AQA GCSE Physics | 8463

SPECIFICATION POINT 4.4.1.3

# The development of the model of the atom (common content with chemistry)

## Mark schemes and examiner comments

| | |
|---|---|
| Tier | **Foundation** |
| Question groups | **5** |
| Available paper years | **2011–2025** |

## Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

**Name:** _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.4.1.3 The development of the model of the atom (common content with chemistry)

Answer 01 · Mark scheme

January 2011 | PHY2F | Original Q6 | Legacy

## Question 6

<table>
<tr><th>question</th><th>answers</th><th>extra information</th><th>mark</th></tr>
<tr><td>6(a)</td><td>electron(s)</td><td></td><td>1</td></tr>
<tr><td>6(b)</td><td>3rd box ticked<br><br>The model cannot explain the results from a new experiment</td><td></td><td>1</td></tr>
<tr><td>6(c)</td><td>all three correct<br><br><table><tr><th>Particle</th></tr><tr><td>Proton</td></tr><tr><td>Electron</td></tr><tr><td>Neutron</td></tr></table></td><td>allow 1 mark for 1 correct</td><td>2</td></tr>
<tr><td>Total</td><td></td><td></td><td>4</td></tr>
</table>

### 4.4.1.3 The development of the model of the atom (common content with chemistry)

**Answer 01 · Mark scheme** January 2011 | PHY2F | Original Q6 | Legacy

**PHY2F**

**Answer 02 · Mark scheme** June 2015 | PH2FP | Original Q8 | Legacy

The full source mark scheme begins on page 9. Follow original question 8 in that document.

4.4.1.3 The development of the model of the atom (common content with chemistry)

Answer 03 · Mark scheme

June 2019 | 8463/1F | Original Q4

## Question 4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **4.1** | A | | 1 | 4.4.1.3<br>AO1 |
| **4.2** | C | | 1 | 4.4.1.3<br>AO1 |
| **4.3** | repels<br><br>increases<br><br>increases | in this order only | 1<br><br>1<br><br>1 | 4.4.1.3<br>4.2.5.2<br>AO1 |
| **4.4** | another scientist repeats the experiment and gets the same results | | 1 | WS3.7<br>4.4.1.3<br>AO1 |
| **Total** | | | **6** | |

4.4.1.3 The development of the model of the atom (common content with chemistry)

Answer 04 · Mark scheme



## Question 2

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.1 | electron | | 1 | AO1 4.4.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.2 | radius = 1.7 × 4.2<br><br>radius = 7.14 (femtometres) | <br><br>allow 7.1 (femtometres) | 1<br><br>1 | AO2 4.4.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.3 | an alpha particle and a gold nucleus are both positively charged | | 1 | AO1 4.4.1.1 4.4.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.4 | a force of repulsion | | 1 | AO1 4.2.5.1 4.2.5.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.5 | A | | 1 | AO3 4.2.5.2 |

4.4.1.3 The development of the model of the atom (common content with chemistry)

Answer 04 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.6** | tiny spheres that can't be divided | | 1 | AO1 4.4.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.7** | Bohr | | 1 | AO1 4.4.1.3 |

| **Total Question 2** | **8** |
|---|---|

4.4.1.3 The development of the model of the atom (common content with chemistry)

Answer 05 · Mark scheme

June 2025 | 8463/1F | Original Q3

## Question 3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.1** | $^{230}_{92}U \rightarrow {}^{226}_{90}Th + {}^{4}_{2}He$ | | 1 | AO1<br>4.4.2.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.2** | 20 (days) | | 1 | AO3<br>4.4.2.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.3** | 20 (days) | allow ecf from question **03.2** | 1 | AO1<br>4.4.2.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.4** | isotope **A**<br><br>shortest half-life<br><br>**or**<br>decays quickest<br><br>**or**<br>graph is steepest (initially)<br><br>**or**<br>smallest percentage of atoms left (at any time after t = 0) | <br><br>MP2 dependent on MP1 | 1<br><br>1 | AO3<br>4.4.2.1<br>4.4.2.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.5** | **A** | | 1 | AO3<br>4.4.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.6** | **D** | | 1 | AO3<br>4.4.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.7** | **B** and **C**<br><br>same number of protons (and different number of neutrons) | <br><br>MP2 dependent on MP1<br>allow same atomic number<br>ignore electrons | 1<br><br>1 | AO3<br><br>AO1<br><br>4.4.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.8** | plum pudding model | | 1 | AO1<br>4.4.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.9** | the mass of the atom is concentrated in the nucleus | | 1 | AO1<br>4.4.1.3 |

