

Cambridge IGCSE™

COMBINED SCIENCE**0653/41**

Paper 4 Theory (Extended)

May/June 2025**MARK SCHEME**Maximum Mark: 80

Published

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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:

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Science-Specific Marking Principles

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	blank page
	unclear response
	two statements are linked
	follow through
	irrelevant material that does not answer the question

Question	Answer	Marks
1(a)(i)	lipase ;	1
1(a)(ii)	glycerol ;	1
1(b)(i)	increases ;	1
1(b)(ii)	130 and 370 ; $\frac{240 \times 100}{130}$ OR $((370 \div 130) \times 100) - 100$; 185 (%) ;	3
1(c)	active transport is against a concentration gradient and diffusion is down a concentration gradient OR active transport is movement from a low to high concentration and diffusion is movement from high to low concentration / AW ; <i>then any one from:</i> active transport requires energy / diffusion does not require energy ; both transport (food) molecules across a cell membrane ;	2

Question	Answer	Marks
2(a)(i)	anther ;	1
2(a)(ii)	pollen is transferred (by wind) ; (pollen moves) from anther to stigma ;	2
2(b)	enzyme denatures ; active site changes shape ; active site no longer complementary to substrate / substrate no longer fits active site ;	3

Question	Answer	Marks
2(c)(i)	(tube A) light not needed for germination (so indicator turns yellow) ; (tube C) water is required for germination (so indicator stays red) ;	2
2(c)(ii)	respiration ; oxygen ; $C_6H_{12}O_6$;	3

Question	Answer	Marks
3(a)(i)	plasmid labelled ;	1
3(a)(ii)	<i>any two from:</i> cell wall ; ribosomes ; cell membrane ; cytoplasm ;	2
3(b)(i)	<i>idea that</i> it helps prevent antibiotic resistance in bacteria ; <i>idea that</i> antibiotic becomes less effective (due to over use) / owtte ;	2
3(b)(ii)	(defence against a pathogen by) production of antibodies ;	1
3(c)(i)	decomposer ;	1
3(c)(ii)	<i>any one from:</i> hygienic food preparation ; personal hygiene / good hygiene ; clean water supply ; waste disposal ; AVP, e.g. vaccination ;	1

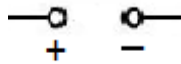
Question	Answer	Marks
4(a)	evaporation ; freezing ;	2
4(b)	(changing arrangement) from regular / fixed, to irregular / random ; (changing movement) from (particle) vibration to idea of, moving / sliding over each / move more freely ;	2
4(c)(i)	chromium / nickel / carbon ;	1
4(c)(ii)	different sized atoms ; (layers/atoms) can no longer slide over each other (in an alloy) / owtte;	2
4(d)	(Fe ₂ O ₃) loses oxygen ;	1

Question	Answer	Marks
5(a)(i)	red-brown ;	1
5(a)(ii)	<i>melting point</i> : from –100 to +24 (°C) inclusive ; <i>physical state</i> : solid ;	2
5(b)(i)	displacement ;	1
5(b)(ii)	chlorine + potassium bromide → potassium chloride + bromine ;	1
5(b)(iii)	(chlorine is) less reactive than fluorine ;	1
5(c)	$3\text{I}_2 + 2\text{Fe} \rightarrow 2\text{FeI}_3$;	1
5(d)(i)	addition ;	1
5(d)(ii)	orange / orange brown to colourless ;	1

Question	Answer	Marks
6(a)	add excess copper oxide (to the acid) ; filter (to remove the excess copper oxide) ; evaporate (some) water ; filter crystals / separate crystals / method of drying crystals slowly (e.g. warm oven / between filter paper / leave in an open space) ;	4
6(b)	sodium with 8 crosses in outer shell ; chloride with 7 dots and 1 cross in outer shell ; (1)+ and (1)– charges ;	3
6(c)	(giant) lattice / regular ; (ions are) alternating ;	2

Question	Answer	Marks
7(a)(i)	chemical ;	1
7(a)(ii)	(efficiency =) $\frac{\text{useful (energy) output}}{\text{total (energy) input}} (\times 100\%)$	1
7(b)	$a = \Delta v \div \Delta t / 18 \div 4.0$; 4.5 (= $\sim 5 \text{ m/s}^2$) ;	2
7(c)	$F = ma / 2000 \times 4.5$; 9000 ; N ;	3
7(d)	$E_k = \frac{1}{2} mv^2 / \frac{1}{2} \times 2000 \times (23^2 - 5.0^2) / 529\,000$ or 25 000 (evidence of use of formula) ; 504 000 (J) ;	2

