CAMBRIDGE
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CO-ORDINATED SCIENCES **0654/32**

Paper 3 Theory (Core) **May/June 2026**

MARK SCHEME

Maximum Mark: 120

Published

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

This document consists of **19** printed pages.

[Turn over

General marking principles

All examiners must apply these marking principles when marking candidate responses.

1	Examiners must award marks for each response in line with: • the specific **content** defined in the mark scheme • the specific **skills** defined in the mark scheme or in the level descriptions • the **standard of response** required as exemplified by the standardisation scripts.
2	Examiners must award **whole marks** (not half marks, or other fractions).
3	Examiners must award marks **positively**. This means that: • marks are not deducted for errors or omissions • marks are awarded for correct/valid answers as defined in the mark scheme and also for **other valid answers** which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate • the quality of spelling, punctuation and grammar are judged **only** when the mark scheme indicates that these features are **specifically assessed** in the question. However, the meaning of all responses must be unambiguous.
4	Examiners must **consistently** apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.
5	Examiners must use the **full range of marks** defined in the mark scheme, unless limited by the quality of the candidate responses seen.
6	Examiners must award marks according to the mark scheme and **must not** award marks with grade thresholds or grade descriptions 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.

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
BOD	benefit of the doubt given
FT	follow through
NBOD	benefit of doubt was considered, but the response was decided to not be sufficiently close for benefit of doubt to be applied.
TV	response is too vague or there is insufficient detail in response
ECF	error carried forward applied
^	information missing or insufficient for credit
	unclear response
I	incorrect or insufficient point ignored while marking the rest of the response

Annotation	Meaning
R	incorrect point or mark not awarded
LNK	two statements are linked
SEEN	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
BP	blank page

Mark Scheme Abbreviations

;	separates marking points
/	separates alternative responses for the same marking point
A	accept (a less-than-ideal answer which should be marked correct)
I	ignore (mark as if this material was not present)
R	reject the response
AND	indicates that two or more parts of a response are required for the mark
AVP	alternative valid point
AW	alternative wording (where responses vary more than usual)
NOT	indicates an incorrect response that would contradict another otherwise correct alternative
OR	alternative responses for the same marking point
owtte	or words to that effect
underline	actual word given must be used by candidate (grammatical variants excepted)
ecf	error carried forward
ORA	or reverse argument
( )	the word / phrase in brackets is not required but sets the context
max	indicates the maximum number of marks

Question	Answer	Marks	Guidance
1(a)	root hair (cell) ;	**1**	**I** root unqualified
1(b)(i)	magnification = $\frac{\text{image size}}{\text{actual size}}$ **or** (magnification =) $\frac{100}{1.3}$; 77 ;	**2**	correct answer on answer line = 2 marks **A** 76.9 **I** units
1(b)(ii)	division of existing cells / cell <u>division</u> ;	**1**	**A** mitosis **I** multiplication of cells / reproduction of cells / replication of cells / asexual reproduction **R** meiosis
1(c)	osmosis ; permeable ;	**2**	
1(d)	large / AW, surface (area) ; **increase** in water uptake / **increase** in mineral ion uptake ; AVP ; ;	**2**	mark points independently **A** long **and** thin / large surface area:volume ratio **I** long roots/hair / just long shape **A** high / more / efficient / as much as possible for increase **A** increased osmosis e.g. lots of mitochondria / provide energy for active transport (of mineral ions) **I** large vacuole to store water
1(e)	chlorophyll ; chloroplast ;	**2**	**R** if both given on one line

Question	Answer	Marks	Guidance
1(f)	<table><tr><td>part of leaf</td><td>iodine colour</td><td>starch present</td></tr><tr><td>no green pigment</td><td>brown</td><td>no / X / false</td></tr><tr><td>green pigment</td><td>blue-black</td><td>yes / ✓ / true</td></tr></table> ; ; two or three correct = 1 mark all four correct = 2 marks	**2**	**A** yellow / orange **R** red **A** black / dark–blue **R** purple

Question	Answer	Marks	Guidance
2(a)	sexually ;	**1**	**A** sexual
2(b)(i)	virus ;	**1**	If more than one circled = 0 marks
2(b)(ii)	from infected mother to baby during pregnancy ; infected blood transfusion ;	**2**	If three ticked and two correct = 1 mark If three ticked and one correct = 0 marks If four or more ticked = 0 marks
2(c)	**any two from:** fusion of sperm **and** egg / AW ; (fusion of) nuclei ; in oviducts ;	**2**	**A** male gamete for sperm and female gamete / ovum for egg **A** joining / combining / penetrates / go in to for fusion **I** mixes / meets **A** in fallopian tubes **R** if fertilisation described in multiple locations **I** references to changes to egg cell

