

# **Cambridge Technicals Applied Science**

## **Unit 1: Science fundamentals**

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

## **Mark Scheme for June 2023**

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. Work crossed out:
  - a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
  - . if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.
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
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	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:

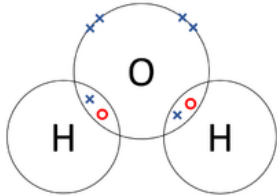
- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

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.

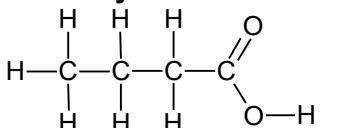
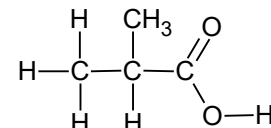
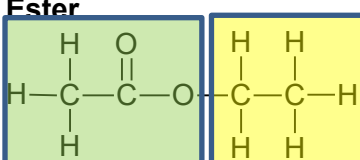
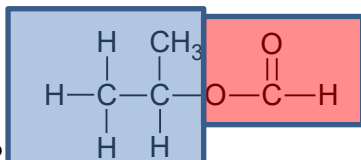
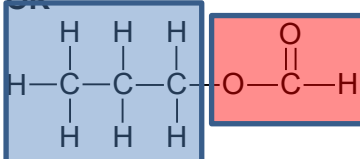
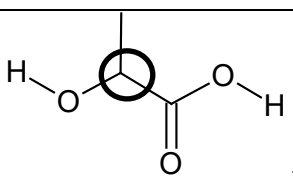
Question		Answer	Marks	Guidance
1	(a)	1 AND 6.9 ✓ 2,8,3 AND 13 ✓ 4/14 AND 14 ✓ 2,8,8,1 AND 39.1 ✓	4	1 mark for each correct row
	(b) (i)	rubidium ✓	1	<b>ALLOW</b> Phonetic spelling <b>ALLOW</b> Rb
	(ii)	<ul style="list-style-type: none"> <li>T/potassium/K loses <b>an/one</b> electron (to become a positive ion) <b>AND</b> Cl gains <b>an/one</b> electron (to become a negative ion) ✓</li> <li>Ionic bond is the <b>attraction</b> between positive and negative / opposite charged ions ✓</li> </ul>	2	<b>ALLOW</b> T gives/donates/transfers <b>an/one</b> electron to Cl/ chlorine <b>IGNORE</b> Metals / non metals <b>ALLOW</b> (they form ions with) opposite/positive and negative charges which <b>attract</b>
	(iii)	<ul style="list-style-type: none"> <li>same number of electrons in outer shell / 7 outer electrons ✓</li> <li>similar <b>chemical</b> properties/characteristics/reactions ✓</li> </ul>	2	<b>DO NOT ALLOW</b> same electron configuration <b>ALLOW</b> same, number of valence electrons / valency <b>ALLOW</b> same = similar

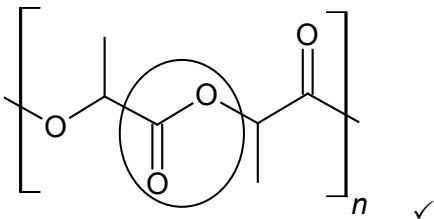
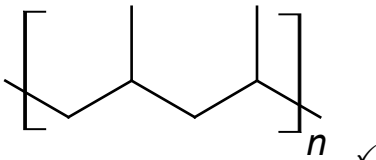
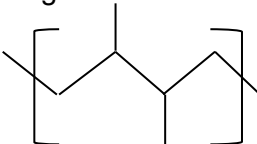
Question		Answer	Marks	Guidance
(c)	(i)	 <p>2 bonded pairs ✓</p> <p>2 lone pairs ✓</p>	2	<p><b>DO NOT ALLOW</b> bonded electrons drawn <b>on</b> the line</p> <p><b>ALLOW</b> lone pairs of electrons in any position outside of the points of overlap</p>
	(ii)	electrons are not shared equally between H and O / has a permanent dipole / oxygen has a greater electronegativity (than hydrogen) / bonding electrons attracted more strongly to oxygen ✓	1	
(d)	(i)	<b>weak</b> (nuclear force) ✓	1	
	(ii)	tritium has <b>one</b> proton and <b>two</b> neutrons, helium-3 has <b>two</b> protons and <b>one</b> neutron. ✓  (they are different elements because) they have different numbers of protons / different atomic numbers. ✓	2	<p><b>MUST</b> include reference to neutrons</p> <p><b>IGNORE</b> reference to isotopes</p>
<b>Total</b>			<b>15</b>	