| **Total Question 3** | **11** |
|---|---|

**4.4.1.3 The development of the model of the atom (common content with chemistry)**



GCSE

# Additional Science / Physics

PH2FP

Mark scheme

4408/4403
June 2015

Version/Stage: 1.0: Final

### 4.4.1.3 The development of the model of the atom (common content with chemistry)



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 Assessment Writer.

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.

Further copies of this mark scheme are available from aqa.org.uk

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## Mark Scheme

## 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 and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives 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

**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.

**4.4.1.3 The development of the model of the atom (common content with chemistry)**



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**

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

**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 e.c.f. 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 Accept / allow**

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

**3.9 Ignore / Insufficient / Do not allow**

Ignore of insufficient 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.

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

## 4. Quality of Communication and levels marking

In Question **8c** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

**Level 1: basic**
- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

**Level 2: clear**
- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

**Level 3: detailed**
- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

### 4.4.1.3 The development of the model of the atom (common content with chemistry)



MARK SCHEME – GCSE ADDITIONAL SCIENCE / PHYSICS – PH2FP– JUNE 2015

| Question | Answers | Extra information | Mark | AO / Spec. ref. | ID |
|---|---|---|---|---|---|
| 1(a) | increases | accept reaches highest value<br><br>do **not** accept increases and decreases | 1 | AO2<br>2.3.2 | E |
| 1(b)(i) | increases | | 1 | AO1<br>2.3.2m | A |
| 1(b)(ii) | increases | | 1 | AO1<br>2.3.2m | A |
| 1(c) | 18<br><br>watt | allow **1** mark for correct substitution i.e. 12 x 1.5 provided no subsequent step<br><br>accept W<br>answer may be indicated in the list | 2<br><br>1 | AO2<br>2.4.2c<br><br>AO1<br>2.4.2c | E |
| Total | | | 6 | | |

### 4.4.1.3 The development of the model of the atom (common content with chemistry)



MARK SCHEME – GCSE ADDITIONAL SCIENCE / PHYSICS – PH2FP– JUNE 2015

| Question | Answers | Extra information | Mark | AO / Spec. ref. | ID |
|---|---|---|---|---|---|
| 2(a) | inside the Sun | | 1 | AO1 2.6.2b | A |
| 2(b) | fusion | | 1 | AO1 2.6.2a | G |
| 2(c) | energy | | 1 | AO1 2.6.2f | A |
| Total | | | 3 | | |

### 4.4.1.3 The development of the model of the atom (common content with chemistry)







| Question | Answers | Extra information | Mark | AO / Spec. ref. | ID |
|---|---|---|---|---|---|
| **3(a)** | 3 (.0) | allow **1** mark for correct substitution i.e. 25 x 0.12 provided no subsequent step | 2 | AO2 2.1.5d | **E** |
| **3(b)(i)** | elastic potential<br><br>kinetic | correct order only | 1<br><br>1 | AO1 2.1.5c 2.2 | **G** |
| **3(b)(ii)** | increases<br><br>to 80(mm) (or more) | accept any number greater than 75<br><br>an answer 'it (more than) doubles' gains both marks | 1<br><br>1 | AO3 2.1.5a | **E** |
| **3(c)(i)** | weight | | 1 | AO1 2.1 | **A** |
| **3(c)(ii)** | Downward speed increases | | 1 | AO1 2.1.1e | **A** |
| **Total** | | | **8** | | |

