

Mark Scheme (Results)

June 2012

GCE Engineering
6931 Paper 01

Engineering Materials, Processes and
Techniques

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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 Number	Answer	Mark															
1	<p>1 mark for each appropriate response No repetition Allow 1 follow through mark for significant property if correct answer provided for an incorrectly identified specific material.</p> <table border="1" data-bbox="373 490 1137 947"> <thead> <tr> <th data-bbox="373 490 553 562">Class of Material</th> <th data-bbox="553 490 740 562">Specific material</th> <th data-bbox="740 490 1137 562">Significant property</th> </tr> </thead> <tbody> <tr> <td data-bbox="373 562 553 674">Metal</td> <td data-bbox="553 562 740 674">Aluminium Copper</td> <td data-bbox="740 562 1137 674">low density, ductile, malleable, good conductivity</td> </tr> <tr> <td data-bbox="373 674 553 781">Alloy</td> <td data-bbox="553 674 740 781">Stainless steel Brass</td> <td data-bbox="740 674 1137 781">hard, corrosion resistant</td> </tr> <tr> <td data-bbox="373 781 553 853">Elastomer</td> <td data-bbox="553 781 740 853">Rubber Neoprene</td> <td data-bbox="740 781 1137 853">insulator, elasticity, flexible</td> </tr> <tr> <td data-bbox="373 853 553 947">Polymer</td> <td data-bbox="553 853 740 947">PVC ABS</td> <td data-bbox="740 853 1137 947">lightweight, insulator, flexibility</td> </tr> </tbody> </table>	Class of Material	Specific material	Significant property	Metal	Aluminium Copper	low density, ductile, malleable, good conductivity	Alloy	Stainless steel Brass	hard, corrosion resistant	Elastomer	Rubber Neoprene	insulator, elasticity, flexible	Polymer	PVC ABS	lightweight, insulator, flexibility	(8)
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2	<p>1 mark for each appropriate response No repetition Allow 1 follow through mark for precaution/control measure if correct answer provided for an incorrectly identified hazard.</p> <table border="1" data-bbox="371 562 1123 1391"> <thead> <tr> <th data-bbox="371 562 601 633">Process</th> <th data-bbox="601 562 839 633">Hazard</th> <th data-bbox="839 562 1123 633">Precaution/control measure</th> </tr> </thead> <tbody> <tr> <td data-bbox="371 633 601 779">Injection moulding</td> <td data-bbox="601 633 839 779">trapped limbs, fumes from release agent</td> <td data-bbox="839 633 1123 779">guards on machine, good ventilation</td> </tr> <tr> <td data-bbox="371 779 601 1028">Cyanoacrylates adhesive bonding</td> <td data-bbox="601 779 839 1028">gluing fingers together, contact with eye/skin, fumes, chemical burns</td> <td data-bbox="839 779 1123 1028">avoid skin contact, safety glasses</td> </tr> <tr> <td data-bbox="371 1028 601 1137">Metal pressing</td> <td data-bbox="601 1028 839 1137">sharp edges, moving parts, trapped limbs</td> <td data-bbox="839 1028 1123 1137">guards on machine, wear gloves</td> </tr> <tr> <td data-bbox="371 1137 601 1391">Oxyacetylene welding</td> <td data-bbox="601 1137 839 1391">danger of burning from flame/sparking, glare, danger of work falling over</td> <td data-bbox="839 1137 1123 1391">wear welding goggles, wear gloves, secure work, safety mask</td> </tr> </tbody> </table>	Process	Hazard	Precaution/control measure	Injection moulding	trapped limbs, fumes from release agent	guards on machine, good ventilation	Cyanoacrylates adhesive bonding	gluing fingers together, contact with eye/skin, fumes, chemical burns	avoid skin contact, safety glasses	Metal pressing	sharp edges, moving parts, trapped limbs	guards on machine, wear gloves	Oxyacetylene welding	danger of burning from flame/sparking, glare, danger of work falling over	wear welding goggles, wear gloves, secure work, safety mask	(8)
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Question Number	Answer	Mark
3(a)(i)	1 mark for identification of material <ul style="list-style-type: none"> • Copper (1) 	(1)

Question Number	Answer	Mark
3(a)(ii)	Up to 2 marks for explanation No repetitions <ul style="list-style-type: none"> • has the least resistivity (1) • conducts effectively (1) • ductile (1) • enables it to be drawn into a fine wire (1) • high tensile strength (1) <p>If answer in 3(a)(i) is incorrect, maximum 1 mark can be awarded for providing a correct answer appropriate to copper</p>	(2)

Question Number	Answer	Mark
3(b)(i)	1 mark for identification of material <ul style="list-style-type: none"> • Urea formaldehyde (1) 	(1)

