

General Certificate of Secondary
Education
Engineering 48501

Mark scheme

4850
June 2015

Version V1: Final Mark Scheme

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

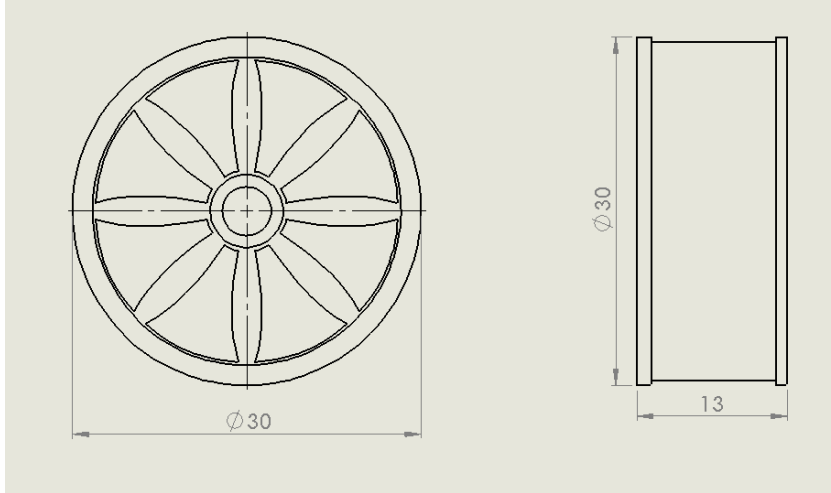
It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Question	Part	Sub Part	Marking Guidance	Mark	Comment
1	a		<p>Figure 1 shows the front of a radio controlled car. Describe the function of each labelled part.</p> <p>Tyre - answers such as:</p> <ul style="list-style-type: none"> • Traction/grip (1mark) • surface contact/different surfaces (1mark) • provide cushioning/absorb Impact (1mark) • grip which allows the vehicle to accelerate/corner/brake (2 marks) <p>Suspension unit - answers such as:</p> <ul style="list-style-type: none"> • absorb impacts (1mark) • assist steering, acceleration & braking (1mark) • maintain contact over uneven terrain or surfaces which increases the level of grip/handling response (2 marks) • prevent damage to the car (1 mark) <p>Bumper – answers such as:</p> <ul style="list-style-type: none"> • increase stiffness to the front of the car (1 mark) • protect the steering/suspension components or bodywork from damage when crashing/driving over uneven/loose terrain (2 marks) <p>[1 mark for each correct point, 2nd mark for description. Max 6]</p>	6	

Question	Part	Sub Part	Marking Guidance	Mark	Comment
1	b	i	<p>The bodywork used on radio controlled vehicles can be made using the vacuum forming process.</p> <p>Name a suitable polymer for vacuum forming.</p> <p>Answers such as:</p> <p>HIPS/Polystyrene PVC ABS Polycarbonate Polypropylene Acrylic (other suitable thermoplastics)</p> <p style="text-align: right;">[Max 1 mark]</p>	1	
1	b	ii	<p>Describe why the polymer you have named in part (b)(i) is suitable for vacuum forming.</p> <p>Accept answers such as:</p> <p>The material becomes softer when heated Takes on the shape of the pattern Hardens when cooled Retains its original material properties Cost effective Easily shaped/trimmed before and after forming Can be re-heated and reformed if unsuccessful Thermoplastic</p> <p style="text-align: right;">[1 mark for each point. Max 2 marks]</p>	2	Do not penalise if 1bi is answered incorrectly but correct response for a thermoplastic is given in 1bii

Question	Part	Sub Part	Marking Guidance	Mark	Comment
1	b	iii	<p>Using notes and/or sketches, describe the vacuum forming process.</p> <p>Correctly annotated sketch or description of process acceptable. 1 mark for each of the following either labelled or written.</p> <ul style="list-style-type: none"> • Mould/pattern placed in position • Load material onto the machine/sheet of material • Heat applied • Air pressurised to raise/balloon the thermoplastic sheet • Raising of Mould/pattern applied to sheet • Vacuum created/Air sucked out • Allowed to cool • Removed and trimmed <p style="text-align: right;">[1 mark for each point. Max 6]</p>	6	<p>[TOTAL FOR SECTION A 15 MARKS]</p>

