

# **Cambridge Technicals Applied Science**

## **Unit 1: Science fundamentals**

Level 3 Cambridge Technical in Applied Science  
**05847 - 05849, 05874 & 05879**

## **Mark Scheme for January 2024**

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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## MARKING INSTRUCTIONS

### PREPARATION FOR MARKING

#### TRADITIONAL

Before the Standardisation meeting you must mark at least 10 scripts from several centres. For this preliminary marking you should use **pencil** and follow the **mark scheme**. Bring these **marked scripts** to the meeting.

#### MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the traditional 40% Batch 1 and 100% Batch 2 deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or by email.
5. **Crossed Out Responses**  
Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

#### **Rubric Error Responses – Optional Questions**

Where candidates have a choice of questions across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. (The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)

#### **Multiple Choice Question Responses**

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate). When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

#### **Contradictory Responses**

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

**Short Answer Questions** (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. (The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)

**Short Answer Questions** (requiring a more developed response, worth **two or more marks**)




If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

**Longer Answer Questions** (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional lined pages if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add an annotation to confirm that the work has been seen.
7. There is a NR (No Response) option. Award NR (No Response)
  - if there is nothing written at all in the answer space
  - OR if there is a comment which does not in anyway relate to the question (e.g. 'can't do', 'don't know')
  - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the questionNote: Award 0 marks - for an attempt that earns no credit (including copying out the question)
8. Assistant Examiners will email a brief report on the performance of candidates to your Team Leader (Supervisor) by the end of the marking period. Your report should contain notes on particular strength displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

## 9. Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
<b>BOD</b>	Benefit of doubt given
<b>CON</b>	Contradiction
<b>RE</b>	Rounding error
<b>SF</b>	Error in number of significant figures
<b>ECF</b>	Error carried forward
<b>L1</b>	Level 1
<b>L2</b>	Level 2
<b>L3</b>	Level 3
<b>NBOD</b>	Benefit of doubt not given
<b>SEEN</b>	Noted but no credit given
<b>I</b>	Ignore

## 10. Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

<b>Annotation</b>	<b>Meaning</b>
/	alternative and acceptable answers for the same marking point
<b>DO NOT ALLOW</b>	Answers which are not worthy of credit
<b>IGNORE</b>	Statements which are irrelevant
<b>ALLOW</b>	Answers that can be accepted
( )	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
<b>ECF</b>	Error carried forward
<b>AW</b>	Alternative wording
<b>ORA</b>	Or reverse argument

11. **Subject-specific Marking Instructions****INTRODUCTION**

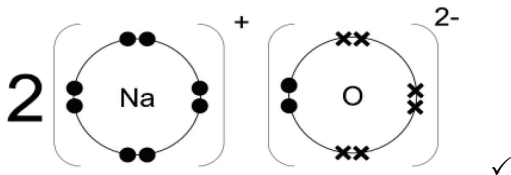
Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

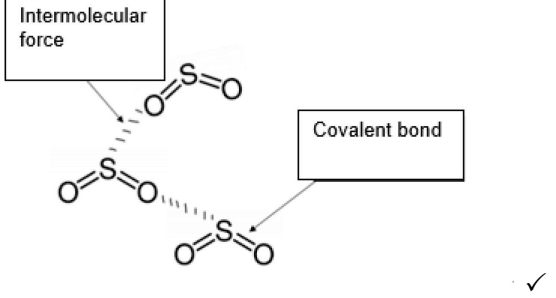
You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader

