-bottom: 20px; display: inline-block;">Modern materials</div> <div style="border: 1px solid black; border-radius: 50%; padding: 10px; width: 150px; margin-bottom: 20px; display: inline-block;">Control technology</div> <div style="border: 1px solid black; border-radius: 50%; padding: 10px; width: 150px; display: inline-block;">Information and Communications Technology (ICT)</div> </div> </div> <p><i>No mark awarded where 2 or more lines are drawn from a term. Lines do not have to be straight but term and key area must be clearly linked.</i></p> <p style="text-align: right;">(7 x 1)</p>	(7)

Question Number	Answer	Mark
4(a)	<p>Appropriate products such as e.g.</p> <ul style="list-style-type: none"> • USB Drive • Smoke alarm • LCD alarm clock • Soldering iron • Digital multimeter • LED head torch • Portable electric drill • Digital camera • Mobile phone • Television • MP3 player • Computer • Satellite dish • A brand name of a specific product <p><i>This list is not exhaustive; accept any product that contains electrical/electronic componentry or has an association with the sector.</i></p>	
	(2 x 1)	(2)

Question Number	Answer	Mark
4(b) (i)	<ul style="list-style-type: none"> • Alloys • Copper • Zinc • Brass • Aluminium alloys • Duralumin • Titanium • Iron alloys • Steel/stainless steel/germanium • Ceramics • Radioactive material, e.g. americium-241 • Composites/carbon fibre/glass reinforced plastics (GRP) • Polymer/plastic [although plastic is not technically correct, accept the term 'plastic'] • Various thermoplastics (PP, HDPE, PVC, ABS etc) • Shape memory alloys (SMAs) / thermo-ceramics • Nanomaterials, e.g. NanoXcel • Adhesives • Coatings • Other appropriate materials/a material currently used for the given application • A brand name of a specific material <p><i>If any product given in 4(a) is not from this sector but is from one of the other engineering / manufacturing sectors then allow follow through.</i></p> <p>No answers to 4(a) no marks for 4(b) (i)</p>	
	(1 x 1)	(1)

Question Number	Answer	Mark
4(b)(ii)	<p>One mark for identifying each benefit One mark for each explanation</p> <ul style="list-style-type: none"> • Smaller size (1) – miniaturisation (1) • Lower weight (1) – better strength to weight ratio (1) • Better appearance (1) – smoother/brighter finishes (1) • Extends the life-time of product (1) – better wear characteristics (1) • Improves wear resistance (1) – harder materials/better surface finish (1) • Reduces cost (1) – easier assembly/improved machineability (1) • Improved functional characteristics (1) – user friendly/ease of operation (1) • Wider customer base (1) – extensive range of products in a variety of colours/textures (1) • Minimising maintenance requirements (1) – longer service intervals (1) • Improved production methods (1) reducing costs of end product (1) • Meeting regulations (1) to protect consumer from potential health and safety issues (1) <p>e.g. improves the wear resistance of the product (1) so it lasts longer (1)</p> <p><i>If an answer in part 4(a) is inappropriate but the material given in 4(b)(i) is appropriate allow follow through up to 2 marks for each of the two benefits. If no answers are given in part 4(a) but the answer to part 4(b)(ii) relates to the material stated in part 4(b)(i) allow follow through up to 1 mark. If no answer or incorrect answer given in part 4(b)(i) no marks awarded for 4(b)(ii).</i></p> <p style="text-align: right;">(2 x 1) (2 x 1)</p>	(4)

Question Number	Answer	Mark
4(c)(i)	<p>Must be related to the sector</p> <ul style="list-style-type: none"> • Polymorph (1) • Shape memory alloys (1) • Smart wire (1) • Memory wire (1) • Smart springs (1) • QTC – Quantum Tunnelling Composite (1) • Nitinol (1) • Exotic stainless steel (1) • Piezoelectric (1) • Ionic polymers (1) • Magneto / electro – rhological fluids (1) • Cold forming polymers (1) • Smart grease (1) • Anodised aluminium (1) • Electrochromic (1) • Or other appropriate smart material <p style="text-align: right;">(2 x 1)</p>	(2)

