



Cambridge IGCSE™

COMBINED SCIENCE

0653/31

Paper 3 Theory (Core)

October/November 2022

MARK SCHEME

Maximum Mark: 80

Published

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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:

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- 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).

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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
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GENERIC MARKING PRINCIPLE 4:

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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.
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- 5 'List rule' guidance

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

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ecf	error carried forward
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Question	Answer	Marks
1(a)(i)	B ;	1
1(a)(ii)	E ;	1
1(b)(i)	breaks down, large / insoluble, molecules into small molecules ; (small / new, molecules are) soluble ;	2
1(b)(ii)	enzymes ;	1
1(c)(i)	42 (g) ;	1
1(c)(ii)	3 (mg) ;	1
1(c)(iii)	the recommended daily allowance for protein for (15–18-year-old males) is higher than for females / AW ;	1
1(d)	needed for, bones / teeth ;	1

Question	Answer	Marks
2(a)(i)	<i>potassium fluoride</i> any symbols showing 2,8,8 ; any symbols showing 2,8 ;	2
2(a)(ii)	(a reaction in which) thermal / heat, energy is released ;	1
2(a)(iii)	<i>element</i> (contains) one type of atom (only) ; <i>compound</i> two or more elements chemically, combined / bonded / joined together ;	2
2(b)(i)	potassium sulfate ;	1
2(b)(ii)	<i>any two from:</i> increase temperature ; decrease particle size (of solid / potassium oxide) ; increase concentration (of acid) ; add a catalyst ;	2
2(c)	potassium carbonate + (dilute) hydrochloric acid → (potassium chloride) + carbon dioxide + water carbon dioxide ; water ;	2

Question	Answer	Marks
3(a)	friction ;	1
3(b)	evidence of, $W = mg$ / $1\,200\,000 \div 10$; 120 000 (kg) ;	2
3(c)(i)	one unit conversion correct ($1\text{ km} = 1000\text{ m}$ / $1\text{ hour} = 3600\text{ s}$) ; speed conversion shown ($= 27.8$ or 28) (m / s) ;	2
3(c)(ii)	evidence of, speed = distance $\div$ time / 28×50 ; 1400 (m) ;	2
3(d)(i)	horizontal line from $t = 0\text{ s}$ to $t = 50\text{ s}$; straight diagonal line from $t = 50\text{ s}$ to $t = 100\text{ s}$; horizontal line at 28 m/s AND diagonal line finishes at 84 m/s ;	3
3(d)(ii)	gravitational (potential) ;	1

Question	Answer	Marks
4(a)(i)	aorta ;	1
4(a)(ii)	pulmonary vein ;	1
4(a)(iii)	to pump blood ;	1
4(b)(i)	$25 \div 85 / 0.294117647$; answer to one sig. fig. / 0.3 ;	2
4(b)(ii)	(artery has / ORA) thicker wall ; smaller hole in centre ;	2
4(c)	hair ; osmosis ; xylem ;	3

Question	Answer	Marks
5(a)(i)	high temperature ;	1
5(a)(ii)	a gas is produced (that leaves the reaction mixture) ;	1
5(a)(iii)	oxygen is, lost / removed (from the copper ions) ;	1
5(a)(iv)	electrolysis ;	1
5(b)(i)	<i>any one from:</i> (good) conductor of electricity ; (good) conductor of heat ; high melting point ; high boiling point ; malleable ;	1
5(b)(ii)	<i>any two from:</i> copper / ORA, forms coloured compounds ; acts as catalyst ; has high density ; has high melting point ;	2
5(c)	metal X magnesium metal Y copper metal X (most reactive) and copper (least reactive) ; magnesium more reactive than metal Y ;	2

Question	Answer	Marks
6(a)	(the hairdryer) blows out unheated air ;	1
6(b)(i)	evidence of, $R = V \div I / 240 \div 9.5$; 25 ; Ω / ohm(s) ;	3
6(b)(ii)	to protect the circuit / to break the circuit if the current gets too high ;	1
6(b)(iii)	13 A ;	1
6(c)	good electrical insulator / bad electrical conductor ; good thermal insulator / bad thermal conductor ;	2

