

OXFORD

INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL GCSE **COMBINED SCIENCE** **9204/PE**

Paper 3 Physics Extension

Mark scheme

June 2022

Version 1.0 Final Mark Scheme



2 2 6 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.

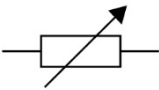
You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

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	any two methods and explanations from: • read measurement at eye level • to avoid parallax error OR • carry out practice drop • so that the student measuring knows approximately where the ball will reach OR • record all measurements from the bottom / top of the ball • so that the diameter of the ball does not affect results OR • film the investigation and use slow motion / freeze • so that the student has more time to take the reading OR • use a set square • to ensure that the ruler is 90° to the surface	1 mark for each method and 1 mark for each explanation max 2 for each allow repeat measurements allow calculate a mean bounce height	4	AO3/AO4 3.18.1d/e

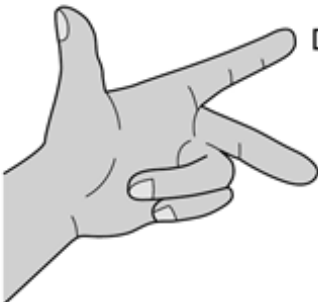
01.2	energy is wasted due to heating (during transfer to elastic potential energy)	allow some energy is transferred to the surroundings	1	AO2 3.18.2a
	so the kinetic energy of the ball is less (after bouncing)	allow work done on ball by air resistance	1	
	so the gravitational potential energy (at the bounce height) is less		1	
01.3	(the ball is) accelerating		1	AO3 3.17.3d
	at a constant rate	MP2 dependent on MP1 allow (acceleration) = 9.8 m/s ²	1	
01.4	mass = 0.060 kg		1	AO2 3.18.1e Mark with 01.5
	velocity at 0.41 s = 4.0 m/s		1	
		subsequent marks may be awarded for correct substitution / calculation using an incorrectly read value of velocity from the graph and / or an incorrectly / not converted value for mass		
	$KE = \frac{1}{2} \times 0.060 \times 4.0^2$		1	
	KE = 0.48 (J)		1	

01.5	GPE = $0.060 \times 9.8 \times 0.55$	allow a correct substitution with an incorrectly / not converted value for mass	1	AO2 3.18.1d Mark with 01.4
	GPE = 0.3234 (J)	allow a correct calculation with an incorrectly / not converted value for mass	1	
	GPE = 0.32 (J)	allow a calculated answer correctly rounded to two significant figures	1	
Total			16	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1			1	AO1 3.21.1f
02.2	connect an ammeter in series with the LED to measure current connect a voltmeter in parallel with the LED to measure potential difference	if no other mark awarded allow 1 mark for measure current with an ammeter and potential difference with a voltmeter	1 1	AO4 3.21.1g
02.3	all points plotted correctly line of best fit drawn	allow 1 mark for 2 or 3 correctly plotted points	2 1	AO2 3.21.1i
02.4	no current below 1.0 V at potential differences above 1.0 V current increases large increase in current above 1.5 V	allow any value between 1.0 V and 1.5 V allow any value between 1.0 V and 1.5 V allow the relationship between potential difference and current is non-linear	1 1 1	AO3 3.21.1i
02.5	no current at any potential difference because an LED only conducts in the forwards direction	allow LED will not emit light at any potential difference	1 1	AO1 3.21.1i/k
02.6	any two from: • LED lamps last longer • LED lamps are brighter • LED lamps use less energy • LED lamps are more efficient • LED lamps are more cost effective		2	AO3 3.21.1k
Total			13	

Question	Answers	Mark	AO / Spec. Ref
03.1	Level 3: The design / plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO4 3.20.1e
	Level 2: The design / plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	
	Level 1: The design / 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 • measure volume of water • use a measuring cylinder • measure mass of salt • use a top pan balance • heat the water • record the temperature when the water is boiling • repeat for different masses of salt • use the same volume of water in the beaker each time • stir to dissolve the salt in the water • ensure reading on the thermometer is constant before recording boiling point		
03.2	the greater the mass of salt added the higher the boiling point of water	1	AO3 3.20.1e
	for each 5 g of salt added the change in boiling point is 0.4 °C	1	
	allow the relationship is linear allow the change in temperature is the same for each 5 g of salt added		

