



Cambridge IGCSE™

CO-ORDINATED SCIENCES

0654/41

Paper 4 Theory (Extended)

May/June 2020

MARK SCHEME

Maximum Mark: 120

Published

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

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

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

This document consists of **14** 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.

Science-Specific Marking Principles

- 1 Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
- 2 The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
- 3 Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
- 4 The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.

5 'List rule' guidance (see examples below)

For questions that require *n* responses (e.g. State **two** reasons ...):

- The response should be read as continuous prose, even when numbered answer spaces are provided
- Any response marked *ignore* in the mark scheme should not count towards *n*
- Incorrect responses should not be awarded credit but will still count towards *n*
- Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response
- Non-contradictory responses after the first *n* responses may be ignored even if they include incorrect science.

6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form, (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (*a*) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Question	Answer	Marks
1(a)(i)	oxygen ;	1
1(a)(ii)	the number of bubbles released / rate of photosynthesis increases and decreases (with temperature) ; peak at 45°C / 71 bubbles per minute ;	2
1(b)	enzymes denature at high temperature ; active site shape is changed ; substrate can no longer fit ; so rate of, reaction / photosynthesis decreases ;	max 3
1(c)(i)	starch ;	1
1(c)(ii)	ref to translocation ; transported as sucrose ; through the phloem ;	max 2

Question	Answer	Marks												
2(a)	<table border="1"> <thead> <tr> <th>particle</th> <th>charge</th> <th>relative mass</th> </tr> </thead> <tbody> <tr> <td>electron</td> <td>-1</td> <td>0.0005 / negligible / 1 + 1835</td> </tr> <tr> <td>neutron</td> <td>0 / no charge</td> <td>1</td> </tr> <tr> <td>proton</td> <td>+1</td> <td>1</td> </tr> </tbody> </table> <p>;; 1 mark for each correct column</p>	particle	charge	relative mass	electron	-1	0.0005 / negligible / 1 + 1835	neutron	0 / no charge	1	proton	+1	1	2
particle	charge	relative mass												
electron	-1	0.0005 / negligible / 1 + 1835												
neutron	0 / no charge	1												
proton	+1	1												
2(b)(i)	symbol – ${}_{35}^{81}\text{Br}$; protons 35, neutrons 46, electrons 35 ;	2												

Question	Answer	Marks
2(b)(ii)	(isotopes have the same properties because) they (both) have the same number of electrons in the outer shell / they (both) have seven electrons in the outer shell ;	1
2(c)(i)	metallic elements lose electrons to form positive ions ; non-metallic elements gain electrons to form negative ions ; (there is a) strong attraction between (oppositely charged) ions ; (because of) their opposite (electrical) charges ;	max 3
2(c)(ii)	bromine is covalent ; weak attractive forces (between molecules) ;	2

Question	Answer	Marks
3(a)	$KE = \frac{1}{2} mv^2$ or $KE = \frac{1}{2} \times 3800 \times 0.4 \times 0.4$; = 300 (J);	2
3(b)	area = 4×0.06 (m ²) or weight = 38 000 N; pressure = force / area = 38 000 / 0.24; = 160 000 (N/m ²);	3
3(c)	value between 0Hz and 20Hz no mark because 20Hz is the minimum audible frequency for a human;	1
3(d)(i)	 compression correctly labelled with a C;	1
3d(ii)	 one wavelength correctly shown with a double headed arrow (\leftrightarrow);	1

Question	Answer	Marks
3(d)(iii)	(region of) high pressure / low pressure or particles closer together / further apart;	1

Question	Answer	Marks
4(a)(i)	7 ;	1
4(a)(ii)	R / V ;	1
4(b)(i)	<p> Cross 1: $Bb \times Bb$ → BB, Bb Cross 2: $BB \times Bb$ → BB, Bb, bb Cross 3: $Bb \times bb$ → bb Cross 4: $bb \times bb$ → Bb, bb ;;; 1 correct for 1 mark 2-3 correct for 2 marks all correct for 3 marks </p>	3
4(b)(ii)	<u>pure</u> ;	1
4(c)	limited number of phenotypes ; cystic fibrosis caused by genes alone ;	2

Question	Answer	Marks
4(d)	alveoli get blocked ; reduces area for gas exchange ; pathogens / bacteria / dust, not removed ; breathing difficulties / coughing / wheezing ; (increased risk of) infection ;	max 3

Question	Answer	Marks
5(a)(i)	oxygen;	1
5(a)(ii)	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ correct formulae; correctly balanced;	2
5(b)(i)	(oxidation because) electrons are lost (from chloride ions);	1
5(b)(ii)	damp litmus paper ; (is) bleached ;	2
5(b)(iii)	$4.8 \div (24 \times 1000)$; 2.0×10^{-4} or 0.0002 ; or volume of chlorine = 0.0048 dm^3 ; ($0.0048 \div 24 =$) 2.0×10^{-4} or 0.0002 ;	2
5(c)	NaCl and I₂	1

Question	Answer	Marks
6(a)	thermal energy transferred as (vibrational) energy of atoms ; vibrations passed from atom to atom ; delocalised electrons transfer energy ;	max 2