Question	Part	Sub Part	Marking Guidance	Mark	Comment
2	a		<p>Figure 3 shows an isometric view of a wheel used on a radio controlled car. The Wheel is 30mm in diameter and 13mm wide. Using standard drawing conventions, add the dimensions to the drawing below.</p>  <p>Use graphic above for reference only – not exhaustively dimensioned</p> <p>1 mark each for dimension in correct place (max 2)</p> <p>1 mark each for correct convention:</p> <ul style="list-style-type: none">• Solid arrow heads inside leader lines• dimension centred and above line• correct use of diameter symbol (max 2)	4	Do not award 2 marks if same convention used twice.

			[Max 4 marks]		
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Question	Part	Sub Part	Marking Guidance	Mark	Comment
2	b	i	<p>Engineers use scale drawings. Explain what is meant by the term ‘scale drawing’.</p> <p>2 marks for correct description which includes:</p> <p>Comment on change in size (1) referring to ratio or proportion (1 mark)</p> <p style="text-align: right;">[Max 2]</p>	2	
2	b	ii	<p>An object is drawn 20 mm wide on a drawing which is scaled at 1:5. How wide is the actual object? Tick the correct answer.</p> <p>1 mark for correct answer including units.</p> <ul style="list-style-type: none"> • Automark 100 mm <p style="text-align: right;">[Max 1]</p>	1	
2	c		<p>When designing new products engineers often use Computer Aided Design (CAD) software. Explain the benefits to the engineer of using CAD instead of drawing by hand.</p> <p>Accept answers such as:</p> <ul style="list-style-type: none"> • Greater degree of accuracy • Easier to rectify mistakes • Computer generated drawings can be easily changed/edited • Computer generated drawings can be emailed/electronically transferred easily • CAD image can be manipulated/modelled to show different views • Designs can be digitally stored • CAD files can be sent to CNC manufacture 	3	Do not accept “easy to use”

			<ul style="list-style-type: none"> • Models can be tested • Easier to create complex designs • Allows collaborative working • Import parts/components from libraries • Accept other relevant answers <p style="text-align: center;">[1 mark for each correct statement. Max 3 marks]</p>		
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Question	Part	Sub Part	Marking Guidance	Mark	Comment
3			<p>Radio controlled toys similar to the one shown in Figure 5 are often fitted with decorative vinyl graphics. Describe how the vinyl graphics could be produced using Computer Numerical Control (CNC) equipment.</p> <p>Description of process such as:</p> <p>Graphics/images designed on computer Checks carried out on design Simulation checks carried out Post processing carried out G-Code produced by software Sent to CNC cutter such as plotter/laser cutter Adjust Settings Material loaded into device Vinyl sheets/roll referred to in context Graphics printed Graphics cut Remove waste material</p> <p style="text-align: right;">[1 mark for each point. Max 6]</p>	6	

Question	Part	Sub Part	Marking Guidance	Mark	Comment
4			<p>Radio controlled handsets are made in different shapes and designs as shown in Figures 6 and 7 below.</p> <p>A client asks a designer to create a new handset.</p> <p>Suggest three user requirements a designer would need to consider before producing a specification for the handset.</p> <p>For each user requirement, state a reason why the designer would need the information.</p> <p>Accept the following user requirements:</p> <ul style="list-style-type: none"> • Ergonomics/shape • anthropometrics • material choice • cost • size • aesthetics • the type of vehicle intending to be controlled • Style of controller • the number of channels required • the power source • End user • Signal frequency <p style="text-align: right;">[1 mark for each point. (up to 3 marks)]</p> <p>Then 1 mark for each relevant reason:</p> <p>For instance - Item Choice of material</p> <p>Reason: related to cost/aesthetics/manufacturing process</p> <p style="text-align: right;">[1 mark for each reason (up to 3 marks)]</p>	6	<p>Do not award 2 marks where reasons are duplicated/repeated.</p> <p>If requirement is incorrect then a mark can still be awarded for a valid reason.</p>