Question	Answer	Marks
7(a)(i)	P (cell) wall ; Q chloroplast ;	2
7(a)(ii)	controls the cell (activities) ;	1
7(b)	M below line of vascular bundles above lower epidermis ;	1
7(c)	water ; glucose + oxygen ;	2
7(d)(i)	respiration ;	1
7(d)(ii)	combustion ;	1

Question	Answer	Marks
8(a)	<i>test</i> copper(II) sulfate ; <i>result</i> turns (white to) blue ; OR <i>test</i> cobalt(II) chloride ; <i>result</i> turns (blue to) pink ;	2
8(b)	<i>compound P</i> alkene / unsaturated ; <i>compound Q</i> alkane / saturated ;	2
8(c)(i)	natural gas ;	1
8(c)(ii)	one pair of electrons correct ; everything else correct ;	2

Question	Answer	Marks								
9(a)	<table><thead><tr><th>word</th><th>description</th></tr></thead><tbody><tr><td>amplitude</td><td>distance between the peaks on consecutive waves</td></tr><tr><td>frequency</td><td>maximum displacement of a wave</td></tr><tr><td>wavelength</td><td>number of waves passing a point in space per second</td></tr></tbody></table> one correct ; three correct ;	word	description	amplitude	distance between the peaks on consecutive waves	frequency	maximum displacement of a wave	wavelength	number of waves passing a point in space per second	2
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	X-rays	ultraviolet	visible (light) ;			radio waves				
9(b)(ii)	reflected ray drawn from mirror to driver's eye AND angles of incidence and reflection equal (judged by eye) ; angles <i>i</i> and <i>r</i> correctly labelled ;	2								
9(b)(iii)	infrared ; conduction ; convection ;	3								



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1(a)(ii)	B ;	1
1(a)(iii)	label line to any of the salivary glands ;	1
1(a)(iv)	make / secrete, saliva / enzymes ;	1
1(b)(i)	glucose ;	1
1(b)(ii)	iodine (solution) ;	1
1(b)(iii)	as temperature increases, enzyme activity increases then decreases / AW ; idea of highest activity between 30 °C and 40 °C ;	2

Question	Answer	Marks
2(a)(i)	<i>solute</i> sodium chloride / salt / NaCl ; <i>solvent</i> water / H ₂ O ;	2
2(a)(ii)	water / H ₂ O / sodium chloride / NaCl ;	1
2(a)(iii)	filtration / filter / magnet;	1
2(b)	a greater number of (sodium chloride) particles per unit volume ;	1
2(c)	<i>anode</i> chlorine (gas) / Cl ₂ ; <i>cathode</i> hydrogen (gas) / H ₂ ;	2
2(d)	<i>electrons</i> 26 AND <i>protons</i> 26 ; <i>neutrons</i> 30 ;	2

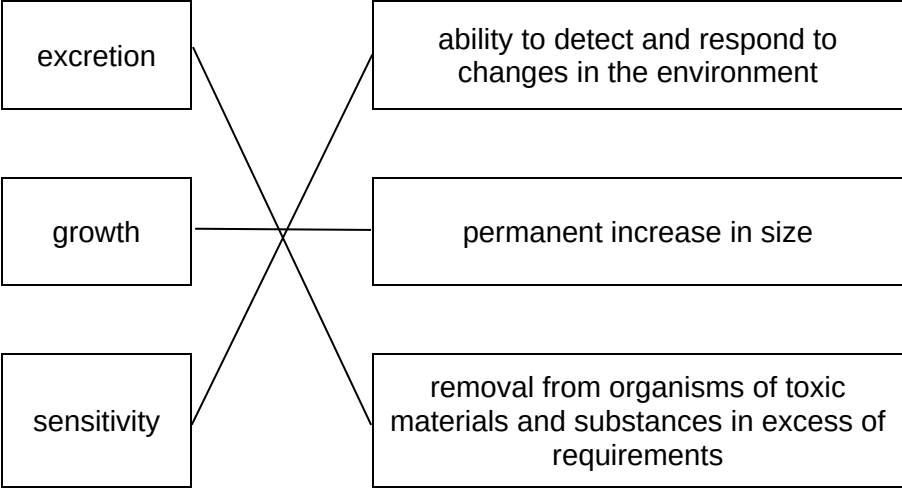
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3(a)(i)	weight ;	1
3(a)(ii)	223 000 (N) ;	1
3(b)(i)	one unit conversion correct (1 km = 1000 m / 1 hour = 3600 s) ; speed conversion shown (= 341) (m / s) ;	2
3(b)(ii)	evidence of, speed = distance ÷ time / 1609 ÷ 341 ; 4.72 (s) ;	2
3(c)	<i>any two from:</i> thermal / heat energy (of, surroundings / car / exhaust gases) ; sound energy (of, car / engines) ; kinetic energy of exhaust gases ; light / radiation, energy (from engines) ;	2
3(d)	time period 0–20 s 20–40 s 40–100 s description constant speed deceleration increasing speed 1 correct ; 3 correct ;	2