### 4.4.1.3 The development of the model of the atom (common content with chemistry)





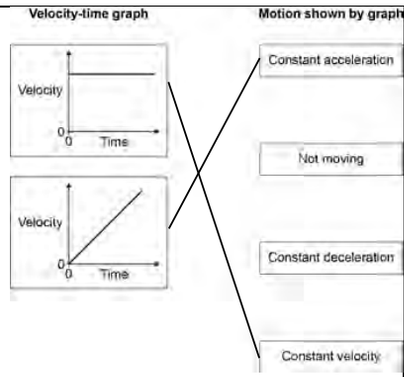
| Question | Answers | Extra information | Mark | AO / Spec. ref. | ID |
|---|---|---|---|---|---|
| **4(a)(i)** | (3-pin) plug | do **not** accept plug socket | 1 | AO1 2.4.1d | **E** |
| **4(a)(ii)** | live and neutral | | 1 | AO1 2.4.1e | **A** |
| **4(a)(iii)** | double | | 1 | AO1 2.4.1j | **G** |
| **4(b)** | Direct current (d.c.) only | | 1 | AO1 2.4.1a | **A** |
| **4(c)(i)** | live | | 1 | AO1 2.4.1g | **G** |
| **4(c)(ii)** | too great a current flows | accept a surge of current<br>accept too great a power<br>accept an electrical fault<br><br>do **not** accept voltage / energy / electricity too high | 1 | AO1 2.4.1g | **E** |
| **4(c)(iii)** | can be reset<br><br>(disconnects circuit) faster | accept does not need replacing<br><br>cheaper is insufficient<br>does not melt is insufficient<br>quicker to fix / replace is insufficient | 1<br><br>1 | AO2 2.4 | **E** |
| **Total** | | | **8** | | |

### 4.4.1.3 The development of the model of the atom (common content with chemistry)







| Question | Answers | Extra information | Mark | AO / Spec. ref. | ID |
|---|---|---|---|---|---|
| **5(a)** |  | if more than one line is drawn from a graph then all those lines are wrong<br>allow **1** mark for 1 correct line | 2 | AO1<br>2.1.2f | **G** |
| **5(b)** | speed | | 1 | AO1<br>2.1.2d | **G** |
| **5(c)(i)** | 2.25 | allow **1** mark for correct substitution i.e.<br>$a = \frac{9-0}{4}$ or $a = \frac{9}{4}$<br>provided no subsequent step | 2 | AO2<br>2.1.2e | **E** |
| **5(c)(ii)** | The air resistance increases | | 1 | AO1<br>2.1.4a | **A** |
| **5(d)** | 2000 J<br><br>mass is half<br>**or**<br>kinetic energy depends on mass | <br><br>do **not** accept weight for mass | 1<br><br>1 | AO2<br>2.2.1g | **E** |
| **Total** | | | **8** | | |

**4.4.1.3 The development of the model of the atom (common content with chemistry)**







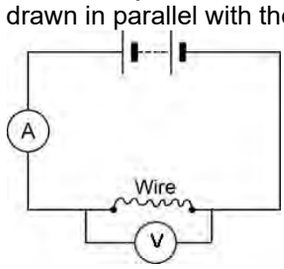
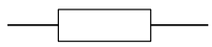
| Question | Answers | Extra information | Mark | AO / Spec. ref. | ID |
|---|---|---|---|---|---|
| **6(a)** | cell damage *or* cancer | accept kills/mutates cells<br><br>radiation poisoning is insufficient<br>ionising is insufficient | 1 | AO3<br>2.5.2g | **E** |
| **6(b)(i)** | any **one** from:<br>• use tongs to pick up source<br>• wear gloves<br>• use (lead) shielding<br>• minimise time (of exposure)<br>• maximise distance (between source and teacher) | accept any other sensible and practical suggestion<br><br>ignore reference to increasing / decreasing the number / thickness of lead sheets | 1 | AO3<br>2.5 | **E** |
| **6(b)(ii)** | <u>background</u> | | 1 | AO1<br>2.5.2b | **E** |
| **6(c)(i)** | curve drawn *from point 2,160* | do **not** accept straight lines drawn from dot to dot | 1 | AO2<br>2.5 | **E** |
| **6(c)(ii)** | (also) increases | less radiation passes through is insufficient | 1 | AO3<br>2.5 | **E** |
| **6(c)(iii)** | 50 | accept any value from 40 to 56 inclusive | 1 | AO3<br>2.5 | **E** |
| **6(d)** | gamma<br><br>only gamma (radiation) can pass through lead | <br><br>accept alpha **and** beta cannot pass through lead<br>a general property of gamma radiation is insufficient | 1<br><br>1 | AO2<br>2.5.2e | **E** |
| **Total** | | | **8** | | |