Question Number	Answer	Mark
4(c)(ii)	<p>One mark for a characteristic One mark for the description</p> <ul style="list-style-type: none"> • Polymorph – a material that can be formed by hand once heated (1) and sets hard once cooled (1) • Shape memory alloy – when heated (1), it will regain its original or memory shape (1) • Smart wire – changes its length with a useful pulling force (1) when a small electric current is passed through it (1) • Memory Wire – can be bent into shape (1) and then dropped in hot water to spring back to original straight shape (1) • Smart springs – can be stretched then electric current passed through (1) to contract spring to original length (1) • QTC – a flexible polymer (1) that shows extraordinary electrical properties (1) • Piezoelectric – as a result of an electrical force, the molecules of the material reorientate themselves (1), changing the shape of the material (1) • Magneto/Electro-Rhological Fluids – when exposed to an electrical and/or magnetic field (1), MR Fluids undergo changes in viscosity, plasticity and elasticity (1) • Electrochromic – materials that change their colour or opacity (1) on the application of a voltage (1) • Or similar <p><i>If at least one material given in 4(c)(i) is appropriate allow follow through up to 2 marks. If no answers or two incorrect answers given in part 4(c)(i) no marks awarded for 4(c)(ii).</i></p> <p style="text-align: right;">(2 x 1)</p>	(2)

Question Number	Answer	Mark
5(a)	<p>One mark for reason One mark for description</p> <ul style="list-style-type: none"> • For accurate drawings (1) – through entry of accurate data on sizes (co-ordinates) (1) • Quicker development time (1) – through simulation (1) • Easier to communicate, i.e. ICT (1) – for transfer of data (1) • Easy to make modifications/edit/change (1) – no paper hard copies (1)/computer data (1) • Lower initial development costs (1) – concurrent design processes (1) • Easier storage of data/information and retrieval (1) – interaction with databases (1) • Ability to convert from 2D to 3D (1) for modelling (1) <p><i>Low response (1) or 2 low responses (1) e.g. its quicker and more accurate – only one mark or detailed response (2) Do not accept 'easier' without explanation</i></p> <p style="text-align: right;">(2 x 1)</p>	(2)

Question Number	Answer	Mark
5(b)(i)	<ul style="list-style-type: none"> • Reduced lead times (1) • Higher production rates/efficiency(1) • Better quality output/control (1) • Complex operations can be carried out (1) • Reduced material costs (1) • Reduced waste/recycling/rework (1) • Reduced processing costs (1) • Reduced materials costs (1) • More consistent products (1) • Ability to produce bespoke/varied products (1) • Rapid prototyping (1) • Improved customer satisfaction (1) • Less chance of human error (1) • Reduced labour (1) • Increased safety (1) • Any other appropriate response <p><i>No repeats</i></p> <p style="text-align: right;">(2 x 1)</p>	(2)

Question Number	Answer	Mark
5(b)(ii)	<p>One mark for identifying the benefit One mark for how</p> <ul style="list-style-type: none"> • More consistent products (1) - fewer returns (1) • Lower purchase price (1) – increased sales (1) • Shorter ordering times (1) – improved response for customer (1) • Automated ordering (1) – in-demand products available (1) • Fewer customer complaints(1) - more repeat sales(1) • Ability to order bespoke/varied products (1) - improved customer satisfaction (1) • Better communication with manufacturer (1) – less likelihood of delivery errors (1) • Receipt and movement of goods inward improved (1) – simplified tracking procedures (1) • Increased number of customer referrals (1) resulting in a larger customer base (1) <p><i>Do not accept 'easier', or 'faster/quicker' without explanation Low response (1) or two low responses (2) or detailed response (2), for each of the benefits</i></p> <p style="text-align: right;">(2 x 1) (2 x 1)</p>	(4)

Question Number	Answer	Mark
6(a)	<ul style="list-style-type: none"> • Software/hardware (1) used to organise/monitor/control production (1) • Technologies used to facilitate production (1) through: <ul style="list-style-type: none"> • Continuous operation (1) • Improved reproducibility (1) • Increased speed (1) • Work in hazardous environments (1) • A computerised/automated method (1) for reducing unpredictability (1) • Any other appropriate response <p><i>Low response (1) or two low responses (2) or up to two marks for a detailed response (2) If example included as an extension then award 2nd mark e.g. Controlling production (1) such as pick and place robots (1)</i></p> <p style="text-align: right;">(2 x 1)</p>	(2)

