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Mark Scheme (Results)

June 2011

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		**(10)**

Class of Material	Material	Significant property
Thermosetting polymers	Bakelite Neoprene	Heat resistant, Insulator Easily shaped
Composites	Concrete MDF	Tough Easy to work
New materials	Shape memory polymers Piezo-electric crystals	Returns to shape after working Pressure produces current
Elastomers	Rubber Neoprene	Elasticity Shock absorbent
Non-ferrous metals	Aluminium Zinc	Light, Good strength/weight ratio Corrosion resistant
	Accept any relevant material	Accept any relevant property for given material

Question Number	Answer	Mark
2		**(8)**

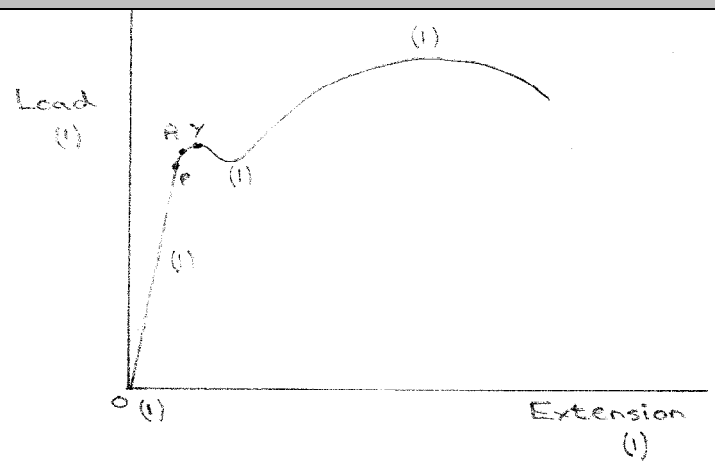
Process	Hazard	Risk
Arc welding	ultra violet/light radiation hot metal	eye damage skin burns
Sawing metal tube	sharp edges falling tube	cuts on hands injured feet
Injection moulding	hot mould fumes from release agent	burns to hands fume extractor
Metal turning	sharp edges loose fragments swarf	cuts on hands eye damage

Question Number	Answer	Mark
3(a)(i)	3 marks for method, must be at least one advantage and one disadvantage • durable (1) • can be painted (1) • seals cut edges (1) • only suitable for low carbon steel (1) • expensive (1) • prevents corrosion/rusting (1)	**(3)**

Question Number	Answer	Mark
3(a)(ii)	3 marks for method, must be at least one advantage and one disadvantage • easy to apply(1) • relatively cheap(1) • easy to clean (1) • can be chipped or cracked(1) • flammable process(1) • comes in a variety of colours/aesthetic (1)	**(3)**

Question Number	Answer	Mark
3(a)(iii)	3 marks for method, must be at least one advantage and one disadvantage • corrosion resistance(1) • decorative(1) • non-stick (1) • expensive(1) • relatively high thickness(1)	**(3)**

Question Number	Answer	Mark
3(b)	• work chemically cleaned (1) • heated to a suitable temperature (1) • fluxed (1) • molten zinc (1) • aluminium added for bright finish (1) • work dipped (1) • work cooled (1) • precautions against heat/PPE (1) • ventilation (1) any 5 of the above	**(5)**

Question Number	Answer	Mark
4(a)	 Axis orientation (1) Units (1) Straight line (1) First peak (1) Trough (1) Curve with max (1)	**(6)**

Question Number	Answer	Mark
4(b)(i)	elastic range -initial straight section	**(1)**

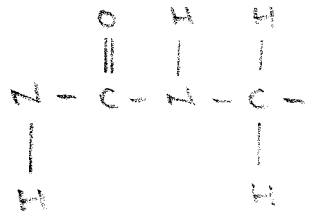
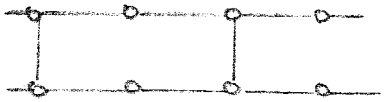
Question Number	Answer	Mark
4(b)(ii)	ultimate tensile strength - max point (highest point on curve)	**(1)**

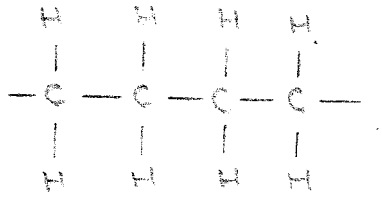
Question Number	Answer	Mark
4(b)(iii)	yield point - first peak Y	**(1)**

