Mark Scheme (Results)

Summer 2018

Pearson Edexcel GCSE
In Manufacturing & Engineering (5EM03)
Paper 3D

Unit 1: Engineering Fabrication

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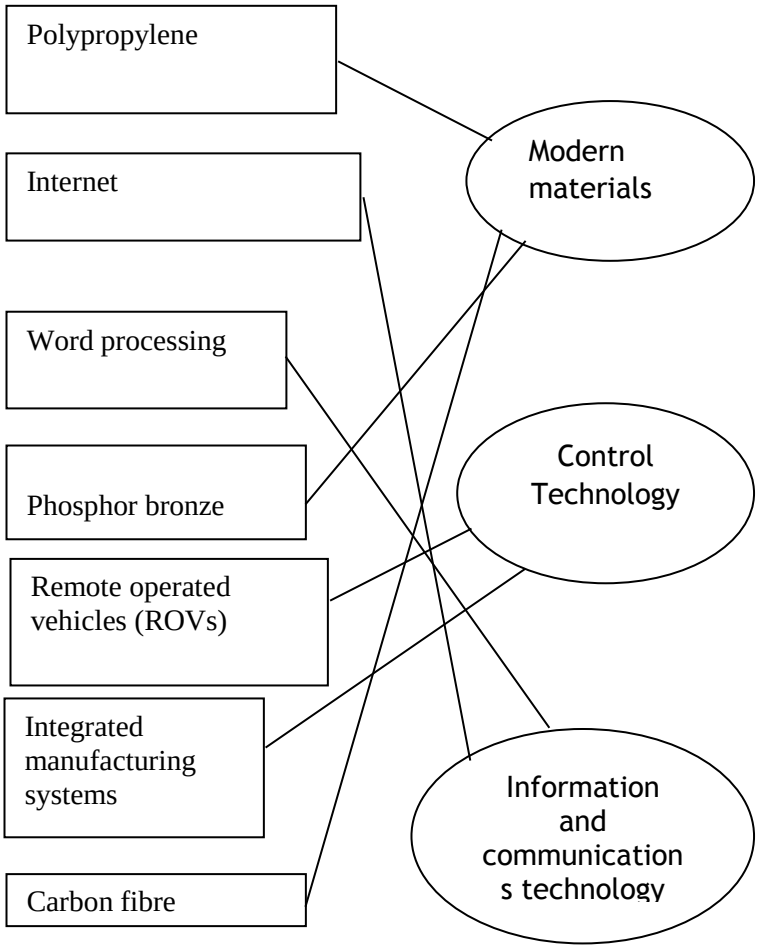
General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates 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 candidate'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 candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question	Answer	Mark
1(a)	• Mechanics vice • Aluminium ladders *If 3 boxes or more crossed - no marks.*	**(2)**
1(b)	• Road barrier • Chuck key *If 3 boxes or more crossed - no marks.*	**(2)**
		(Total 4 marks)

Question	Answer	Mark
2 (a)(i)	Accept any of the following answers: • Engineers' square • Try square • Square • 90 degree square • Right angle square • Marking out square • Metal square *Accept any recognisable spelling (phonetic) of the answers above.* *Do not accept set square or right angle on its own.*	**(1)**
2 (a)(ii)	Accept any of the following answers: • Die • Split die • External die *Accept any recognisable spelling (phonetic) of the answers above.* *Do not accept die stock or die nut / threaded nut.*	**(1)**
2 (b)(i)	An answer that makes reference to two of the following points: • Used with a bolt (1) • Used with a washer (1) • Temporary fastener (1) • To secure material together (1) *Accept any other appropriate response* e.g. used with a bolt (1) to secure two materials together (1)	**(2)**
2 (b)(ii)	An answer that makes reference to two of the following points: • Used to reduce friction (1) • Used to produce smooth movement/motion (1) • Used between a rotating component and a stationary component (1) • Can be used at high speeds (1) *Accept any other appropriate response* e.g. Used between a rotating component and a stationary component (1) to reduce friction (1)	**(2)**
		(Total 6 Marks)

