

INTERNATIONAL GCSE **COMBINED SCIENCE**

9204/PE

Paper 3 Physics Extension

Mark scheme

November 2023

Version: 1.0 Final



2 3 B Y 9 2 0 4 / P E / M S

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement
- the Assessment Objectives, level of demand and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

- 2.1** In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.
- 2.2** A bold **and** is used to indicate that both parts of the answer are required to award the mark.
- 2.3** Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a/; eg allow smooth/free movement.
- 2.4** Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of errors/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols/formulae

If a student writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(.....) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do **not** accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this.

The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

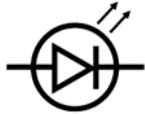
An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	the oscillations are perpendicular	allow vibration for oscillation	1	AO2 3.19.1b
	to the direction of energy transfer	allow to the direction of wave travel	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	$\Delta\theta = 71\text{ (}^{\circ}\text{C)}$		1	AO2 3.20.1b
	$E = 0.94 \times 3600 \times 71$		1	
	$E = 240\,264\text{ (J)}$		1	
	$E = 240\,000\text{ (J)}$		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	any two from: - temperature (of the surroundings) (conductivity of) the surface the pie is in contact with - surface area of the pie - thickness of pastry	allow other factors related to pastry	2	AO3 3.20.1b

Total			8	
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1			1	AO1 3.21.1f

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	Level 2: A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.		3–4	AO3 3.21.1k
	Level 1: Relevant points are made. They are not logically linked.		1–2	
	No relevant content.		0	
	Indicative content • LEDs are much more efficient so therefore waste less energy • The lifetime of an LED is 25× greater than a filament lamp • LEDs are 4× more expensive than filament lamps • 4 filament lamps would cost the same as 1 LED but have a lifetime of 21 000 fewer hours • Lifetime per \$ – Filament lamp = 1000 hours, LED = 6250 hours • LEDs also use a smaller current than filament lamps to access level 2 the answer must be supported by appropriate calculations.			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	$0.75 = \frac{6.6}{\text{total power input}}$		1	AO2 3.18.2e
	$\text{total energy input} = \frac{6.6}{0.75}$		1	
	total power input = 8.8 (W)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	the energy is transferred/dissipated to the surroundings		1	AO1 3.18.2c

Total			9	
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	Level 3: The method would lead to the production of a valid outcome. Steps are logically sequenced.		5–6	AO4 3.19.1f
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.		3–4	
	Level 1: The method plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.		1–2	
	No relevant content.		0	
	Indicative content - place the glass block on a piece of paper - draw around the glass block and then remove from the paper - use the protractor to draw a normal line at 90° to one side of the block - use the protractor to measure and draw a line at an angle (eg 10°) from the normal - replace the glass block - using the ray box, point a ray of light down the line - mark the ray of light emerging from the glass block - remove the glass block - draw the path of the refracted ray through the glass block - measure the angle of refraction using the protractor - repeat for different angles of incidence			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	all points plotted correctly	allow 1 mark for 3 or 4 points plotted correctly allow a tolerance of $\pm \frac{1}{2}$ a small square	2	AO3 3.19.1f
	correctly drawn line of best fit		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	both variables are continuous		1	AO4 3.19.1f

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	(speed) decreases		1	AO1 3.19.1f

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	the ray of light enters along the normal	allow the angle of incidence is 0° allow the angle between the light ray and the glass block is 90°	1	AO3 3.19.1f

Total			12	
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	$A_2 = 10 \text{ (mA)}$	this order only	1	AO2 3.21.1o
	$A_4 = 30 \text{ (mA)}$		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	voltmeter in parallel with resistor R_2 and circuit symbol for voltmeter	both need to be correct to award mark	1	AO1 3.21.1f

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	20 mA = 0.02 A	allow a correct rearrangement using an incorrectly/not converted value of current	1	1×AO1 3×AO2 3.21.1g
	$R = \frac{9.0}{0.02}$		1	
	450		1	
	Ω / Ohms		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	9.0 V		1	AO1 3.21.1o

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	(free) electrons collide with (metal) ions	allow atoms for ions throughout	1	AO1 3.21.1p 3.20.2a
	transferring energy		1	
	which increases the amplitude of ion vibration		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	resistance increases and current decreases		1	AO3 3.21.1ghp
Total			12	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	constant acceleration	this order only	1	AO3 3.17.3
	constant velocity	allow zero acceleration allow constant speed	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	deceleration = $\frac{(0 - 14)}{(21 - 16)}$	ignore minus signs	1	AO2 3.17.3e
	deceleration = 2.8 (m/s ²)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	distance = $\frac{(14 \times 9)}{2} + (14 \times 7) + \frac{(14 \times 5)}{2}$	allow 1 mark for the correct calculation of the area of any section of the graph	2	AO2 3.17.3f
	distance = 196 (m)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	the (minimum) distance travelled under the (maximum) braking force		1	AO1 3.17.4c