Question Number	Answer	Mark
6(b)(i)	<ul style="list-style-type: none"> • Process control (1) • PLCs (1) • Embedded computers (1) • CIM (1) • CAD/CAM links (1) • CAM (1) • CIE (1) • Quality control (1) • Automation (1) • Expert systems (1) <p><i>Do not accept examples that are about handling data and information e.g. databases / spreadsheets , CAD, computers, CNC</i></p> <p style="text-align: right;">(1 x 1)</p>	(1)

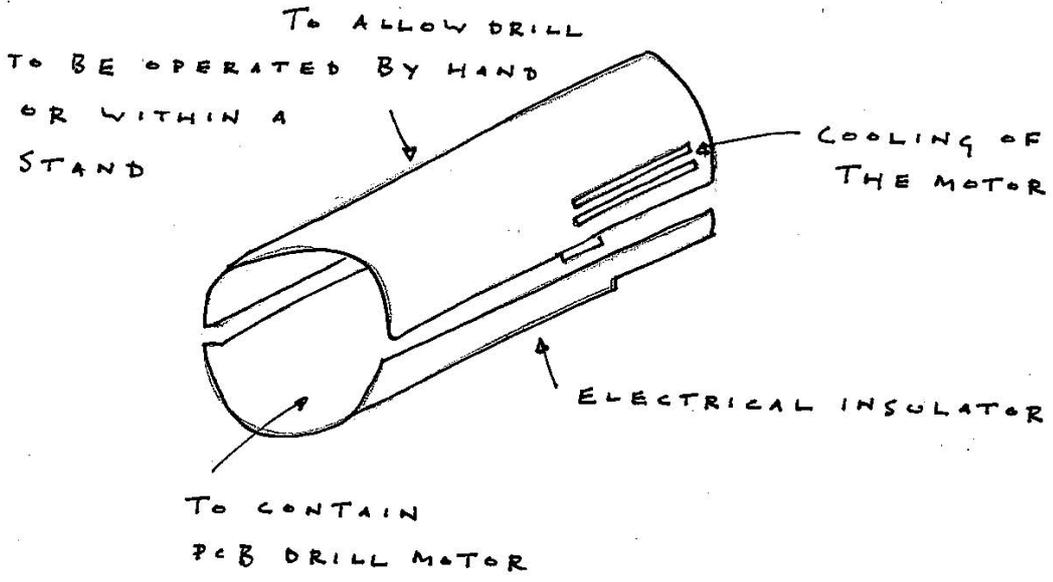
Question Number	Answer	Mark
6(b)(ii)	<ul style="list-style-type: none"> • Cam timers (1) • Manual operations associated with the sector (1) • Manual placing (1) • Manual testing (1) • Manual recording (1) • Manual measurement (1) • Physical activity/employees (1) • Any other appropriate answer (1) <p><i>Must be a feasible replacement</i> <i>If answer in 6(b)(i) is not appropriate allow follow through</i> <i>If no answer in 6(b)(i) no mark for 6(b)(ii)</i></p> <p style="text-align: right;">(1 x 1)</p>	(1)

Question Number	Answer	Mark
6(b)(iii)	<p>One mark for identifying the benefit One mark for how</p> <p>Examples:</p> <ul style="list-style-type: none"> • Improved safety (1) minimal human input (1) • Ability to operate in extreme conditions (1) offering new manufacturing possibilities (1) • Does not make mistakes (1) as it does not tire (1) • Less injuries (1) as robotic sensors can detect danger (1) • Other safety features may not be necessary (1) as robots operate in a variety of environments (1) / as robots work in a guarded environment (1) / as robots work in sealed/no atmosphere (1) • Less need to pay compensation for injuries (1) reduces risk of bad publicity (1) <p><i>Response must relate to hazardous conditions</i> <i>Low response (1) or two low responses (1) or detailed response (2) per benefit</i></p> <p style="text-align: right;">(2 x 1) (2 x 1)</p>	(4)

