



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

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**CO-ORDINATED SCIENCES**

**0654/33**

Paper 3 Extended Theory

**October/November 2016**

MARK SCHEME

Maximum Mark: 120

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**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1(a)	decomposer ;	<b>1</b>
1(b)	decay releases (named) nutrients ;	<b>1</b>
1(c)	no light ; prevents photosynthesis ;	<b>2</b>
1(d)(i)	grass / seeds → mouse → owl correct organisms in order ; arrows orientated correctly ;	<b>2</b>
1(d)(ii)	energy losses at each stage ; due to respiration / heat / excretion / not all eaten ; less energy available to the owls ;	<b>max 2</b>
	<b>Total:</b>	<b>8</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
2(a)(i)	any noble gas / carbon dioxide / water vapour ; [allow other trace gases]	<b>1</b>
2(a)(ii)	idea of incomplete combustion ; of fuel / named fuel ; which is a hydrocarbon ;	<b>3</b>
2(a)(iii)	6 / three pairs ;	<b>1</b>
2(b)(i)	$3O_2 \rightarrow 2O_3$ formula of oxygen ; balanced ;	<b>2</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
2(b)(ii)	sterilisation / kills (harmful) microorganisms/bacteria ;	<b>1</b>
	<b>Total:</b>	<b>8</b>

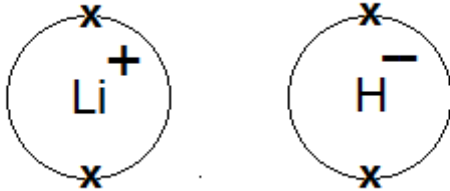
<b>Question</b>	<b>Answer</b>	<b>Marks</b>
3(a)(i)	$(\frac{1}{2} \times 10 \times 36 + 120 \times 36 + \frac{1}{2} \times 20 \times 36) = 4860$ (m) ;	<b>1</b>
3(a)(ii)	area under graph ;	<b>1</b>
3(a)(iii)	correct values shown from graph ; = $36 / 10$ (= $3.6 \text{ m/s}^2$ ) ;	<b>2</b>
3(b)(i)	(force =) mass $\times$ acceleration / $ma / 7 \times 10^4 \times 3.6$ ; $2.52 \times 10^5$ ; N ;	<b>3</b>
3(b)(ii)	(KE =) $\frac{1}{2} mv^2 / \frac{1}{2} \times 7 \times 10^4 \times 36 \times 36$ ; $4.5 \times 10^7$ (J) ;	<b>2</b>
3(c)(i)	(coil) spins / turns ; (current produces) magnetic field around coil / conductor / wire ; magnetic fields interact ; force on, coil / conductor / wire, carrying current in opposite directions ; force on opposite sides in opposite directions ;	<b>max 3</b>
3(c)(ii)	reverses current (every half turn) ; keeps the coil spinning (in the same direction) ;	<b>2</b>
	<b>Total:</b>	<b>14</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
4(a)	capillary ; lacteal ; epithelium ;	<b>3</b>
4(b)	increased surface area ; for absorption ;	<b>2</b>
4(c)(i)	nutrients absorbed less (efficiently)/loss of weight/ AVP ;	<b>1</b>
4(c)(ii)	eat small amounts frequently / eat easily digested or absorbed foods / eat nutrient-dense foods ;	<b>1</b>
	<b>Total:</b>	<b>7</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
5(a)(i)	sodium may explode / too reactive (to be safe) ; sulfur does not react ;	<b>2</b>
5(a)(ii)	increases ; acid concentration decreases / acid is used up / solution becomes less acidic ;	<b>2</b>
5(b)(i)	cobalt chloride paper ; changes (from blue) to pink ; OR anhydrous copper sulfate ; changes (from white) to blue ;	<b>2</b>
5(b)(ii)	(smaller) burning of hydrogen is exothermic ; chemical potential energy transferred from reactants as thermal energy (to surroundings) ;	<b>max 2</b>

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Question	Answer	Marks
5(c)(i)	 <p>correct electron configurations ; correct charges ;</p>	2
5(c)(ii)	<p>(M<sub>r</sub> LiH =) 8 ; moles of LiH = 100 ÷ 8 = 12.5 ; moles of hydrogen = 12.5 ÷ 2 = 6.25 ; calculate volume of hydrogen = 6.25 × 24 = 150 (dm<sup>3</sup>) ;</p>	4
	<b>Total:</b>	<b>14</b>

Question	Answer	Marks
6(a)(i)	<p>temperature change = 80 °C ; (energy =) mass × SHC × change in temperature / (mCΔT / 5000 × 4200 × 80 ; 1.68 × 10<sup>9</sup> (J) ;</p>	3
6(a)(ii)	latent heat (of vaporisation)/energy required to separate molecules from each other ;	1
6(a)(iii)	<p>(water is) <b>B</b> most particles are touching and random arrangement ; (steam is) <b>C</b> particles are spread out (and random arrangement) ;</p>	2
6(b)	<p>4 half-lives / 1 / 16 remains ; 0.0625 kg ;</p>	2

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
6(c)	electric field – alpha deflected gamma not ; magnetic field – alpha deflected gamma not ; alpha is charged / gamma is not charged / is a wave ;	<b>3</b>
	<b>Total:</b>	<b>11</b>

