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Mark Scheme (Results)

Summer 2014

Pearson Edexcel GCE
Engineering (6931/01)

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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.

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>1</td><td>One mark for each class of material (4x1 mark)
One mark for each significant property (4x1 mark)

<table>
<tr><th>Specific material</th><th>Class of material</th><th>Significant property of material</th></tr>
<tr><td>Rubber</td><td>Elastomer</td><td>Tough, flexible, good solvent resistance, soft, high coefficient of friction, high elastic limit (returns to shape after deformation).</td></tr>
<tr><td>Duralumin</td><td>Non - Ferrous (Alloy)</td><td>Ductile, soft, malleable, lightweight, corrosion resistant, machines well, age-hardens.</td></tr>
<tr><td>Glass reinforced plastics (GRP)</td><td>Composites</td><td>Lightweight, tough, heat resistant, strong in tension and compression, less brittle.</td></tr>
<tr><td>Cast Iron</td><td>Ferrous</td><td>Strong in compression, brittle, good fluidity, machines well, good resistance to wear.</td></tr>
</table>

Ensure properties are different. Do not award a second mark for repeat property.

Any other appropriate response.</td><td>(8)</td></tr>
</table>

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>2</td><td>One mark for each correct risk (4x1 mark)
One mark for each correct precaution (4x1 mark)

<table>
<tr><th>Process</th><th>Risk</th><th>Precaution/Control measure</th></tr>
<tr><td>Sawing metal tube</td><td>Sharp edges - cuts on hands

Tube falling to floor - injured feet

Saw blade breaking</td><td>Wear safety gloves

Wear suitable footwear

Have a guard in place / wear safety glasses</td></tr>
<tr><td>Final electrical testing</td><td>Electric shock</td><td>Operator to stand on rubber mat</td></tr>
<tr><td>Spot welding</td><td>Sparks into eyes

Cuts

Electric shock</td><td>Wear goggles / face shield

Wear gloves

Ensure welding machine is insulated</td></tr>
<tr><td>Centre lathe turning</td><td>Swarf flying off workpiece

Work coming loose from the chuck

Cuts to hands
Loose clothing</td><td>Safety glasses, machine guard to protect fellow workers

Guards in place, ensure chuck jaws are tight

Safety gloves when removing workpiece from chuck</td></tr>
</table>

Ensure precaution/control comments are different. Do not award a second mark for repeat precaution/control comment.

Any other appropriate response</td><td>(8)</td></tr>
</table>

Question Number	Answer	Mark
3 (a)(i)	1 mark for identification of material • Aluminium Alloy • Stainless Steel	**(1)**

Question Number	Answer	Mark
3 (a)(ii)	Up to 2 marks for explanation Aluminium Alloy • Aluminium is light weight (1) which improves performance (1) • Aluminium has a low melting point (1) and suitable for die-casting (1) • Aluminium resists corrosion (1) so allows a longer working life of the product (1) Stainless Steel • It is tough and hard (1) so will last a long time (1) • It resists corrosion (1) so allows a longer working life of the product (1) • It is hard-wearing (1) so resists wear/retains shape (1) Any other appropriate response – Must link to (a)(i) If answer to 3(a)(i) is incorrect but 3(a)(ii) is correct in relation to 3(a)(i), **one** mark can be awarded for 3(a)(ii).	**(2)**

Question Number	Answer	Mark
3 (b)(i)	1 mark for identification of material • Rubber	**(1)**

Question Number	Answer	Mark
3 (b)(ii)	Up to 2 marks for explanation Rubber is hard wearing (1) so brake blocks will last a long time (1) Has a high coefficient of friction (1) for effective braking (1) Any other appropriate response If answer to 3(b)(i) is incorrect but 3(b)(ii) is correct in relation to 3(b)(i), **one** mark can be awarded for 3(b)(ii).	**(2)**