Question			Answer	Marks	Guidance
1	(a)	(i)	(Isotopes are atoms of the same element with the) same number of protons but different numbers of neutrons ✓	1	<b>ALLOW</b> same atomic (or proton) number, but different mass (or nucleon) number / atomic mass. <b>ALLOW</b> amount = number <b>IGNORE</b> references to electrons/atoms/elements
		(ii)	16,18,16✓	1	
		(iii)	Same number of outer electrons <b>OR</b> both have 6 outer/valence electrons✓ Similar <b>chemical</b> properties / non-metals✓	2	<b>DO NOT ALLOW</b> same number of electrons (unqualified) <b>IGNORE</b> references to protons/physical properties
	(b)	(i)	Na: 2,8,1✓ O: 2,6 ✓	2	<b>ALLOW</b> $1s^2, 2s^2, 2p^6, 3s^1$ <b>ALLOW</b> $1s^2, 2s^2, 2p^4$
		(ii)	 <p>Correct charges on ions</p> <p>2 Na<sup>+</sup> ions shown correctly✓</p> <p>1 O<sup>2-</sup> ion shown correctly ✓</p>	3	<b>DO NOT ALLOW</b> covalent presentation <b>ALLOW</b> 2 Na <sup>+</sup> and 1 O <sup>2-</sup> in any arrangement <b>ALLOW</b> 6 dots and 2 crosses for O <sup>2-</sup> <b>ALLOW</b> correct electron configurations <b>BUT</b> incorrect charges for Na or O = 1 mark <b>max</b> <b>ALLOW</b> For Na <sup>+</sup> , either 8 electrons or no electrons. <b>ALLOW</b> For O <sup>2-</sup> , dot and crosses required.
	(c)	(i)	<b>shared</b> ✓ <b>atoms</b> ✓	2	<b>ALLOW</b> only responses in correct order



Question	Answer	Marks	Guidance
(ii)		1	<p><b>ALLOW</b> IMF = intermolecular force</p> <p><b>ALLOW</b> = covalent (without 'bond')</p>
(iii)	<p>The intermolecular forces (IMF) are <b>weak</b>, ✓</p> <p>so only a <b>small</b> amount of / less energy is needed to break / weaken them. ✓</p>	2	<p><b>ALLOW</b> small = weak</p> <p><b>ALLOW</b> intermolecular forces/IMF are easily broken A/W = 1 mark max</p> <p><b>IGNORE</b> references to electromagnetic attraction</p>
(iv)	<p>The electrons/charges are shared unequally / O and S have different electronegativity / oxygen is more electronegative ✓</p>	1	
(d)	<p><b>Description</b></p> <p>(As atomic number increases) the atomic radius <b>decreases</b> ✓</p> <p><b>Explanation</b></p> <p><b>Greater attraction</b> between nucleus/protons AND <b>outer</b> electrons (as number of protons increases). ✓</p>	2	
	<b>Total</b>	<b>17</b>	

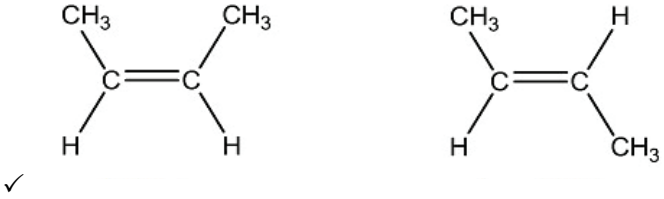
Question			Answer	Marks	Guidance
2	(a)	(i)	substitution ✓	1	
		(ii)	radicals ultraviolet intensity ✓✓	2	<b>ALLOW</b> any clear indication of choice 3 correct responses = 2 marks 2 correct responses = 1 mark 1 or 0 correct responses = 0 marks
		(iii)	increase in pressure <b>increases</b> the rate of reaction ✓ particles are closer together / more tightly packed ✓ more (frequent) collisions occur between particles ✓	3	MARK as independent points <b>ALLOW</b> reaction will happen more quickly / <b>ALLOW</b> less space <b>IGNORE</b> references to energy
	(b)		<b>chlorine</b> - 2 colour changes / displacements (both bromine and iodine) / displaces 2 halogens ✓ <b>bromine</b> – 1 colour change / displacement (iodine but not chlorine) / displaces 1 halogen ✓ <b>iodine</b> – no colour changes / displacements (does not displace chlorine or bromine) ✓ order of reactivity is chlorine, then bromine, then iodine ✓ A/W	4	<b>DO NOT ALLOW</b> chloride (unqualified) <b>DO NOT ALLOW</b> bromide (unqualified) <b>DO NOT ALLOW</b> iodide (unqualified) <b>ALLOW</b> chlorine most reactive <b>AND</b> iodine least reactive
	(c)		Fluorine is <b>reduced</b> because electrons are <b>gained</b> ✓ Chloride ions are <b>oxidised</b> because electrons are <b>lost</b> ✓	2	
<b>Total</b>				<b>12</b>	