<b>Question</b>	<b>Mark Scheme Details</b>	<b>Marks</b>
7(a)	amylase ;	<b>1</b>
7(b)	energy source ; can be converted to alcohol ; provides sweetness / flavour ;	<b>max 2</b>
7(c)(i)	<u>anaerobic</u> respiration ;	<b>1</b>
7(c)(ii)	glucose → alcohol + carbon dioxide ;	<b>1</b>
7(d)	(rate of yeast growth increases) increased respiration ; ref to oxygen / aerobic respiration ; (aerobic respiration releases) more energy (for growth) ; rate of beer / alcohol production increases because more yeast ; AVP ;	<b>max 3</b>
	<b>Total:</b>	<b>8</b>

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Question	Answer	Marks
8(a)	butene ; alkenes ;	2
8(b)(i)	as $M_r$ increases the boiling point increases ; heavier/larger molecules: have greater intermolecular (attractive) forces/require a larger amount of (thermal/heat) energy to separate molecules ;	2
8(b)(ii)	72 ; each member is 14 units greater than the previous so $58 + 14 = 72$ ;	2
8(c)(i)	(addition) polymerisation ; poly(ethene) ;	2
8(c)(ii)	at least two carbon atoms with correct number of hydrogen atoms and only single bonds ; clear indication of continuation ;	2
	<b>Total:</b>	<b>10</b>

Question	Answer	Marks
9(a)	<u>kinetic</u> energy of particles increases / particles move faster ; more frequent collisions <u>with tyre</u> / hit tyre, with more force / harder ;	2
9(b)	use of $1/R_T = 1/R_1 + 1/R_2$ OR statement that combined resistance of 2 equal resistances in parallel is half one of the resistances ; $R_T = 2.5/2 = 1.25 (\Omega)$ ;	2
9(c)	relay uses a low current to switch on a high current ; safety/protection of low current, circuits/switches/cables ;	2
9(d)(i)	(E no mark) CSA of E is greater ;	1

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
9(d)(ii)	(D no mark) nichrome (has greatest resistance for same length and CSA) ; greater length and least CSA ;	<b>2</b>
	<b>Total:</b>	<b>9</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
10(a)	light ; high surface area (to volume ratio) ;	<b>max 1</b>
10(b)(i)	seed ;	<b>1</b>
10(b)(ii)	anchorage / holds the seed still (for germination) / AW ;	<b>1</b>
10(c)(i)	no, because not correlated / owtte ;	<b>1</b>
10(c)(ii)	mass / weight / size ;	<b>1</b>
10(d)	colonises new areas / reduces competition (within the species) / AVP ;	<b>1</b>
10(e)(i)	animals ; AVP ;	<b>max 1</b>
10(e)(ii)	matching adaptation ;	<b>1</b>
	<b>Total:</b>	<b>8</b>



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Question	Answer	Marks
11(a)	<b>A and E ;</b>	<b>1</b>
11(b)(i)	sulfuric (acid) ; water ;	<b>2</b>
11(b)(ii)	zinc is more reactive (than copper)/zinc atoms form ions more easily (than copper)/zinc displaces copper ;	<b>1</b>
11(b)(iii)	(copper ions) gain electrons ;	<b>1</b>
11(c)(i)	<b>X</b> cathode <u>and</u> <b>Y</b> anode ;	<b>1</b>
11(c)(ii)	(mass of negative electrode increases – no mark) copper <u>ions</u> are attracted / move to the cathode ; copper <u>ions</u> , gain electrons / are discharged, at the cathode ; copper <u>atoms</u> are formed at the cathode ;	<b>max 2</b>
	<b>Total:</b>	<b>8</b>

Question	Answer	Marks							
12(a)	$3.8 \times 10^{26} / 4.2 \times 10^{-12}$ ; $= 9 \times 10^{37}$ ;	<b>2</b>							
12(b)	fission – <u>nuclei</u> split (but fusion nuclei join) ;	<b>1</b>							
12(c)(i)	<table border="1" style="width: 100%; text-align: center;"> <tr> <td style="width: 15%;">γ-rays</td> <td style="width: 15%;"></td> <td style="width: 15%;">UV</td> <td style="width: 15%;">visible light</td> <td style="width: 15%;">IR</td> <td style="width: 15%;">microwaves</td> <td style="width: 15%;"></td> </tr> </table> ;	γ-rays		UV	visible light	IR	microwaves		<b>1</b>
γ-rays		UV	visible light	IR	microwaves				
12(c)(ii)	gamma ;	<b>1</b>							

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
12(d)	sound needs a medium / particles to travel through / sound does not travel through a vacuum ;	<b>1</b>
	<b>Total:</b>	<b>6</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
13(a)	$6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$ correct formulae of reactants and products ; balanced equation ;	<b>2</b>
13(b)(i)	P = cuticle ; Q = palisade / mesophyll ; R = xylem ;	<b>3</b>
13(b)(ii)	arrow coming in through the lower epidermis / stoma ;	<b>1</b>
13(c)(i)	palisade cells ; many chloroplasts / cells near the top of the leaf ;	<b>2</b>
13(c)(ii)	converted to chemical energy ;	<b>1</b>
	<b>Total:</b>	<b>9</b>