

Engineering (Double Award)

General Certificate of Secondary Education **J322**

General Certificate of Secondary Education(Double Award) **J344**

Mark Schemes for the Units

January 2010

J322/J344//MS/R/10J

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A622B Engineering Processes

Question Number	Syllabus Ref	Expected Answer	Mark	Rationale
1 (a)	A	1 mark for each correct link shown: Passenger Information System to Rail and Marine Smoke alarm to electronic and electrical Wheelchair to medical and pharmaceutical Windscreen to Automotive.	[4]	Examples are products from the specification and are not exhaustive. Accept others clearly from the stated sector.
(b)	A	1 mark for each of two different sectors, from 3 below 1 mark for a product from each sector eg below <u>Aerospace</u> wing rotors passenger aircraft doors. <u>Chemical & Process</u> coatings (paint, plastics) cement shampoo. <u>Computers, Communication and IT</u> portable data storage webcams radio.	[4]	
2 (a)	M	one mark each for goggles and apron.	[2]	

Question Number	Syllabus Ref	Expected Answer	Mark	Rationale
(b)	M	<p>two marks for each of two safety precautions when using a pillar drill, including how or why for example:</p> <p>Make sure you know where the safety cut off switch/isolator is (1) before you start work (1) Ensure you have been trained in using it (1) so that... Guard in place (1) so.... Tie back hair and tuck in all loose clothing (1) because... Clamp work to machine table or hold in machine vice (1) to avoid it spinning (1). Avoid contact with swarf (1) which may cut (1).</p>	[4]	
(c) (i)	F	One mark for Vernier callipers, go-no go gauge, ruler, or jig.	[1]	
(ii)	F	<p>Two marks for describing correct use: callipers or ruler – must state how to read correctly One mark for incomplete answer (eg see if it fits, measure it).</p>	[2]	
(iii)	F	<p>Two marks for a description of a quality check including what is done and why/when for example: Visual test of colour after treatment/surface finish Using jig to check alignment of parts Testing strength of a sample by applying weight.</p>	[2]	

Question Number	Syllabus Ref	Expected Answer	Mark	Rationale	
3	(a)	B	One mark for each correct statement. (i) should be different from (ii)		
	(b)	D	<p>i) ABS or Nylon is a polymer</p> <p>ii) Nylon/ABS is also a polymer</p> <p>iii) Brass is a non-ferrous metal</p> <p>iv) porcelain is a ceramic</p> <p>v) GRP (glass reinforced plastic) is a composite.</p> <p>One mark for each of two materials commonly available in sheets</p> <p>For example: aluminium alloy, glass, PVC film, aluminium laminate film, ETFE (Ethylene Tetrafluoroethylene), stainless steel, brass, copper...</p>		
	(c)	D	<p>Describe one benefit to an engineering company of using sheet materials.</p> <p>Two marks for a clearly described benefit, for example;</p> <p>Standard (off the shelf/readily available)</p> <p>handling/processing equipment can be used (1) because they are set up for the standard size</p> <p>ICT systems have pre-loaded data (1) (for CAD, costing)</p> <p>Thickness already correct for many products/designs</p> <p>Forming sheets/stamping uses less expensive equipment than injection moulding/casting</p> <p>More readily available (1) than cut to size or made to order (1).</p>	[5]	For two marks there must be expansion or detail given.
			[2]		

Question Number	Syllabus Ref	Expected Answer	Mark	Rationale
4	G	Two marks for clear description relating an appropriate technology to the use given. For example <u>When researching</u> Use search engine to find material properties on internet Look up material properties/components on a database Word process/email letters to manufacturers to find out...	[2]	For two marks there must be expansion or detail given. Internet – 0 Use google – 1.
	L	<u>Communication when designing engineered products:</u> Presentation package to show design ideas to client Spreadsheet to calculate loadings/costs/total weight Word processor to write for details of..... Email to write for.../ to attach CAD files /etc to send to.... Mobile phone to check with site surveyors.	[2]	Communication aspect must be clear for 2 marks. Email client – 1.

Question Number	Syllabus Ref	Expected Answer	Mark	Rationale
	G	<u>Ensure quality when making an engineered product:</u> Computerised sampling and testing/production monitoring Sensors are used to check dimensions and the computer controls which are passed, sent for rework or rejected Computer selects a random sample and runs electrical tests on them.	[2]	For two marks there must be expansion or detail given.
5 (a)	E	One mark for a correct example of each process: Heat treatment – (case) hardening, tempering, stress relieving, cleaning, annealing Chemical treatment – galvanising, pickling, dipping, anodising, blacking.	[2]	
(b)	K	Six marks for a full description, taken across the response, including all 3 areas. Examples below show type of information to be credited OR 1 mark for each of 6 relevant points up to 4 in each area (ie prep, programming, processing).		For 6 marks there must be at least 1 mark in each part.

