Cambridge IGCSE™

CO-ORDINATED SCIENCES	**0654/41**
Paper 4 Theory (Extended)	**May/June 2022**
MARK SCHEME	
Maximum Mark: 120	

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.

Cambridge International is publishing the mark schemes for the May/June 2022 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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.

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 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)	B – root hair (cell) ; E – sperm (cell) ;	**2**
1(a)(ii)	presence of cilia ; to remove mucus (from the, trachea / bronchi / gas exchange system) ;	**2**
1(a)(iii)	*any two from:* biconcave shape ; contain haemoglobin ; no nucleus ;	**2**
1(b)	*any two from:* white blood cells ; platelets ; plasma ;	**2**
1(c)(i)	to prevent bursting / withstand high pressure (of blood) ;	**1**
1(c)(ii)	to prevent backflow of blood ;	**1**
1(c)(iii)	so there is a short diffusion distance / AW ;	**1**

Question	Answer	Marks
2(a)	alkenes ;	**1**
2(b)	cracking ;	**1**
2(c)(i)	long chain (molecule) / owtte ; formed from (many), small units / molecules / monomers ;	**2**

Question	Answer	Marks
2(c)(ii)	; ;	2
2(d)	H_2 ;	1
2(e)	(molecules contain) **only** single bonds ;	1
2(f)	;	1
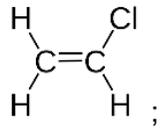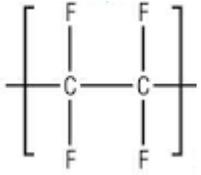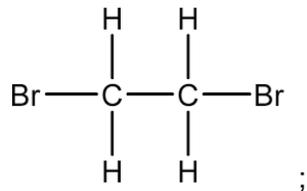
Question	Answer	Marks
3(a)(i)	(W = mg / 140 × 10) = 1400 (N) ;	1
3(a)(ii)	(W =) fxd / 1400 × 1.5 ; 2100 ; Joules / J ;	3
3(b)(i)	12 – 0.50 (= 11.5) ;	1
3(b)(ii)	(R =) V / I or 11.5 / 9.20 ; 1.25 (Ω) ;	2

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Question	Answer	Marks
4(a)(i)	4 ;	1
4(a)(ii)	unaffected ; Tt ; tt ; recessive ;	4
4(a)(iii)	0(%) ;	1
4(b)	*Mitosis joined to:* occurs after exact duplication of chromosomes ; produces cells with diploid nuclei ; produces nuclei with paired chromosomes ;	3
4(c)	46 / 23 pairs ;	1
4(d)	mutation ;	1

Question	Answer	Marks
5(a)(i)	increases / owtte ;	1
5(a)(ii)	salt ;	1
5(a)(iii)	$H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$;;	2
5(a)(iv)	H^+ ;	1
5(b)	132 ;	1
5(c)(i)	source of nitrogen is air **and** source of hydrogen is natural gas / methane ; *plus any two from:* (pressure of) 200 atmospheres ; (temperature of) 450 °C ; (iron) catalyst ;	3

Question	Answer	Marks
5(c)(ii)	relative formular mass of NH_3 =17 **and** of NH_4NO_3 = 80 ; $\dfrac{80 \times 51}{17}$ = 240 (kg) ;	**2**

Question	Answer	Marks
6(a)(i)	the moon ;	**1**
6(a)(ii)	(v =) $\sqrt{(2KE / m)} / \sqrt{(2 \times 1.62)}$ in any form ; 1.8 (m / s) ;	**2**
6(b)(i)	arrow drawn N to S ;	**1**
6(b)(ii)	slip ring(s) ; maintains electrical contact with brushes or circuit / prevents wires from becoming tangled / allows production of an ac output ;	**2**
6(b)(iii)	sinusoidal wave ; constant period and amplitude ;	**2**
6(c)	(v =) 3×10^8 (m / s) ; (f =) v / λ or $3 \times 10^8 / 4.0 \times 10^{-7}$; 7.5×10^{14} (Hz) ;	**3**

| Question	Answer	Marks
7(a)	stigma ;	**1**
7(b)	(pollen is) larger / heavier / stickier / less numerous ; (petals are) larger / brightly coloured / possess guidelines / scented ;	**2**
7(c)	ovule / ovary ;	**1**

Question	Answer	Marks
7(d)	no (genetic) variation ; a disease more likely to wipe out whole population / unable to adapt to changes in the environment ;	**2**
7(e)	*any two from:* oxygen ; water ; suitable temperature ;	**2**

Question	Answer	Marks
8(a)	**argon** – proton number = 18 ; **magnesium** – electronic configuration = 2.8.2 ;	**2**
8(b)(i)	same proton or atomic number / same number of protons ; (but) different nucleon number / different number of neutrons ;	**2**
8(b)(ii)	(both have) same numbers of electrons in the outer shell / same electronic structure ;	**1**
8(c)	(argon has) a full **outer** shell (of electrons) / AW ;	**1**
8(d)	(lattice of) positive ions ; in a 'sea of electrons' ;	**2**
8(e)	$MgCl_2$;	**1**
8(f)	$F_2 + 2NaCl \rightarrow Cl_2 + 2NaF$;;	**2**

Question	Answer	Marks
9(a)	reference to collisions ; with, light fast-moving particles / air particles / molecules ;	**2**
9(b)	initially pd is (directly) proportional to current / resistance is constant ; (as pd is increased) resistance increases shown by decreasing gradient ; as the filament heats up ;	**3**