Question	Answer	Marks	Guidance
2(d)	**any two from:** ovulation / release of egg/ovum (cell from ovaries) ; **lining** of uterus becomes thick / spongy / more vascular ; AVP ;	**2**	**A** egg cells develop **I** production of egg cell **I** references to ovulation during menstruation or after fertilisation **A** new uterus **lining** forms / uterus **lining** regenerates **I** uterus wall / uterus unqualified e.g. ovaries release oestrogen

Question	Answer	Marks	Guidance
3(a)	community ; environment ;	**2**	
3(b)	leopard / scorpion ; baboon ;	**2**	**A** baboon
3(c)	feeding ;	**1**	If more than one circled = 0 marks
3(d)	**any three from:** energy from the Sun (to grass / plant / producer) ; **grass** is the producer ; light (energy) transferred to chemical energy (by grass/producer) ; energy transferred to impala from grass ; energy transferred to leopard from impala ; *idea that* energy lost to the environment ;	**3**	**A** sunlight **I** light **I** plants for grass **A ecf** plants for MP3 and 4 **A** photosynthesis (by grass / producer) **I** other organisms from food web if relationship is correct **A** idea of eats / feeding for energy transfer **A** example of energy loss (max 1) e.g. respiration / *idea that* only 10% of energy transferred / energy transferred to surroundings **I** energy used up

Question	Answer	Marks	Guidance
3(e)	**any two from:** **less** food for primary consumers / **lower** population of primary consumers ; *idea of* impact higher up food chains ; loss of <u>habitat</u> ; loss of <u>biodiversity</u> ; loss of soil / flooding ; AVP ;	**2**	**A** locust / impala / baboons / herbivores for primary consumer **A** no primary consumers **I** more competition for food **A** less food for leopard / scorpion / carnivores / secondary consumers / extinction of consumers / animals **I** less food unqualified **A** less food for animals if no mark for MP1 and 2 e.g. smoke pollution / other organisms damaged by fire / increased carbon dioxide in atmosphere **I** global effects e.g. climate change / global warming **I** pollution unqualified

Question	Answer	Marks	Guidance
4(a)	allele — alternative form of a gene genotype — genetic make-up of an organism phenotype — observable features of an organism	**2**	one or two correct lines =1 mark three correct lines = 2 marks **R** if more than one line from any word or definition
4(b)(i)	transmission of genetic information ; (passed) from generation to generation ;	**2**	**A** getting / passing / transfer of genetic information / genes / alleles **A** (passed) to offspring / received from parents

Question	Answer	Marks	Guidance
4(b)(ii)	X or X X or Y X and X X and Y ; ; two or three rows correct = 1 mark all four rows correct = 2 marks	**2**	chromosomes in either order **A** just X **I** XX and XX **I** XY and XY
4(c)(i)	2 ;	**1**	
4(c)(ii)	two identical alleles (of a particular gene) / AW ;	**1**	**A** same (type of) alleles / both alleles are the same / two recessive or two dominant alleles **I** only one allele present / two recessive alleles / example genotypes
4(c)(iii)	**any two from:** haemoglobin needed to carry oxygen ; less (aerobic) respiration ;	**2**	**A** red blood cells carry oxygen / not enough oxygen in blood **I** no oxygen

Question	Answer	Marks	Guidance
5(a)(i)	copper **and** zinc ;	**1**	either order **A** Cu and Zn
5(a)(ii)	calcium **and** magnesium ;	**1**	either order **A** Ca and Mg
5(a)(iii)	aluminium ;	**1**	**A** Al **A** potassium or K / sodium or Na / calcium or Ca / magnesium or Mg
5(a)(iv)	potassium **and** sodium ;	**1**	**A** K and Na

Question	Answer	Marks	Guidance
5(a)(v)	iron / copper ;	1	**A** Fe / Cu **A** zinc or Zn / silver or Au / gold or Ag
5(b)	16 (g) ;	1	
5(c)	carbon dioxide ;	1	**A** CO_2
5(d)	loses electrons ; 2 electrons ;	2	**R** sharing two electrons for MP1 and MP2 **Note** loses 2 electrons = 2 marks **I** incorrectly repeated content of question

Question	Answer	Marks	Guidance
6(a)	mixture ; nitrogen ; argon ; methane ;	4	
6(b)(i)	8 ;	1	
6(b)(ii)	8 ;	1	
6(b)(iii)	2, 6 ;	1	**A** dot for comma **A** correct diagram showing electron shells
6(c)(i)	magnesium + copper oxide → magnesium oxide + copper ;	1	**A** reactants in either order and products in either order **Note** if no attempt at word equation accept symbol equation if all formulae correct and balanced. If both words and symbols given, ignore symbols