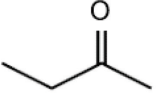
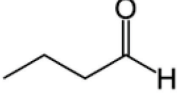
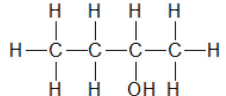
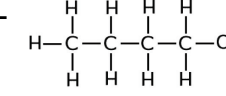
Question			Answer	Marks	Guidance
3	(a)	(i)	<p style="text-align: center;"><b>Label</b></p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 5px; width: 100px; text-align: center;">F</div> <div style="border: 1px solid black; padding: 5px; width: 100px; text-align: center;">G</div> </div> <div style="display: flex; justify-content: center; margin-top: 20px;"> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Cristae</div> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Chromatin</div> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Matrix</div> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Stroma</div> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Thylakoid</div> </div> <p style="text-align: right; margin-top: 10px;">✓✓</p>	2	
	(b)		<p>mitochondria are the site for, (aerobic) respiration / the release/provision of energy / the production of ATP ✓</p> <p>muscles require <b>a lot</b> of energy / ATP (for their function / to contract / movement) ✓</p>	2	<p><b>DO NOT ALLOW</b> production of energy (unqualified)  <b>IGNORE</b> powerhouse of the cell  <b>ALLOW</b> production of ATP as a source of energy</p>
	(c)		<p><b>movement</b> (of the skeleton/body) ✓</p>	1	<p><b>IGNORE</b> contraction (unqualified)</p>
	(d)	(i)	<p><b>Any one from:</b> ✓                      (myosin and actin filaments) <b>overlap</b> each other</p> <p>myosin filaments are inside actin filaments</p> <p>actin filaments cover myosin filaments</p>	1	<p><b>ALLOW</b> correct labelled diagram (showing overlapping filaments)</p> <p><b>ALLOW</b> crossover = overlap</p> <p><b>IGNORE</b> found in bundles (unqualified) / are parallel to each other</p>

Question		Answer	Marks	Guidance
	(ii)	<p><b>Any two from:</b></p> <p>myosin filaments are <b>stationary</b> ✓ A/W</p> <p>myosin <b>head</b> attaches to actin ✓</p> <p>actin slides over myosin ✓</p> <p>(ends of) actin filaments move towards each other ✓</p>	2	
(e)	(i)	Ca <sup>2+</sup> ✓	1	
	(ii)	<p>carbohydrate ✓</p> <p>lipid ✓</p>	2	<b>ALLOW</b> any clear indication of choice
(f)	(i)	Fe <sup>2+</sup> ✓	1	
	(ii)	cardiac ✓	1	<b>ALLOW</b> myocardium <b>IGNORE</b> heart
	(iii)	<p>blood <b>leaving</b> left side of the heart travels to the <b>rest of the body</b> / blood has further to travel / more body parts to reach ✓</p> <p>more <b>force</b> / <b>pressure</b> is needed (to pump the blood) ✓</p>	2	<b>ALLOW</b> reverse argument for right side throughout <b>IGNORE</b> references to speed of blood flow <b>IGNORE</b> references to (de)oxygenated
<b>Total</b>			<b>15</b>	

Question			Answer	Marks	Guidance
4	(a)	(i)	polysaccharide ✓	1	
		(ii)	glycosidic ✓	1	<b>ALLOW</b> correct phonetic spelling
		(iii)	condensation ✓	1	
		(iv)	<p><b>Any three from:</b> ✓✓✓</p> <ul style="list-style-type: none"> <li>• <b>strong</b> / strength / support / shape / structure</li> <li>• pliable/flexible/can bend</li> <li>• insoluble</li> <li>• water-permeable</li> <li>• cross-linking / hydrogen-bonding between chains</li> <li>• OH groups attract water molecules</li> <li>• porous</li> <li>• mesh-like structure</li> </ul>	3	<p><b>ALLOW</b> reference to covalent bonds being strong</p> <p><b>ALLOW</b> reference to rotation around links</p> <p><b>DO NOT ALLOW</b> semi-permeable</p>