Question Number	Answer	Mark
7(a)	<p>One mark for identifying implication Up to two marks for how</p> <ul style="list-style-type: none"> • Accurate sales information (1) – instant feedback (1) higher sales (1) • Detailed customer information (1) – tailoring product to target market (1) matching customer requirements better (1) • Information for marketing strategies/campaigns (1) – choosing correct media (1) • Information for advertising campaigns (1) – model sales versus demand (1) importance of correct parameters (1) • Profit / loss information available (1) – meeting demand (1) can be shown in graphical form (1) • Ordering to meet sales faster (1) meeting on demand (1) more efficient (1) • Information overload (1) too much detail to process (1) can lead to inaccuracies (1) • Incorrect data (1) can lead to wrong decisions being made (1) when marketing products (1) • Increased computer capacity may be needed (1) to store all marketing information (1) • Recall products (1) so they can deal with problems (1) • Or any other appropriate response <p><i>Low response (1) or detailed statement (3)</i></p> <p style="text-align: right;">(1 x 3)</p>	(3)

Question Number	Answer	Mark
<p>7(b)</p>	<p>One mark for identifying implication Up to two marks for how</p> <ul style="list-style-type: none"> • Less likelihood of material shortages (1) – reduced down time (1) better utilisation (1) • Highlight threshold stock levels (1) – automatic ordering (1) ensures continuous supply (1) • Reduction in order complexity/lead time (1) –ability to use JIT (1) • Receipt and movement of goods inward improved (1) – simplified tracking procedures (1) • Easier to allocate materials to individual products (1) for traceability (1) • Better communication with materials supplier (1) – less likelihood of delivery errors (1) • Automatic ordering (1) could lead to purchase of obsolete materials (1) which would be wasted (1) • Accurate information (1) – updated regularly (1) • Detailed information (1) – high storage space (1) • Fast access to data (1) – search / sort / query (1) • Improved planning (1) – short lead times (1) • Forecasting (1) – collects volumes of data / modelling (1) • Cost of control (1) – better scheduling (1) • Reduced stock holding(1) – tracks trends / JIT (just in time) (1) • Inaccurate bill of materials / product data (1) could lead to incorrect ordering of materials (1) that will be wasted (1) • Or any other appropriate answer <p><i>Low response (1) or detailed statement (3)</i></p>	<p>(1 x 3) (3)</p>

Question Number	Answer	Mark
8(a)	<p>An answer that makes reference to any of the following points:</p> <ul style="list-style-type: none"> • To hold the drill bit (1) • Rotating collar releases or grips the drill bit (1) via the opening/closing mechanism (1) • To contain the three jaw mechanism (1) • To self-centre on the drill bit (1) • To operate and grip without a chuck key (1) • To rotate the drill bit (1) safely (1) and/or accurately (1) and/or at high speed (1) • To restrict the diameter of the drill bit (1) • Or similar <p><i>Answer must contain both notes and sketches.</i></p> <p><i>Max two marks if only notes or only sketches used.</i></p> <div style="text-align: center; margin-top: 20px;"> <p>8 (a)</p> </div>	<p>(3 x 1)</p> <p>(3)</p>

Question Number	Answer	Mark
8(b)	<p>An answer that makes reference to any of the following points:</p> <ul style="list-style-type: none"> • To contain the PCB drill motor (1) • To allow the switch to be placed in the most appropriate/ergonomic position (1) • To allow for cooling of the motor [casing slots] (1) • To allow the PCB drill to be operated safely (1) by hand (1) • To allow the PCB drill to fit securely into a PCB drill stand (1) and be operated accurately (1) • To act as an electrical insulator (1) • Or similar <p><i>Answer must contain both notes and sketches.</i></p> <p><i>Max two marks if only notes or only sketches used.</i></p> <div style="text-align: center; margin-top: 20px;"> <p>8 (b)</p>  </div> <p style="text-align: right; margin-top: 20px;">(3 x 1)</p>	(3)

Question Number	Answer	Mark
8(c)	<p>An answer that makes reference to any of the following points:</p> <ul style="list-style-type: none"> • To allow the PCB drill to be switched on/off easily (1) • To allow single finger/thumb operation (1) • To minimise the possibility of the drill being switched on accidentally (1) • Has 'I' and 'O' etched on to indicate state as a further safety precaution (1) • Can be produced in bright colours so it can be seen easily (1) • To be durable in use (1) • To be reliable in use (1) • Or similar (1) <p><i>Answer must contain both notes and sketches.</i></p> <p><i>Max two marks if only notes or only sketches used.</i></p> <div style="text-align: center; margin-top: 20px;"> <p>8 (c)</p> </div>	<p>(3 x 1) (3)</p>

