Pearson

Mark Scheme (Results)

Summer 2017

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 (1x3 marks)
One mark for each significant property (1x3 marks)

<table>
<tr><th>Specific material</th><th>Class of material</th><th>Significant property of material</th></tr>
<tr><td>High carbon steel</td><td>Alloy or ferrous metal</td><td>High strength, hard, wear resistant, malleable, tough, ductile</td></tr>
<tr><td>Polyamide (nylon)</td><td>Thermoplastic polymer</td><td>Tough, flexible, self lubricating, high plastic strength, good solvent resistance</td></tr>
<tr><td>Urea formaldehyde (UF)</td><td>Thermosetting polymer</td><td>High tensile strength, low water absorbtion, non-conductive, good heat resistance</td></tr>
</table>

Ensure class/property comments are different.
Do not award a second mark for repeat class/property comment.</td><td>(6)</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 (1x4marks)
One mark for each correct precaution (1x4 marks)

<table>
<tr><td>Process</td><td>Risk</td><td>Precaution/Control measure</td></tr>
<tr><td>Metal drilling</td><td>Drill caught in clothing or hair, drill breaks, drill snags in workpiece,</td><td>Make sure no loose clothing and tie hair back, wear protective glasses, clamp workpiece to table</td></tr>
</table></td><td>(8)</td></tr>
</table>

	cut/burns from swarf		
MIG welding	Fumes, skin burns, fire, arc eye	Wear respirator, protect all skin, tidy work area with no combustible materials, eye protection	
Spray painting	Fumes, paint on skin, paint in eyes	Safety mask, work in well ventilated area, wear full safety suit, wear protective glasses	
Handling hot metal	Burns, manual lifting of hot material	Wear gloves or gauntlets, use tongs or other holding device, clear work area of people	

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

Question Number	Answer	Mark
3 (a)(i)	I mark for identification of material • Copper	**(1)**

Question Number	Answer	Mark
3 (a)(ii)	Up to 2 marks for explanation • Ductile (1) so it can be drawn into a thin wire (1) • Copper is an excellent conductor of electricity (1) so current will flow effectively (1) • Copper is corrosion resistant (1) so it will resist weathering / ensures long life (1) Accept any other appropriate response Ensure answer is relevant to material chosen in 3(a)(i). If answer in 3(a)(i) incorrect award one mark only.	**(2)**

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

	• Rubber	

Question Number	Answer	Mark
3 (b)(ii)	Up to 2 marks for explanation • Can be moulded (1) so can produce intricate tread patterns (1) • Tough (1) so can resist impact/ wear and tear (1) • It is corrosion resistant/water resistant (1) so can withstand chemical/weathering conditions (1) Accept any other appropriate response Ensure answer is relevant to material chosen in 3(b)(i). If answer in 3(b)(i) incorrect award one mark only.	**(2)**

Question Number	Answer	Mark
3 (c)(i)	I mark for identification of material • Cast Iron/Aluminium Alloy (1)	**(1)**

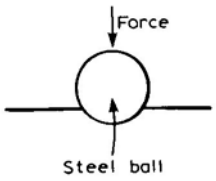
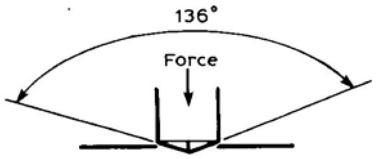
Question Number	Answer	Mark
3 (c)(ii)	Up to 2 marks for explanation <u>Cast Iron</u> • Can be formed using the casting process (1) so complex shapes can be formed/produced (1) • Very hard material (1) which will increase the lifetime cycle of the block (1) • High density (1) therefore stable in use (1) <u>Aluminium</u> • Can be formed using the casting process (1) so complex shapes can be formed/produced (1) • Very light material (1) which will enhance performance requirements i.e. speed (1) • Corrosion resistant (1) which will increase the lifetime cycle of the block	**(2)**

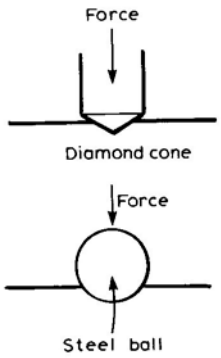
	Accept any other appropriate response Ensure answer is relevant to material chosen in 3(c)(i). If answer in 3(c)(i) incorrect award one mark only.	

