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Mark Scheme (Results)

Summer 2015

Pearson Edexcel GCE in Engineering (6931) Paper 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 (1x5 marks)
One mark for each significant property (1x5 marks)

<table>
<tr><th>Specific material</th><th>Class of material</th><th>Significant property of material</th></tr>
<tr><td>Brass</td><td>Alloy
Non-ferrous</td><td>Malleable, corrosion resistant, good conductor of electricity</td></tr>
<tr><td>Carbon fibre</td><td>Composite</td><td>Lightweight, high tensile strength, high impact resistance</td></tr>
<tr><td>Polyvinyl chloride (PVC)</td><td>Thermoplastic</td><td>Electrical insulator, chemically resistant, flexible</td></tr>
<tr><td>Neoprene</td><td>Elastomer</td><td>Good electrical and heat resistance, solvent and water resistant, tough, elastic</td></tr>
</table>

All answers must be different.

Accept 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 (1x4 marks)
One mark for each correct precaution (1x4 marks)

<table>
<tr><th>Process</th><th>Risk or hazard</th><th>Precaution/Control measure</th></tr>
<tr><td>Use of epoxy resins</td><td>Skin irritation

Fumes</td><td>Wear gloves, use barrier cream

Provide ventilation
Wear face mask</td></tr>
<tr><td>Chemical etching</td><td>Chemical burns

Splashes in eyes/skin</td><td>Wear gloves

Safety glasses
Wear apron</td></tr>
<tr><td>Injection moulding</td><td>Trapped limbs

Burns

Fumes from release agent

Materials coming loose</td><td>Guards on machine

Wear gloves

Good ventilation, wear face mask

Wear protective footwear</td></tr>
<tr><td>Sawing engineering materials</td><td>Sharp edges

Blade breaking</td><td>Wear gloves or apron

Correct use of equipment</td></tr>
</table>

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

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

Question Number	Answer	Mark
3 (a)(i)	1 mark for identification of material • Low carbon steel /Mild steel • Aluminium	**(1)**

Question Number	Answer	Mark
3 (a)(ii)	Up to 2 marks for explanation LCS can be easily formed (1) therefore can be easily manufactured/complex shapes can be formed (1) LCS is relatively cheap (1) so the product will be cost effective. Aluminium is lightweight (1) which will enable the trolley to moved easier using less power from the battery (1) Aluminium does not rust (1) and therefore does not require a further finish for anti corrision (1) Ensure explanation is relevant to material chosen in 3 (a)(i) If answer in 3 (a)(i) incorrect, maximum one mark to be awarded in 3 (a)(ii)	**(2)**

Question Number	Answer	Mark
3 (b)(i)	1 mark for identification of material • Copper Do not accept aluminium as a correct answer	**(1)**

Question Number	Answer	Mark
3 (b)(ii)	Up to 2 marks for explanation Copper is corrosion resistant (1) so it will resist weathering (1) Copper is a good conductor of electricity (1) so current will flow effectively (1) Ensure explanation is relevant to material chosen in 3 (b)(i) If answer in 3 (b)(i) incorrect, maximum one mark to be awarded in 3 (b)(ii)	**(2)**

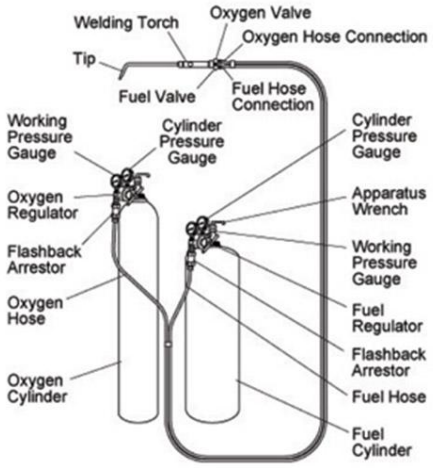
Question Number	Answer	Mark
3 (c)(i)	1 mark for identification of material • Rubber	**(1)**