Question	Answer	Marks
4(a)	X produce / release, pollen ; Y attract insects (for pollination) ;	2
4(b)	(presence of) water ; (presence of) oxygen ;	2
4(c)(i)	cortex ;	1
4(c)(ii)	mesophyll ;	1
4(d)(i)	iron ;	1
4(d)(ii)	pH 6.0–8.0 ;	1
4(d)(iii)	chlorophyll ; maximum ;	2

Question	Answer	Marks
5(a)(i)	(magnesium) + hydrochloric acid → magnesium chloride + hydrogen hydrogen ; hydrochloric acid AND magnesium chloride ;	2
5(a)(ii)	<i>any one from:</i> increase temperature / heat ; increase (acid) concentration ; use a catalyst ; use, powdered / smaller pieces of, magnesium ;	1
5(a)(iii)	<i>any one from:</i> aluminium / Al ; zinc / Zn ; iron / Fe ;	1
5(a)(iv)	sulfuric (acid) ;	1
5(a)(v)	<i>test</i> (acidified aqueous) silver nitrate ; <i>result</i> white precipitate ;	2
5(b)(i)	oxygen is, added / gained ;	1
5(b)(ii)	any named carbon-containing compound ;	1
5(b)(iii)	methane ;	1

Question	Answer	Marks
6(a)(i)	correct symbol drawn ;	1
6(a)(ii)	amp(s) / ampere(s) ;	1
6(a)(iii)	5.4 A circled AND current at every point in a series circuit is the same / AW ;	1
6(a)(iv)	45 (Ω) ;	1
6(b)(i)	<i>switch 1</i> CLOSED AND <i>switch 2</i> OPEN ;	1
6(b)(ii)	(current) decreases AND total resistance (in the circuit) increases ;	1
6(b)(iii)	the combined resistance of two resistors / heating elements in parallel is less than that of either resistor / heating element by itself ;	1
6(b)(iv)	if one heating element breaks, the other still works / AVP ;	1

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Question	Answer	Marks
7(a)	 one correct ; all three correct ;	2
7(b)	respiration releases energy ; energy needed for muscle contraction ;	2
7(c)(i)	nucleus ;	1
7(c)(ii)	(in the) blood / plasma ;	1
7(d)(i)	concentration ; random ;	2
7(d)(ii)	osmosis ;	1

Question	Answer	Marks
8(a)	metal(lic) to non-metal(lic) ;	1
8(b)	X any transition metal named ; Y any Group I metal named ;	2
8(c)(i)	21(%) ;	1
8(c)(ii)	water ;	1
8(d)(i)	(consists of /contains) a single / one, atom ;	1
8(d)(ii)	has a full <u>outer</u> electron shell ;	1

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9(a)(i)	<table><tr><td>gamma</td><td></td><td></td><td></td><td>infrared</td><td></td><td>radio waves ;</td></tr></table>							gamma				infrared		radio waves ;	1
gamma				infrared		radio waves ;									
9(a)(ii)	number ; hertz / Hz ;							2							
9(b)(i)	radiation ;							1							
9(b)(ii)	conduction ;							1							
9(b)(iii)	any two from: geothermal ; hydroelectric ; tidal ;							2							
9(b)(iv)	centre ray not refracted ; outer two rays converging AND all three rays intersecting at F ;							2							