Question		Answer	Marks	Guidance									
(b)	(i)	<table border="1"> <tr> <td></td> <td>Polyethene</td> <td></td> </tr> <tr> <td></td> <td>Polyvinyl chloride (PVC)</td> <td></td> </tr> <tr> <td></td> <td><u>Polypropene</u> <u>/PP</u> ✓</td> <td></td> </tr> </table>		Polyethene			Polyvinyl chloride (PVC)			<u>Polypropene</u> <u>/PP</u> ✓		3	<b>ALLOW</b> one Cl bonded above or below either carbon
		Polyethene											
	Polyvinyl chloride (PVC)												
	<u>Polypropene</u> <u>/PP</u> ✓												
	(ii)		1	<b>IGNORE</b> use of brackets <b>DO NOT ALLOW</b> use of n / n = 3 <b>DO NOT ALLOW</b> terminal hydrogens									

Question		Answer	Marks	Guidance
(c)	(i)		1	Both structures correct for one mark <b>ALLOW</b> displayed or skeletal formulae
	(ii)	<ul style="list-style-type: none"> <li>atoms / groups <b>cannot</b> rotate freely around the double bond ✓</li> <li>but-2-ene has two <b>different</b> atoms / groups on each carbon atom in double bond ✓</li> </ul>	2	<b>ALLOW</b> double bond cannot rotate about its axis. <b>ALLOW</b> movement = rotate <b>ALLOW</b> limited / restricted = cannot <b>IGNORE</b> references to cis and trans / E and Z
<b>Total</b>			<b>13</b>	

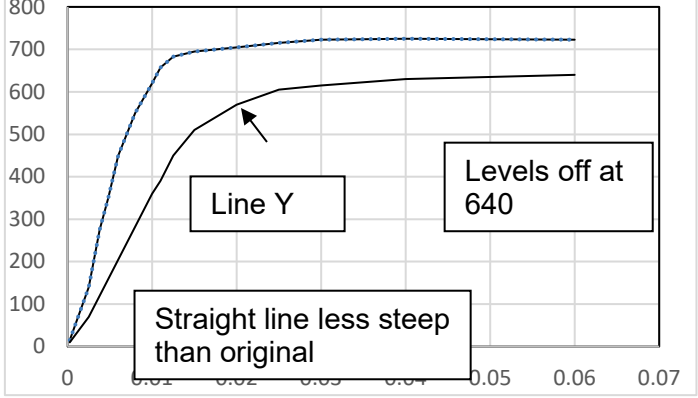
Question	Answer	Marks	Guidance - Indicative scientific points
5	<p><b>[Level 3]</b> Candidate makes a <b>detailed</b> comparison between compounds <b>Q</b> and <b>R</b> based on the three features listed. The comparison includes similarities <b>AND</b> differences. <i>(5 – 6 marks)</i></p> <p><b>[Level 2]</b> Candidate makes a <b>realistic</b> comparison between compounds <b>Q</b> and <b>R</b> based on the three features listed. The comparison includes similarities <b>AND</b> differences. <i>(3 – 4 marks)</i></p> <p><b>[Level 1]</b> Candidate makes a <b>limited</b> comparison between compounds <b>Q</b> and <b>R</b> based on the three features listed. The comparison includes similarities <b>OR</b> differences. <i>(1 – 2 marks)</i></p> <p><b>[Level 0]</b> Candidate includes fewer than two valid points. <i>(0 marks)</i></p>	6	<p><b>Name and Type</b></p> <ul style="list-style-type: none"> <li>• same name prefix</li> <li>• difference in name suffix</li> <li>• <b>Q</b> is <b>butanone</b></li> <li>• <b>Q</b> is a ketone</li> <li>• <b>R</b> is <b>butanal</b></li> <li>• <b>R</b> is an aldehyde</li> </ul> <p><b>Molecular and structural formulae</b></p> <ul style="list-style-type: none"> <li>• molecular formula is the same / <math>C_4H_8O</math></li> <li>• same number of carbon / hydrogen / oxygen (atoms)</li> <li>• both have <math>C=O</math> / double bond / carbonyl groups</li> <li>• skeletal formulae are different</li> <li>• position of <math>C=O</math> is different / (functional group) isomers</li> <li>• allow either Q and/or R models</li> </ul> <div style="display: flex; align-items: center; justify-content: center;"> <div style="text-align: center; margin-right: 20px;">   <b>Q</b> </div> <div style="text-align: center; margin-right: 20px;">   <b>R</b> </div> <div style="border: 1px solid black; padding: 5px; margin-left: 20px;">       -H optional for R     </div> </div> <p><b>How they are formed from alcohols</b></p> <ul style="list-style-type: none"> <li>• oxidation of alcohols / butanols</li> <li>• suitable oxidising agent (e.g. dichromate / manganate)</li> <li>• <b>Q</b> is formed from a <b>secondary</b> alcohol / butan-2-ol</li> <li>• correct formula of butan-2-ol</li> </ul> <div style="text-align: center; margin: 10px 0;">  </div> <ul style="list-style-type: none"> <li>• <b>R</b> is formed from <b>primary</b> alcohol / butan-1-ol</li> <li>• correct formula of butan-1-ol</li> </ul> <div style="text-align: center; margin: 10px 0;">  </div> <p><b>ALLOW</b> valid points added to the figure.</p>
	<b>Total</b>	<b>6</b>	