**4.4.1.3 The development of the model of the atom (common content with chemistry)**



MARK SCHEME – GCSE ADDITIONAL SCIENCE / PHYSICS – PH2FP– JUNE 2015

| Question | Answers | Extra information | Mark | AO / Spec. ref. | ID |
|---|---|---|---|---|---|
| **7(a)(i)** | p.d. is (directly) proportional to current<br>**or**<br>gradient/slope is constant<br>***or***<br>the lines show constant resistance | accept lines are straight / diagonal | 1 | AO2<br>2.3.2d/e/g | **E** |
| **7(a)(ii)** | C<br><br>for the same p.d. the current is the smallest | reason only scores if C is chosen<br><br>accept lowest gradient **and** the gradient = 1/R | 1<br><br>1 | AO2<br>2.3.2i | **E** |
| **7(b)(i) clip with table 1** | ohm | accept correct symbol Ω<br>accept an answer written in Table 1 if not given in answer space | 1 | AO1<br>2.3.2h | **E** |
| **7(b)(ii)** | K and L<br><br>only length varies | reason only scores if both K and L are chosen<br><br>accept type of metal and the diameter are the same | 1<br><br>1 | AO3<br>2.3.2 | **E** |
| **7(b)(iii)** | measure the resistance of more wires made from different metals | accept test more (types of) metals<br>measure the resistance of more wires is insufficient<br>they only use two metals is insufficient | 1 | AO3<br>2.3.2 | **E** |

| | | | | | |
|---|---|---|---|---|---|
| **7(c)(i)** | voltmeter symbol correct and drawn in parallel with the wire   | accept voltmeter symbol correct and drawn in parallel with the battery | 1 | AO1<br>2.3.2c/f | **E** |
| **7(c)(ii)** | correct symbol drawn  | symbol must be rectangular | 1 | AO1<br>2.3.2c | **E** |
| **Total** | | | **9** | | |

| **Question** | **Answers** | **Extra information** | **Mark** | **AO / Spec. ref.** | **ID** |
|---|---|---|---|---|---|
| **8(a)** | (an equal amount of) positive charge | do **not** accept charge on the atom / nucleus is positive | 1 | AO3<br>2.5.1 | **E** |
| **8(b)(i)** | a (significant) number of alpha particles were scattered by more than 4°<br>**or**<br>alpha particles deflected backwards<br><br>measurements / results could not be explained by 'plum pudding' model<br>**or**<br>measurements / results did not support predictions | accept (some) measurements / results were unexpected<br><br>can be explained by the nuclear model is insufficient<br><br>accept measurements / results did not support hypothesis | 1<br><br>1 | AO1<br>2.5<br><br>AO1 | **E** |
| **8(b)(ii)** | many/(over)100 000 measurements / results taken | accept Rutherford(and Marsden) were respected scientists<br>**or**<br>scientists were respected<br><br>accept measurements / results taken over several months<br><br>the experiment was repeated many times is insufficient | 1 | AO3<br>2.5 | **E** |

### 4.4.1.3 The development of the model of the atom (common content with chemistry)



**Question 8 continues on the next page . . .**

| Question | Answers | Extra information | Mark | AO / Spec. Ref. | ID |
|---|---|---|---|---|---|
| 8(c) | | | 6 | AO1 2.5.1a/b/c | E |

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

| 0 marks | Level 1 (1–2 marks) | Level 2 (3–4 marks) | Level 3 (5–6 marks) |
|---|---|---|---|
| no relevant content | A brief description is given with some particles correctly named | A description is given with all three particles named<br>**plus either**<br>the polarity of charge associated with the three particles<br>**or**<br>the relative mass of the three particles<br>**or**<br>the relative mass for one particle and the relative charge for one particle given | A more detailed description is given, naming the particles and polarity of charge<br>**and either**<br>the relative mass is given for at least two particles<br>**or**<br>the relative charge is given for at least two particles |