Question Number	Answer	Mark
3 (c)(i)	1 mark for identification of material • Stainless steel	**(1)**

Question Number	Answer	Mark
3 (c)(ii)	Up to 2 marks for explanation Stainless steel has a high tensile strength (1) so the shape of the wheel will be maintained (1) Stainless steel is ductile (1) and can be drawn into thin sections (1) Any other appropriate response If answer to 3(c)(i) is incorrect but 3(c)(ii) is correct in relation to 3(c)(i), **one** mark can be awarded for 3(c)(ii).	**(2)**

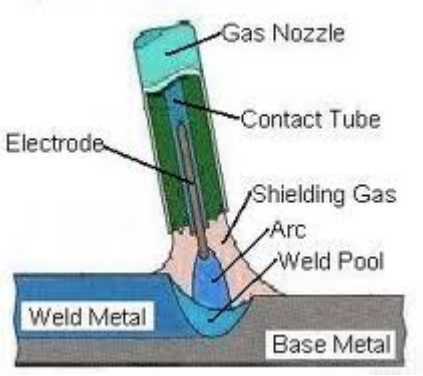
Question Number	Answer	Mark
3 (d)(i)	1 mark for identification of material • PVC	**(1)**

Question Number	Answer	Mark
3 (d)(ii)	Up to 2 marks for explanation Can be extruded (1) so can be produced in long lengths (1) High resistivity (1) insulates against electric shocks (1) Flexible (1) to allow the cable to bend (1) Is water resistant (1), reducing the likelihood of circuit short circuiting (1) Any other appropriate response If answer to 3(d)(i) is incorrect but 3(d)(ii) is correct in relation to 3(a)(i), **one** mark can be awarded for 3(d)(ii).	**(2)**

Question Number	Answer	Mark
4 (a)	One mark for correct answer • Welding (1) • Brazing (1) Any other appropriate response	**(1)**

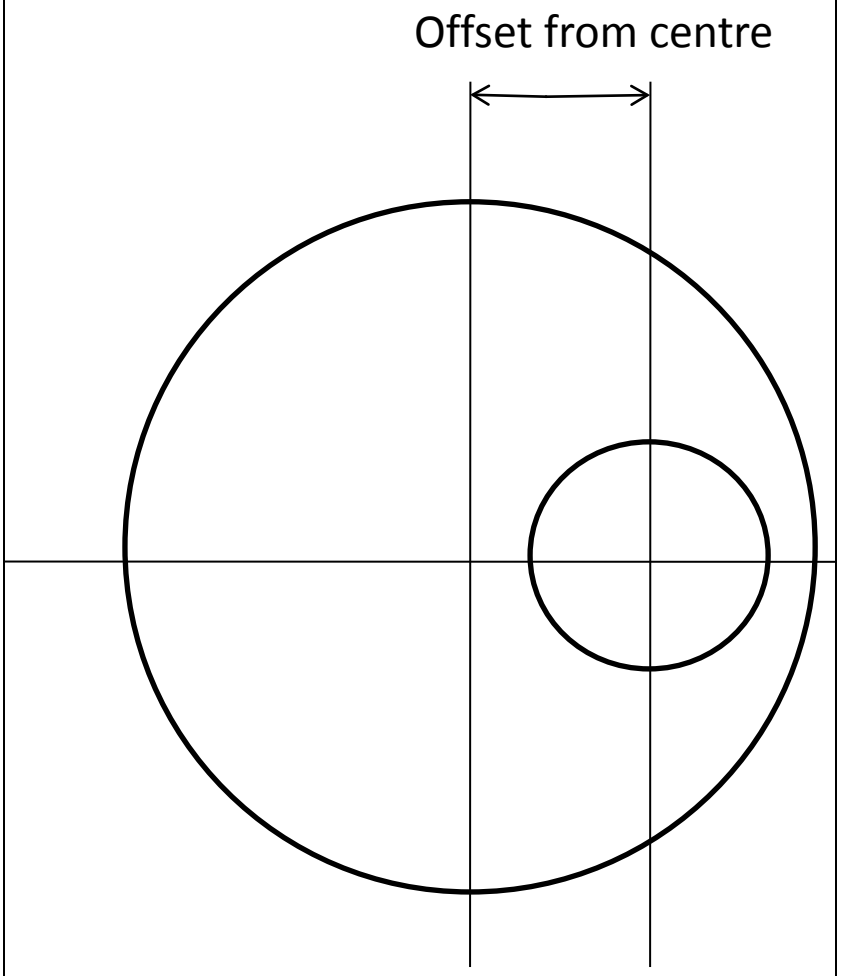
Question Number	Answer	Mark
4 (b)	One mark for each correct advantage (2x1 mark) • Provides strength to join (1) • Requires little (if any) future maintenance (1) • Provides secure join to both materials (1) Any of the above or any appropriate response. If answer to 4(a) is incorrect but 4(b) is correct in relation to 4(a), **one** mark can be awarded for 4(b).	**(2)**