Question	Answer	Mark
3	Key terms linked to a key area  *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.* (7 x 1)	**(7)**
		(Total 7 marks)

Question	Answer	Mark
4 (a)(i)	Appropriate two **products** such as: • Bike stand • Bicycle brake caliper • Bicycle hand pump • Skateboard • Office stapler • Lawn sprinkler • Shopping trolley • Hole punch • Golf trolley • Mechanics Vice • Wheelbarrow • Darts A brand name of a specific product is acceptable *This list is not exhaustive; accept any product associated with the engineering fabrication sector that uses automation in its manufacture.*	**(2)**
4 (b)(i)	Accept any of the following answers: • Process control • Computer Integrated Manufacturing (CIM) • Robotics • Continuous operation • Embedded computers • Computer Aided Manufacture (CAM) • Conveyor systems / belts • PLCs • Sensors *Accept any appropriate response*	**(1)**
4 (b)(ii)	One mark for identifying reason One mark for explanation of reason Process control • Waste control (1) – as monitors processes and quality control of processes (1) • Product consistency (1) – as better control of processes (1) • Energy conservation (1) – as tighter control of energy into process (1)	**(4)**

	CIM • Product consistency (1) – as machine is programmed to repeat manufacture (1) • Minimal waste material (1) – as parts can be machined/organised to be cut to maximise material space (1) • Operator safety (1) – machining carried out in controlled environment (1) Robotics • Product consistency (1) – as better control of processes (1) • Efficiency (1) - as less waste/faulty parts (1) • Competitiveness (1) – as faster rates of production (1) Continuous operation • Efficiency (1) - process parameters are more closely monitored (1) • Operator safety (1) – operations carried out in a controlled environment (1) Embedded computers • Cost control (1) – multi core processors not required (1) • Perform dedicated operations (1) - rarely need hardware changes (1) Computer Aided Manufacture (CAM) • Competitiveness (1) – as faster rates of production through application of CAM techniques (1) • Efficiency (1) – as less waste/faulty parts (1) • Product consistency (1) – as better control of processes (1) Conveyor systems / belts • Faster distribution (1) – as conveyors sort products quickly (1) • Continuous product flow (1) – space saving (1) PLCs • Process monitoring (1) - reducing costs (1) • Operates a closed loop system (1) – more efficient production (1) Sensors • Use of thermostats (1) – improved temperature control (1) • Use of optical sensors (1) – accurate positioning of products (1) *Accept any appropriate response* *No answer or incorrect answer to 4(b)(i), no marks for 4(b)(ii)* *Low response (1) or two low responses (2) or detailed response (2), for each of the 2 benefits* *If benefits do not relate to the automation given in 4(b)(i) award no marks.*	