Question Number	Answer	Mark
3(b)(ii)	Up to 2 marks for explanation No repetition <ul style="list-style-type: none"> • high resistivity (1) • good insulation properties (1) • protects from electric shocks (1) • low thermal conductivity (1) • will not get too hot (1) <p>If answer in 3(b)(i) is incorrect, maximum 1 mark can be awarded for providing a correct answer appropriate to urea formaldehyde</p>	(2)

Question Number	Answer	Mark
3(c)(i)	1 mark for identification of material <ul style="list-style-type: none"> • Brass (1) 	(1)

Question Number	Answer	Mark
3(c)(ii)	<p>Up to 2 marks for explanation No repetition</p> <ul style="list-style-type: none"> • good tensile strength (1) • retains its shape (1) • low resistivity (1) • conducts effectively (1) • will not corrode (1) <p>If answer in 3(c)(i) is incorrect, maximum 1 mark can be awarded for providing a correct answer appropriate to brass</p>	(2)

Question Number	Answer	Mark
3(d)(i)	<p>1 mark for identification of material</p> <ul style="list-style-type: none"> • High impact polystyrene (1) 	(1)

Question Number	Answer	Mark
3(d)(ii)	<p>Up to 2 marks for explanation No repetition</p> <ul style="list-style-type: none"> • low density (1) • lightweight (1) • can be produced in various colours for aesthetic reasons (1) • easy to injection mould (1) • can be mass produced (1) • low electrical conductivity (1) • low thermal conductivity (1) <p>If answer in 3(d)(i) is incorrect, maximum 1 mark can be awarded for providing a correct answer appropriate to high impact polystyrene</p>	(2)

Question Number	Answer	Mark
4(a)(i)	strip cable end (1) position sleeve of lug on cable end (1) set crimping tool (or press) to correct size (1) apply pressure (1)	(3)

Question Number	Answer	Mark
4(a)(ii)	strip cable end (1) tin cable end (1) apply flux (1) fit lug to cable end (1) apply heat(1) apply solder (1)	(3)

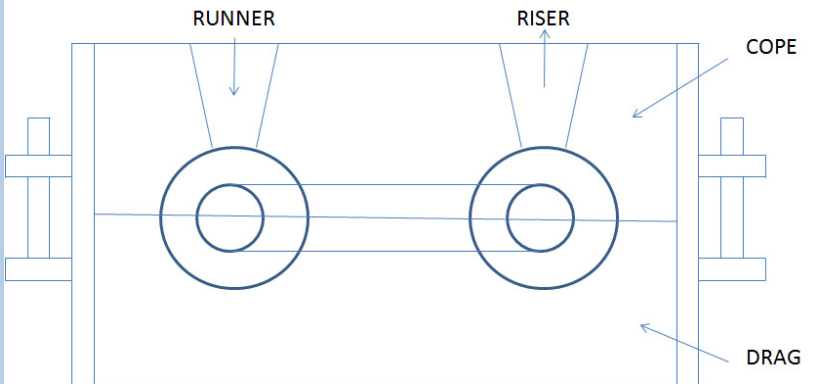
Question Number	Answer	Mark
4(b)	1 mark for each benefit <ul style="list-style-type: none"> • guaranteed better connection • better conductivity • better mechanical strength • less chance of disconnection • longevity 	(2)

Question Number	Answer	Mark
5(a)(i)	1 mark for identification of purpose Increase resistance to wear (1)	
5(a)(ii)	Up to 3 marks for process <ul style="list-style-type: none"> • heat (1) • until it is red/critical temperature (1) • quench (1) • quick cooling process (1) <p>If identification of purpose is incorrect, maximum 2 marks can be awarded for providing the correct process appropriate to hardening carbon steel</p>	
		(4)

Question Number	Answer	Mark
5(b)(i)	1 mark for identification of purpose To increase toughness/reduce brittleness (1)	
5(b)(ii)	Up to 3 marks for process <ul style="list-style-type: none"> • heat (1) • until oxides form (1) • quench when appropriate oxide colour is visible (1) <p>If identification of purpose is incorrect, maximum 2 marks can be awarded for providing the correct process appropriate to tempering carbon steel</p>	
		(4)

Question Number	Answer	Mark
5(c)(i)	1 mark for identification of purpose To soften/remove internal stresses/malleable (1)	
5(c)(ii)	Up to 3 marks for process <ul style="list-style-type: none"> • heat (1) • until it is red/critical temperature (1) • allow to cool (1) <p>If identification of purpose is incorrect, maximum 2 marks can be awarded for providing the correct process appropriate to annealing carbon steel</p>	
		(4)

Question Number	Answer	Mark
6(a)	<p>Any three from, in appropriate order:</p> <ul style="list-style-type: none"> • Manufactured from wood/MDF (1) • Pattern cut and shaped slightly larger than required (1) • Cut down the centre (1) • Allow for thickness of cut (1) • Add location pins (1) • Seal and paint (1) <p>Any other suitable response</p>	(3)