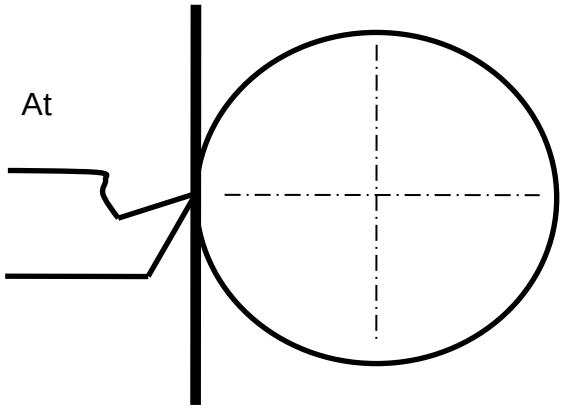
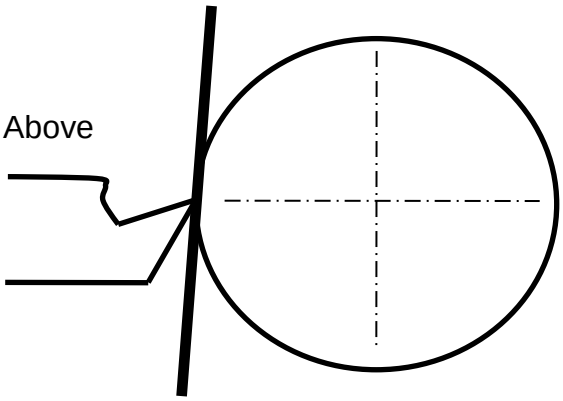
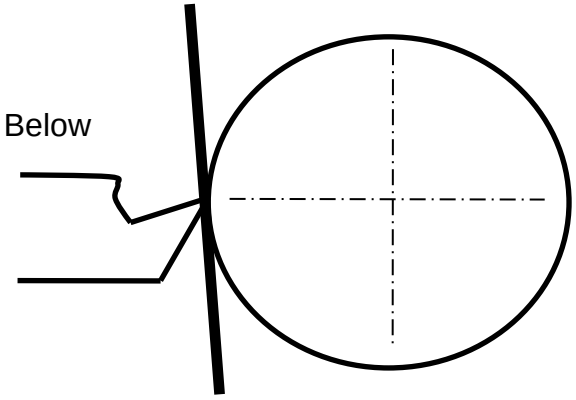
Question Number	Answer	Mark
4 (c)	One mark for each correct disadvantage (2x1 mark) • Permanent fastening has to be broken if parts need to be removed (1) • Skilled labour required to make permanent join (1) • Provides a more expensive solution to problem (1) • Uses high levels of electricity/current/energy (1) Any of the above or any appropriate response. If answer to 4(a) is incorrect but 4(c) is correct in relation to 4(a), **one** mark can be awarded for 4(c).	**(2)**