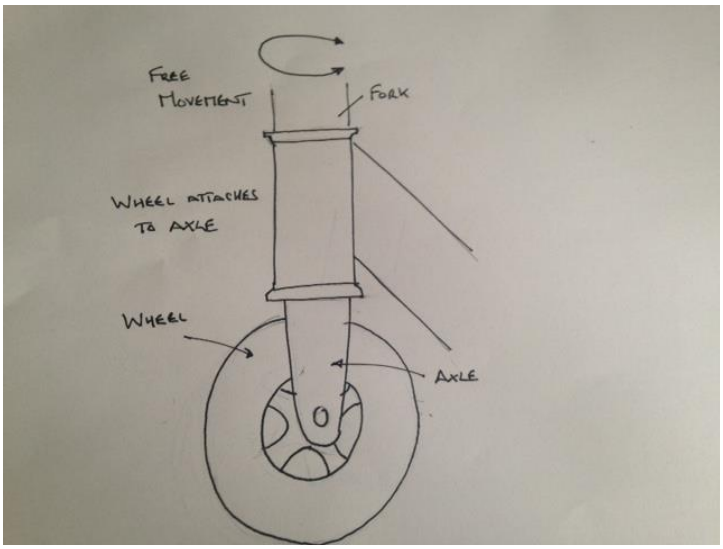
4 (c)i	Accept any appropriate modern material suitable for a product from this sector e.g. • steel/low carbon steel/mild steel • aluminium/ aluminium alloy • brass • titanium • Various thermoplastics (Acrylic, PP, HDPE, PVC etc) *Accept any other appropriate response* *Do not accept generic terms such as metals, polymers, plastics, composites.*	**(1)**
4 (c)ii	One mark for identifying change One mark for description • functional characteristics (1) – better strength to weight ratio / size / protection / rigidity (1) • mechanical characteristics (1) – strength / durability (1) • aesthetic characteristics (1) - surface finish / texture / colour / appearance (1) • Meets requirements of intended markets (1) – appeal to target audience (1) • quality standards (1) – consistency / reliability (1) *Accept any other appropriate response* ***If no answer or answer is not related to the material in part 4(c)(i) no marks awarded for 4(c)(ii).*** *Low response (1) or two low responses (2) or detailed response (2)*	**(2)**
		(Total 10 marks)

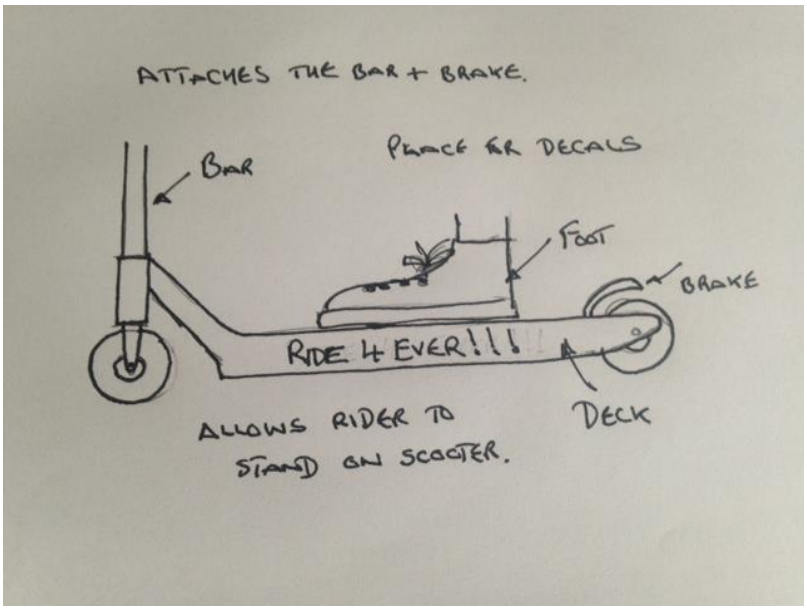
Question	Answer	Mark
5(a)	One mark for benefit One mark for description • more consistent products (1) – accurate processes (1) • shorter order times (1) – faster production (1) • consistent quality (1) – can produce to tighter tolerances (1) • may have many variations on product design/model (1) – can be flexible production methods (1) *Accept any other appropriate response* Answer must relate to the consumer *Low response (1) or 2 low responses (1) e.g. its quicker and more accurate – only one mark or detailed response (2)*	**(2)**
5(b)	One mark for each advantage One mark for each extension • For accurate drawings (1) – through entry of accurate data on sizes (coordinates) (1) • Real-time development (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/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) *Accept any other appropriate response* Answer must relate to the manufacturer *Do not accept 'easier' without justification.* *No credit for repetition* *Low response (1) or 2 low responses (1) e.g. its quicker and more accurate – only one mark or detailed response (2)*	**(6)**
		(Total 8 marks)