Question Number	Answer	Mark
3 (d)(i)	I mark for identification of material • Low carbon steel /mild steel (1)	**(1)**

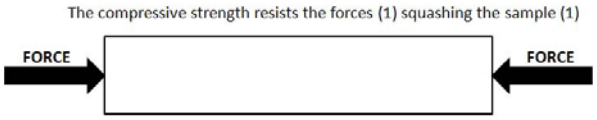
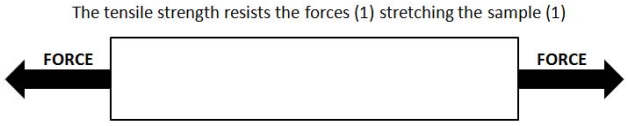
Question Number	Answer	Mark
3 (d)(ii)	Up to 2 marks for explanation • Low carbon steel / Mild steel is malleable (1) so can be easily shaped (1) • Low carbon steel / Mild steel is relatively cheap (1) so the product will be cost effective (1) • Low carbon steel / Mild steel is ductile (1) so can be drawn into the tubular shape of the axle (1) Accept any other appropriate response Ensure answer is relevant to material chosen in 3(d)(i). If answer in 3(d)(i) incorrect award one mark only.	**(2)**

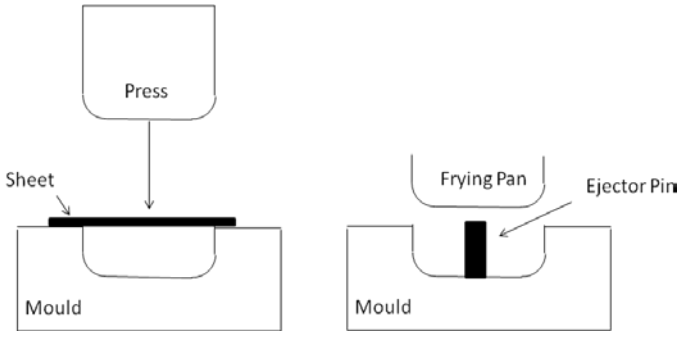
Question Number	Answer	Mark
4(a)	• The crankshaft needs to be tough in the body (1) to resist torque / twisting / flexing under rotation (1). • The crankshaft needs to be tough so it doesn't twist out of shape (1) as it is subjected to sideways load from each cylinder (1). • The crankshaft bearing areas need to be hard (1) to resist wear over time (1). • The crankshaft needs to be hard to resist wear (1) due to the constant friction against the connecting rod small end bearing (1)	**(4)**

Question Number	Answer	Mark
4(b)	There are three main types of hardness test, Brinell, Vickers and Rockwell. The description of the hardness test must relate to the test named by the candidate. <u>Brinell hardness test</u>  • Named hardness test (1) • Suitable diagram (1) • Hardened steel ball (1) • Is pressed by force into the material (1) • The diameter of indentation is measured (1) • Brinell hardness number (HB) is obtained by pre-set tables for the diameter of the ball or calculation (1) <u>Vickers hardness test</u>  • Named hardness test (1) • Suitable diagram (1) • Uses a diamond indenter (1) • Is pressed by force onto the surface of the material under test (1) • Diagonals of the indentation are measured (1)	**(6)**

	• Vickers hardness number (HV) (1) is obtained by dividing size of the force applied into surface area of the indentation (1) <u>Rockwell hardness test</u>  • Named hardness test (1) • Suitable diagram (1) • Uses a diamond indenter or steel ball (1) • A force is applied to press the indenter in contact with the surface (1) • A further force is then applied (1) causing an increase in depth of the indenter penetration into the material (1) • Additional force removed and this causes a reduction in depth of the indenter (1) • The difference between the final depth and initial depth is calculated for the Rockwell hardness number (HR) (1)	

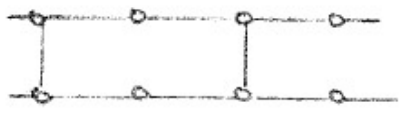
Question Number	Answer	Mark
4(c)	<u>Compressive Strength</u> • The ability to withstand loads (1) tending to reduce size (1) • Ability of a material (1) to breaking under pressure (1)	**(6)**

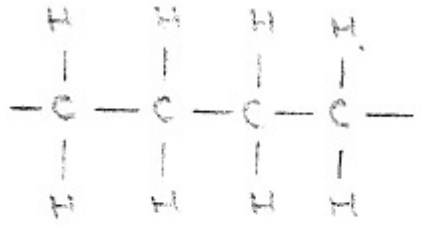
	 *Must contain drawing and explanation for full marks.* <u>Tensile Strength</u> • The resistance of a material to breaking (1) under stretching (1) • Capacity of a material (1) to withstand loads that stretch / elongate (1)  *Must contain drawing and explanation for full marks.*	

Question Number	Answer	Mark
5(a)	Up to three marks for description of process and one mark for sketch. The material is placed in the press (1). The press is lowered into the mould (1) using considerable force (1) forcing the shape of the frying pan in the mould (1). An ejector pin forces the body out of the mould (1). On release from the mould the edges will be trimmed (1).  Must have sketch and explanation of	**(4)**