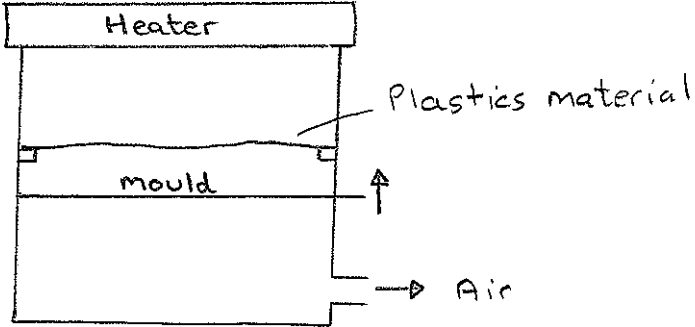
Question Number	Answer	Mark
6(b)	 <p>'cope' must be labelled correctly on top and 'drag' must be labelled correctly on bottom</p>	(4)

Question Number	Answer	Mark
6(c)	<p>Any four from, in appropriate order:</p> <ul style="list-style-type: none"> • Pattern appropriately placed in cope and drag (1) • Sprinkled with parting powder (1) • Sprue pins to create runner and riser (1) • Fill the flask with sand (1) • Create gates (1) • Remove pattern and sprue pins (1) • Pour metal and allow to cool (1) • Remove casting and fettle (1) <p>Any other suitable response in appropriate order.</p>	(4)

Question Number	Answer	Mark
6(d)	Make the pattern oversize	(1)

Question Number	Answer	Mark
6(e)	Any two of: <ul style="list-style-type: none"> • Accuracy (1) • Speed of production (1) • Complexity of shape (1) • Self finishing (1) • Smoother finish on die-casting (1) • Die can be used repeatedly (1) • Economies of scale (1) • Die-casting less labour intensive (1) 	(2)

Question Number	Answer	Mark
7(a)(i)	Maximum 1 mark for any one of: <ul style="list-style-type: none"> • ABS (1) • Acrylic (1) • Polystyrene (1) • PVC (1) • Polythene (1) Do not accept 'thermoplastic' or 'low impact polystyrene'	
7(a)(ii)	Max 2 marks for appropriate explanation <ul style="list-style-type: none"> • Low melting/softening point (1) so can be easily moulded (1) • Rigid (1) to secure/protect CD player once packaged (1) 	(3)

Question Number	Answer	Mark
7(b)	<p>Max 6 marks for combination of notes and sketches, Max 4 marks for either just notes or just sketches</p> <ul style="list-style-type: none"> • Platen placed into vacuum chamber (1) • Plastic sheet clamped in position (1) • Heated (1) • Platen is raised (1) • Switch on compressor/vacuum applied (1) • Moulding cooled (1) • Removed and trimmed (1) 	(6)

Question Number	Answer	Mark
8	<p>Marks will be awarded for design features relating to those below.</p> <ul style="list-style-type: none"> • Method of extending forward from and back to the wall (2) fully workable (2) partially workable (1) • Method of swinging from side to side through 120° (2) fully workable (2) partially workable (1) • Method of locking the angle once set (2) fully workable (2) partially workable (1) • Method of securing the CD player safely on the device (2) fully workable (2) partially workable (1) • Reason for choosing the material used (1) appropriate reason (1) <p>An example of an appropriate design solution is shown below.</p> <p><i>Two pivoted arms (1) can fold in towards the wall and extend to their full length because of the simple plain bearing joints (1).</i></p> <p><i>The joints allow both arms to swing (1) and their side to side movement is more than 120° especially when combined (1).</i></p> <p><i>Two knurled wheel-nuts are turned on threaded spindles (1) to lock the swing arms in place when the angle is set (1).</i></p> <p><i>A threaded rod is fixed to the bottom of the bracket and moves in slots on the support plate. When the CD player is in place, the brackets are moved to fit over the feet of the CD player (1) and are tightened into place by a thumb screw to secure the CD player (1).</i></p> <p><i>Aluminium is the material chosen for the design because it is lightweight and has a good strength to weight ratio. (1)</i></p>	(10)

Question Number		Indicative Content
*9		<p>Aluminium has the benefits of being lightweight (1), and corrosion resistant (1). It can also easily be formed into a variety of shapes (1).</p> <p>It is however expensive (1) and is an electrical conductor (1). These are not major drawbacks but both contribute to higher costs than using ABS.</p> <p>ABS has the benefits of being tough (1), hard (1), lightweight (1) inexpensive (1) It is also an electrical insulator (1). It is however flammable but only under extreme and unlikely conditions (1).</p> <p>On balance ABS is the more appropriate material but for more expensive versions aluminium would be better.</p>
Level	Mark	Descriptor
	0	No rewardable material
1	1-3	Some benefits and limitations of materials listed.
2	4-6	Most benefits and limitations in well constructed sentences.
3	7-9	As level 2 with a balanced comparison and a conclusion.

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