Question Number	Syllabus Ref	Expected Answer	Mark	Rationale
5 (b) cont'd		<p>Machining <u>Material and equipment preparation:</u> Components for machining are delivered to the cell (1) and manually loaded in batches (1) Tools are checked. <u>Programming:</u> controlled directly from files created by CAM software packages (1) accept older tech eg punched tape/floppy disks used to transfer G-codes into the controller. <u>Processing:</u> First part loaded for machining – sensors to check positioning (1) Machined with first tool (1). Next tool in sequence loaded automatically (1) Machine checks whether tool needs replacing (1) may call operator (1) then will continue processing other parts up to that tool.</p> <p>Paint Spraying <u>Material and equipment preparation:</u> Correct coating material is loaded (powder or liquid) Spray nozzles. Masking of product where required. <u>Programming:</u> by linking the robot controller via communication cable (1) to a computer to load CAD file or codes (1). Robots can also be taught via a teach pendant, (1) a handheld control and programming unit. (1)</p>		

Question Number	Syllabus Ref	Expected Answer	Mark	Rationale
5 (b) cont'd		<p><u>Processing:</u> products are taken to the paint area suspended on harness to moving track. (1) stop at paint station (1) position checked by sensors (1) and the position adjusted (1). The spray arm is positioned for the first pass (1) then spraying begins, with the arm moving around the product. (1)</p> <p>Welding</p> <p><u>Material and equipment preparation:</u> Body panels are prepared and checked Tools are checked.</p> <p><u>Programming:</u> by linking the robot controller via communication cable (1) to a computer to load CAD file or codes (1). Robots can also be taught via a teach pendant.</p> <p><u>Processing:</u> The body panels are taken to the robot on a conveyor belt (1) and lifted into position with a mechanical grip (1). Alignment is checked by sensors (1) and the position adjusted until both parts are perfectly aligned (1). The arc weld arm is positioned for the first weld (1) then moved to each position in turn. (1)</p>		

Question Number	Syllabus Ref	Expected Answer	Mark	Rationale
5 (b) cont'd		<p>Surface mount technology <u>Material and equipment preparation:</u> Components on reels/in tubes are loaded Pcb's stacked in holders. <u>Programming:</u> Direct from CAD file. <u>Processing:</u> Solder paste is applied to all the solder pads with a stainless steel stencil (1) Pick-and-place machines remove the parts from the reels or tubes and place them on the PCB The boards are then conveyed into the reflow soldering oven. (1)</p>	[6]	
6	C	<p>Three marks for each detailed response including both function and use:</p> <p>Cam Change rotary (1) to reciprocating motion (1) used in car engines, sewing machines.</p> <p>Diode Allows current (1) to pass in one direction (1) Example to protect equipment where reverse polarity could damage components.</p> <p>Double acting cylinder Allows air to move piston (1) in or out (1) Example in pumps, steam engine.</p> <p>Rack and pinion gears convert between linear (1) and rotary motion (1) Example in Snowdon (other) railway for steep slope.</p>	[2 x 3]	<p>Uses list is not exhaustive Note: Function and use headings are to help candidates structure their response – take as a whole.</p>

Question Number	Syllabus Ref	Expected Answer	Mark	Rationale
7 (a)	D	1 mark for D.	[1]	Check question to ensure candidate understands 10 – excellent, 1 – poor.
(b)	H	Two marks for explanation showing understanding of JIT production. Examples of points Because in JIT production, materials arrive as they are needed (1). D is not readily available (1) the fact that it is not easy to store is not relevant for JIT (1). It does not have any major weaknesses. (1)	[2]	Note if response other than D given in (a) may get a response showing understanding of JIT (give credit) with incorrect statements (ignore).
(c)	M	3 marks for clear explanation, with reasoning, giving points such as: The only good feature of material D is its ease of use, so this must be very important (1), perhaps because the workforce is unskilled (1) or production cannot be automated (1). There must be a lot of space for storage. It could be a premium product made of an expensive and rare material.	[3]	Give credit to responses where examples from the data are used methodically to reach a decision.

