CAMBRIDGE
International Education

Cambridge IGCSE™

CO-ORDINATED SCIENCES **0654/43**

Paper 4 Theory (Extended) **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.

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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.

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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.
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.

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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.

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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

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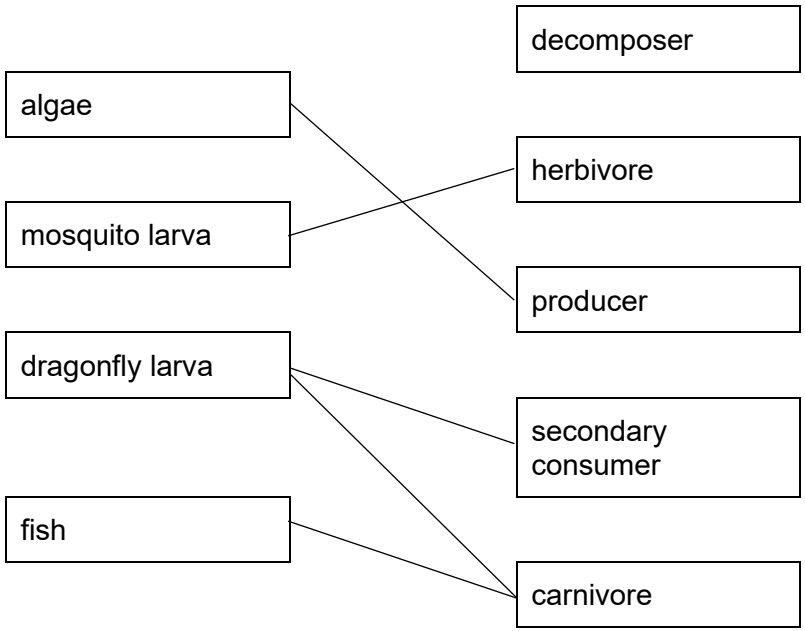
Annotation	Meaning
R	incorrect point or mark not awarded
LNK	two statements are linked
SEEN	point has been noted, but no credit has been given or blank page seen
	key point attempted / working towards marking point / incomplete answer / response seen but not credited / blank page seen
BP	blank page

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Mark Scheme Abbreviations

;	separates marking points
/	separates alternative responses for the same marking point
Allow	accept (a less-than-ideal answer which should be marked correct)
Ignore	ignore (mark as if this material was not present)
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

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Question	Answer	Marks	Guidance
1(a)	 ; ; ;	**3**	1 organism correct = 1 mark 2 or 3 organisms correct = 2 marks 4 organisms correct = 3 marks if an incorrect line is drawn from an organism then no mark for that organism
1(b)(i)	biodiversity ;	**1**	**DO NOT ALLOW** community / population / ecosystem
1(b)(ii)	(659 / 4) 165 ; the average number of species has decreased (over time) ;	**2**	**ALLOW** 164.75 / 164.8 **ecf** on **1(b)(i)** term **ALLOW** decreased (as less than last year) **ALLOW** loss in biodiversity compared to last year / over time

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Question	Answer	Marks	Guidance
1(c)(i)	nuclear division ; giving rise to genetically identical cells ;	**2**	**ALLOW** splitting of nucleus **ALLOW** genetically identical offspring **IGNORE** cell division / splitting of cell **IGNORE** references to asexual reproduction / identical offspring
1(c)(ii)	carbon dioxide + water → glucose + oxygen left hand side correct, either order ; right hand side correct, either order ;	**2**	**IGNORE** light / chlorophyll / ATP **ALLOW** symbol equation: $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ even if unbalanced