Question Number	Answer	Mark
4 (d)	One mark for each answer (6x1 mark) A solid steel wire (1) is fed from a contact tip (gun) (1). The tip is hot or electrically charged (1). The trigger is pulled and melts the wire (1) for the weld puddle (1). Inert gas flows out of the gun (1) and keeps the weld puddle shielded from the atmosphere (1).  Answer must include a diagram Any of the above or any appropriate response. Maximum 4 marks for only notes OR sketches	**(6)**

Question Number	Answer	Mark
5 (a)	One mark for each correct answer (1x1) • Eccentric • Off-centre	**(1)**

Question Number	Answer	Mark
5 (b)	One mark for each correctly identified answer (3x1) A chuck key is required to open the jaws on both three and four jaw chucks (1). Turning the chuck key on a three-jaw chuck opens or closes all the jaws simultaneously (1) but turning the chuck key on a four-jaw chuck opens or closes one jaw individually (1).	**(3)**

Question Number	Answer	Mark
5 (c)	One mark for each correctly identified answer (6x1)  Operator must use a four jaw chuck and ensure workpiece is clamped on machine centre line (1). The operator has to determine the distance the workpiece has to be off set (1). Using a Dial Test Indicator (1) move the workpiece off centre to new position (1). Ensure all jaws are tightly locked (1). Set appropriate slow speed/feed to remove material (1). Accept any appropriate method.	**(6)**

Question Number	Answer	Mark
5 (d)	One mark for following statements max (4x1) Trial and error method (1) using a steel rule (1) between point of tool (1) and circumference of round bar (1). When vertical tool is at correct height (1).    Any other appropriate response with sketch(es)	**(4)**

Question Number	Answer	Mark
6 (a)	One mark for correct answer • Phenolic resins (Bakelite) • Urea formaldehyde (UF) • Urea methanol resins (Formica) • Methanal melamine resins (Melamine) • Epoxy resins • Polyester resins Any of the above or any appropriate response.	**(1)**

Question Number	Answer	Mark
6 (b)	One mark for correct answer • Polythene • Polypropylene • Poly vinyl chloride (PVC) • Polystyrene • Acrylic (PMMA) • Polytetrafluoroethylene (PTFE) • Polyamide (Nylon) Any of the above or any appropriate response.	**(1)**

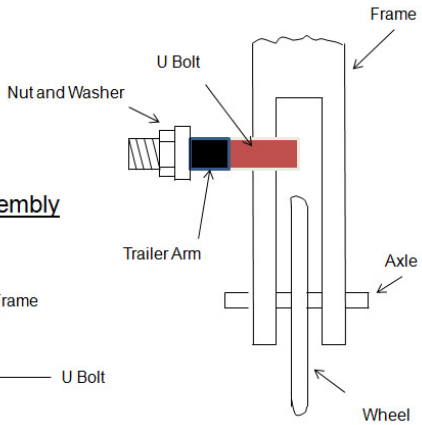
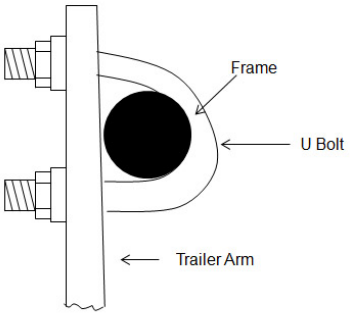
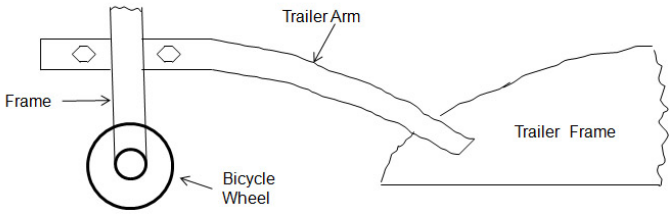
Question Number	Answer	Mark
6 (c)	One mark for each correctly identified answer (4x1) Once set these plastics cannot be reheated (1). The molecules of these plastics are cross linked (1) in three dimensions (1) and this is why they cannot be reshaped (1) or recycled (1). The bond between the molecules is very strong (1).	**(4)**