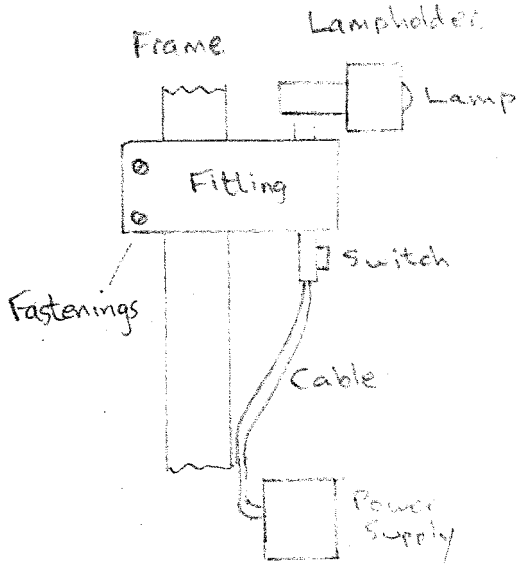
Question Number	Answer	Mark
4(c)(i) **(ii)**	strain = increase/original length (1) = 0.3/100 1 mark per number (2) = 0.003 (no unit) 1 mark only if unit attached (2)	**(5)**

Question Number	Answer	Mark
4(c)(iii) **(iv)**	stress = Force/Area (1) = 6000/30 x 10^{-6} (2) = 200 x 10^{6} Nm^{-2} (2)	 **(5)**

Question Number	Answer	Mark
5(a)	Thermosetting polymer • rigid • brittle • not softened by heating • cannot be reshaped Thermoplastic polymer • more flexible • soften when heated • can be reshaped maximum 3 marks for each polymer	 **(6)**

Question Number	Answer	Mark
5(b)(i)	 Or  cross linked chains, bonds between molecules (1) labels (1)	 **(2)**

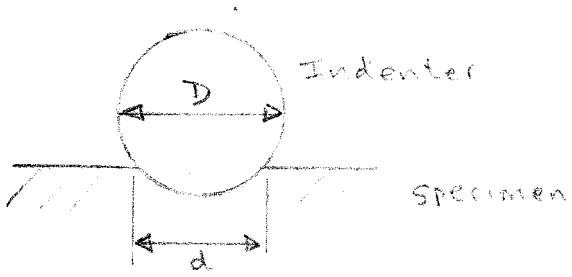
Question Number	Answer	Mark
5(b)(ii)	 or  long chains, bonds along chain (1) labels (1)	**(2)**

Question Number	Answer	Mark
6(a)	 Design must include the following: • Attachment, bracket, screws (2) • Control method, switch (2) • Adjustment, hinge, ball and socket (2) • Storage method, box compartment, pocket (2)	**(8)**

Question Number	Answer	Mark
6(b)(i)	Materials copper, steel, aluminium, pvc any 2	**(2)**

Question Number	Answer	Mark
6(b)(ii)	Description of properties Copper – good conductor, flexible, malleable Steel – high tensile strength, tough Aluminium – good conductor, cheap, ductile Pvc – good insulator, flexible, cheap 2 marks per material, any two materials.	**(4)**

Question Number	Answer	Mark
6(b)(iii)	Explanation of why given property is required.	**(1)**

Question Number	Answer	Mark
7(a)	 Brinell test • Steel/tungsten carbide ball indenter (1) • Downward load (1) • Test specimen (1) • indentation (1) Also accept Vickers test Acceptable proprietary machine methods	**(4)**

Question Number	Answer	Mark
7(b)	Brinell test smaller diameter (1) of indentation of harder material (1) Accept formula HV= F/A (1)	**(2)**

Question Number	Answer	Mark
7(c)	• any shape can be obtained (1) • complex shapes are possible (1) • large numbers possible/quickly (1) • economies of scale (1) any 2 mentioned	**(2)**

Question Number	Answer	Mark
7(d)	aluminium alloy advantages – • lightweight(1) • corrosion resistant (1) aluminium alloy disadvantages – • expensive (1) • lower tensile strength (1) low carbon steel advantages – • inexpensive (1) • higher tensile strength than aluminium(1) low carbon steel disadvantages – • heavy, dense (1) • corrodes/rusts if not protected (1) **must be at least one advantage and disadvantage stated** **marks awarded if expressed coherently and justified to max of 6**	**(6)**

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