Question Number	Answer	Mark
9(a)(i)	<ul style="list-style-type: none"> • Materials supply and control/materials supply/materials control (do not accept 'supply' or 'control' on its own) • Assembly and finishing/assembly/finishing <p><i>Must be in this order</i></p> <p style="text-align: right;">(2 x 1)</p>	(2)

Question Number	Answer	Mark
9(a)(ii)	<ul style="list-style-type: none"> • Marketing • Stage 2/stage two • 2/ two <p style="text-align: right;">(1 x 1)</p>	(1)

Question Number	Answer	Mark
9(b)(i)	<p>Appropriate descriptions including three of the following points (statements must be applicable to PCB drills):</p> <ul style="list-style-type: none"> • Scheduling production (1) • Converting order to production (1) • Materials requirements (1) • Labour requirements (1) • Deadlines (1) • Throughputs (1) • Machinery/equipment requirements (1) • Quality checks (1) • Control points (1) • Health and safety (1) • Storing (1) • Any other appropriate response <p style="text-align: right;">(3 x 1)</p> <p>e.g. The stage where the manufacturer decides how the product is going to be made (1), what materials are needed (1) and what processes will be used during manufacturing (1).</p> <p>e.g. The stage where the specification of the PCB drill is used by the planning team to set out all operations and to schedule (1) the PCB drill through the production department to meet the required delivery deadlines (1). This could include ordering any special materials, tooling or consumables (1) and stating machinery or process requirements (1).</p> <p><i>Up to 3 marks</i> <i>1 x 1 mark low response, 3 x 1 mark 3 low responses or up to 3 for detailed response</i></p>	(3)

Question Number	Answer	Mark
9(b)(ii)	<p>Appropriate descriptions including three of the following points (statements must be applicable to PCB drills):</p> <ul style="list-style-type: none"> • Application of protective packaging (1) • Assembling orders (1) • Application of codes, dates, technical information (1) • Picking orders (1) • Assembling loads (1) • Packing into outer boxes (1) • Generating records (1) • Application of labels to boxes, e.g. bar codes (1) • Final visual checks (1) • Sending to distributor (1) • Collation of multiple items (1) • Details sent to finance department for invoicing requirements (1) • Or similar, but must related to the manufacture of PCB drills <p style="text-align: right;">(3 x 1)</p> <p>e.g. The stage where the completed PCB drills have any labels added (1) and are prepared for shipment via the use of protective materials, such as bubble wrap (1). The packaged PCB drills are then loaded onto the preferred method of dispatch (1) to be sent to the distributor (1). The details of this would then be sent to the distributor (customer) to ask for the money that they owe (1).</p> <p><i>Up to 3 marks</i> <i>1 x 1 mark low response, 3 x 1 mark 3 low responses or up to 3 for detailed response</i></p>	(3)

Question Number	Answer	Mark
10(a)	<p>Specific materials used for the drill chuck</p> <ul style="list-style-type: none"> • Carbon steel • Stainless steel • Alloy steel • High carbon steel • Tool steel • Polypropylene (PP) • Any other appropriate material <p><i>Accept any recognisable spelling (phonetic) of the answers above</i></p> <p><i>Do not accept generic answers, i.e. 'steel' or 'plastic'</i></p> <p style="text-align: right;">(1 x 1)</p>	(1)

Question Number	Answer	Mark
10(b) (i)	<p>Any three of the following:</p> <ul style="list-style-type: none"> • Drilling • Milling • Turning • Grinding • Boring • Fitting • Fabricating • Compression moulding • Soldering/crimping • Winding • Coating • Other appropriate process <p><i>1 mark per response up to 3</i> <i>Do not accept moulding on its own.</i> <i>Accept any recognisable spelling (phonetic) of the answers above.</i></p> <p style="text-align: right;">(3 x 1)</p>	(3)