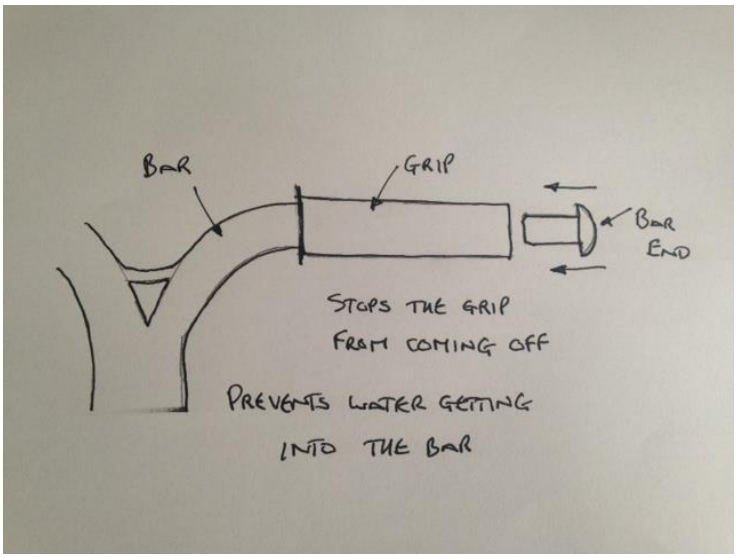
Question	Answer	Mark
6(a)(i)	An answer that makes reference to any of the following: • A wireless standard (1) for exchanging data (1) • Used over short distances (1) between fixed/mobile devices (1) • Enables interconnectivity (1) between different devices (1) *Accept any other appropriate response* *Low response (1) or two low responses (2) or detailed response (2)*	**(2)**
6(a)(ii)	One mark for an advantage One mark for an explanation • Convenience (1) – don't have to travel to venue (1) • Travel costs reduced (1) better utilisation of time (1) • Time savings (1) – communication in real time (1) • Can take place in individuals work place (1) – all material/information at hand (1) • Access to outside experts (1) – regular meetings to compare data etc (1) • Staff development (1) – encourages employees to keep up to date with modern technology (1) • Can be arranged at short notice (1) – avoids lengthy planning (1) • Can be recorded (1) – played back to remind/recall information (1) *Accept any other appropriate response* *Low response (1) or two low responses (2)* *or detailed response (2)*	**(2)**

Question	Answer	Mark
6(b)(ii)	One mark for identifying each advantage One mark for each explanation • Provides a fast and efficient way of dealing with customers (1) leading to rapid transactions (1) • Handle calculations involved with ordering (1) reducing the need for time consuming manual stock checks (1) • Integrate directly with payment systems (1) allowing instant payments from customers (1) • Keep track of stock levels (1) giving company real time updates for future sales (1) • Keep track of customer information (1) assisting with future marketing campaigns (1) • Highlight individual products performance (1) ensuring there is adequate supply (1) • Records large quantities of information (1) that can easily be accessed and analysed (1) • A flexible process (1) as there are many different types of software/hardware to suit different environments (1) *Accept any other appropriate response* *No credit for repetition* *Low response (1) or two low responses (2), or detailed* *response (2) for each of the advantages*	(4)
		(Total 9 marks)