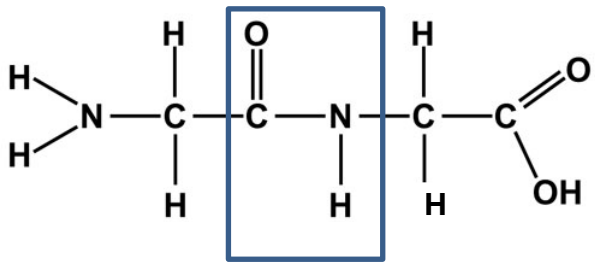


Question		Answer	Marks	Guidance						
2	(a) (i)	<p>V = DNA W = ribosome X = cytoplasm Y = cell wall</p> <p style="text-align: right;">✓✓</p>	2	<p>4 correct labels = 2 marks 3 or 2 correct labels = 1 mark 1 or 0 correct labels = 0 marks</p>						
	(ii)	<p>no membrane-bound organelles <b>OR</b> DNA is in a loop / not in a nucleus/membrane/envelope ✓</p>	1	<b>ALLOW</b> a named organelle which is <b>not</b> present (e.g. nucleus, mitochondria, chloroplasts, Golgi apparatus)						
	(b) (i)	<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; width: 50%;">Process</th> <th style="text-align: left; width: 50%;">Molecule formed</th> </tr> </thead> <tbody> <tr> <td style="vertical-align: top;"> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 10px;">transcription</div> </td> <td style="vertical-align: top;"> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">carbohydrate</div> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">lipid</div> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">mRNA</div> </td> </tr> <tr> <td style="vertical-align: top;"> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 10px;">translation</div> </td> <td style="vertical-align: top;"> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">protein</div> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">tRNA</div> </td> </tr> </tbody> </table> <p style="text-align: right;">✓✓</p>	Process	Molecule formed	<div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 10px;">transcription</div>	<div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">carbohydrate</div> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">lipid</div> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">mRNA</div>	<div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 10px;">translation</div>	<div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">protein</div> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">tRNA</div>	2	
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	(ii)	<p>DNA is <b>found/located</b> in the nucleus ✓</p> <p>DNA is in the <b>form</b> of chromatin (material) / chromosomes / chromatids ✓</p> <p>(free movement restricted by the) nuclear <b>membrane</b> / double <b>membrane</b> / envelope ✓</p>	3	<p><b>ALLOW</b> found in mitochondria</p> <p><b>ALLOW</b> form is a double helix <b>IGNORE</b> references to bases</p> <p><b>ALLOW</b> DNA too big to pass through the nuclear pores OWTTE</p>						
	(iii)	(codes for) ribosome production ✓	1							

Question		Answer	Marks	Guidance
	(c) (i)	gamete ✓	1	
	(ii)	testes ✓ oocytes ✓	2	<b>ALLOW</b> only correct words selected from the list provided <b>MUST</b> be in correct order
	(d) (i)	elastin <b>OR</b> collagen ✓	1	
	(ii)	fibrocytes/fibroblasts ✓	1	
	(iii)	supports/binds structures/cells/tissues/organs / gives structure ✓	1	<b>ALLOW</b> protection
<b>Total</b>			<b>15</b>	

Question	Answer	Marks	Guidance
3 (a) (i)	alcohol ✓	1	
(ii)	methyl propanoate ✓	1	
(iii)	<p><b>Carboxylic Acid</b></p>  <p>OR</p>  ✓	3	<p><b>ALLOW</b> any correct shortened or full structural/displayed formulae (or a combination of both) for all formulae</p> <p>CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>COOH <b>OR</b> CH<sub>3</sub>CH(CH<sub>3</sub>)COOH</p> <p><b>ALLOW</b> OH = O-H</p> <p><b>ALLOW</b> CH<sub>3</sub>COOCH<sub>2</sub>CH<sub>3</sub> <b>OR</b> CH<sub>3</sub>CH(CH<sub>3</sub>)OCHO</p> <p>methanoate or ethanoate group correctly drawn = 1 mark</p> <p>ethyl or propyl group attached to O of ester group = 1 mark</p>
	<p><b>Ester</b></p>  <p>OR</p>  ✓		
	<p><b>OR</b></p>  ✓✓		
(b) (i)	 ✓ It has four <b>different</b> groups attached to it ✓	2	<p><b>DO NOT ALLOW</b> if circle covers more than one atom</p> <p><b>IGNORE</b> functional <b>DO NOT ALLOW</b> atoms</p>