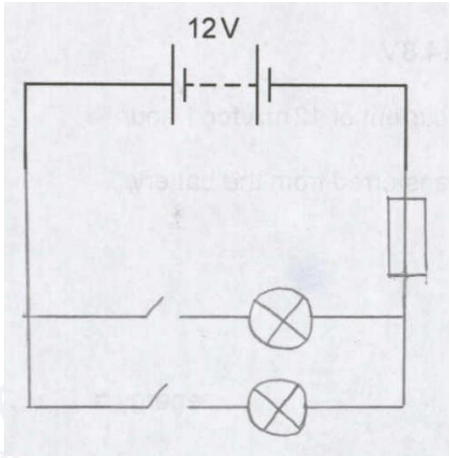
Question	Answer	Marks	Guidance
6(c)(ii)	a reaction involving (simultaneous) oxidation and reduction / (magnesium) gains oxygen and loss of oxygen (from copper oxide) ;	**1**	**A** magnesium is oxidised and copper (oxide) is reduced **A** gain and loss of electrons in correct context **I** oxygen moves from copper to magnesium
6(d)	high melting points / high boiling points ; good electrical conductivity when aqueous or molten / poor electrical conductivity when solid ; AVP ;	**2**	**I** generally soluble in water **A** solid at room temperature e.g. brittle

Question	Answer	Marks	Guidance
7(a)(i)	6 ;	**1**	
7(a)(ii)	2 × 12 **or** 4 × 1 **or** 24 + 4 ; 28 ;	**2**	correct answer on answer line = 2 marks **I** units
7(a)(iii)	unsaturated – contains a (C=C) double bond ; hydrocarbon – (compound) containing carbon and hydrogen (atoms) ; carbon and hydrogen **only** ;	**3**	points only accepted under correct heading **I** only double bonds / just 'double bond'
7(a)(iv)	(aqueous) bromine ; goes (orange to) colourless ;	**2**	Mark independently **A** yellow / orange–brown / brown for orange **A** decolorises for colourless **I** clear
7(b)(i)	poly(ethene) ;	**1**	**A** polyethene / polythene
7(b)(ii)	addition ;	**1**	

Question	Answer	Marks	Guidance
7(c)	motion – rapid / random (direction) ; separation – **widely** separated ;	**2**	**Note** Mark points anywhere but must be linked to correct idea **A** fast **A** unpredictable / irregular movement **I** moves freely **A far** apart / **large** gaps / **widely** spaced **I** more space / not tightly packed / very loosely packed / not touching / more separated

Question	Answer	Marks	Guidance
8(a)(i)	coal ;	**1**	
8(a)(ii)	(fossil fuel) contains sulfur / sulfur compounds ;	**1**	**A** fossil fuels made of sulfur **I** descriptions of reactions taking place
8(b)(i)	any number 4 – 6 inclusive ;	**1**	**A** below 7
8(b)(ii)	use universal indicator ; check colour on pH chart ;	**2**	**I** just pH paper / pH strips **I** pH scale
8(c)	**2** (H_2) ; **2** (H_2O) ;	**2**	**A** multiples if oxygen also balanced
8(d)	(pure) water boils at 100 °C / impurities increase the boiling point of water to above 100 °C ;	**1**	**A** boiling point of water is 100 **I** references to impure water boiling over a range of temperatures / it exceeded the boiling point of 100 °C

Question	Answer	Marks	Guidance
9(a)	6 000 000 (N) **;**	**1**	**A** 6(.0) × 10^6
9(b)(i)	radon (gas) / rocks / buildings / food / drink / AVP ;	**1**	**A** soil / ground / granite / nuclear accidents / nuclear weapons testing / medical **I** lightning **R** non–ionising radiation examples inc. UV
9(b)(ii)	cancer / cell death / mutations / AVP ;	**1**	**A** radiation burns / cataracts / skin burns / sterility / damages cells / damages DNA **I** affects DNA / cells unqualified / burn unqualified
9(b)(iii)	helium ;	**1**	**A** He
9(c)	red giant / white dwarf ; red giant **then** white dwarf (and planetary nebula) ;	**2**	**I** red super giant **I** black dwarf after white dwarf **R** other stages given for MP2
9(d)(i)	sound waves need a medium ;	**1**	**A** will not travel through the vacuum (of space) / space is a vacuum / there are no particles in space **I** sound waves need air particles **I** no air in space / it is a vacuum
9(d)(ii)	speed = distance ÷ time (in any form) **or** (distance =) 3.0 × 10^5 × 500 ; 150 000 000 (km) ;	**2**	correct answer on answer line = 2 marks **A** 1.5 × 10^8
9(d)(iii)	visible light in middle box ;	**1**	**A** visible / light **A** any indication of correct box if nothing else written e.g. tick **I** any other inserted waves