Question Number	Answer	Mark
3 (c)(ii)	Up to 2 marks for explanation Rubber is hard wearing (1) so the wheels will last longer (1) Rubber is flexible (1) so it grips well (1) Ensure explanation is relevant to material chosen in 3 (c)(i) If answer in 3 (c)(i) incorrect, maximum one mark to be awarded in 3 (c)(ii)	**(2)**

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

Question Number	Answer	Mark
3 (d)(ii)	Up to 2 marks for explanation The material is tough (1) so it can withstand every day use (1) The material has good fluidity (1) so it can be shaped into any form (1) High electrical resistivity (1) avoids possibility of electrocution (1) Ensure explanation is relevant to material chosen in 3 (d)(i) If answer in 3 (d)(i) incorrect, maximum one mark to be awarded in 3 (d)(ii)	**(2)**

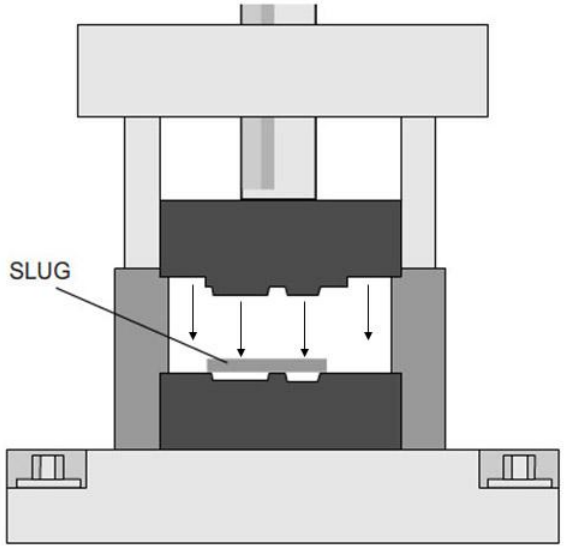
Question Number	Answer	Mark
4 (a)	One mark for each correctly identified explanation (1x2) Oxyacetylene process is portable (1) so you can use it in any location (1) Oxyacetylene doesn't require a power supply (1) so you can use it in any location (1) Oxyacetylene has a wide temperature range (1) so can be used for brass welding (brazing) (1) Accept any other appropriate response	**(2)**

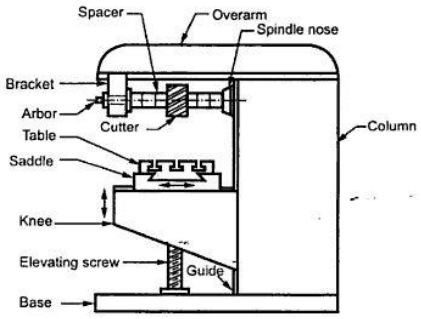
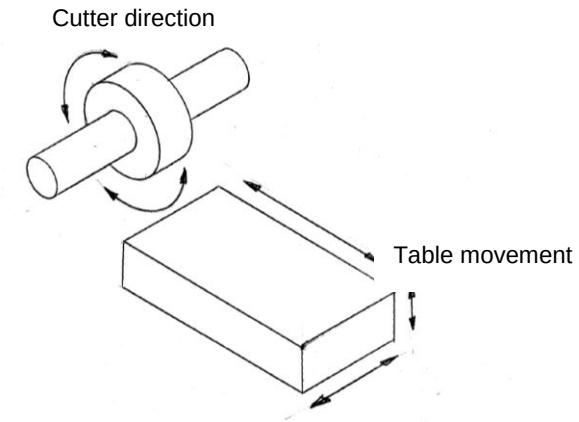
Question Number	Answer	Mark
4 (b)	One mark for each correctly identified part (1x4) • Oxygen bottle / Oxygen identified as black cylinder (1) • Acetylene bottle / Acetylene identified as maroon cylinder (1) • Separate hoses (1) • Separate valves to control flow (1) • Regulators / pressure gauge (1) • Welding torch (1) • Welding tip (1)  Up to three marks if only notes or sketch of equipment. Both notes and sketch must be evident for maximum marks.	**(4)**