Question		Answer	Marks	Guidance
	(ii)	the two isomers are (non-superimposable) mirror images ✓	1	<b>NO NOT ALLOW</b> cis – trans <b>ALLOW</b> rotate polarised light in opposite direction <b>ALLOW</b> R and S / D and L (enantiomers)
	(iii)	 ✓	1	
	(iv)	 ✓	1	<b>ALLOW</b> as written <b>OR</b> as mirror image <b>OR</b> both vertical lines pointing down 
	(v)	condensation ✓ addition ✓	2	<b>MUST</b> be in correct order
(c)	(i)	glucose ✓	1	
	(ii)	source of energy/glucose store ✓	1	<b>DO NOT ALLOW</b> for respiration
	(d)	<b>Any three from</b> found around/covers nerve fibres / axons ✓ insulation ✓ <b>increases</b> speed of nerve impulse transmission / allows action potential to jump from one node of Ranvier to next ✓ stops interference of electrical impulse (from adjacent fibres/axons) ✓	3	<b>ALLOW</b> nerve cells / neurons <b>ALLOW</b> protection <b>IGNORE</b> reaction
<b>Total</b>			<b>17</b>	

Question		Answer	Marks	Guidance
4	(a)	metabolism ✓ degradation ✓	2	<b>MUST</b> be in correct order
	(b) (i)	<b>Benefit:</b> lower energy costs / catalyst does not get used up ✓ <b>Explanation:</b> lowers <b>activation</b> energy / adsorbtion weakens bonds ✓ allows a reaction to proceed via a different route ✓	3	<b>Mark across both response areas for all marks</b> <b>ALLOW</b> catalyst can be reused  <b>ALLOW</b> easier route
	(ii)	redox ✓	1	
	(iii)	KNO <sub>3</sub> ✓	1	
	(c) (i)	ammonium (ion) / NH <sub>4</sub> <sup>+</sup> ✓	1	<b>DO NOT ALLOW</b> ammonia
	(ii)	 <p>The diagram shows the structural formula of glycylglycine: H<sub>2</sub>N-CH<sub>2</sub>-C(=O)-NH-CH<sub>2</sub>-COOH. A blue rectangular box highlights the peptide bond, which is the covalent bond between the carbonyl carbon of the first amino acid (glycine) and the nitrogen of the second amino acid (glycine).</p>	2	1 mark for correct peptide link shown in any location 1 mark for correct remainder of molecule  <b>ALLOW</b> one mark for a structural formula i.e. H <sub>2</sub> NCH <sub>2</sub> CONHCH <sub>2</sub> COOH or reverse
	(iii)	enzymes / carrier proteins/molecules (in the plasma membrane) ✓	1	<b>DO NOT ALLOW</b> energy source <b>IGNORE</b> growth
	(d) (i)	sugar – phosphate - sugar ✓	1	

Question		Answer	Marks	Guidance
	(ii)		2	<b>ALLOW</b> negative OR 1- OR -1 <b>DO NOT ALLOW</b> any other negative number
	(iii)	manganese ion ✓	1	
	(iv)	non-polar outside hydrophilic protein  ✓✓✓	3	<b>ALLOW</b> responses <b>only</b> in the correct order  4 correct = 3 marks 3 correct = 2 marks 1 or 2 correct = 1 mark
<b>Total</b>			<b>18</b>	

Question	Answer	Marks	Guidance
5	<p><b>[Level 3]</b> Candidate give detailed calculations of stiffness <b>AND</b> explanations of suitability. (5 – 6 marks)</p> <p><b>[Level 2]</b> Candidate give limited calculations of stiffness <b>AND</b> explanations of suitability. (3 – 4 marks)</p> <p><b>[Level 1]</b> Candidate give basic calculations of stiffness <b>AND/OR</b> explanations of suitability. (1 – 2 marks)</p> <p><b>[Level 0]</b> Candidate includes fewer than two valid points. (0 marks)</p>	6	<p><b>Indicative valid points:</b></p> <p><b>Calculations</b></p> <p><b>Stiffness</b></p> <ul style="list-style-type: none"> <li>• Aluminium <math>S = 71 \times 10^9 \div 2820</math></li> <li>• <math>= 2.52 \times 10^7</math></li> <li>• Steel <math>S = 190 \times 10^9 \div 7980</math></li> <li>• <math>= 2.38 \times 10^7</math></li> <li>• Correct units = <math>\text{Nm kg}^{-1}</math></li> </ul> <p><b>E ratio</b></p> <ul style="list-style-type: none"> <li>• <math>1.9 \times 10^{11} \div 71 \times 10^9 = 2.68x</math> (ORA = 0.374x)</li> </ul> <p><b>Density ratio</b></p> <ul style="list-style-type: none"> <li>• <math>7980 \div 2820 = 2.83x</math> (ORA = 0.353x)</li> </ul> <p><b>Explanations</b></p> <ul style="list-style-type: none"> <li>○ aluminium is most suitable because it is less likely to flex / bend</li> <li>○ because aluminium has a greater stiffness</li> <li>○ aluminium is most suitable as it would have less weight than a steel handlebar</li> <li>○ because aluminium has a lower density</li> <li>○ steel will be most suitable because it is less likely to break / stronger</li> <li>○ because steel has a higher Young's modulus E</li> <li>○ qualified and balanced judgment (based on evidence above).</li> </ul>
	<b>Total</b>	<b>6</b>	