			[Max 6 marks]		
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Question	Part	Sub Part	Marking Guidance	Mark	Comment
5	a		<p>A wide variety of engineered products are manufactured using moulds.</p> <p>Give three ways that the block shown in Figure 8 would need to be modified to be used for casting a product.</p> <ul style="list-style-type: none"> • rounded edges • smooth finish • draft angle • allow for shrinkage/oversize • knock out/ejector pin • Addition of sprue/runner/funnel/channel for material to enter the mould • Made from suitable heatproof material • Addition of a lid/second half • Location pins • Add riser/vent/air holes • Lubricate <p style="text-align: right;">[1 mark for each correct label. Max 3 marks]</p>	3	
5	b		<p>List three benefits of using moulds to manufacture products.</p> <ul style="list-style-type: none"> • speed of production • lower manufacturing costs • allows mass/batch production • consistency • quality of finish 	3	

			<ul style="list-style-type: none">• repeatability• accuracy <p>[1 mark for each correct statement. Max 3 marks]</p>		
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Question	Part	Sub Part	Marking Guidance	Mark	Comment
5	c		<p>Some moulds are manufactured using a milling machine. Name three health and safety hazards when using a milling machine. For each one, suggest a safety measure.</p> <p>2 marks available for each hazard and relevant safety measure.</p> <p>Answers such as:</p> <p>Hazards:</p> <ul style="list-style-type: none"> • swarf/debris flying out/away from the work piece • sharp edges/trapping hands/fingers • loose hair/clothing/jewellery • work piece/cutting tool/chuck key coming loose • lubricant/cutting fluid as an irritant • other relevant hazards <p>Safety measures:</p> <ul style="list-style-type: none"> • wear safety goggles/correct PPE • ensure that the machine safety guard is in place • tie long hair back/remove jewellery • ensure that safety checks are carried out before starting the machine • double check tightening of the work piece before and periodically during machining • other relevant safety measures <p>[1 mark for each correct hazard and 1 mark for associated protective measure. Max 6 marks]</p>	6	

Question	Part	Sub Part	Marking Guidance	Mark	Comment
6	a		<p>Radio controlled cars are one type of electrical product. Copper is often used in electrical products. Explain why copper is a suitable material for use in electrical products.</p> <p>Accept:</p> <ul style="list-style-type: none"> • ductile (1) so can be drawn into long wires (1) • low electrical resistance so allows current to flow • high electrical conductivity so enables current to flow effectively • can be plated (1) which allows it to be used in PCB manufacture (1) • malleable (1) which allows it to be shaped/formed (1) • Recyclable or reusable <p>[1 mark for property and 1 mark for explanation as to suitability. Max 4 marks]</p>	4	Do not accept durable in this context
6	b	i	<p>Radio controlled cars can be fitted with working Light Emitting Diode (LED) headlights. A computer program has been used to design the circuit below. In the spaces below, identify the electrical components labelled A to D on the circuit diagram.</p> <p>A - Switch B - Resistor C – LED D – Battery/cell 1 mark each</p> <p style="text-align: right;">[Max 4 marks]</p>	4	

Question	Part	Sub Part	Marking Guidance	Mark	Comment
6	b	ii	<p>Explain the benefits of using a computer program to design the circuit.</p> <p>1 mark for each correctly made point.</p> <p>Allows simulation (1) of a circuit which saves money (1), adjustments/amendments can be made (1). Circuit can be shown to client (1) without manufacture costs being incurred (1) Different configurations can be tried (1) PCB layout can be automatically generated (1) microcontroller program can be created (1) and edited (1) Allows access to components which you don't have in stock (1) Can be sent to CNC (1)</p> <p style="text-align: right;">[Max 3 marks]</p>	3	
6	c		<p>Describe how to connect electrical components together using solder.</p> <p>Soldering:</p> <ul style="list-style-type: none"> • bare wires tinned • components placed in contact with each other/placed on PCB • heat applied/use of soldering iron • solder introduced. • heatshrink used to insulate/strengthen connection <p style="text-align: right;">[1 mark per correct step. Max 3 marks]</p>	3	Maximum marks should only be awarded where processes are in sequence.