Question Number	Syllabus Ref	Expected Answer	Mark	Rationale
*8	I	<p>Six marks for discussion QWC as below.</p> <p>QWC</p> <p>Level 1 (0-2 marks) Basic discussion showing some understanding of the impact of systems and control technology on production. Will be little, or no, use of specialist terms. Answers may be ambiguous or disorganised. Errors of spelling, punctuation and grammar may be intrusive.</p> <p>Level 2 (3-4 marks) Adequate discussion showing an understanding of the impact of systems and control technology on production. There will be some use of specialist terms, although these may not always be used appropriately. The information will be presented for the most part in a structured format. There may be occasional errors in spelling, punctuation and grammar.</p> <p>Level 3 (5-6 marks) Thorough analysis, showing a clear understanding of the impact of systems and control technology on production. Specialist terms will be used appropriately and correctly. The information will be presented in a structured format. The candidate can demonstrate the accurate use of spelling, punctuation and grammar.</p>	[6]	<p>Examples of relevant points</p> <ul style="list-style-type: none"> • The use of S&CT (mechanical controls) has enabled automation • Electronics and mechatronics brought further sophistication in automation and concurrent quality monitoring • Computer technology brings self-adjusting production systems. • All impact on consistency of quality, speed of production and reduction in reject rate. <p>List is not exhaustive</p>
		Paper mark total 60		

A624B Impact of modern technologies on engineering

Question Number		Syllabus Ref	Expected Answer	Mark	Rationale
1	(a)	A	One mark for each correct answer Aerospace – landing gear Automotive – motorcycle fairing Electrical and Electronics – Hot drinks vending machine Medical and Pharmaceutical – Mobility scooter	[4]	
1	(b)	A	For each of two products stated: One mark for a material used in the product, and one for a benefit, for example: Hot drinks vending machine shape memory alloy/nitinol (cuts off immediately temp reached) or thermochromic dye (shows when surfaces hot to touch) Landing gear advanced alloys (improved function/strength to weight ratio) Mobility scooter carbon fibre/composites for lightweight bodywork, (battery life) Motorcycle fairing Yacht navigation system	[4]	Modern/smart material should relate to product. Accept benefit of smart material stated List is not exhaustive.
2	(a)	L	Two marks for each of two benefits clearly described. For example a feature and why or how it is beneficial to a product's designer: Designs are tested as models(1) so avoid wasted prototyping(1). Calculations can be carried out on design (1) so can optimise designs(1) to use less material (1). Designs can be amended without redrawing (1), saving effort/time Designs can be emailed (1) for feedback (1) reducing turnaround time (1)	[2+2]	Amplification needed for second mark

Question Number		Syllabus Ref	Expected Answer	Mark	Rationale
2	(b)	L	Two marks for a clear description, for example: Customised products can be made by amending basic CAD files (1) and sending direct to CAM. (1) Basic file (1) is loaded then customising options selected (1). Prepare and load keyring blanks/other example (1) load customised designs (1) and run. Input customer requirements(1) from internet order(1) then process design(1)	[2]	For the second mark the customisation aspect must be clear.
2	(c)	I	Two marks for a clear description of a benefit to end users, for example: Product is produced accurately (1) – no human error (1) so to exact requirements (1). Expensive tooling up (1) is not required (1) because it runs from CAD file so cost to end user kept down.	[2]	Amplification needed for second mark
3		H	No marks for product, but subsequent marks should relate to the product stated. Production process. 1 mark for controllable process	[1]	
		H	Input 2 marks sensor type(1), what is being measured(1)	[2]	
		H	Output 1 mark. eg power to heater on/off, signal to main computer, warning light.	[1]	

Question Number		Syllabus Ref	Expected Answer	Mark	Rationale
3		H	<p>Explanation of how control system works.</p> <p>4 marks for a coherent account, describing the steps in the control process, drawing together the control blocks.</p> <p>Examples of credit worthy points: as the packets move along the conveyor (1), they pass over the load cell and the weight is compared(1) to the acceptable range(1) if a packet is not in range, a signal is sent to operate a moving arm(1) which sweeps it off the belt(1)</p>	[4]	
4	(a)	B	<p>Two marks for each feature described in a stated product. Relevant point + reason/amplification, to a maximum of 6.</p> <p>Examples below are for a jug kettle</p> <p>Use of recyclable materials – Injection moulded body(1) can be remoulded(1)</p> <p>Design for disassembly – Clips join body parts (1), separate power module(1) so can separate parts made of different materials(1)</p> <p>Reduced product energy consumption – Volume indicator (1)so don't heat more than need(1), Insulated outer wall (1) to reduce heat loss(1), ceramic disc heat element (1) – efficient design/does not scale up (1).</p>	[6]	<p>Amplification or reason is needed for second mark.</p> <p>Look across response for credit.</p>
4	(b)	B	<p>Two marks for a clear description, including, for example:</p> <p>At each stage of the design process (1) consider materials (1) and manufacturing methods (1) checking whether any of the options considered could potentially cause hazardous waste (1) select materials(1) that do not give rise to HW when they were produced(1) or when worked. Consider disposal methods (1)/potential for recycling.</p>	[2]	<p>Amplification needed for second mark.</p>