Question		Answer	Marks	Guidance					
6	(a)	(i)	solution ..... colloid ..... suspension ✓	1	<b>MUST</b> be in correct order				
		(ii)	<table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; width: 40%;">Description</th> <th style="text-align: left; width: 60%;">Colloid</th> </tr> </thead> <tbody> <tr> <td style="vertical-align: top;"> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 10px;">gas dispersed in a liquid</div> <div style="border: 1px solid black; padding: 2px; width: fit-content;">liquid dispersed in a gas</div> </td> <td style="vertical-align: top;"> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">aerosol</div> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">emulsion</div> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">foam</div> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">gel</div> <div style="border: 1px solid black; padding: 2px; width: fit-content;">sol</div> </td> </tr> </tbody> </table> <p style="text-align: right; margin-top: 10px;">✓✓</p>	Description	Colloid	<div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 10px;">gas dispersed in a liquid</div> <div style="border: 1px solid black; padding: 2px; width: fit-content;">liquid dispersed in a gas</div>	<div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">aerosol</div> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">emulsion</div> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">foam</div> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 5px;">gel</div> <div style="border: 1px solid black; padding: 2px; width: fit-content;">sol</div>	2	
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	(b)	(i)	(melting point) decreases and then increases ✓ Lowest melting point is <b>62-64%</b> / <b>184 (±2) °C</b> ✓	2					
		(ii)	212 ±1(°C) ✓ 85 ±1 (%) ✓	2					
		(iii)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 1.8 (g) award 3 marks</b>  Solder with a melting point of 280 °C is 20% tin / 80% lead ✓  mass of tin is quarter of the amount of lead ✓  mass of tin = 7.2 x 0.25 = 1.8 (g) ✓	3	<b>ALLOW</b> 1 mark <b>max.</b> if (20% of 7.2 =) 1.44 (g)				
<b>Total</b>			<b>10</b>						



Question			Answer	Marks	Guidance
7	(a)	(i)	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = 15 <math>\Omega</math> award 2 marks</b></p> <p><math>\frac{1}{R_t} = \left( \frac{1}{22} + \frac{1}{47} \right) = 0.067</math> or <math>\frac{1}{R_t} = (0.045 + 0.021) = 0.067</math> ✓</p> <p><math>R_t = 15 (\Omega)</math> ✓</p>	2	<p><b>ALLOW</b> 0.067 anywhere in working space = 1 mark <b>max</b></p> <p><b>ALLOW</b> 14.9 / 14.93 / 15.0 = 1 mark <b>max</b></p>
		(ii)	<p><math>V = IR</math> OR <math>V = 0.3 \times 15</math></p> <p><math>V = 4.5 (V)</math> ✓</p>	1	<p><b>ALLOW ecf</b> using <math>0.3 \times a(i)</math></p> <p><b>ALLOW</b> 4.47 / 4.479 / 4.5</p>
		(iii)	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = 5.7 Coulombs award 3 marks</b></p> <p><math>I_2 = V/R_2 = 4.5 \div 47</math></p> <p><math>I_2 = 0.0957(\dots) A</math> ✓</p> <p><math>Q_2 = I_2 \times \text{time} = (0.0957 \times 60) = 5.7</math> ✓</p> <p>Units: Coulombs ✓</p>	3	<p><b>ALLOW ecf</b> using <math>a(ii) \div 47 = 1</math> mark</p> <p><b>ALLOW ecf</b> for <math>I_2</math> i.e. <math>I_2 \times 60 = 1</math> mark</p>
		(iv)	<p>energy transferred = <math>Q_2 \times V = 5.7 \times 4.5</math>  <math>= 25.65J</math> ✓</p>	1	<p><b>ALLOW ecf</b> using candidate's answers to <b>(a)(iii) x (a)(ii) = (a)(iv)</b></p>
	(b)		<p>lamp, cell, ammeter and variable resistor in series ✓</p> <p>voltmeter in parallel with the lamp ✓</p>	2	<p><b>IGNORE</b> voltmeter in series for mp1</p> <p><b>ALLOW</b> only if <b>no</b> obvious gaps</p>
<b>Total</b>				<b>9</b>	

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