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**CO-ORDINATED SCIENCES**

**0654/42**

Paper 4 Theory (Extended)

**May/June 2019**

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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This document consists of **12** printed pages.

**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)	45 (°C) ;	1
1(a)(ii)	enzyme denatures ; shape of, active site / enzyme, changes <b>or</b> substrate no longer fits into enzyme / active site ;	2
1(b)	correct axes labels ; correct shape ; peak in acidic region ;	3
1(c)	blue to purple ; enzymes are proteins ;	2

Question	Answer	Marks
2(a)(i)	nitrogen ; methane ;	2
2(a)(ii)	carbon dioxide ; water (vapour) ;	2
2(b)	cracking ;	1
2(c)(i)	$C_2H_4Br_2$ ;	1
2(c)(ii)	steam / water (vapour) ;	1
2 (d)(i)	ethene is <u>monomer</u> ; <u>many</u> , monomers / molecules, join to make a (long chain) <u>polymer</u> ;	2
2(d)(ii)	$\left[ \begin{array}{cc} \text{H} & \text{CH}_3 \\   &   \\ \text{---C} & \text{---C---} \\   &   \\ \text{H} & \text{H} \end{array} \right]_n ;$	1

Question	Answer	Marks
3(a)(i)	g to kg conversion ; (KE) = $\frac{1}{2} mv^2 / \frac{1}{2} \times 0.046 \times 50 \times 50$ ; = 57.5 (J) ;	3
3(a)(ii)	speed has magnitude (only) and velocity has magnitude and direction ;	1
3(b)(i)	from 0 to 400 g ; extension directly proportional to mass / straight line ;	2
3(b)(ii)	working e.g. $1.6 / 10 \times 300$ ; = 48 (g) ;	2
3(c)(i)	radiation ;	1
3(c)(ii)	fusion ;	1

Question	Answer	Marks
4(a)(i)	<b>A</b> (waxy) cuticle ; <b>B</b> (lower) epidermis ;	2
4(a)(ii)	arrow pointing to or through the stomata ;	1
4(b)	cells tightly packed ; cells are close to the surface of the leaf ; contain, (many) chloroplasts / (lots of) chlorophyll ; large vacuole / chloroplasts are at the edge of cell ; thin cell walls ;	max 2
4(c)	transfers light energy to chemical energy ; for the synthesis of (named) carbohydrates ;	2
4(d)	$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ left hand side correct ; right hand side correct ;	2

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
5(a)(i)	filtration ;	<b>1</b>
5(a)(ii)	solid / insoluble (substance) / residue / large particles, does not pass through filter paper / pores ;	<b>1</b>
5(b)(i)	solvent surface above bottom of paper and below spot ;	<b>1</b>
5(b)(ii)	xanthophyll ; second, highest / furthest up paper or third furthest, from solvent front or second highest $R_f$ ;	<b>2</b>
5(b)(iii)	<i>idea of isolating orange spot ;</i> dissolve compound in solvent ; evaporate solvent ;	<b>3</b>

Question	Answer	Marks
6(a)(i)	$1/R_T = 1/R_1 + 1/R_2$ or $1/33 + 1/33 = 0.06$ or $2/33$ ; $R_T = 16.5 (\Omega)$ ;	2
6(a)(ii)	current = voltage / resistance or $12/33$ ; = 0.36 (A) ; charge = current $\times$ time or $0.36 \times 30 (\times 60)$ ; = 650 (C) ;	4
6(b)(i)	(molecules) collide with / hit / rebound from, <u>walls</u> of tyre ; <u>exerting a force</u> ;	2
6(b)(ii)	increases ;	1
6(c)(i)	incident energy makes particles, vibrate <u>more</u> / gain energy ; this, vibration / energy, is transferred from particle to particle ; reference to, delocalised / free, electrons ; (delocalised / free) electrons transfer energy <u>through the solid</u> ;	max 3
6(c)(ii)	stronger forces of attraction between particles in solid ; particles in solid are in <u>fixed</u> positions or particles in gas are free to move throughout the gas ;	2

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
7(a)	septum labelled ;	<b>1</b>
7(b)	ref to <u>muscular / muscles</u> ; <u>contraction</u> of the, atria / ventricles ;	<b>2</b>
7(c)	vena cava ; pulmonary vein ;	<b>2</b>
7(d)(i)	stop smoking ; reduce consumption of fatty food / eat a more balanced diet ;	<b>2</b>
7(d)(ii)	male ; genetic predisposition / family history ;	<b>1</b>