Question Number	Answer	Mark
4 (c)	Up to two marks for each correct explanation (2x2) Welding rods are fed automatically (1) which allows continuous welding. (1) In MIG welding the heat is localised (1) which means that larger areas don't warp (1) MIG welding is an easier process to learn (1) so skills can be gained more quickly (1) Higher welding speeds (1) which increases productivity (1) Less cleaning needed post welding (1) which makes process quicker (1) Automatic robots/machines can be used (1) which makes the welding process faster (1) Accept any other appropriate response	**(4)**

Question Number	Answer	Mark
5 (a)	Two marks for each correctly identified explanation (2x2) Compression moulding is suited to high volume production (1) so you can make more products in a shorter time. (1) Compression moulding uses heat and high pressure (1) so complex shapes can be produced (1) Very little post production waste (1) so compression moulding is cost effective (1) Low-cost moulding procedure after initial set up costs (1) so it is cost effective. (1) Accept any other appropriate response	**(4)**

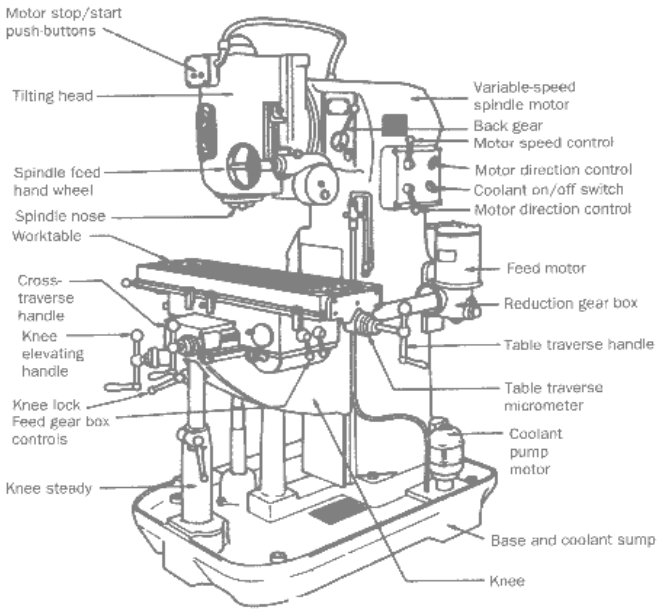
Question Number	Answer	Mark
5 (b)	Two marks for correctly explained disadvantage (1x2) Once thermosetting plastics/urea formaldehyde have been formed (1), they cannot be recycled (1) Can be a costly process if products are malformed (1) as thermoset materials have to be discarded/cannot be re-used like thermoplastics (1) Only a limited range of materials can be used (1) so range of products is limited (1) Pellets/slugs have to be partially formed before moulding (1) which adds time to the process (1) Production can take longer compared to injection moulding (1) which increases comparable costs (1) Accept any other appropriate response	**(4)**

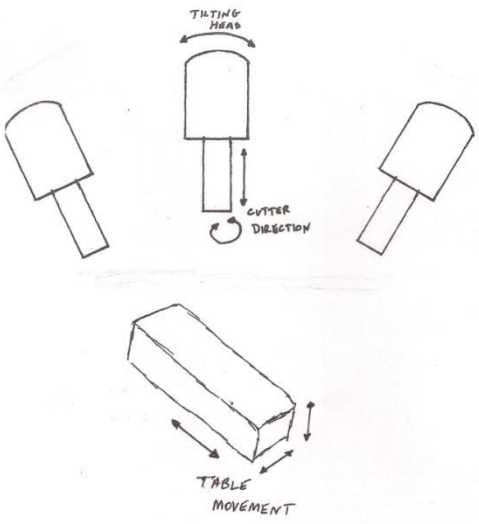
Question Number	Answer	Mark
5 (c)	One mark for each correct comment (1x4) • The mould is heated (1) • Plastic slug inserted in mould (pellets can be used) (1) • At correct temperature upper mould moves downwards(1) • As upper and lower mould meet the plastic is compressed into shape of mould (1) • Upper mould moves upwards and shape is removed (1) • Any excess material removed (1) Accept any other appropriate response  HYDRAULIC PRESS *Up to 4 marks maximum for description only*	**(6)**

