



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

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**CO-ORDINATED SCIENCES**

**0654/42**

Paper 4 Theory (Extended)

**May/June 2018**

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.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

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**PUBLISHED****Generic Marking Principles**

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

**GENERIC MARKING PRINCIPLE 1:**

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

**GENERIC MARKING PRINCIPLE 2:**

Marks awarded are always **whole marks** (not half marks, or other fractions).

**GENERIC MARKING PRINCIPLE 3:**

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

**GENERIC MARKING PRINCIPLE 4:**

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

**GENERIC MARKING PRINCIPLE 5:**

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

**GENERIC MARKING PRINCIPLE 6:**

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Question	Answer	Marks
1(a)(i)	L ; F ; E ;	3
1(a)(ii)	emulsifies fats / owtte ; increasing surface area ;	2
1(b)	by lacteal ; in the villi / villus ; in the small intestine ;	3
1(c)	lipase / enzyme, doesn't work in acidic conditions / low pH ; lipase / enzyme, denatured / shape changed / substrate no longer fits in active site ;	2

Question	Answer	Marks
2(a)(i)	temperature reading increases ; loss of magnesium ; bubbling;	max 2
2(a)(ii)	magnesium chloride ;	1
2(a)(iii)	reference to loss of electrons ;	1
2(b)	$2\text{Mg} + \text{CO}_2 \rightarrow 2\text{MgO} + \text{C}$ all formulae correct ; correctly balanced ;	2
2(c)(i)	$2 \times (100 - (8.5)) / 183 \text{ (g)} ;$	1
2(c)(ii)	$183 \div 24 = 7.6(3) ;$	1
2(c)(iii)	stronger / resists corrosion better ;	1

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
3(a)(i)	athletes <b>P, Q</b> and <b>S</b> ; evidence of time = distance / speed ; speed required is greater than 9.76 m / s / times for all athletes calculated ;	<b>3</b>
3(a)(ii)	KE = $\frac{1}{2} mv^2$ or $\frac{1}{2} \times 80 \times 9.80 \times 9.80$ ; = 3800 (J) ;	<b>2</b>
3(b)	same height as nose <b>and</b> behind mirror ; same distance behind mirror as object is in front ;	<b>2</b>
3(c)(i)	water molecules have a range of kinetic energies ; fastest moving / most energetic water molecules, escape / leave the surface ; bonds are broken / overcome forces of attraction between molecules ;	<b>3</b>
3(c)(ii)	increased surface area ; increased air flow / wind ; increased temperature ; decreased humidity ;	<b>max 2</b>

Question	Answer	Marks
4(a)	any <b>two</b> from: breast milk has more protein ; breast milk has more fat ; formula milk has more calcium ;  <b>and</b> correct data manipulation including units ;	<b>max 3</b>
4(b)(i)	nutrients pass from mother's <u>blood</u> to baby's <u>blood</u> ; nutrients cross the placenta ; by diffusion from mother to baby ; transported to baby by umbilical cord ;	<b>max 3</b>
4(b)(ii)	carbon dioxide circled ; urea circled ;	<b>2</b>

Question	Answer	Marks
5(a)(i)	<b>C and D ;</b>	<b>1</b>
5(a)(ii)	<b>B ;</b>	<b>1</b>
5(a)(iii)	<b>C and E ;</b>	<b>1</b>
5(b)(i)	air is liquefied ; fractional distillation of liquid air ;	<b>2</b>
5(b)(ii)	high pressure / 150 to 350 atm ; high temperature / 400 to 500 °C ; iron catalyst ;	<b>max 2</b>
5(c)(i)	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> ; reference to charge balance ;	<b>2</b>
5(c)(ii)	warm with sodium hydroxide ; test <u>gas</u> with damp red litmus paper ; litmus paper turns blue ;	<b>3</b>

Question	Answer	Marks
6(a)	black surfaces are good emitters of radiation / good radiators ; cooling fins have a large surface area ; copper is good thermal conductor ;	<b>max 2</b>
6(b)	$\Delta T = \Delta E / m \times shc$ or $475000 / 7.5 \times 4200$ ; = 15 (°C) ;	<b>2</b>
6(c)(i)	W – magnet X – coil Y – commutator Z – battery  2 or 3 correct ; 4 correct ;	<b>2</b>
6(c)(ii)	turns / spins faster ;	<b>1</b>
6(d)	region in which an electric charge experiences a force ;	<b>1</b>
6(e)	relay switches on high current circuit using a small current circuit / switch ;	<b>1</b>
6(f)(i)	suitable formula / substitution ; 1.5 ( $\Omega$ ) and 3 ( $\Omega$ ) ;	<b>2</b>
6(f)(ii)	1 ( $\Omega$ ) ;	<b>1</b>



Question	Answer	Marks															
7(a)	<table border="1"> <thead> <tr> <th>name of part</th> <th>letter</th> <th>function</th> </tr> </thead> <tbody> <tr> <td>cornea</td> <td>F</td> <td>refracts light and allows light to enter eye</td> </tr> <tr> <td>iris</td> <td>C</td> <td>controls amount of light entering (eye)</td> </tr> <tr> <td>lens</td> <td>D</td> <td>focuses <u>light</u> (onto retina)</td> </tr> <tr> <td>retina</td> <td>A</td> <td>contain light sensitive cells</td> </tr> </tbody> </table> <p>1 mark for each correct row ;;;;</p>	name of part	letter	function	cornea	F	refracts light and allows light to enter eye	iris	C	controls amount of light entering (eye)	lens	D	focuses <u>light</u> (onto retina)	retina	A	contain light sensitive cells	4
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7(b)	<i>ciliary muscle</i> relax / loosen ; <i>suspensory ligaments</i> tighten / stretch ; <i>lens becomes</i> long / thin ;	3															
7(c)	closer / less distance for impulse to travel ;	1															