Question Number	Answer	Mark
10(b) (ii)	<p>Appropriate explanation including three of the following points:</p> <ul style="list-style-type: none"> • Quick method/fast production rate • Produces 3D shape/intricate shapes can be produced • Quick to clean up • Little finishing required • Unit costs are low • Can be automated • Or similar <p>e.g. Injection moulding is a high speed process (1) through which intricate shapes [such as the motor casing] can be produced (1) and is economical for high volumes (1).</p> <p>e.g. After the initial set up costs, the unit cost is low (1) as it can be an automated process (1) with a fast production rate (1).</p> <p><i>1 x 1 mark low response, or up to 3 marks for detailed response</i></p> <p style="text-align: right;">(3 x 1)</p>	(3)

Question Number	Answer	Mark
10(c)	<p>An explanation that makes reference to three of the following points:</p> <ul style="list-style-type: none"> • Improved aesthetics • Improved wear resistance • Less maintenance/maintenance free • Better ergonomics • Better functionality/strength • Fewer parts • Longer lasting/durable • More consistent product • More accurate product • More reliable product • Safer product • Lower costs • Increased efficiency • Lower purchase price • Allows for product guarantee • Allows for increased range/variation of product • Lighter product • Appropriate-sized product • Or similar <p>e.g. The use of modern materials has meant PCB drills can be made from a smaller number of components (1) making it more durable (1) and less likely to fail in use (1).</p> <p><i>1 x 1 mark low response, or up to 3 marks for detailed response</i></p> <p style="text-align: right;">(3 x 1)</p>	(3)

Question Number	Answer	Mark
11(a)	<ul style="list-style-type: none"> • The use of systems (1) to control: <ul style="list-style-type: none"> • Machinery (1) • Processes (1) • The use of control systems (1) to replace human operators (1) • The ability of a process (1) to operate without the need for human sensory input (1) • Mechanical devices that are operated electronically (1) and function automatically (1) • Or similar <p><i>Low response (1) or two low responses (2) or up to two marks for a detailed response (2)</i> <i>If example included as an extension then award 2nd mark e.g. Controlling processes (1) such as using conveyor systems (1)</i></p> <p style="text-align: right;">(2 x 1)</p>	(2)

Question Number	Answer	Mark
11(b)(i)	<p>Must have relevant automation technology link</p> <p>Examples of automation:</p> <ul style="list-style-type: none"> • PLCs (1) to control processes in production (1) • Use of conveyor systems (1) to move the PCB drill from one process to the next (1) • Embedded computers (1) to perform dedicated functions (1) • Remotely operated vehicles (1) moving PCB drill parts or components to another stage of production / storage (1) • Any similar <p><i>Do not accept 'CIM' or 'CNC' without links to Automation</i></p> <p><i>Must relate to production stage</i></p> <p><i>Low response (1) or two low responses (2) or detailed response (2) per example</i></p> <p style="text-align: right;">(2 x 1) (2 x 1)</p>	(4)

Question Number	Answer	Mark
11(b)(ii)	<p>Must be appropriate to those described in (b)(i) and relate to the manufacturer, e.g.</p> <ul style="list-style-type: none"> • Flexible production (1) leads to meeting customer requirements better (1) • Consistent results and quality (1) achieved through accurate use of technology (1) • Reduced human intervention (1) of plant means safer operation (1) • Reduced labour costs (1) as less people involved (1) • Safer method (1) as humans have less exposure (1) • Reduced customer complaints (1) as better quality product (1) • Control of costs (1) - lower unit cost as less waste (1) • Retailer confidence (1) through less complaints (1) • Customer confidence increased (1) through more reliable systems (1) • Reduced waste (1) as less mistakes being made (1) • Reduced energy costs (1) through increased efficiency (1) • Improved production rates (1) through reduced downtime (1) • Gives customers a variety of products in a quicker time (1) as faster production changeovers (1) <p><i>If answer in 11(b)(i) is inappropriate, allow follow through up to one mark. If no answer given in (b)(i), no mark.</i></p> <p><i>Low response (1) or two low responses (2) or detailed response (2)</i></p> <p style="text-align: right;">(2 x 1)</p>	(2)