Question	Answer	Marks
8(a)(i)	tyre A (<i>no mark</i>) same force (on both tyres due to shared weight of motorcycle) ; (over) smaller area (so greater pressure on road) / ORA ;	2
8(a)(ii)	moving particles colliding with, tyre / wall / owtte ; (particle / they) create / exert, a force and reference to area ;	2
8(b)(i)	radio waves ;	1
8(b)(ii)	3.0×10^8 (m/s) ;	1
8(b)(iii)	$v = f\lambda / 3.0 \times 10^8 \div 3.5 \times 10^8$; 0.86 (m) ;	2

Question	Answer	Marks
9(a)(i)	 AND current only flows in one direction in LED / current only able to flow in this direction through LED ;	1
9(a)(ii)	current in motor = $6.6 - 0.30 = 6.3$ A ; $R = V \div I / 9.0 \div 6.3$; 1.4 (Ω) ;	3
9(b)(i)	generator ;	1
9(b)(ii)	work ; charge ;	2
9(c)(i)	$v = 2\pi r \div T$ (<i>in any form</i>) / $2 \times \pi \times 15\,000 \div 17$; 5500 or 5.5×10^3 (s) ;	2
9(c)(ii)	13.8 billion years ;	1

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Question	Answer			Marks
1(a)	name of part	letter	function of part	3
	stomach	C	digestion	
	small intestine	E	(digestion and) absorption (of digested food)	
	salivary gland	A	produce, saliva / amylase	
	one mark for each correct row			
1(b)	protease: digests / breaks down, proteins (into amino acids) ; hydrochloric acid: kills, (harmful) microorganisms / pathogens / bacteria ; provides optimum / acidic / low pH, for enzyme / protease ;			3
1(c)	enzyme will denature ; active site changes shape ; active site no longer complementary to substrate / substrate no longer fits active site ;			3

Question	Answer	Marks
2(a)(i)	(F) root hair (cell) ; (G) xylem ;	2
2(a)(ii)	surface area ; mineral ions ;	2
2(b)	y-axis labelled as rate of transpiration ; line constantly increasing / constantly increasing then levelling off ;	2

Question	Answer	Marks
2(c)	<i>any three from:</i> (requires) carbon dioxide / CO ₂ and water / H ₂ O ; (requiring presence of) chlorophyll ; light energy converted to chemical energy ; (synthesis of), carbohydrates / glucose / C ₆ H ₁₂ O ₆ and oxygen / O ₂ formed (as a by product) ;	3

Question	Answer	Marks
3(a)(i)	<i>any two from:</i> second infection results in higher number of antibodies (compared to first infection) ; less time to release antibodies in second infection / faster response to second infection ; antibody number remains high(er) after infection ;	2
3(a)(ii)	vaccination ;	1
3(b)	(clean water contains) no pathogens (to transmit diseases) ;	1
3(c)(i)	converts units to match or bacteria diameter ÷ virus diameter (seen) ; 2.5 (×) ;	2
3(c)(ii)	antibiotics, have no effect on virus / only kill bacteria ; (excessive use / misuse, of antibiotics) results in bacteria with antibiotic resistance ;	2
3(c)(iii)	protein coat ;	1

Question	Answer	Marks
4(a)	high boiling point ;	1
4(b)	sodium with 8 crosses in outer shell ; fluoride with 7 dots and 1 cross in outer shell ; (1)+ and (1)– charges ;	3

Question	Answer	Marks
4(c)(i)	decomposition of an ionic compound (when molten or in aqueous solution) ; by (the passage of an electric) current ;	2
4(c)(ii)	<i>positive electrode</i> : fluorine / F ₂ ; <i>negative electrode</i> : sodium / Na ;	2
4(d)	NaF + AgNO ₃ → NaNO ₃ + AgF ;	1

Question	Answer	Marks
5(a)(i)	(because decomposition / use of fossil fuels) produces CO ₂ ; (CO ₂) is a greenhouse gas ;	2
5(a)(ii)	bond breaking takes in energy ; bond forming gives out energy ; more energy taken in than given out ;	3
5(a)(iii)	products labelled and higher than reactants and a maximum shown ; <i>E</i> _a correctly labelled ; overall energy change labelled and upward arrow only ;	3
5(b)(i)	Ca(OH) ₂ ;	1
5(b)(ii)	<u>yellow</u> ;	1