Question Number		Syllabus Ref	Expected Answer	Mark	Rationale	
5		F M	In each of 3 parts, two marks for a clear description of what needs to be considered with how or why. No credit for repeated points. For example: <u>Material removal</u> : eg Risks from loose material (eg swarf) Or moving machinery PPE/guards	[2]	Amplification needed for second mark.	
		FM	<u>Heat treatment</u> Protection from burns/scalds will hazardous fumes/waste be formed. PPE/guards	[2]	Amplification needed for second mark.	
		FM	<u>Shaping and manipulation</u> Energy used by process/alternatives will hazardous dust/fumes be formed. PPE/guards	[2]	Amplification needed for second mark.	
6	(a)	(i)	H	For each part, two marks for a clear description of a benefit. Marketing: Results of market research can be stored and analysed using ICT <ul style="list-style-type: none"> so that products can be made/priced/modified to suit target market. mail shots and marketing campaigns can be targeted to a specific group of buyers 	[2]	Amplification needed for second mark.

Question Number			Syllabus Ref	Expected Answer	Mark	Rationale
6	(a)	(ii)	H	Packaging Quantities can be accurately measured out using control technology Modern packaging materials prevent/slow down product deterioration. Barcodes/batch numbers can be stamped using controlled printing technology so that products can be tracked/traced.	[2]	Amplification needed for second mark.
6	(a)	(iii)	H	Dispatching Products can be bar-coded and matched to orders to ensure sent to correct destination Delivery routes can be calculated and planned using ICT Conveyor belts deliver packages to loading dock – saving physical effort.	[2]	Amplification needed for second mark.
6	(b)		H	Two marks for describing an issue to be addressed. the cost vs. benefits, or clear potential problem: For example Whether employees will need to be laid off How much disruption to production when introducing Whether quality/consistency will be improved Whether any of the benefits in (a) above will be realised	[2]	
7	(a)		I	One mark for each correct response: False True False False	[4]	

Question Number		Syllabus Ref	Expected Answer	Mark	Rationale
7	(b)	B	Two marks for description including a named product that gives rise to chemical emissions (1) and the type of contamination(1):	[2]	
			(i) <u>Distribution</u> eg Road/rail/ – exhaust gases from engine.		
	(ii)		<u>Normal use</u> eg motor vehicle, central heating system (products of combustion) NOT at the end of the product's useful life, or unintended use (eg from exploding aerosols in fires etc)	[2]	
8*		D	Six marks for discussion as below. Examples of points (<u>specialist terms</u>): contribute to <u>single fixing policy</u> – spare components can be used in other products so no unusable extras <u>to dispose of</u> minimises waste, reduces <u>landfill/disposal</u> with examples Readily available so transport and delivery less <u>harmful to environment</u> When product at end of life, components can be reused, saving raw materials Company resources – workforce facility Level 1 (0-2 marks) Basic discussion showing some understanding of the implications of using bought-in components in engineered products. There will be little, or no, use of specialist terms. Answers may be ambiguous or disorganised. Errors of spelling, punctuation and grammar may be intrusive.	[6]	

Question Number	Syllabus Ref	Expected Answer	Mark	Rationale
8*		<p>Level 2 (3-4 marks) Adequate discussion showing an understanding of the implications of using bought-in components in engineered products. There will be some use of specialist terms, although these may not always be used appropriately. The information will be presented for the most part in a structured format. There may be occasional errors in spelling, punctuation and grammar.</p> <p>Level 3 (5-6 marks) Thorough analysis, showing a clear understanding of the implications of using bought-in components in engineered products. Specialist terms will be used appropriately and correctly. The information will be presented in a structured format. The candidate can demonstrate the accurate use of spelling, punctuation and grammar.</p>		

Grade Thresholds

**General Certificate of Secondary Education
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There were no entries for this session.

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