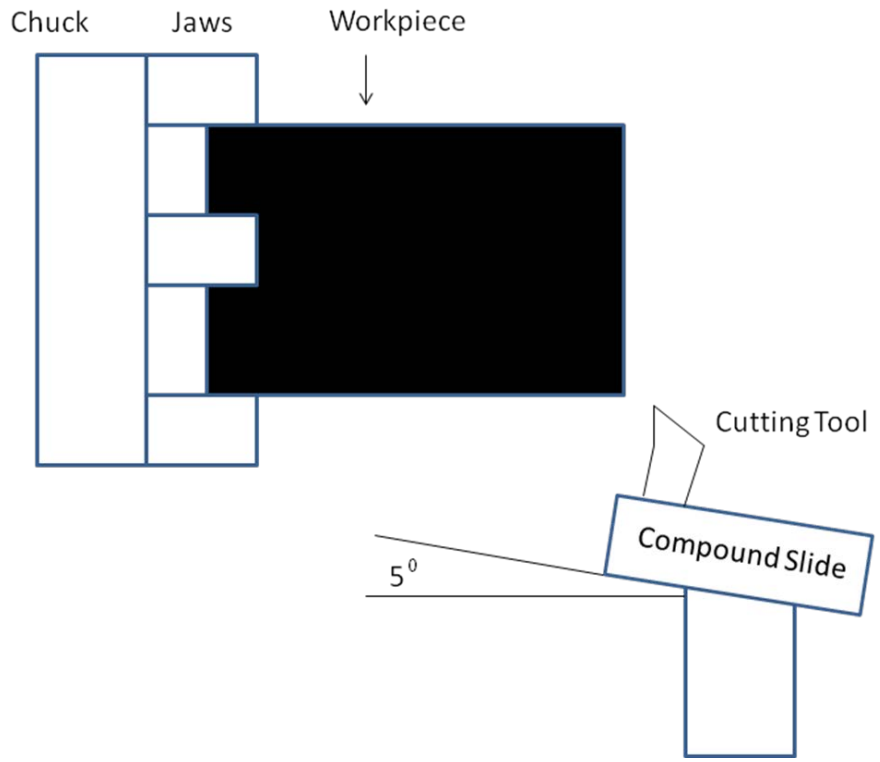
	manufacturing process to gain maximum marks.	

Question Number	Answer	Mark
5(b)	**Two** explanations from: • Aluminium is malleable (1) so it can be easily pressed (1) • Aluminium is a good conductor of heat (1) so it will cook food effectively (1) • Aluminium is lightweight (1) so easy to handle (1) • Aluminium can be coated with non-stick surface (1) allowing it to be easily cleaned (1) • Aluminium is resistant to corrosion (1) so it is durable (1) Accept any other appropriate response.	**(4)**

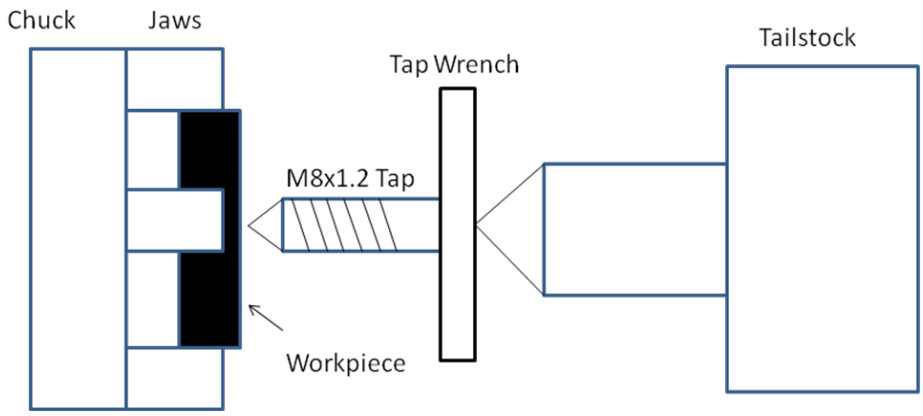
Question Number	Answer	Mark
5(c)	Up to eight marks for description of process (max 8). Thermosetting polymers  Or  Thermoplastic polymers	**(8)**

	 or  • Thermosetting polymers retain their shape when subjected to heat (1) which means that the handle will not deform during use (1). • The molecular chains in thermosetting polymers develop cross links (1) which means once formed they cannot be deformed (1). • Thermoplastics polymers do not retain their shape under heat (1) because the long chain molecules are free to move independently and can change shape (1). • In direct contact with the heater from the cooker a thermoplastic polymers handle would melt (1) causing toxic fumes (1). Accept any other appropriate response.	

Question Number	Answer	Mark
6.	Cutting Taper Set Up	**(12)**



Screw Thread Set Up



A sequence of making tasks

- Drill hole and tap (1) before taper turning (1).