Question	Answer	Marks
6(a)	<i>any two from</i> : same general formula ; similar chemical properties ; trend in physical properties ;	2
6(b)	a compound that contains a double carbon to carbon bond ;	1

Question	Answer	Marks
6(c)	<u>cracking</u> ;	1
6(d)	<u>monomer</u> ;	1
6(e)(i)	acid(ic) ;	1
6(e)(ii)	contains oxygen / contains atoms other than carbon and hydrogen ;	1

Question	Answer	Marks
7(a)(i)	P ;	1
7(a)(ii)	tram is not moving up or down / is stationary in the vertical direction ;	1
7(b)(i)	$F = ma$ or $32\,000 \times 0.75$; 24 000 ; N ;	3
7(b)(ii)	$(\Delta v =) at / 0.75 \times 8.0$; 6.0 (m/s) ;	2

Question	Answer	Marks
7(b)(iii)	Method 1 (energy calculation) $E_k = \frac{1}{2}mv^2$ in any form or $\frac{1}{2} \times 32\,000 \times 6.0^2$ or 576 000 ; (power calculation) $P = E \div t$ in any form or $576\,000 \div 8.0$; OR Method 2 (energy calculation) $W = Fd$ or $24\,000 \times 24$ or 576 000 ; (power calculation) $P = E \div t$ in any form or $576\,000 \div 8.0$; OR Method 3 (power calculation) $P = F \times v$ or $24\,000 \times v$; (average velocity) $6 \div 2$; (power =) 72 000 (W) ;	3

Question	Answer	Marks
8(a)	<u>variable resistor</u> ;	1
8(b)(i)	plastic / wood / AVP ;	1
8(b)(ii)	free / delocalised electrons or electrons move ; particle / lattice <u>vibrations</u> or particle collisions or collision of electrons with, particles / the metal / the lattice or electrons / thermal energy, move from <u>hot area to cold area</u> ;	2
8(c)	(LED symbol)  ; (d.c. supply symbol)   ; LED correctly connected for polarity of supply ;	3

Question	Answer	Marks
9(a)(i)	<u>mass</u> ;	1
9(a)(ii)	$v = 2\pi r \div T$ in any form ; correct time = $365 \times 24 \times 3600$ OR 31536000s OR correct distance = $2\pi \times 1.5 \times 10^8$ OR 9.42×10^8 km ; (orbital speed =) 30 (km/s) ;	3
9(a)(iii)	Mars is further from the Sun (than Venus) ; less force of attraction / gravitational field (strength) of the Sun decreases with distance ;	2
9(b)(i)	supernova ; neutron star ;	2
9(b)(ii)	nuclear reactions or fusion ; fusion of hydrogen into helium ;	2

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

Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	correct point or mark awarded
	incorrect point or mark not awarded
	information missing or insufficient for credit
	incorrect or insufficient point ignored while marking the rest of the response
	contradiction in response, mark not awarded
	benefit of the doubt given
	error carried forward applied
	benefit of doubt was considered, but the response was decided to not be sufficiently close for benefit of doubt to be applied
	response is too vague or there is insufficient detail in response
	incorrect point or mark not awarded

Annotation	Meaning
	point has been noted, but no credit has been given or blank page seen
	key point attempted / working towards marking point / incomplete answer / response seen but not credited / blank page seen
	blank page
	unclear response
	two statements are linked
	follow through
	irrelevant material that does not answer the question

Question	Answer	Marks
1(a)(i)	red blood cell ;	1
1(a)(ii)	produce antibodies / phagocytosis ;	1
1(a)(iii)	prevent blood loss ; prevent entry of pathogens ;	2
1(b)(i)	larger / wider, lumen (than artery) ; thinner (muscular) wall (than artery) / less muscular wall ;	2
1(b)(ii)	magnification = image size ÷ actual size <i>in any form</i> or $15 \div 75$ or 0.2 ; 0.2×1000 ; 200 (μm) ;	3

Question	Answer	Marks
2(a)	G ; A ; B ;	3
2(b)	chlorophyll ; transfers light energy to chemical energy ; to synthesise / produce, carbohydrates / glucose ;	3
2(c)(i)	25 ($^{\circ}\text{C}$) ;	1
2(c)(ii)	enzymes denature (at high temperature) ; active site changes shape ; active site no longer complementary to substrate / substrate no longer fits active site ;	3