Question Number	Answer	Mark
6 (a)	One mark for correct relevant point <u>Horizontal Milling</u> • Horizontal cutting tool direction (1) • Cutting tool remains in constant position (1) • Workpiece moved to cutting tool for material removal (1) • Table movement in three axis identified (1) • The harder the material, the slower the speed (1) • Mention of up cut/down cut (climb) milling (1)   	**(6)**

Vertical Milling

- Vertical cutting tool rotational direction (1)
- Vertical cutting tool vertical direction (1)
- Cutting tool can be moved towards the workpiece for material removal (1)
- Tilting head allows further cutting tool positioning (1)
- Table movement in three axis identified (1)
- Limitations of cuts using mills





Up to 5 marks for labelled diagram (max 5 marks)

A maximum of 5 marks for either notes or diagram, total mark to be awarded is 6 marks.

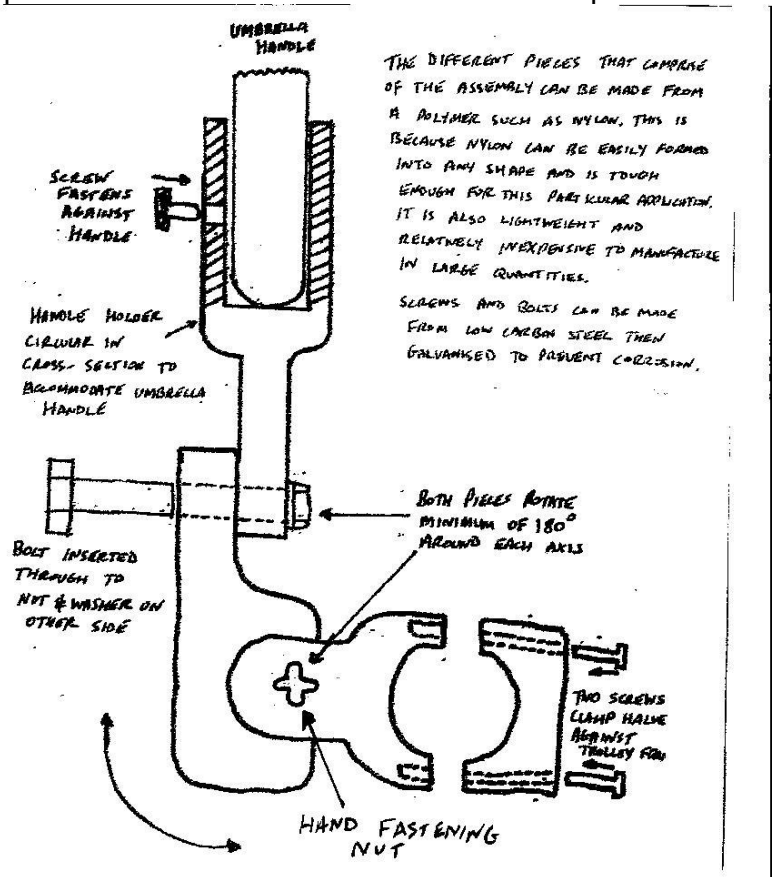
Question Number	Answer	Mark
6(b)	One mark for each relevant point (max 2 marks) Coolant is used to keep cutter cool (1) which improves the finish (1) Coolant is used to carry away swarf (1) which improves the efficiency of the cut (1) Accept any other appropriate response	**(2)**