Question	Answer	Marks
6(b)	evaporation can occur at any temperature / boiling occurs at the boiling point; evaporation happens only at the surface / boiling occurs throughout the liquid; during boiling all / most molecules have enough energy to leave / evaporation only lets the molecules with the greatest kinetic energy escape; evaporation can occur using the internal energy of the system / boiling requires a(n external) source of heat; evaporation is a slow process / boiling is a rapid process; evaporation produces cooling / boiling does not produce cooling;	max 2
6(c)	most – air and least copper ;	1
6(d)	evidence of division by 2 twice; 0.005 (Ω) ;	2
6(e)	$1/R_T = 1/R_1 + 1/R_2$ or $R_T = R_1 R_2 / R_1 + R_2$ or correct substitution; 0.24 (Ω) ;	2
6(f)(i)	coil labelled correctly;	1
6(f)(ii)	rotate coil faster ; increase magnetic field strength ;	2

Question	Answer			Marks
7(a)(i)	name of part	letter in Fig. 7.1	function	4
	umbilical cord	F	attaches growing baby to placenta	
	amnion / amniotic sac	D	contains amniotic fluid	
	amniotic fluid	E	protects baby from mechanical damage	
	placenta	A	site of exchange between the blood of the fetus and mother	
 1 mark for each row			
7(a)(ii)	carbon dioxide ;			1
7(b)(i)	sperm and eggs ;			1
7(b)(ii)	meiosis ;			1
7(b)(iii)	gametes have haploid nuclei / body cells have diploid nuclei ; gametes have unpaired chromosomes / body cells have paired chromosomes ; gametes have 23 chromosomes / body cells have 46 or 23 pairs ;			max 2

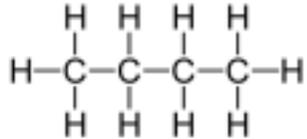
Question	Answer	Marks
8(a)	$\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$ correct formulae ; correctly balanced ;	2

Question	Answer	Marks
8(b)	$(0.75 \times 1000) \div 500$; $1.5 \text{ (mol/dm}^3\text{)}$; or volume of water = 0.500 dm^3 ; $(0.75 \div 0.500 =) 1.5 \text{ (mol/dm}^3\text{)}$;	2
8(c)	higher the concentration, higher the rate of reaction ; particles are more crowded / more particles per unit volume / more particles per cm^3 / increased chance of collision ; more frequent collisions / more collisions per second ;	3
8(d)(i)	(reaction in which), thermal energy / heat, is given out / more energy is given out than taken in / energy of products is less than energy of reactants ;	1
8(d)(ii)	B	1

Question	Answer	Marks
9(a)(i)	$3 \times 10^8 \text{ m/s}$;	1
9(a)(ii)	$v = \text{frequency} \times \text{wavelength}$ or correct substitution; 3.75×10^{19} ; Hz;	3
9(b)(i)	angles approximately correct for at least two reflections;	1
9(b)(ii)	angle of incidence exceeds critical angle;	1
9(c)(i)	relatively short half-life; γ -radiation can pass through body cells and be detected outside the body; γ -radiation is the least ionising;	max 2
9(c)(ii)	two half-lives (have occurred); 26 (hours);	2

Question	Answer	Marks
10(a)(i)	phototropism ;	1
10(a)(ii)	X drawn on the upper side of the shoot bend ;	1
10(a)(iii)	auxin ;	1
10(b)	auxin / hormone / chemical, produced at the shoot tip_;	1
10(c)	magnesium ions required to make chlorophyll ; chlorophyll absorbs light energy (and converts this to chemical energy) ; (chemical) energy used to synthesise, carbohydrates or glucose / carbohydrates or glucose are used to make proteins (for growth) ;	3
10(d)(i)	permanent ; mass ;	2
10(d)(ii)	any two from: movement reproduction sensitivity excretion nutrition respiration ;;	2

Question	Answer	Marks
11(a)	bitumen – road surfaces ; gasoline – fuel in cars ; refinery gas – bottled gas for heating or cooking or camping ;	3

Question	Answer	Marks
11(b)(i)	low boiling point colourless ignites easily unreactive any general property of a gas ;;	max 2
11(b)(ii)	 <p>1 mark for structure with 4 carbon atoms ; 1 mark for the rest of the structure correctly drawn ;</p>	2
11(b)(iii)	(family of compounds with) same general formula ; similar chemical properties ;	2
11(c)(i)	fermentation	1
11(c)(ii)	relative molecular mass of $C_2H_4 = 28$ and of $C_2H_5OH = 46$ or $(46 \times 5.6) \div 28$; $= 9.2$;	2

Question	Answer	Marks
12(a)	transfer of electrons; from pipe to fuel;	2
12(b)(i)	correct working (e.g. 50/40) ; $1.25 \text{ (m/s}^2\text{)}$;	2
12(b)(ii)	straight line;	1

Question	Answer	Marks
12(c)(i)	molecules further apart ; fewer molecules collide with, surfaces / walls, in unit time / lower frequency of collision of molecules with, surfaces / walls ;	2
12(c)(ii)	molecular motion – molecules in liquid water can move throughout but molecules in ice vibrate about a fixed point ; molecular arrangement – molecules in liquid water in random arrangement / molecules in ice in regular arrangement ;	2