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Question	Answer	Marks	Guidance
2(a)	**E ;** **C ;**	**2**	
2(b)(i)	lower pressure in vein / higher pressure in artery ; **max two from:** artery has thick walls to withstand pressure ; artery has narrow lumen to maintain pressure of blood ; vein has valves to prevent backflow of blood ;	**3**	must be comparative **A** high pressure in arteries **and** low pressure in veins **ALLOW** artery has elastic walls to stretch / recoil as blood has high pressure **ALLOW** vein has thin walls to allow muscles (in surrounding tissues) to move the blood as blood is under lower pressure / vein has thin walls as blood is under lower pressure ; **ALLOW** artery has thin lumen as blood under high pressure **ALLOW** vein has large lumen as blood is under lower pressure ; NOTE arteries are narrow tubes / veins are large tubes is insufficient – need lumen **ALLOW** vein has valves to allow one way flow
2(b)(ii)	(function) transfer nutrients / oxygen (to all cells of body) ; (explanation) (very) thin / permeable <u>walls</u> (so diffusion distance is small) ;	**2**	mark as a whole **ALLOW** remove carbon dioxide / urea from (all cells of body) **ALLOW** gas exchange **ALLOW** <u>walls</u> are 1 cell thick **IGNORE** just ‘thin’ must refer to walls

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Question	Answer	Marks	Guidance
2(c)	**G** ; **H** ; **I** ;	**3**	

Question	Answer	Marks	Guidance
3(a)	(net) movement of water (molecules) from a region of higher water potential to a region of lower water potential ; through a partially permeable membrane ;	**2**	**ALLOW** movement of water down a water potential gradient **DO NOT ALLOW** movement of solutions **ALLOW** selectively permeable / semi permeable **IGNORE** from dilute to concentrated solution
3(b)	mesophyll cells ; xylem ; root cortex cells ;	**3**	**IGNORE** references to evaporation **ALLOW** xylem tissue / vessels IGNORE stem
3(c)(i)	7.0 ;	**1**	**ALLOW** 7 **ALLOW** answer written in table but answer line takes precedence

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Question	Answer	Marks	Guidance
3(c)(ii)	as wind speed increases, rate of water uptake increases ; **and any two from:** increased air movement, decreases humidity around the leaf ; (idea of more wind) gives steeper concentration gradient ; faster/more <u>evaporation</u> / <u>diffusion</u> (of water vapour) ; more movement of water through the xylem ;	**3**	**ALLOW** transpiration for water uptake **ALLOW** greater transpiration pull through the xylem
3(c)(iii)	(water intake) increase ; because faster / more diffusion of water molecules (within leaf) / faster/more evaporation of water (from mesophyll cells) ;	**2**	**Allow** more (water) particles have sufficient energy to evaporate

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Question	Answer	Marks	Guidance
4(a)	nutrient / glucose ; energy ;	**2**	**ALLOW** carbohydrate **IGNORE** food **ALLOW** ATP
4(b)	**any two from**: (anaerobic) less energy released (per glucose molecule) ; (anaerobic) lactic acid made ; (aerobic) makes carbon dioxide / water ;	**2**	**IGNORE** ref to oxygen use **ALLOW** more energy released (per glucose molecule) in aerobic respiration **IGNORE** different products made **IGNORE** anaerobic produces oxygen debt **ALLOW** as extra marking point aerobic occurs in the mitochondria whereas anaerobic occurs in the cytoplasm
4(c)(i)	any two from: substrate binds to active site of enzyme ; forming enzyme-substrate complex ; (product forms and) product released from active site / enzyme ;	**2**	**ALLOW** ESC for enzyme-substrate
4(c)(ii)	enzymes are specific ;	**1**	**ALLOW** enzymes only bind with one substrate

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Question	Answer	Marks	Guidance
4(c)(iii)	Any **two** complete rows **enzyme** / **substrate(s)** / **product(s)** amylase / starch / reducing sugars proteases / protein / amino acids lipase / fats / oils / lipid / fatty acids and glycerol ; ;	**2**	**ALLOW** maltose / glucose / simple sugars **ALLOW** carbohydrase **and** carbohydrates **and** sugars **ALLOW** pepsin or trypsin or peptidase for protease