Question	Answer	Marks
3(a)(i)	bronchiole ;	1
3(a)(ii)	<i>any two from:</i> large surface area ; thin surface ; good blood supply ; good ventilation (with air) ; AVP ;	2
3(b)	$C_6H_{12}O_6 + 6O_2 \rightarrow 6H_2O + 6CO_2$;; <i>correct reactants (in either order) and balanced = 1 mark</i> <i>correct products (in either order) and balanced = 1 mark</i>	2
3(c)(i)	<i>any two from:</i> decrease in photosynthesis ; so less carbon dioxide removed from atmosphere / carbon dioxide (in atmosphere) increases ; AVP ;	2
3(c)(ii)	<i>any one from:</i> habitat destruction ; reduced biodiversity ; extinction ; loss of soil ; flooding ;	1

Question	Answer	Marks
4(a)(i)	(compound) B (no mark) high MP (and BP) or MP (and BP) above 25 °C ; (and) does not conduct electricity ;	2
4(a)(ii)	(compound) C and is a gas (at room temperature) / has a low BP (and MP) ;	1

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Question	Answer	Marks
4(b)	<i>arrangement</i> : from regular to random ; <i>energy</i> : increases ; <i>motion</i> : from fixed / vibrating, to, moving over each other / sliding over each other / moving around / moving freely ;	3
4(c)	compound A breaks down / electrolysis happens ; elements (from the compound) are formed ;	2

Question	Answer	Marks
5(a)(i)	<u>bromine</u> ;	1
5(a)(ii)	chlorine is more reactive than bromine ORA ;	1
5(a)(iii)	<u>endothermic</u> ;	1
5(b)(i)	sodium with 8 crosses in outer shell ; chloride with 7 dots and 1 cross in outer shell ;	2
5(b)(ii)	+ and – ions alternate along a row or down a column ; an adjacent row or column of correspondingly opposite ions ;	2
5(c)(i)	precipitation ;	1
5(c)(ii)	<u>sodium nitrate</u> ;	1

Question	Answer	Marks
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Question	Answer			Marks
6(a)(i)	molecule	formula of product	reaction conditions	4
	Br ₂ (aq)	C₂H₄Br₂ / CH₂BrCH₂Br ;	room temperature	
	H ₂ O(g)	C ₂ H ₅ OH	high temperature OR acid catalyst ;	
	H₂ ;	C ₂ H ₆	nickel catalyst ;	
6(a)(ii)	gas / gaseous ;			1
6(b)(i)	C₇H₁₄ ;			1
6(b)(ii)	same general formula / always has twice as many hydrogen atoms as carbon atoms / successive members differ by CH ₂ ; boiling points increase (down the series) ORA ;			2
6(b)(iii)	(they all) contain hydrogen / H and carbon / C only ;			1

Question	Answer	Marks
7(a)(i)	matter; gravitational ;	2
7(a)(ii)	$W = mg / 0.64 \times 9.8$; 6.3 (N) ;	2
7(b)(i)	$F = ma / 0.64 \times 0.25$; 0.16 (N) ;	2
7(b)(ii)	$(\Delta v =) a \times t$ or 0.25×5.2 ; 1.3 (m / s) ;	2
7(c)(i)	efficiency = $\frac{\text{power output}}{\text{power input}} \times 100$ OR $\frac{0.75}{3.00} \times 100$; 25 (%) ;	2
7(c)(ii)	energy transfer, to surroundings / internal energy of car / thermal energy of tyres, etc. or (by) work done against, friction / air resistance ;	1

Question	Answer	Marks
8(a)	heated water becomes less dense or heated water expands or heated molecules move further apart ; heated water rises ;	2
8(b)(i)	boiling ;	1
8(b)(ii)	(forces / they) decrease ;	1
8(c)(i)	alternating current / a.c. ;	1

Question	Answer	Marks
8(c)(ii)	$P = IV / 2000 \div 240$; 8.3 A ; 30 A fuse is not appropriate AND it would allow too large a current ;	3

Question	Answer	Marks
9(a)	13.8 billion years ;	1
9(b)	<i>any three from:</i> (from interstellar clouds of) gas / dust / a nebula ; due to gravitational attraction ; (stable stars are formed from) protostars ; gravity and pressure are balanced ;	3
9(c)(i)	$3.0 \times 10^8 \text{ m / s}$;	1
9(c)(ii)	ultraviolet ; visible light AND infrared ;	2
9(c)(iii)	sound waves need a medium (such as air) / cannot travel through a vacuum ORA or sound waves are longitudinal waves AND electromagnetic waves are transverse waves ;	1