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Question	Answer	Marks
9(c)(i)	 **F** = principal focus Image drawn and labelled ;	3
9(c)(ii)	(n =) sin i / sin r / sin 50 / sin 28 ; 1.63 ;	2
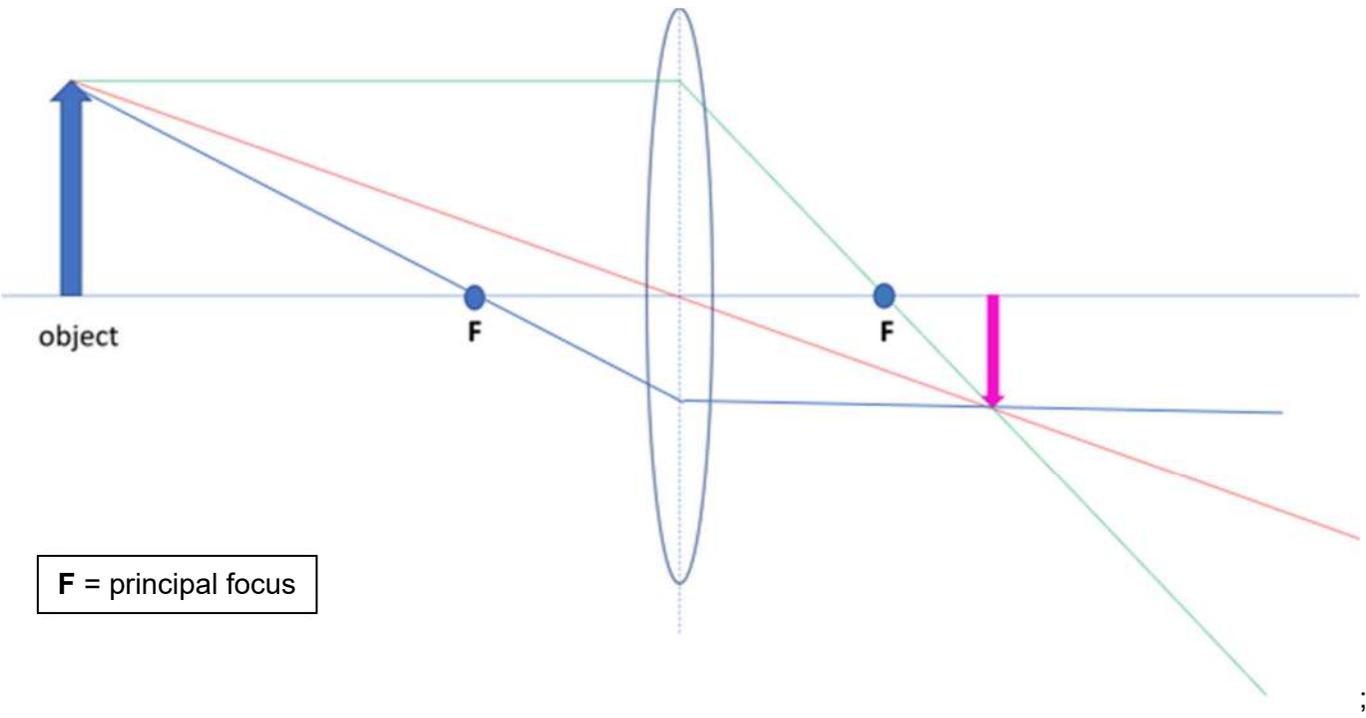
Question	Answer	Marks
10(a)	coughing ticked ; sneezing ticked ;	2
10(b)	sensitivity ;	1
10(c)(i)	60 (minutes) ;	1

Question	Answer	Marks
10(c)(ii)	*any three from:* increase in blood glucose concentration is <u>detected</u> by pancreas ; insulin released ; glucose converted to glycogen ; glycogen stored in liver ; **Max 3**	**3**
10(c)(iii)	negative feedback / homeostasis ;	**1**
10(d)	glucagon ; adrenaline ; AVP ;	**2**

Question	Answer	Marks
11(a)	2 **and** 3 ;	**1**
11(b)	***temperature*** (as the temperature increases, the rate of reaction) increases / owtte ; particles move faster / particles have more (kinetic) energy / more particles have, activation energy / sufficient energy, to react ; ***concentration*** (as the concentration increases, the rate of reaction) increases / owtte ; more particles per unit volume / less space between particles ;	**4**
11(c)	$(0.1 \times 36.5) = 3.65$ (g / dm^3) ;	**1**
11(d)	bond breaking is endothermic / absorbs energy owtte ; bond making is exothermic / releases energy owtte ; more <u>energy</u> is given out (in bond making) than is taken in (in bond breaking) ;	**3**

Question	Answer	Marks
12(a)(i)	7.9×10^6 (N) ;	**1**
12(a)(ii)	accelerates ; upwards;	**2**
12(a)(iii)	gravitational field strength decreases / rocket uses up fuel ;	**1**
12(b)	(125 mins =) 7500 (s) or 125×60 ; (d =) vxt / 7.1×7500 or 53 250 (km) ; (r_{orbit} =) d / 2π / 53 250 / (2×3.14) or 8475 (km) ; (r_{earth} =) 8475 − 2000 or r^{orbit} − 2000 = 6475 (km) ;	**4**
12(c)(i)	alpha AND beta ; they are charged / gamma is not charged ;	**2**
12(c)(ii)	$^{131}_{53}I \rightarrow {}^{131}_{54}Xe + {}^{0}_{-1}\beta$;;	**2**