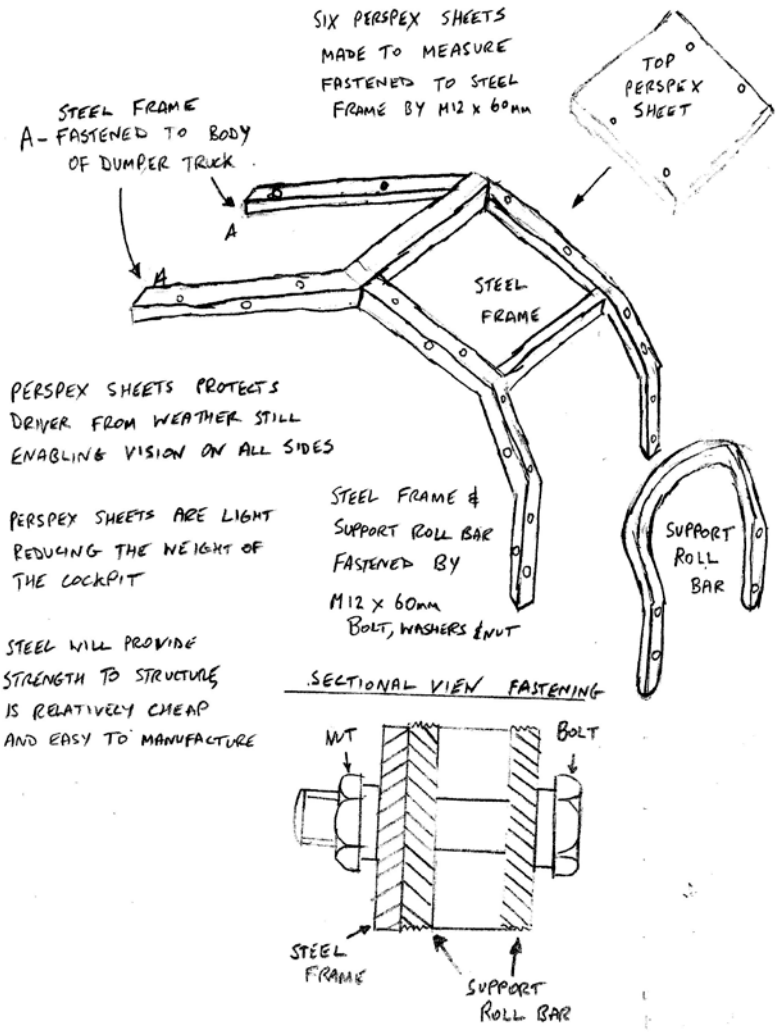
How the work is held centrally in the lathe

- Using a four jaw chuck (1) and using a datum (1).

How the taper is achieved

- Offset compound slide (1) by 5.0 degrees (1). 5 degrees is correct, TR

	How the screw thread is produced on the lathe using a tap • Centre drill (1) drill a 6.8mm hole (1) use taper tap (1) use plug tap (1). How a drunken thread (a thread that wobbles in use) is avoided • Fix a tap in the Jacob's chuck (1) to ensure is at right angles to hammer head (1) Accept any other appropriate response.	

Question Number	Answer	Mark
7	 A canopy that partly protects the driver from the weather (1) completely protects the driver from the weather (2) A canopy that enables the driver to see less than 360 degrees (1) a canopy that enables the driver to see 360 degrees (2) A permanent method of fastening the canopy (1) temporary method of fastening the canopy to the dumper truck (2) A design that functions but not safe (1) a safe	**(10)**

	working design that completely functions (2) Identifying materials for each individual component (1) with appropriate reason and justification of materials (2)	

Question Number		Indicative Content
8		Mild steel is a low carbon steel with less than 0.3 % carbon content. This makes the steel cheaper to buy as aluminium alloy is more expensive to purchase. Mild steel is a tougher material than aluminium. Aluminium alloy however is easier to work with during manufacture. Mild steel is a stronger/tougher material than aluminium alloy which tends to be a softer/ weaker material. Mild steel has a higher density than aluminium alloy which makes mild steel heavier than aluminium alloy. This is important as a more powerful engine would be required to move a mild steel dumper truck than an aluminium alloy dumper truck. Usually after manufacture mild steel will have a protective coating coated on its outer shell to prevent corrosion which is necessary working in an outside environment. Aluminium alloy will not require a protective coating as the material is non-corrosive.
Level	Mark	Descriptor
	0	No rewardable material
1	**1-3**	Some brief acknowledgement of the difference between the two materials. 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 both criteria. 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 full understanding and detailed comparison of the difference between the two materials. The answer should consider two criteria (performance requirements and ease of manufacture) reflecting arguments to determine 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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