Question Number	Answer	Mark
11(b)(iii)	<p>Must be appropriate to those described in (b)(i) and relate to the consumer, e.g.</p> <ul style="list-style-type: none"> • Consistent product (1) - controlled better (1) • Product reliability (1) - more likely to be produced to specification (1) • Reduced time to distributor/shorter delivery times (1) as manufacturer can vary product to meet demand (1) • Less wastage (1) as processes monitored better (1) • Lower prices (1) less waste/quicker production (1) • Better availability (1) due to faster throughput • Better quality (1) through improved process control (1) • Better value (1) because production costs are reduced (1) • Product guarantee (1) as confidence in process (1) • Customer satisfaction (1) because of consistent products <p><i>If answer in 11(b)(i) is inappropriate, allow follow through up to one mark. If no answer given in (b)(i), no mark.</i></p> <p><i>Low response (1) or two low responses (2) or detailed response (2)</i></p> <p style="text-align: right;">(2 x 1)</p>	(2)

Question Number	Answer	Mark
11(c)	<ul style="list-style-type: none"> • Mechanisation provides assistance (1) with the muscular requirements of work only (1) • The use of operator controlled machines (1) to replace manual labour (1) • The use of machines (1) which are not automated (1) • Or similar <p>Eg. Using automation, the pressing of the motor winding case would be monitored by a control system (1), whereas mechanisation would only involve the use of a mechanical press tool (1)</p> <p><i>Must refer to 'mechanisation' or 'machines' not just 'automation'</i></p> <p style="text-align: right;">(2 x 1)</p>	(2)

Question Number	Answer	Mark
12(a)(i)	<ul style="list-style-type: none"> • Mobile phone/infrared/bluetooth • Email/messaging • Internet/wireless/Wi-Fi • Video conferencing • EDI • ISDN • Texting • Phone • Walkie talkie • Fax • VoIP/Skype <p><i>1 mark per relevant type</i> <i>Do not accept: TV, CAD, radio, computer laptop/ database, EPOS</i></p> <p style="text-align: right;">(2 x 1)</p>	(2)

Question Number	Answer	Mark
12(a)(ii)	<p>One mark for identifying the benefit One mark for how</p> <ul style="list-style-type: none"> • Mobile phone – can talk to client when needed (1) flexibility/roaming location (1) • Email – can send or receive instructions that are accurate/can get or send written confirmation of instructions (1) immediate permanent record (1) • Internet – can order immediately/in real time (1) immediate vast access to information for inspiration/ideas etc (1) • Video conferencing – no travel expenses/less time wasted in travelling (1) but has face to face contact (1) • EDI – immediate transfer of information for prototyping or to suppliers/no hard copies needed/less storage space (1) by use of secure on-line facilities (1) • ISDN – more data transferred in parallel (1) faster response rate with supplier through use of technology (1) • Texting – can refer back to what message was given (1) stored record of transaction (1) • Phone – can clarify and confirm without having to re-visit the discussion later (1) immediate two way conversation (1) • Walkie talkie – can clarify and confirm without having to re-visit the discussion later (1) immediate two way conversation/flexibility/roaming location/cost (1) • Fax – can refer back to what message was given (1) stored record of transaction (1) • VoIP/Skype – can see images (1) and can use other functions on computer (1) <p>Other benefits may be seen in the light of:</p> <ul style="list-style-type: none"> • Speed, accuracy, information retrieval, meeting consumer deadlines, reduced lead times, fast exchange of ideas, opinions or any other appropriate reason <p><i>Answer must relate to technology given in 12(a)(i), up to 2 marks</i> <i>If only one mark is awarded for 12(a)(i) allow follow through</i> <i>If 12(a)(i) is not answered no mark awarded for 12(a)(ii)</i></p>	<p>(2 x 1) (2)</p>

Question Number	Answer	Mark
12(b)(i)	<p>One check such as:</p> <ul style="list-style-type: none"> • Visual checks • Size checks • Functional checks • Positional and dimensional checks • Surface finish checks • Properties testing • Electronics testing • Or similar <p><i>Must be within production</i></p>	(1 x 1) (1)