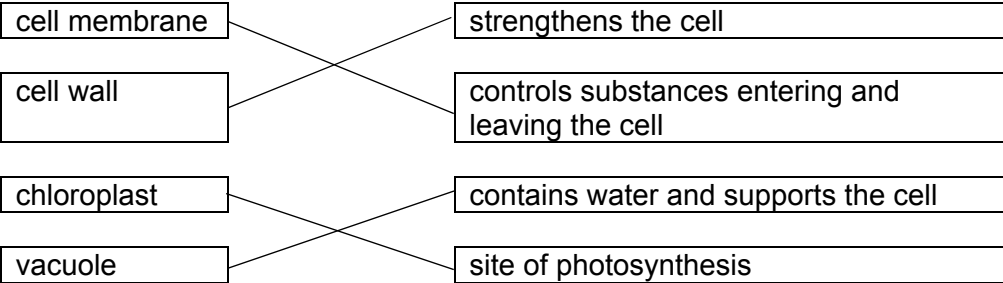
Question	Answer	Marks
8(a)(i)	brown solution / brown or black precipitate ; iodine displaced / chlorine more reactive than iodine ;	2
8(a)(ii)	outer electron shell in argon atoms is full / complete ;	1
8(b)	$Cl^-$ ; arranged alternately in two dimensions in the circles ;	2
8(c)	<b>X</b> sodium chloride / NaCl ; <b>Y</b> hydrogen / H <sub>2</sub> ; <b>Z</b> sodium hydroxide / NaOH ;	3

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
9(a)(i)	31000 (N) ;	<b>1</b>
9(a)(ii)	WD = F × D or 31000 × 50 ; = 1550 000 (J) ;	<b>2</b>
9(a)(iii)	1550 000 (J) ;	<b>1</b>
9(a)(iv)	pressure = force / area or 31000 / 2400 ; 13 (N / cm <sup>2</sup> ) ;	<b>2</b>
9(b)(i)	value below 20 Hz ; <u>20 Hz</u> is the minimum frequency humans can hear ;	<b>2</b>
9(b)(ii)	compression region of high pressure / rarefaction region of low pressure ; compression particles closer together / rarefaction particles further apart ;	<b>2</b>
9(b)(iii)	distance between two compressions or rarefactions ;	<b>1</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
10(a)(i)	snails ;	<b>1</b>
10(a)(ii)	frogs ;	<b>1</b>
10(b)(i)	sulfur dioxide ;	<b>1</b>
10(b)(ii)	carbon dioxide is a greenhouse gas / enhanced greenhouse effect ; carbon dioxide absorbs, heat / radiation, from Earth ; causes, global warming / climate change ; AVP ;	<b>max 3</b>

Question	Answer	Marks
11(a)(i)	petroleum / crude oil ;	1
11(b)(i)	$  \begin{array}{cccc}  \text{H} & \text{H} & \text{H} & \text{H} \\    &   &   &   \\  \text{H} - \text{C} - & \text{C} - & \text{C} - & \text{C} - \text{H} \\    &   &   &   \\  \text{H} & \text{H} & \text{H} & \text{H}  \end{array}  $ ;	2
11(b)(ii)	<p><b>difference</b>            butene has (two) fewer H atoms / butane is C<sub>4</sub>H<sub>10</sub> and butene is C<sub>4</sub>H<sub>8</sub> ;            butene is unsaturated / butene contains (C=C) double bond / ORA ;</p> <p><b>similarity</b>            both contain four carbon atoms / both are hydrocarbons / both contain covalent bonds</p>	2
11(c)(i)	the amounts of both gases are much greater in the exhaust gas mixture ; because both gases are produced when gasoline / hydrocarbons burn ;	2
11(c)(ii)	oxygen in air is in excess / there is more than required to burn all the gasoline / not all used up in combustion / owtte ;	1
11(d)(i)	nitrogen combines / reacts with oxygen / nitrogen is oxidised ;	1
11(d)(ii)	a catalyst ;	1
11(d)(iii)	nitrogen / N <sub>2</sub> since reduction involves removal of oxygen / oxygen removed from NO <sub>2</sub> ;	1

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
12(a)	stay the same increase increase  2 correct ; 3 correct ;	<b>2</b>
12(b)	top ray shows correct reflection ; middle ray strikes directly and bottom ray misses can ;	<b>2</b>
12(c)	energy needed to, increase / change, the temperature of an object by 1 °C ;	<b>1</b>

Question	Answer	Marks
13(a)	<b>P</b> upper epidermis ; <b>Q</b> spongy mesophyll cell ;	<b>2</b>
13(b)(i)	sucrose / amino acids ;	<b>1</b>
13(b)(ii)	xylem ; phloem ;	<b>2</b>
13(c)	 <p>1 correct ; 2 / 3 correct ; 4 correct ;</p>	<b>3</b>