Question		Answer	Marks	Guidance															
6	(a)	biological/organic catalyst ✓	1	<b>ALLOW</b> protein/polypeptide that, acts as a catalyst / speeds up reactions (in cells/living organisms) <b>IGNORE</b> speeds up reactions (unqualified)															
	(b)	<table border="1"> <thead> <tr> <th></th> <th>True</th> <th>False</th> </tr> </thead> <tbody> <tr> <td>hydrogenase is a reactant</td> <td></td> <td>✓</td> </tr> <tr> <td>the reaction is reversible</td> <td>✓</td> <td></td> </tr> <tr> <td>H<sub>2</sub> is oxidised to H<sup>+</sup></td> <td>✓</td> <td></td> </tr> <tr> <td>electrons are gained by H<sub>2</sub></td> <td></td> <td>✓</td> </tr> </tbody> </table> ✓✓✓		True	False	hydrogenase is a reactant		✓	the reaction is reversible	✓		H <sub>2</sub> is oxidised to H <sup>+</sup>	✓		electrons are gained by H <sub>2</sub>		✓	3	4 correct rows = 3 marks 2 or 3 correct rows = 2 marks 1 correct row = 1 mark
	True	False																	
hydrogenase is a reactant		✓																	
the reaction is reversible	✓																		
H <sub>2</sub> is oxidised to H <sup>+</sup>	✓																		
electrons are gained by H <sub>2</sub>		✓																	
	(c) (i)	The <b>breakdown</b> of a compound (due to its reaction) with <b>water</b> ✓	1	<b>ALLOW</b> chemical bond = compound <b>ALLOW</b> breaks up = breakdown															
	(ii)	H <sub>2</sub> NCONH <sub>2</sub> + H <sub>2</sub> O (✓) → CO <sub>2</sub> + 2 NH <sub>3</sub> (✓)	2	<b>ALLOW</b> H <sub>3</sub> N = NH <sub>3</sub> and OH <sub>2</sub> = H <sub>2</sub> O															
	(d) (i)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 49(g) award 2 marks</b>  100g nuts contain 510µg Ni 1.00g nuts provide 5.10µg Ni ✓  mass of nuts providing 250µg Ni = 250 ÷ 5.10 = 49 g ✓	2	<b>ALLOW</b> 49.02 / 49.0196  <b>ALLOW</b> 510 (µg) ÷ 100 (g) seen anywhere = 1 <b>max</b>															
	(ii)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 10.1 (µg) award 2 marks</b>  150g kidney beans contain (45 x 150) ÷ 100 = 67.5 µg Ni ✓ Mass Ni absorbed = (67.5 x 15) ÷ 100 = 10.1µg ✓	2	<b>ALLOW</b> 10 / 10.13 / 10.125  <b>ALLOW</b> 45 (µg) ÷ 100 (g) <b>OR</b> (67.5 µg) x 0.15 / 15% seen anywhere = 1 <b>max</b>															
<b>Total</b>			<b>11</b>																