Question Number	Answer	Mark
12(b)(ii)	<p>Description of quality check such as:</p> <ul style="list-style-type: none"> • Visual inspection (1) and checking against prototype/first-off/template etc. (1) • Size checks – by direct measurement or templates/optical sensors (1) and checking against drawing/specification/tolerances (1) • Functional checks – using a test rig (1) and operation of the PCB drill (1) • Positional and dimensional checks – use of gauges (1) and inspection equipment/techniques (1) • Surface finish checks – use of variable quality indicator/probe (1) and comparing with preferred or standard values (1) • Properties testing - in use testing (1) or destructive testing of final product (1) • Electronics testing – voltage and current levels (1) and correct power consumption (1) <p><i>If no answer or incorrect answer for 12(b)(i) allow follow through up to 1 mark for a correct answer to 12 (b)(ii) Low response (1) or two low responses (2) or detailed response (2)</i></p>	(2 x 1) (2)

Question Number	Answer	Mark
12(b)(iii)	<p>An explanation that makes reference to three of the following points:</p> <ul style="list-style-type: none"> • Safer product to use • Easier product to use • Confidence in product reliability • Consistent product • Don't have to buy new as often • Helps to maintain standards • Product reliability • Confidence in the company • Lower prices • Any other appropriate response <p><i>Must relate to the user</i></p> <p style="text-align: right;">(3 x 1)</p>	(3)

Question Number	Answer	Mark
13	<p>An explanation that makes reference to a combination of four of the following to a maximum of four marks</p> <p>Workforce:</p> <ul style="list-style-type: none"> • Less jobs • Change in skills • Less employment for unskilled • Change in size • Retraining often required • Job insecurity • Different skills needed • Change in work patterns • Increased travel to work centralisation • Working pattern/ 24/7 operation • Less repetitive/boring work • Any other appropriate response <p>Working environment:</p> <ul style="list-style-type: none"> • Safer • Cleaner • Quieter • Healthier • Noise pollution • Any other appropriate response <p style="text-align: right;">(4 x 1)</p> <p><i>A maximum of 3 marks if only workforce/working environment considered</i></p>	(4)

Question Number	Answer	Mark
14 QWC i, ii, iii	<p>Indicative content</p> <p>Discussion may address the following issues:</p> <ul style="list-style-type: none"> • <i>Issue</i> <ul style="list-style-type: none"> ▪ Use of ICT enables a faster time to market for a wider range of PCB drills • <i>Development</i> <ul style="list-style-type: none"> ▪ Product proliferation causes problems with using up resources and/or energy ▪ Over production causes waste in manufacture and results in waste to landfill ▪ Internet marketing encourages consumerism • <i>Issue</i> <ul style="list-style-type: none"> ▪ Use of modern and smart materials enabling a larger variety of PCB drills • <i>Development</i> <ul style="list-style-type: none"> ▪ Marketing of modern/smart materials with appealing characteristics encourages further purchases/consumerism ▪ Polymers are made from oil-based finite resources ▪ Problems associated with recycling polymers and alloys ▪ Problems associated with recycling PCB drills due to complex construction ▪ Irresponsible disposal of polymers and packaging causes litter and land pollution (landfill) • <i>Issue</i> <ul style="list-style-type: none"> ▪ Use of modern processes and systems and control technology enabling more efficient production • <i>Development</i> <ul style="list-style-type: none"> ▪ Continuous production increases energy consumption and emissions ▪ Modern processes, such as injection moulding, are only cost effective when producing large volumes and as such are heavily energy dependant • Or other appropriate answer/s 	(6 x 1) (6)
Level	Mark	Descriptor
	0	No material deserving of reward
1	1-2	Learner identifies the issue(s) with no development OR identifies and develops one issue. Shows limited understanding of the issues. The learner uses everyday language and the response lacks clarity and organisation. Spelling, punctuation and the rules of grammar used with limited accuracy.
2	3-4	Learner identifies some issues with associated developments showing some understanding of the issues. The learner uses some technological/manufacturing/environmental terms and shows some focus and organisation. Spelling, punctuation and the rules of grammar used with some accuracy. Some spelling errors may still be found.
3	5-6	Learner identifies a range of issues with associated developments showing a detailed understanding of the issues, including those associated with the conflict between efficient/modern technologies and sustainability. The learner uses a range of appropriate technological/manufacturing/environmental terms and shows good focus and organisation. Spelling, punctuation and the rules of grammar used with considerable accuracy.

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