Question	Answer	Mark
7(a)	One mark for benefit Two marks for explanation • accurate control (1) – always responds (1) to given manufacturing situations (1) • allows multitasking (1) – can have many inputs and outputs (1) allowing complex manufacturing tasks to be carried out (1) • increases production / output (1) – gives immediate reactions (1) to varying inputs (1) • changes in manufacturing space requirements (1) – older technology requires larger component parts (1) such as cabinets / wiring / switches / relays (1) • cost effective production (1) – reliable (1) and doesn't make mistakes (1) • can be used for analysis of manufacturing system / process (1) – allows improvements to be made (1) or find out what went wrong (1) • good waste control (1) – process monitoring / control (1) reducing costs (1) • can detect faulty products (1) – tracks trends (1) and reacts accordingly (1) *Accept any other appropriate response* *Low response (1) or detailed statement (up to 3)*	**(3)**
7(b)	One mark for benefit Two marks for explanation • Immediate reaction to hazardous situations (1) – applying particular outputs (1) to given inputs (1) • Reduces danger (1) – part of the monitoring system (1) that reacts very quickly (1) • Is likely to continue working over a period of time (1) – older technology may fail earlier (1) and cause accidents (1) • Could save life or reduce injuries (1) - due to the speed of processing (1) and action /alert (1) Accept any appropriate response up to 3 marks for detail *Low response (1) or detailed statement (up to 3)*	**(3)**
		(Total 6 marks)
	Total Marks for Section A	**50**

Question	Answer	Mark
8(a)	An answer that makes reference to any of the following points: • To allow the wheel to be attached (1) • To allow the handle bars to be attached (1) • To allow the handle and wheel to turn/rotate freely (1) • To support the front of the scooter (1)  *Accept any other appropriate response* *Must have notes and sketches (notes or sketches only, maximum 2 marks)* *1 x 1 mark low response, or up to 3 marks for detailed response*	**(3)**
8(b)	An answer that makes reference to any of the following points: • This is where the rider can stand/sit/kneel (1) • Allows the rear wheel to be attached (1) • Allows the steering system to be attached (1) • Allows the brake to be attached (1) • Allows the griptape to be attached (1) • Where advertising decals can be a placed (1) • Allows the rider to perform tricks/stunts (1)	**(3)**

Question	Answer	Mark
	 *Accept any other appropriate response* *Must have notes and sketches (notes or sketches only, maximum 2 marks)* *1 x 1 mark low response, or up to 3 marks for detailed response*	
8(c)	An answer that makes reference to any of the following points: • Stops the grips from coming free (1) • Prevents damage to scooter handlebars (1) • Prevents damage when lent against a wall (1) • Prevents a finger trap (1) • The end provides an area for advertising (1) • Press fit for sealing against moisture (1) • Can come in a range of colours for decorative purposes (1)	**(3)**

Question	Answer	Mark
	 *Accept any other appropriate response* *Must have notes and sketches (notes or sketches only, maximum 2 marks)* *1 x 1 mark low response, or up to 3 marks for detailed response*	
		(Total 9 marks)

Question	Answer	Mark
9(a)(i)1	Accept any of the following answers: • Production Planning • Planning • Planning Production *Accept any recognisable spelling (phonetic) of the answers above*	
9(a)(i)2	Accept any of the following answers: • Materials supply and control • Materials control and supply • Materials control • Materials supply • Materials purchase *Accept any recognisable spelling (phonetic) of the answers above*	**(2)**
9(a)(ii)	Accept any of the following answers: • Production and processing • Production • Processing • Stage 5/stage five • Five/5 • Fifth/ Fifth stage	**(1)**
9(b)	An answer that makes reference to any 3 of the following: • Assembled in the correct order (1) • Attaching the wheels (1) • Fitting the end caps (1) • Testing the scooters function (1) • Adding the decals (1) • Polishing/cleaning the parts (1) • Assembling the fork components (1) • Attaching the brake (1) • Fitting the grips (1) • Welding parts together (1) *Accept any other appropriate response*	**(3)**

Question	Answer	Mark
9(c)	An answer that makes reference to any of the following: Marketing • Gathering consumer opinion (1) • Calculating products costs (1) • Developing market plan (1) • Using market research (1) • Developing a competitive edge (1) • Advertising the stunt scooter (1) • Promoting the stunt scooter (1) • Carrying out questionnaires / surveys (1) • Pricing for the target market (1) • Using trade/electronic (internet, email) media (1) *Accept any other appropriate response* *Must be related to the marketing stage* e.g. The stage where the manufacturer uses a range of market research strategies (1) to gather people's opinions (1) to be able to advertise and promote the stunt scooter. (1) *Up to 3 marks* *1 x 1 mark low response, 3 x 1 mark 3 low responses, or up to 3 marks for a detailed response*	**(3)**
		(Total 9 marks)