Question	Part	Sub Part	Marking Guidance	Mark	Comment
7			<p>Computer numerical control (CNC) and chemical etching are two methods of producing a Printed Circuit Board (PCB). Choose one of the methods above. Give three advantages and three disadvantages of using the method you have chosen to manufacture a PCB.</p> <p>1 mark for each of the following:</p> <p>Etching</p> <p>Advantages</p> <ul style="list-style-type: none"> • Suitable for batch/mass production • Faster rate of production in large volumes • Low setup cost • No need for PC/software • Circuit can be hand drawn <p>Disadvantages</p> <ul style="list-style-type: none"> • Chemicals are harmful to environment/difficult to dispose of • Health and safety risk from chemicals • Health and safety risk from UV exposure • Over/under exposure to UV or chemicals can result in failed boards/faulty circuits • Several steps/processes • Training/skill required • Mounting and component holes have to be drilled separately <p>Any other relevant point.</p>	6	

			<p>CNC/Routing Advantages</p> <ul style="list-style-type: none">• High degree of precision/accuracy• Complex circuits are more feasible• Repeatable for batch/mass production• Mounting holes and component holes can be drilled by CNC at the same time as machining the tracks• No hazardous chemicals <p>Disadvantages</p> <ul style="list-style-type: none">• High setup cost• Training required in software/CNC machinery operation• Health and safety risk from moving parts• Equipment/machinery maintenance costs <p>Any other relevant point.</p> <p>[1 mark per relevant point made. Max 6 marks]</p>		
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Question	Part	Sub Part	Marking Guidance	Mark	Comment
8			<p>Radio controlled vehicles are usually powered by batteries. Discuss the environmental effects of disposing of batteries. You will be assessed on Quality of Written Communication (QWC) in the question.</p> <ul style="list-style-type: none"> • waste going to landfill • improper disposal of batteries leads to chemicals being released into the ground • contamination of ground/groundwater • harmful to wildlife/ecological balance • the use of recycling stations to allow recycling of chemical/material components. • issues related to hazardous chemicals <p>Marks awarded as follows:</p> <ul style="list-style-type: none"> • No answer worthy of credit (0 marks) • Simple statements based on 1 or more of the issues outlined above. Candidate will tend to respond superficially with little detail given. Response is structured poorly with little or no use of Engineering terminology with numerous errors in grammar, punctuation and spelling. (1-2 marks) • Sound understanding of the issues with candidate commenting on 2 or more issues above. Response is well structured with good use of appropriate Engineering terminology. Candidate shows a good grasp of grammar, punctuation and spelling. (3-4 marks) • Excellent understanding of the issues above. Candidate comments in detail on 3 or more of the issues above. Response shows excellent use of engineering terminology and is well structured. Candidate displays high levels of 	6	<p>Response must be technically accurate to be awarded 6 marks</p> <p style="text-align: center;">[TOTAL FOR SECTION B 60 MARKS]</p> <p style="text-align: center;">[TOTAL FOR QUESTION PAPER 75 MARKS]</p>

			<p>grammar, punctuation and spelling to give a technically accurate response. If structured using bullet points then detailed sentences must be employed. (5-6 marks)</p> <p>Up to 3 marks available for command of English.</p> <ul style="list-style-type: none">• some attempt made (1)• logical, structured answer possibly with some punctuation and grammar inaccuracies. (2)• technically correct and well punctuated in good flowing english. (3) <p style="text-align: right;">[Max 6 marks]</p>		
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