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	$\frac{(20 - 16)}{20} \times 100$		1	AO2 3.17.4c
	= 20%		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	the empty truck has a lower mass		1	AO2 3.17.4b 3.18.1a
	and because $F = ma$		1	
	the empty truck has a greater rate of deceleration (for the same braking force)		1	
	OR			
	the empty truck has a lower mass (1)			
	so has less kinetic energy (1)			
	less work is done to stop the empty truck (for the same braking force) (1)			
Total			13	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	repeatedly changes direction		1	AO1 3.19.2b

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	(the kettle's casing is plastic) plastic is an electrical insulator	allow (the kettle is) double insulated	1	AO2 3.22.1e,f
	(if a fault occurred) the casing would not become live	allow (if a fault occurred) the user would not receive an electric shock	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	if there is too much current in the wire of the fuse		1	AO1 3.22.1f
	the wire melts and breaks the circuit	allow the fuse blows and breaks the circuit	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	power = 2.4 kW		1	AO2 3.22.3f
	time = 0.05 hours		1	
	energy transferred = 2.4×0.05 = 0.12 (kWh)	allow a correct substitution using incorrectly/not converted values of power and/or time	1	
	cost = 0.12×0.25 = (\$) 0.03	allow a correct calculation using an incorrectly calculated value of energy transferred	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	the particles closest to the heating element gain energy and move faster		1	1 × AO2 3 × AO1 3.20.2a
	causing the particles to move further apart		1	
	so the warmer water expands and becomes less dense		1	
	causing it to rise and be replaced by falling colder water	allow more dense water falls	1	

Total			13	
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	two protons and two neutrons		1	AO1 3.23.2e

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	Level 2: Relevant points are identified, given in detail and logically linked to form a clear account.		3–4	AO1 × 2 AO3 × 2 3.23.1b
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.		1–2	
	No relevant content.		0	
	Indicative content • most of the alpha particles were not deflected • providing evidence that most of the atom is empty space • some of the alpha particle particles were deflected through small angles • providing evidence that the nucleus is charged • very few of the alpha particles were deflected through very large angles • providing evidence that the mass of an atom is contained in a very small volume			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	$\frac{5.1 \times 10^{-6}}{1.7 \times 10^{-10}}$		1	AO2 3.23.1b
	30 000		1	
	3.0×10^4		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	mass number = 206		1	AO2 3.23.2f
	atomic number = 82		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	alpha radiation is highly ionising		1	AO1 × 2
	outside the body alpha radiation cannot penetrate the skin	allow has a short range in air	1	AO3 × 2 3.19.2g 3.23.2g
	inside the body alpha radiation reaches living cells		1	
	so can cause cancer/ mutations	allow can cause cell death	1	

Total			14
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	the gravitational field strength on Mars is weaker (than on Earth)		1	AO1 3.17.1e

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	1800g = 1.8 kg		1	AO2 3.18.1d,f
	$\Delta E_p = 1.8 \times 3.7 \times 3.0$	allow a correct substitution using an incorrectly/not converted value of mass	1	
	$\Delta E_p = 19.98 \text{ J}$	allow a correct calculation using an incorrectly/not converted value of mass	1	
	$5.55 = \frac{19.98}{t}$	allow correct use of their calculated value of E_p	1	
	$t = \frac{19.98}{5.55}$		1	
	$t = 3.6 \text{ (s)}$		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	the centripetal force acting on Phobos is greater (than that acting on Deimos)		1	AO1 AO2 3.24.2f
	so orbital speed increases as the separation of orbiting masses decreases		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	(Phobos and Deimos) are constantly changing direction		1	AO1 3.24.2e
	so their velocities are changing		1	
	acceleration is the rate of change of velocity		1	

Total			12	
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	motor effect		1	AO1 3.22.2a

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	point the first finger in the direction of the magnetic field and point the second finger in the direction of the current		1	AO1 3.22.2c
	the thumb then shows the direction of the force		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	reverse the direction of the current		1	AO1 3.22.2c
	reverse the direction of the magnetic field		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	the permanent magnet experiences an equal and opposite force to the force on the wire		1	AO3 3.22.2a 13.17.3a
	so the downward force on the permanent magnet increases		1	

Total			7	
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