Question	Answer	Marks	Guidance
5(a)(i)	blue ;	**1**	
5(a)(ii)	M_r of H_2O = 18 ; 250 – 160 = 90 ; 90 ÷ 18 = 5 ;	**3**	**NOTE** award 3 marks if answer is 5 **A ecf** from incorrect M_r
5(b)	Sedimentation and **filtration** to remove solids. → Use of carbon to remove **tastes / odours** → **chlorination** to kill microbes ; ; ;	**3**	**ALLOW** filter / filterisation **IGNORE** screening / sieving **ALLOW** chlorine

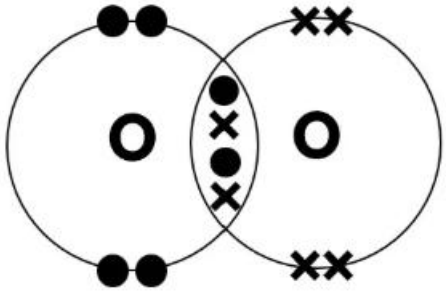
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Question	Answer	Marks	Guidance
5(c)	(similarity) same **number** of protons / both have 6 protons ; (difference) different **number** of neutrons / ^{12}C has 6 neutrons and ^{13}C has 7 neutrons ;	**2**	**ALLOW** same number of electrons / both have 6 electrons **ALLOW** same atomic number / both have atomic number 6 **DO NOT ALLOW** same molecular mass / same M_r **ALLOW** different number of nucleons / ^{12}C has 12 nucleons and ^{13}C has 13 nucleons
5(d)	same **number** of electrons / both have 6 electrons ; (so) same electronic configuration / both have electronic configuration of 2.4 ;	**2**	**IGNORE** same number of protons **ALLOW** same number of outer shell electrons **ALLOW** same electronic configuration ;; If no marks scored **ALLOW** 1 max for same number of electrons in the outer shell

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Question	Answer	Marks	Guidance
6(a)	exothermic ;	**1**	**IGNORE** exothermal / neutralisation **ALLOW** combustion
6(b)	the activation energy should be from the reactants (line to the peak) ; the products (line) should be below the reactants (line) / the products should have less energy than the reactants ;	**2**	**ALLOW** correct arrow drawn on the diagram **ALLOW** correct diagram **ALLOW** the products (line) is above the reactants (line) / the products have more energy than the reactants / the diagram shows an endothermic reaction
6(c)	(advantage) the <u>only</u> product is water / they do not produce CO_2 / they release more energy (per kg than petrol) / more efficient / quieter or less noise pollution fossil fuels are non-renewable / is renewable ; (disadvantage) hydrogen is difficult or expensive to store / transport / there are only a small number of hydrogen filling stations / idea that fuel cells are less efficient at low temperatures ;	~~2~~	**IGNORE** do not emit green house gases / do not cause climate change **NOTE** renewable / non-renewable credited only once across adv and disadv **ALLOW** hydrogen is obtained (steam reforming of methane / electrolysis of water) using energy obtained from combustion of fossil fuels therefore releasing CO_2 **IGNORE** range
6(d)	0.55 (kg) × 1000 = 550 g ; mol = <u>mass</u> = <u>550</u> = 275 ; M_r 2 volume = mol × 24 = 275 × 24 = 6 600 (dm^3) ;	**3**	**NOTE** award 3 marks if answer is 6 600 **award** 2 marks if answer is 6.6 (dm^3) **award** 1 mark if answer is 13.2 (dm^3) award 2 marks if answer is 13 200 (dm^3) **ALLOW** 2 marks for power of 10 answer **ALLOW ecf** from 0.55 kg 0.55 / 2 = 0.275 **ALLOW ecf** from incorrect mol