Question	Answer	Mark
10(a)	Accept any of the following answers: • aluminium • aluminium alloy • mild steel • steel • low carbon steel • medium carbon steel • stainless steel • titanium Do not accept metal on its own *Accept any other appropriate response*	**(1)**
10(b)(i)	Any three of the following: • Grinding • Hardening • Annealing/Normalising / anodising • Moulding • Welding • Forging • Die/sand casting • Drilling • Milling • Turning • Boring • Cutting • Parting off • Reaming • Tapping • Thread cutting • Extrusion *Accept any other appropriate response* *Accept any recognisable spelling (phonetic) of the answers above*	**(3)**

Question	Answer	Mark
10(b)(ii)	An explanation that makes reference to three of the following points: • Creates a quality finish • Reliable process • Minimal waste • Products have consistent quality • Suitable for a variety of materials • Can deal with complex operations • Can be automated • Safer process • Aids cost control • Quick method/fast production rate when set up • Unit costs are very low for high volume production runs • Not labour intensive *Accept any other appropriate response* CNC machining produces a consistent quality product (1) which results in minimal waste (1). A quality surface finish is produced which requires little or no finishing (1) *3 x 1 mark for 3 low responses, or up to 3 marks for a detailed response*	**(3)**
10(c)	An explanation that makes reference to three of the following points: • Improved aesthetics • Better ergonomics • Warmer to the touch • Better grip • Longer lasting/more durable • Flexibility when removing/fitting • Safer product • Lower cost • Range of product colours • Lighter product • Can be recycled *Accept any other appropriate response* e.g. Polymers are warmer to the touch (1), are more flexible when removing and fitting grips (1) and allow for greater consumer choice in terms of colour (1) *3 x 1 mark for 3 low responses, or up to 3 marks for a detailed response*	**(3)**
		(Total 10 marks)

Question	Answer	Mark
11(a)	An answer that makes reference to any of the following: • A system of maintaining standards in manufactured products (1) by testing a sample of the output against the specification (1) • A system used to monitor (1) the standard of products throughout production (1) • A system for verifying and maintaining the desired standard of a product (1) through inspection/careful planning (1) • A part of a quality assurance process (1) that employs detection and measurement activities (1) *Accept any other appropriate response* *Low response (1) or two low responses (2) or detailed response (2)*	**(2)**
11(b)(i)	One mark for each example One mark for each description • Visual inspection (1) to check for any physical damage to the scooter parts (1) • Dimensional checks (1) to ensure parts of the scooter are to the correct size (1) • Positional checks (1) to ensure that the parts of the scooter align correctly (1) • Welding checks (1) to ensure that joints are free from cracks (1) • Functional checks (1) to ensure parts work correctly prior to assembly (1) *Accept any other appropriate response* *No credit for repetition* *Low response (1) or two low responses (2) or detailed response (2) per each example*	**(6)**

Question	Answer	Mark
11(b)(ii)	One mark for the disadvantage One mark for the explanation • Increased capital cost (1) due to purchase of equipment (1) • Time consuming (1) due to creation of an audit trail (1) • Increased maintenance costs (1) as more equipment to monitor and maintain (1) • Additional training requirements (1) to be able to react to QC analysis (1) *Accept any other appropriate response* *Answer must relate to the manufacturer* *Low response (1) or two low responses (2) or detailed response (2)*	**(2)**
11(b)(iii)	One mark for the benefit One mark for the explanation • Product reliability (1) as more likely to be produced to specification (1) • Lower prices (1) as less waste and quicker assembly (1) • Product guarantee (1) as confidence in the quality control process (1) • Customer satisfaction (1) because of consistent products (1) • Less inconvenience (1) as less faulty products/ fewer products will require returning (1) *Accept any appropriate response* *Answer must relate to the consumer* *Low response (1) or two low responses (2) or detailed response (2)*	**(2)**
		(Total 12 marks)