Question			Answer	Marks	Guidance
7	(a)	(i)	700(MPa) ✓	1	<b>ALLOW</b> 700 +/- 20 (MPa)
		(ii)	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = 80000 (MPa) award 2 marks</b></p> <p><b>Triangle</b> on the graph in the <b>straight-line</b> region ✓</p> <p>Young's modulus is the gradient e.g. <math>400/0.005 = 80000</math> (MPa) ✓</p>	2	<p><b>ALLOW</b> 80000 +/- 10000 (MPa)</p> <p><b>ALLOW</b> correct answer = 2 marks, even without the working shown on the graph</p> <p><b>ALLOW</b> evidence of an acceptable attempt to determine gradient on the graph e.g. straight line(s) / cross / other clear mark for 1 mark <b>max</b></p>
	(b)	(i)	<p>Volume = mass ÷ density</p> <p><math>25 \div 2.71 \times 10^3 = 0.009</math> (m<sup>3</sup>) ✓</p>	1	<b>ALLOW</b> 0.01 / 0.009225 / $9.22 \times 10^{-3}$ (m <sup>3</sup> )
		(ii)	<p>Mass Mg = <math>\frac{25 \times 5}{100} = 1.25</math> (kg) ✓</p>	1	

Question		Answer	Marks	Guidance
	(iii)	<b>Any two from:</b> ✓✓ Alloy X may be <ul style="list-style-type: none"><li>• more durable</li><li>• stronger / harder to break</li><li>• less ductile</li><li>• more resistant to fatigue</li><li>• less malleable</li><li>• harder</li></ul>	2	<b>ALLOW ORA</b> pure aluminium in all marking points  <b>ALLOW</b> alloy more tough / impact resistant  <b>IGNORE</b> references to stress point

Question	Answer	Marks	Guidance
(c)	<p>The <b>curved</b> line should be less steep / drawn to the right of alloy X ✓</p> <p>Line starts at 0,0 <b>AND</b> levels off <b>AND</b> stops at 640 +/-10 MPa ✓</p>	2	 <p><b>ALLOW</b> straight line starting at 0,0 <b>AND</b> stops at 640 +/-10 MPa, which remains under alloy X = 1 mark <b>max</b></p> <p><b>ALLOW</b> 2 small squares tolerance for 0,0</p>
	<b>Total</b>	<b>9</b>	

Question			Answer	Marks	Guidance
8	(a)	(i)	$\frac{1}{R_D} = \frac{1}{9} + \frac{1}{6}$ $R_D = 3.6 (\Omega) \checkmark$	1	<b>ALLOW</b> $\frac{18}{5}$ or $3\frac{3}{5}$
		(ii)	$R_t = 3.6 + 3.0 = 6.6 (\Omega) \checkmark$	1	<b>ALLOW</b> ecf for $R_D$ from (a)(i) i.e. value for (a)(i) + 3 <b>OR</b> correct answer using value from (a)(i)
		(iii)	$I = 4.5 \div 6.6 = 0.681 (A) \checkmark$	1	<b>ALLOW</b> 0.68 / 0.7 <b>ALLOW</b> ecf for $R_t$ from (a)(ii) i.e. $4.5 \div$ (a)(ii) <b>OR</b> correct answer using value from (a)(ii)
		(iv)	$P = 4.5 \times 0.681 = 3.07$ <b>AND</b> Watts / W $\checkmark$	1	<b>ALLOW</b> 3.0681/ 3.0645 / 3.06 <b>ALLOW</b> ecf for $I$ from (a)(iii) i.e. $4.5 \times$ (a)(iii) <b>BUT</b> must also state Watts / W <b>OR</b> correct answer using value from (a)(iii)
	(b)	(i)	The <b>wires</b> have different <b>thicknesses</b> / <b>cross sectional areas</b> $\checkmark$	1	<b>ALLOW</b> diameter / radius = thickness
		(ii)	<b>Using calculations</b> $I_A = 2.45 \div 9 = 0.272$ $I_B = 2.45 \div 6 = 0.4083 \checkmark$ $0.4083 \div 0.272 = 1.5 \checkmark$  <b>OR</b>  <b>Description</b>  <b>resistance</b> of A is 1.5 x <b>resistance</b> of B $\checkmark$ <b>same</b> p.d. / voltage across both $\checkmark$	2	<b>ALLOW</b> $I_B: I_A = R_A: R_B$ <b>OR</b> $I_A/I_B = R_B/R_A \checkmark$ $= 9: 6 = 1.5: 1 \checkmark$  <b>ALLOW</b> resistor A (9.0 $\Omega$ ) is 1.5 x bigger than resistor B (6.0 $\Omega$ ) = 1 mark <b>max.</b>
			<b>Total</b>	<b>7</b>	

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