Question	Answer	Marks	Guidance
10(a)	horizontal forces are balanced / zero resultant (horizontal) force ;	1	**A** air resistance is equal to driving force / the (horizontal) forces are equal and opposite **I** forces are in equilibrium / forces cancel each other out
10(b)(i)	correct symbols for fuse **and** lamps **and** switches ; two lamps in parallel connection ; two switches in correct position ; fuse in series with battery ;	4	e.g.  **I** small gaps in circuit **A** symbol seen once for MP1 **A ecf** two switches in parallel with two of the same component e.g. bulb **Note** symbol in MP must be correct for MP2, 3 and 4. If circuit drawn in series no MP2 or 3 but fuse can be positioned anywhere.
10(b)(ii)	melts when <u>current</u> is too high (and breaks circuit) ;	1	**I** current heats up too much
10(c)(i)	electrons ;	1	**A** delocalised electrons **I** negative charge **R** if other particles given / positively charged electron
10(c)(ii)	(particles move) faster ;	1	**A** speed up / gain kinetic energy **I** more energetic / just 'increases' / vibrate faster/more / motion increases

Question	Answer	Marks	Guidance
11(a)	(12 mA =) 0.012 A **or** (1 hour =) 3 600 s ; energy = IVt (in any form) **or** $14.8 \times 0.012 \times 3\,600$; 640 (J) ;	**3**	correct answer on answer line = 3 marks **A** substitution with incorrect unit conversion as evidence of IVt e.g. $14.8 \times 12 \times 1$ or $14.8 \times 12 \times 60$ **A** P = IV **and** $E = Pt$ (in any form) **A** 639.36 **A ecf** if incorrect unit conversion used with evidence of IVt e.g. 178 / 177.6 (J)
11(b)(i)	Weight = mg (in any form) **or** Work done = $F \times d$; $4.0 \times 9.8 \times 15$ **or** 39.2×15 **or** 588 (J) ;	**2**	**A** $\Delta E_p = mg\Delta h$ **A** $\Delta E_p = mg\Delta h$ **and** $4.0 \times 9.8 \times 15$ for 2 marks **Note** where working shown **A** use of g=10 e.g. g=10 or formula **and** substitution for MP2
11(b)(ii)	power = energy ÷ time (in any form) **or** (power =) 590 ÷ 3.0 ; 197 (W) ;	**2**	correct answer on answer line = 2 marks **A** power = work done ÷ time **A** 196 (use of 588) **A** 196.6667
11(b)(iii)	gravitational potential (energy) ;	**1**	**A** GPE **I** just gravitational / gravity / gravitational force **R** gravitational potential difference
11(c)(i)	5 (m / s) ;	**1**	
11(c)(ii)	evidence of use of area under graph / ½ bh / distance is area under graph ; $½ \times 20 \times 5 = 50$;	**2**	e.g. area of triangle labelled **I** vertical line at t=20s

Question	Answer	Marks	Guidance
12(a)(i)	sound with a frequency above 20 kHz ;	**1**	**A** 20 000 Hz for 20 kHz **A** sound over 20 kHz
12(a)(ii)	number of waves passing a (fixed) point per second ;	**1**	**A** number of waves per second / number of oscillations / vibrations / peaks per unit time / amount of waves per second **I** number of peaks per second **I** pitch / amount of waves
12(a)(iii)	any number below 20 (Hz) ; audible range is above 20 (Hz) ;	**2**	**I** 20 Hz **A** the stated value is below the limit of human hearing / humans can't hear below 20 Hz **I** too quiet (to hear)
12(b)	total area = 0.52 m^2 ; pressure = force ÷ area (in any form) **or** 35 000 ÷ 0.52 ; 67 000 (N / m^2) ;	**3**	**A** 67 000 for 3 marks **A ecf** 35 000 ÷ 0.13 **A** 67 308 **A ecf** 270 000 / 269 231
12(c)(i)	gas ; energetic ; surface ;	**3**	**A** vapour **A** energised / energy **I** active / faster **I** top
12(c)(ii)	(evaporation) causes cooling ;	**1**	**A** idea of cooling effect after water has evaporated / decrease temperature **I** to remove insects / cleaning