edexcel
advancing learning, changing lives

Mark Scheme (Final)
Summer 2008

GCE

GCE Engineering (6931/01)

Edexcel Limited. Registered in England and Wales No. 4496750
Registered Office: One90 High Holborn, London WC1V 7BH

A PEARSON COMPANY

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.

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>1</td><td>Allow 1 mark for each correct box

<table>
<tr><th>Hazards</th><th>Risk</th><th>Precaution/Control Measure</th></tr>
<tr><td>spot welding</td><td>• Sparks into eyes
• cuts
• electric shock
• burns</td><td>• Goggles/face shield
• wear gloves
• ensure welder is insulation tested</td></tr>
<tr><td>use of epoxy adhesives</td><td>• Skin irritations
• fumes</td><td>• Wear gloves/protect hands
• ventilation</td></tr>
<tr><td>soldering</td><td>• Fumes into lungs
• skin burns</td><td>• Fume extraction
• Place iron in stand when not in use</td></tr>
<tr><td>milling</td><td>• Small pieces of swarf flying off
• workpiece flying off
• tool coming off</td><td>• Guard and/or goggles
• clamp workpiece
• clamp tool</td></tr>
</table>

Allow suitable alternative answers</td><td>(8)</td></tr>
</table>

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>2</td><td>1 mark for each correct box.

<table>
<tr><th>Class of material</th><th>Specific material</th><th>Significant property of material</th></tr>
<tr><td>Non-ferrous metal</td><td>• Brass
• Copper
• Aluminium
• Zinc
• Tungsten
• Duralumin
• Tin</td><td>Non –magnetic, good conductor</td></tr>
<tr><td>Ferrous metal</td><td>• Any Steel
• cast iron</td><td>High melting point or high tensile strength</td></tr>
<tr><td>Composite</td><td>• Rubber
• carbon Fibre</td><td>• Flexible
• Compressive strength</td></tr>
<tr><td>Ceramic</td><td>• Porcelain
• borosilicate glass/pyrex</td><td>Brittle or high melting point</td></tr>
</table>

Allow suitable alternative answers</td><td>(8)</td></tr>
</table>

If specific material is incorrect, 1 mark can be allowed for an appropriate property of the material.

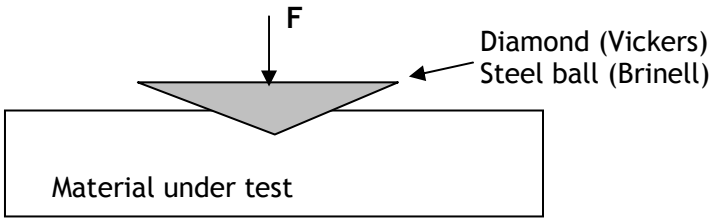
Question Number	Answer	Mark
3(a)(i)	Galvanising • The steel (1) should be chemically cleaned (1) (allow pickling) in a caustic solution (1) first. Steel is then dipped into molten zinc (1). *Any 3 points*	(3)
3(a)(ii)	Electroplating • The metal (1) should be chemically cleaned (1). The metal is put into a chemical bath (1) containing salts of the metal to be deposited. A dc (1) electric current is passed (1) through the bath, with the object to be coated as an (1) electrode. *Any 3 points*	(3)
3(b)	Reason • To prevent corrosion/rusting/oxidation of the metal • Aesthetic reasons Any 1 point	(1)

Question Number	Answer	Mark
4(a)(i)	• Any steel • Stainless Steel • Carbon Fibre	(1)
4(a)(ii)	• Resist Oxidisation • High tensile strength (not "strong") • Inexpensive • Aesthetic (Any 2)	(2)
4(b)(i)	• Perspex • Glass • Acrylic • Polycarbonate	(2)
4(b)(ii)	• Glass has disadvantage of being brittle (1) but advantage of being scratch proof (1) • Acrylic has advantage of being easier to manufacture (1) and of being a lower cost (1) *If part (b)(i) is incorrect, but the follow through in (b)(ii) is appropriate for the learner's materials, marks must be allowed for part (b)(ii).*	(4)