Question Number	Answer	Mark
6 (d)	One mark for each correctly identified answer (4x1) These plastics can be heated and softened (1) and moulded (1) due to long chain monomers (1) that are not interconnected (1). They can be reheated and remoulded into a different shape (1) as they do not undergo significant change (1). Reheating and reshaping can be repeated (1). The bond between the molecules is weak (1) and becomes weaker when reheated (1) allowing reshaping (1). These types of plastics can be recycled (1).	**(4)**

Question Number	Answer	Mark
6 (e)	One mark for each correctly identified answer (3x1) Ultra Violet Degradation is one form of polymer degradation (1). Ultra Violet absorption leads to molecular chain degradation (1) and loss of strength (1) at sensitive points in the chain structure (1). Colour of the polymer can also be affected (1). Brittleness occurs (1) Accept any other appropriate answer	**(3)**

Question Number	Answer	Mark
6 (f)	One metal is more electrically positive than the other (1) when mixed with electrolyte such as rainwater (1) electrolysis causes chemical reaction (1) and the most positive metal corrodes first (1). Accept any other appropriate answer	**(3)**

Question Number	Answer	Mark
6 (g)	One mark for each correctly identified answer (2x1) A Shape Memory Alloy remembers its original shape (1) when heat/electric current is applied (1). Accept any other appropriate answer	**(2)**

Question Number	Answer	Mark
7	Marks will be awarded for design features relating to those below. • enough wheels for safe transportation (2) • temporary method of fastening trailer to frame (2) • trailer that can support young child (2) • appropriate safe system to fasten child in seat (2) • suitable choice of materials (1) • appropriate reasons for material choice (1) Accept any other appropriate response Child Trailer  Rear View  Plan View U Bolt Assembly  Side View  	**(10)**

Question Number		Indicative Content
8		When looking at the two materials mild steel has a dull finish and carbon fibre can be coated to any required finish. By choosing the colour of the carbon fibre the frame will be aesthetically pleasing to the user. Carbon fibre is self finishing. Mild steel can be painted for aesthetic but principally for protective reasons/prevent corrosion. Mild steel is a low carbon steel with less than 0.3% carbon content. This makes the steel cheaper to buy and easy to work with which makes easier to mass produce and keeps the cost down/economies of scale. Carbon fibre is more expensive to buy but can be formed into any shape making the material more suitable for use as a bicycle frame, and allows customised shapes to be produced. Carbon fibre is lighter than mild steel which helps in the performance of the machine. Mild steel is easier to manufacture with than carbon fibre. Expensive equipment must be bought to produce carbon fibre products but in the long term the expense is reduced by producing many components.
Level	Mark	Descriptor
	0	No rewardable material
1	**1-3**	Some brief acknowledgement of the difference between the two materials with reference to design needs. Writing communicates ideas using everyday language but the response lacks clarity and organisation. The candidate spells, punctuates and uses the rules of grammar with limited accuracy.
2	**4-6**	Some justification of the difference between the two materials with reference to design needs. Writing communicates ideas using engineering terms accurately and showing some direction and control in the organising of material. The candidate uses some of the rules of grammar appropriately and spells and punctuates with some accuracy, although some spelling errors may still be found.
3	**7-9**	There should a detailed understanding and evaluation of the difference between the two materials with reference to design needs, and a justified decision of the most appropriate material. Writing communicates ideas effectively, using a range of appropriately selected engineering terms and organising information clearly and coherently. The candidate spells, punctuates and uses the rules of grammar with considerable accuracy.

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