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Question	Answer	Marks	Guidance
6(e)	idea of increasing the pressure of the (hydrogen) gas / compressing the (hydrogen) gas ;	1	**ALLOW** reduce the temperature of the gas **IGNORE** put in a smaller container
6(f)	 two shared pairs of electrons between the two oxygen atoms ; rest of the molecule correct ;	2	**NOTE** electrons may be all dots or all crosses **IGNORE** inner electrons if drawn

Question	Answer	Marks	Guidance
7(a)	$Zn + 2\,HCl \rightarrow ZnCl_2 + H_2$ All formulae correct ; balancing correct ;	**2**	**ALLOW** correct multiples
7(b)(i)	reading from graph = 35 ; (mean rate of reaction = <u>total volume</u> or <u>35</u>) = 0.58 (cm^3 / s) total time 60 ;	**2**	**ALLOW** 2 marks for correct final answer **ALLOW** working shown on graph **ALLOW ecf** M2 from incorrect volume of gas
7(b)(ii)	curve drawn with steeper gradient ; but still levelling off at 35 cm^3 ;	**2**	**ALLOW** ± ½ small square
7(c)	smaller pieces of zinc have a larger surface area / ORA ; frequency of collision (of molecules) is higher / more collisions per second ;	**2**	**ALLOW** more exposed particles **DO NOT ALLOW** particles have more KE / particles move faster **IGNORE** faster collisions/ more successful collisions
7(d)(i)	non-malleable ☐ only form white compounds ☐ high density ☑ ; low melting point ☐	**1**	

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Question	Answer	Marks	Guidance
7(d)(ii)	(substance which) increases the rate of a reaction / AW ; (and is) unchanged at the end of the reaction ;	**2**	**IGNORE** lowers activation energy **ALLOW** is not **used up** during the reaction **IGNORE** is not used in the reaction / does not take part in the reaction

Question	Answer	Marks	Guidance
8(a)(i)	colour change ☑ ; metal sinks ☐ no bubbling ☐ no temperature change ☐	**1**	
8(a)(ii)	D B A C ; ;	**2**	**NOTE** award 1 mark for D and C in correct position and 1 mark for B and A in correct position ✓

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Question	Answer	Marks	Guidance
8(b)	magnesium atom or Mg loses electrons, which is oxidation ; copper <u>ion</u> gains electrons, which is reduction ;	**2**	**DO NOT ALLOW** copper gains electrons **IF** no marks scored **ALLOW** 1 max for magnesium loses electrons **AND** copper <u>ions</u> gain electrons **OR** magnesium is oxidised **and** copper <u>ion</u> is reduced **IGNORE** oxidation is loss of electrons and reduction is gain of electrons **IGNORE** OILRIG **ALLOW** explanation in terms of oxidation number
8(c)	anode – oxygen / O_2 ; cathode – copper / Cu ;	**2**	**ALLOW** O **IGNORE** water **ALLOW** products in an equation even if the equation is incorrect **DO NOT ALLOW** Cu^{2+} / Cu(II) If no marks awarded **ALLOW** 1 max for oxygen at cathode and copper at anode

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Question	Answer	Marks	Guidance
9(a)(i)	(due to) mobile electrons (move through the metal) ;	**1**	**ALLOW** delocalised electrons / sea of electrons / free electrons (move through the metal) **DO NOT ALLOW** mobile ions
9(a)(ii)	clockwise arrow indicated ;	**1**	
9(a)(iii)	$I = Q \div t$ or $0.85 = Q \div (2 \times 60)$; 102 (C) ;	**2**	Award 2 marks for 102 1 mark for 1.7
9(a)(iv)	current increases / current doubles ; lower combined resistance ;	**2**	**ALLOW** resistors in parallel have less resistance than 1 resistor alone **IGNORE** current entering is equal to sum of the currents leaving
9(b)(i)	primary and secondary coils (of wire) ; (around a soft) iron core ; more turns on secondary coil (than primary coil) ;	**3**	bod right and left **IGNORE** secondary coil is larger than primary coil **IGNORE** secondary coil has larger voltage
9(b)(ii)	$I_pV_p = I_sV_s$ or $80 \times 10\,000 = I_s \times 230$; 3500 (A) ;	**2**	3 478.26…
9(b)(iii)	at a substation / near consumers / near homes ;	**1**	**ALLOW** when / before entering the home