Question	Answer	Marks
8(a)(i)	$2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$ correct formulae ; balanced ;	<b>2</b>
8(a)(ii)	oxidising agent: $Fe^{3+}$ / $Fe_2O_3$ / iron oxide <b>and</b> reducing agent: $Al$ / aluminium ; oxidising agent gains electrons and reducing agent loses electrons ;	<b>2</b>
8(b)(i)	to supply activation energy / described ;	<b>1</b>
8(b)(ii)	products have less (chemical) <u>energy</u> than reactants ;	<b>1</b>
8(c)(i)	reference to delocalised electrons ; lattice of positive ions ;	<b>2</b>
8(c)(ii)	mixture of a metal with other elements ;	<b>1</b>
8(c)(iii)	hardness ; malleability ; ductility ; melting / boiling, point ;	<b>max 2</b>

Question	Answer	Marks
9(a)(i)	number of waves passing a given point per unit time ;	1
9(a)(ii)	frequency greater than 20 000 Hz ;	1
9(a)(iii)	vibration / oscillation is in the same direction as energy transfer ;	1
9(b)	total internal reflection shown ; angle correct ;	2
9(c)	$1 \times 10^{14}$ (atoms remain) ; indication of 2 half-lives ; ( $50 \times 2 =$ ) 100 days ;	3

Question	Answer	Marks
10(a)(i)	two arrows pointing from the cells to outside the cells ;	1
10(a)(ii)	cell D (no mark) the concentration <u>gradient</u> is larger ;	1
10(b)(i)	removal from, organism / body ; of, (waste) products of metabolism / toxic materials / substances in excess of requirements ;	2
10(b)(ii)	across the (blood) capillary wall ; into the, alveoli / lungs ; through the, bronchioles / bronchus / trachea ; (breathed) out of, nose / mouth ;	max 3

Question	Answer	Marks
11(a)	reversible ;	1
11(b)(i)	450 °C ;	1
11(b)(ii)	greater yield / more sulfur trioxide produced ;	1
11(b)(iii)	reduced rate of reaction ;  <i>any two from</i>  particles have, lower speed / less (kinetic) energy ; fewer particles have sufficient, energy to react / activation energy or fewer successful collisions ; lower frequency of collision ;	max 3
11(c)	<u>oleum</u> ;	1
11(d)	Step 1: $(1000 / 32) = 31.25$ ; Step 2: 31.25 ; Step 3: $M_r (\text{H}_2\text{SO}_4) = 98$ ; Step 4: $31.25 \times 98 = 3100 \text{ (g)}$ ;	4

Question	Answer	Marks
12(a)	tracks spread weight over larger (surface) area ; so pressure is less ;	2
12(b)	$(v) = f \times \lambda$ <b>or</b> $5.98 \times 10^{14} \times 5.01 \times 10^{-7}$ ; $= 3.00 \times 10^8 \text{ (m)}$ ;	2
12(c)	all transverse waves ;	1
12(d)	(coil experiences) changing magnetic field ; (changing magnetic field) <u>induces</u> emf ; direction of emf changes every half turn ;	max 3

Question	Answer	Marks									
13(a)(i)	<p><i>any three from</i></p> <p>increase in availability of, nitrate (ions) / ions ;            (increased) growth of, plants / algae, on surface ;            block (sun) light ;            (plants below surface) can't photosynthesise ;</p>	<b>max 3</b>									
13(a)(ii)	<p><i>any three from</i></p> <p>decomposers / bacteria, feed on the (dead) plants ;            decomposers / bacteria, multiply ;            ref to respiration (of bacteria) ;            oxygen removed / lack of oxygen (in the water) ;</p>	<b>max 3</b>									
13(b)	<table border="1" data-bbox="340 691 1933 890"> <thead> <tr> <th data-bbox="340 691 770 756">mineral ions</th> <th data-bbox="770 691 1368 756">function</th> <th data-bbox="1368 691 1933 756">effect of deficiency</th> </tr> </thead> <tbody> <tr> <td data-bbox="340 756 770 821">magnesium</td> <td data-bbox="770 756 1368 821">needed for chlorophyll synthesis</td> <td data-bbox="1368 756 1933 821">yellow leaves</td> </tr> <tr> <td data-bbox="340 821 770 887">nitrate</td> <td data-bbox="770 821 1368 887">Making amino acids</td> <td data-bbox="1368 821 1933 887">stunted growth</td> </tr> </tbody> </table> <p>one row correct ; two rows correct ;</p>	mineral ions	function	effect of deficiency	magnesium	needed for chlorophyll synthesis	yellow leaves	nitrate	Making amino acids	stunted growth	<b>2</b>
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