Question	Answer	Mark
12(a)(i)	An answer that makes reference to two of the following points: • Reduced noise pollution (1) • Better dust/fume extraction (1) • Improved temperature control (1) • Cleaner/healthier (1) • Improved lighting (1) • Improved safety (1) • More space in the workplace (1) • Improved equipment design (1) • Less labour intensive (1) *Accept any other appropriate response*	**(2)**
12(a)(ii)	One mark for identifying each effect One mark for each explanation • Continuous operation (1) reducing time (1) • Modern machines (1) faster packaging and dispatch (1) • Reduced costs (1) by automating processes (1) • Instant access to data (1) allows constant monitoring (1) • Less waste produced (1) due to carefully controlled packaging techniques (1) • Deskilling the workforce (1) leads to lack of motivation (1) • Overreliance on automation (1) leads to complacency (1) *Accept any other appropriate response* *Do not accept cheaper, faster, quicker without an explanation* *No credit for repetition* *Low response (1) or two low responses (2), or detailed* *response (2) for each of the effects*	**(4)**

Question	Answer	Mark
12(b)	One mark for identifying each disadvantage One mark for each explanation One mark for each disadvantage. One mark for each explanation. • Reduced employment opportunities (1) leading to lower income (1) • Increase competition for jobs (1) meaning higher level of skills required (1) • Increased emotional stress (1) due to job insecurity (1) • Changes to working patterns (1) alterations to lifestyle (1) • Changes to work environment (1) lack of social interaction (1) *Accept any other appropriate response* *No credit for repetition* *Low response (1) or two low responses (2), or detailed* *response (2) for each of the disadvantages*	**(4)**
		(Total 10 marks)

Question	Answer	Mark
13	An answer that makes reference to any of the following points with explanation: • Productivity improvements along the supply chain • Better collaboration with suppliers • Reduced number of key suppliers • Improved accountability/traceability • Goods arrive when required • Reduced inventory • Inaccuracies in documentation reduce efficiency • Lower costs i.e. of storing raw materials/work in progress/finished goods • Less storage space needed • Less product obsolescence • Changes to work patterns • Improved motivation/workers empowered • Staff become multi-skilled • Factory reorganisation • Extra staff training *Accept any other appropriate positive/negative response* *Low response (1) or detailed response (up tp 4)* e.g. JIT saves money by reducing inventory (1), thus reducing the cost of storing of raw materials and finished goods (1) to achieve this factory reorganisation may be required (1) and extra staff training may be necessary (1).	**(4)**
		(Total 4 marks)

Question	Answer	Mark
14 **QWC i, ii, iii**	**Indicative content** Discussion may address the following impacts: Impact • Use of ICT enables a faster time to market for a wider range of stunt scooters Development • 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 • References to ICT / communications technology which reduces environmental impact Impact • Use of modern and smart materials enabling a larger variety of stunt scooters Development • Marketing of modern/smart materials with appealing characteristics encourages further consumerism • Problems associated with recycling some of the materials associated with stunt scooters • Irresponsible 'dumping' of scooters causes litter and land pollution Impact • Use of systems and control technology enabling more efficient production Development • Continuous production increases energy consumption • Quality control systems in place to monitor production more efficiently Any other appropriate responses	**(6)**
		(Total 6 marks)

Level	Mark	Descriptor
	0	No material deserving of reward
1	**1–2**	Learner identifies the impact(s) with no development OR identifies and develops one impact. 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 impact with associated developments showing some understanding of the impact. 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 impact with associated developments showing a detailed understanding of the impact, 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.
		(Total 6 marks)
Total Marks for Section B		**60**
Total Marks for the whole paper for Sections A & B		**110**

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