03.3	$E = 115 \times 300$		1	AO2 3.20.1d 3.22.3b
	$E = 34\,500 \text{ (J)}$	allow a correct calculation using an incorrectly / not converted value of t	1	
		a valid equation must have been used to calculate E to score subsequent marks		
	$34\,500 = m \times 2.3 \times 10^6$	allow a correct substitution using their calculated value of E	1	
	$m = \frac{34\,500}{2.3 \times 10^6}$	allow a correct rearrangement using their calculated value of E	1	
	$m = 0.015 \text{ (kg)}$	allow a correct calculation using their calculated value of E	1	
03.4	not all of the energy from the Bunsen burner is transferred to the water	some of the energy from the Bunsen burner is transferred to the surroundings	1	AO1/AO3 3.18.2c
	so the gain in energy by the water is less		1	
03.5	some particles gain enough kinetic energy (below the boiling point)		1	AO1 3.20.2b
	to leave the surface of the water		1	
Total			17	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	the compass needles line up with the Earth's magnetic field	allow the compass needles all point to the North pole	1	AO1 3.21.2e
04.2	the compass needles form a circular pattern		1	AO1 3.21.2e
04.3	force field current	this order only allow 1 mark for one or two correct labels	2	AO1 3.22.2c
	Direction of _____ force _____ Direction of _____ field _____ Direction of _____ current _____			
04.4	into the page		1	AO2 3.22.2c
04.5	use more powerful magnets	allow increase the strength of the magnetic field	1	AO1 3.22.2b
	increase the current	allow increase the potential difference across the wire	1	

04.6	the current is in opposite directions on each side of the coil so forces act in opposite directions on each side of the coil so the coil rotates (continuously)	allow first 2 marks for downward force on AB and upward force on CD	1 1 1	AO1 3.22.2a/c/d
Total			10	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	$220 = I \times 550$		1	AO2 3.21.1o 3.21.1g
	$I = \frac{220}{550}$		1	
	0.40 (A)		1	
05.2	the heater only operates when switches A and B are closed		1	AO3 3.21.1o
	so the heater cannot be switched on without the fan / motor		1	
05.3	if the current in the circuit is too high		1	AO1 3.22.1e
	the fuse heats up and melts		1	
	which causes the circuit to break		1	
05.4	an earth wire is needed	allow the hairdryer needs to be earthed	1	AO1 3.22.1f
	so that if a fault occurs it provides a low resistance path for charge	allow current is harmlessly conducted away	1	
	reducing the risk of electrocution		1	

05.5	$220 = \frac{E}{2100}$		1	AO2 3.20.1b 3.21.1e
	$E = 220 \times 2100$		1	
	$E = 462\,000\text{ J}$	a valid equation must have been used to calculate E to score subsequent marks	1	
	$462\,000 = m \times 1000 \times 35$	allow a correct substitution using their calculated value of E	1	
	$m = \frac{462\,000}{35\,000}$	allow a correct rearrangement using their calculated value of E and / or an incorrect value of $\Delta\theta$	1	
	$m = 13.2\text{ kg}$	allow a correct calculation using their calculated value of E and / or an incorrect value of $\Delta\theta$	1	
Total			17	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	nuclear radiation is ionising		1	AO1 3.23.2g
	which can damage / kill cells	allow which can cause cancer	1	
06.2	any two from: - do not direct the source at anyone - handle with forceps - limit exposure time - wear (disposable) gloves - hold away from the body - move students away from the source		2	AO1 3.23.2g
06.3	measure the counts in one minute with no radioactive source present		1	AO4 3.23.2d
	repeat several times and calculate a mean	allow measure over a long period of time	1	
06.4	the counts per minute would not change with paper		1	AO1 / AO3 3.23.2g
	because beta (radiation) and gamma can pass through paper	allow because only alpha (radiation) is absorbed by paper	1	
	the counts per minute would reduce with aluminium		1	
	because beta (radiation) is absorbed by aluminium		1	
	the counts per minute would reduce to background radiation with lead		1	
	because gamma is absorbed by lead		1	
06.5	${}_{39}^{90}\text{Y}$		1	AO2 3.23.2f
	${}_{-1}^0\beta$		1	

06.6	after 11 years there is still 75% of the original radiation released	allow 74% to 76% allow any value correctly read from graph for a reasonable timescale allow half-life is 30 years	1	AO2/AO3 3.23.3d
	so the levels have not reduced very much		1	
	and it will take a long time to reduce to safe levels (so that people can return)		1	
Total			17	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	gravitational field strength on the Moon is less than that on Earth and weight = mass × gravitational field strength	do not allow gravity is less	1 1	AO1 3.17.1e
07.2	d = 520 000 000 m $3.0 \times 10^8 = \frac{520\,000\,000}{t}$ $t = \frac{520\,000\,000}{3.0 \times 10^8}$ 1.73 (s)	allow a correct substitution of an incorrectly calculated value of d allow a correct rearrangement using an incorrectly calculated value of d allow a correct calculation using an incorrectly calculated value of d allow 1.7 (s)	1 1 1 1	AO2 3.17.2c
07.3	12 GHz = 1.2×10^{10} $3.0 \times 10^8 = 1.2 \times 10^{10} \times \lambda$ $\lambda = \frac{3.0 \times 10^8}{1.2 \times 10^{10}}$ $\lambda = 0.025 \text{ m}$	allow a correct substitution of an incorrectly / not converted value of f allow a correct rearrangement using an incorrectly / not converted value of f allow a correct calculation using an incorrectly / not converted value of f	1 1 1 1	AO2 3.19.1h
Total			10	