Question Number	Answer	Mark
7(a)	One mark for each relevant point (max 2 marks) Sand casting has relatively inexpensive production costs (1) as patterns can be made cheaply / sand is cheap and can be re-used (1) The use of cores (1) allows hollows and holes to be produced during casting (1) Large component parts can be cast (1) without the use of expensive die casting moulds (1) Sand casting is used as the vice body has an irregular shape (1) which can be produced in sand with the correctly formed pattern(s) (1) Accept any other appropriate response	**(2)**

Question Number	Answer	Mark
7(b)	Any four from, in appropriate order: • Pattern appropriately placed in cope and drag (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) Accept any other appropriate response	**(4)**

Question Number	Answer	Mark
7(c)	One mark for each relevant point (max 2 marks) The jaws are made from carbon steel which is a very hard material (1) which will not be easily worn or damaged (1) The jaws are made from carbon steel so they can be hardened / heat treated (1) to minimise wear (1) Accept any other appropriate response	**(2)**

Question Number	Answer	Mark
7(d)	One mark for each relevant point (max 2 marks) The buttress thread has a flat face and angular face (1) which allows the vice to be fastened tightly but allows for quick release when required (1) Accept any other appropriate response	**(2)**

Question Number	Answer	Mark
8	One mark each for point relevant to design task (max 5 marks) • temporary fastening device on golf trolley frame, fully workable (2), partially workable (1) • temporary method of securing the umbrella into the designed accessory, fully workable (2), partially workable (1) • designed accessory must be able to move in any direction, fully workable (2), partially workable (1) • fully workable locking device in any position (2) partially workable (1) • suitable choice of materials (1) • appropriate reasons for material choice (1) Accept any other appropriate response Up to 5 marks for identification of above points  *A maximum of 5 marks for either notes or diagram, total mark to be awarded is 10 marks.*	**(10)**

Question Number	Indicative Content
9	Initial correct identification of materials from both classes (2 x 1 marks). Relevant points, non-ferrous material (up to 4 marks), polymer material (up to 4 marks). I will choose aluminium as my non-ferrous material (1) and ABS (Acrylonitrile Butadiene Styrene) as my polymer (1) Aluminium has a higher tensile strength than ABS (1). As ABS comprises of three materials, there is a greater range of properties available by varying the composition of the three materials (1). Aluminium is a tougher/harder material than ABS (1) which means it will be hard wearing (1) offering better performance requirements over a longer period (1). ABS can be brittle (1) resulting in the frame breaking under load (1). The trolley frame will be of tube section to reduce the overall weight of the product (1). An ABS frame would require a thicker wall section than aluminium to provide the same strength and rigidity in the product (1). A thicker wall frame would require more material, increasing manufacturing costs (1). ABS products are mainly manufactured using the injection moulding process (1) but other processes can be used such as extrusion and blow moulding (1). Injection moulding has very high set-up costs (1) so this process would only be used for high volume manufacture (1). Aluminium products can be manufactured using various processes depending on the product number required (1). For small low number batches sand casting can be used which has very low set-up costs (1), but for high volume production, using an extrusion process would incur high set-up costs (1). One advantage of the injection moulding process is that the ABS product can be coloured during manufacture (1) to suit the requirements of the client (1). Aluminium would require a further process to colour the product (1) increasing manufacturing costs (1). Both materials have similar properties (1) so other factors such as how sturdy (1) the frame will need to be considered. The trolley needs to support a golf bag (1) and it needs to remain upright (1) and not be blown over in windy conditions (1). If this was a sole major factor then aluminium would have to be chosen for the manufacture of the frame (1) as it is heavier than plastic (1). Overall for the factors mentioned above I will choose ABS as

	my material to manufacture the golf trolley frame (1). Maximum four marks if properties mentioned are not justified in reference to golf trolley.

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	**7-10**	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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