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3(b)(ii)	evidence of, speed = distance ÷ time / 1609 ÷ 341 ; 4.72 (s) ;	2
3(c)	<i>any two from:</i> thermal / heat energy (of, surroundings / car / exhaust gases) ; sound energy (of, car / engines) ; kinetic energy of exhaust gases ; light / radiation, energy (from engines) ;	2
3(d)	time period 0–20 s 20–40 s 40–100 s description constant speed deceleration increasing speed 1 correct ; 3 correct ;	2

Question	Answer	Marks
4(a)	X produce / release, pollen ; Y attract insects (for pollination) ;	2
4(b)	(presence of) water ; (presence of) oxygen ;	2
4(c)(i)	cortex ;	1
4(c)(ii)	mesophyll ;	1
4(d)(i)	iron ;	1
4(d)(ii)	pH 6.0–8.0 ;	1
4(d)(iii)	chlorophyll ; maximum ;	2

Question	Answer	Marks
5(a)(i)	(magnesium) + hydrochloric acid → magnesium chloride + hydrogen hydrogen ; hydrochloric acid AND magnesium chloride ;	2
5(a)(ii)	<i>any one from:</i> increase temperature / heat ; increase (acid) concentration ; use a catalyst ; use, powdered / smaller pieces of, magnesium ;	1
5(a)(iii)	<i>any one from:</i> aluminium / Al ; zinc / Zn ; iron / Fe ;	1
5(a)(iv)	sulfuric (acid) ;	1
5(a)(v)	<i>test</i> (acidified aqueous) silver nitrate ; <i>result</i> white precipitate ;	2
5(b)(i)	oxygen is, added / gained ;	1
5(b)(ii)	any named carbon-containing compound ;	1
5(b)(iii)	methane ;	1

Question	Answer	Marks
6(a)(i)	correct symbol drawn ;	1
6(a)(ii)	amp(s) / ampere(s) ;	1
6(a)(iii)	5.4 A circled AND current at every point in a series circuit is the same / AW ;	1
6(a)(iv)	45 (Ω) ;	1
6(b)(i)	<i>switch 1</i> CLOSED AND <i>switch 2</i> OPEN ;	1
6(b)(ii)	(current) decreases AND total resistance (in the circuit) increases ;	1
6(b)(iii)	the combined resistance of two resistors / heating elements in parallel is less than that of either resistor / heating element by itself ;	1
6(b)(iv)	if one heating element breaks, the other still works / AVP ;	1

Question	Answer	Marks
7(a)	one correct ; all three correct ;	2
7(b)	respiration releases energy ; energy needed for muscle contraction ;	2
7(c)(i)	nucleus ;	1
7(c)(ii)	(in the) blood / plasma ;	1
7(d)(i)	concentration ; random ;	2
7(d)(ii)	osmosis ;	1

Question	Answer	Marks
8(a)	metal(lic) to non-metal(lic) ;	1
8(b)	X any transition metal named ; Y any Group I metal named ;	2
8(c)(i)	21(%) ;	1
8(c)(ii)	water ;	1
8(d)(i)	(consists of /contains) a single / one, atom ;	1
8(d)(ii)	has a full <u>outer</u> electron shell ;	1

Question	Answer							Marks							
9(a)(i)	<table><tr><td>gamma</td><td></td><td></td><td></td><td>infrared</td><td></td><td>radio waves ;</td></tr></table>							gamma				infrared		radio waves ;	1
gamma				infrared		radio waves ;									
9(a)(ii)	number ; hertz / Hz ;							2							
9(b)(i)	radiation ;							1							
9(b)(ii)	conduction ;							1							
9(b)(iii)	any two from: geothermal ; hydroelectric ; tidal ;							2							
9(b)(iv)	centre ray not refracted ; outer two rays converging AND all three rays intersecting at F ;							2							