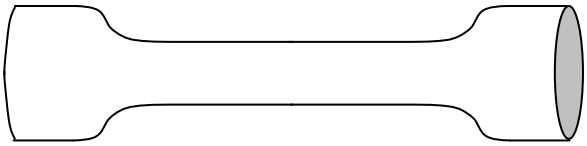
Question Number	Answer	Mark
5(a)(i)	Material • Low carbon steel (1) OR • Aluminium alloy Reason • Low carbon steel - high tensile strength (1), low cost (1). • Aluminium alloy - high tensile strength (1), light weight (1) and is corrosion resistant (1).	(3)
5(a)(ii)	Material • Copper (1) Reason • Lowest electrical resistivity and flexible for wiring (2).	(3)
5(a)(iii)	Material • Aluminium alloy (1) Reason • Lowest density, but has suitably high tensile strength (2).	(3)
5(a)(iv)	Material • Low carbon steel (1) Reason • Lowest relative cost (1), easily formed (1)	(3)
5(b)(i)	• Aluminium alloy	(1)
5(b)(ii)	• Molten metal (1) is poured into the die under gravity (1). The die is usually made of steel (1). After cooling the die is split if needed (1) and the part removed. Removal of any excess (1). Allow to cool (1)	(4)
5(c)	• Stainless steel will not rust or corrode (1), so will not need to be replaced frequently (1) • Stainless steel is self- finishing (1), saving costs of coating (1) • Stainless steel is aesthetically pleasing, adding to the appeal of the motorcycle (1). • Stainless steel has high tensile strength(1), corrosion resistant (1).	(4)

Question Number	Answer	Mark
6(a)	• A mould (1) of the surface is needed, and a release agent (1) is coated onto the mould. Onto this layers of carbon fibre (1) are laid, interspersed with resin (1). The direction can be changed, to give strength in all directions 1) of the surface. The composite is then cured (1) and finally removed from the mould (1). For safety, goggles (1) should be used and the area should be ventilated well (1). A colour pigment may also be used (1) *Any 5 suitable points*	(5)
6(b)	• High tensile or compressive strength • Resistance to corrosion • Light weight	(1)

Question Number	Answer	Mark
7(a)	• The wire is stripped of it insulation (1), and then soldered (1) onto the terminal. Both terminal and wire must be cleaned or tinned first if necessary (1). • The wire may need stripping (depends on type of crimp) (1) and then it is mechanically crimped (1) to a connector, and finally pushed onto the terminal (1). • Screw/block method (1), strip insulation (1). *Maximum 4 marks*	(4)
7(b)	• Soldering gives a good connection (1), but it is permanent normally (1), fume extractor needed (1), and requires more skill. (1) • A crimped terminal can be disassembled (1) easily. Crimping gives a good connection quickly (1), but needs an extra connector (1). • Crimping is the best method for mass production (1), combining speed of assembly and disassembly (1), lower cost (1) • Screw method – labour intensive (1), bulkier (1), more cost (1), disassemble (1). *Allow any 6 suitable points*	(6)

Question Number	Answer	Mark
8(a)(i)	• Vicker's test • Brinell test • Rockwell	(1)
8(a)(ii)	 • Indenter (diamond or steel ball) (1) • Force shown (1) • Material (1)	(3)
8(a)(iii)	Brinell: • A hardened (1) steel ball (1) is used to indent the surface (1). A force F, (1) from 1 to 100 kgf (1) is used, and the area, A (1) of indent is measured, in square mm (1). Vicker's: • A diamond indenter (1) is used, with a pyramid (1) shape of 136 degrees (1) • The hardness is then given by HV = F/A (1) or from a look-up table, using diameter of indentation (1)	(4)
8(b)	• A suitable unit or scale, e.g. N/m^2 or BHN (Brinell Hardness number) or Rockwell scale, HB (1)	(1)

Note: Up to 3 marks may be allowed for a good description of scratch test.

Question Number	Answer	Mark
9(a)(i)	•  Any 2 points from: • Showing the centre uniform section (or mention of gage length) (1) (Not a tube) • Showing larger end pieces (1) • Showing a taper or radius between centre and ends.	(2)
9(a)(ii)	Stress • $\frac{Force}{Cross-sectional\ area}$ (2) Strain • $\frac{elongation}{original\ length}$ (2)	(4)
9(b)(i)	• Material B	(1)
9(b)(ii)	• It has a larger extension than A (1) with no increase in stress (or load) (1)	(2)
9(b)(iii)	• Material A is stiffer	(1)
9(b)(iv)	• It deforms much less (1) for a given stress or load (1)	(2)