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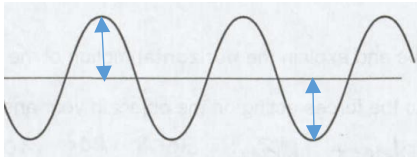
Question	Answer	Marks	Guidance
10(a)	alpha most ionising and gamma least ionising and beta more than alpha and less than gamma ;	**1**	**ALLOW** alpha most ionising and gamma the least ionising
10(b)(i)	neutron (transforms and) ; becomes a proton and electron ;	**2**	
10(b)(ii)	the idea of variations in thickness alter the (measurable) level of radiation that passes through ;	**1**	**ALLOW** alpha is stopped too easily, gamma is not stopped (enough) **ALLOW** reduction in count rate is the most useful / wider range of values **ALLOW** Alpha penetrates the least and gamma penetrates the most **ALLOW** gives most useful reduction in count rate **ALLOW** beta is partially absorbed by the material and the rest gets through to the detector **ALLOW** transmission rate is highly sensitive to small variations of thickness (of paper, plastics, foils etc.) **ALLOW** range of particles absorbed is appropriate for the thickness of material being measured **IGNORE** medium penetration unqualified
10(c)	$^{241}_{95}\mathbf{Am} \rightarrow {}^{237}_{93}\mathrm{Np} + {}^{4}_{2}\alpha$ correct numbers on alpha ; correct numbers on Np ;	**2**	If no marks awarded **ALLOW 1 max ecf** if consequential Np numbers balance the equation (incorrect alpha)

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Question	Answer	Marks	Guidance
10(d)(i)	nuclear fusion ; of hydrogen into helium ;	2	**DO NOT ALLOW** nuclear fission
10(d)(ii)	distance ; travelled by light in one year ;	2	**ALLOW** e – m radiation for light

Question	Answer	Marks	Guidance
11(a)(i)	constant velocity ;	1	**ALLOW** constant speed
11(a)(ii)	constant deceleration ;	1	**ALLOW** slowing down at constant rate **ALLOW** constant negative acceleration
11(a)(iii)	$a = \Delta v \div \Delta t$ or $a = 5 \div 2$ etc ; 2.5 (m / s^2) ;	2	Award 2 marks for 2.5
11(b)	$E = 0.5\,mv^2$ or $230\,000 = 0.5 \times m \times 18^2$ or $m = 230\,000 \div (0.5 \times 18^2)$; 1 400 (kg);	2	Award 2 marks for 1 400 / 1 419.753 min 2 sf Power of 10 error award 1 mark
11(c)(i)	decelerates / slows down (from initial 18 m/s) ; (because of) air resistance ;	2	**IGNORE** pushed back **ALLOW** drag force / wind resistance / air friction **DO NOT ALLOW** no resultant force
11(c)(ii)	weight ; accelerates / speeds up ;	2	**ALLOW** gravitational force / W = mg / F = mg / gravity

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Question	Answer	Marks	Guidance
12(a)	amplitude marked as half full height ;	**1**	
12(b)	any three from: same size ; same distance from mirror ; laterally inverted ; virtual ; upright / erect ;	**3**	
12(c)(i)	n=sin i ÷ sin r or n = sin 60 ÷ sin 38 ; n = 1.4 ;	**2**	award 2 marks for 1.4 / 1.40666 to min 2 sf
12(c)(ii)	increase the angle of incidence ; so that it is greater than the critical angle ;	**2**	**ALLOW** greater than 46°

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