| examples of the points made in the response | extra information | | |
|---|---|---|---|
| **brief description**<br>contains protons, neutrons and electrons<br><br>protons are positive<br>electrons are negative<br>neutrons are uncharged<br><br>has a nucleus<br><br>**relative charge**<br>proton +1<br>electron – 1<br>neutron 0<br><br>**relative mass**<br>proton 1<br>neutron 1<br>electron (about) 1/2000<br><br>**more detailed description**<br>protons and neutrons make up the nucleus<br>electrons orbit the nucleus<br>electrons are in shells<br>most of the atom is empty space<br>nucleus occupies a very small fraction of the volume of the atom<br>electrons orbit at a relatively large distance from the nucleus<br>most of the mass of the atom is contained in the nucleus<br>the nucleus as a whole is positively charged<br>total number of protons in the nucleus equals the total number of electrons orbiting it in an atom | accept protons and neutrons have the same mass<br><br>accept electrons have tiny / negligible mass<br>zero mass is neutral | | |

| | | |
|---|---|---|
| **Total** | | **10** |

4.4.1.3 The development of the model of the atom (common content with chemistry)

**Answer 04 · Examiner comments** June 2023 | 8463/1F | Original Q2

**Question 2 (Low Demand)**

**02.1** 47% of students correctly identified the particle.

**02.2** 86% of students scored 2 marks on this calculation question.

**02.3** 57% of students correctly identified the charges.

**02.4** 75% of students correctly identified the description of the force.

**02.5** 78% of students identified the correct alpha particle.

**02.6** 39 % of students answered correctly. 'Tiny spheres' was enough to score the mark for students who could not manage to write all 6 words.

**02.7** 23 % of students identified the correct model.

**Answer 05 · Examiner comments** June 2025 | 8463/1F | Original Q3

## 03.1

Almost 70% of the students chose the correct nuclear equation for alpha decay.

## 03.2

The vast majority of the students scored a mark for correctly reading the value on the graph for 50 %.

## 03.3

Just fewer than 40 % of the students scored this mark for identifying the half-life of uranium. Most students did not realise that the two questions, 03.2 and 03.3 were asking for the same value in slightly different ways.

**4.4.1.3 The development of the model of the atom (common content with chemistry)**

**Answer 05 · Examiner comments** June 2025 | 8463/1F | Original Q3

## 03.4
A surprisingly large number of the students chose isotope B, scoring no marks. 13 % of the students scored 1 mark for choosing isotope A with an incorrect reason, while 27 % of the students scored 2 marks. A comparison was needed to score the second mark. 'A steep graph' was insufficient, but 'a steeper graph' would have scored the reason mark.

## 03.5
The vast majority of the students chose the nucleus with the smallest mass number correctly.

## 03.6
Just over half of the students chose the correct nucleus with an atomic number of 4.

## 03.7
Students who realised that the nuclei should have the same number of protons generally scored both marks. 'Same amount of protons' was equivalent to 'same number of protons'.

## 03.8
Just over half of the students chose the correct model of the atom.

## 03.9
Nearly 70 % of the students knew that the mass of an atom is concentrated in the nucleus.

### 4.4.1.3 The development of the model of the atom (common content with chemistry)



AQA

# GCSE
# PHYSICS

8463/1F: Paper 1
Report on the Examination

8463
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### 4.4.1.3 The development of the model of the atom (common content with chemistry)



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**4.4.1.3 The development of the model of the atom (common content with chemistry)**





**General**

Grade 1-3 calculation questions were well answered, where the equation is always given and students will not be required to rearrange the equation. Grade 4-5 calculation questions involving equation recall were answered better this year than in 2018 and students are scoring many of their marks on the paper by answering the subsequent calculation questions correctly. At grade 4-5 students are expected to be able to either rearrange an equation or convert a unit, so it is beneficial for students to be able to quickly identify if the units given in a question are correct for the use in the equation. Question 10.1 was generally well attempted and students who had carried out Required Practical Activity 2 would have had a material advantage over those who hadn't.

Handwriting sometimes makes it very difficult for examiners to read what has been written. Students who have handwriting that is difficult to read may benefit from a scribe or from word processing their answers in exams.

**Levels of demand**

Questions are set at two levels of demand on this paper:

- low demand questions are targeted at students working at grades 1–3
- standard demand questions are targeted at students working at grades 4–5.

A student's final grade, however, is based on their attainment across the qualification as a whole, not just on questions that may have been targeted at the level at which they are working.

**Question 1 (Low demand)**

**01.1** Around 77% of students scored 2 marks. Around 16% of students scored 1 mark.

**01.2** Only around 8% of students scored 2 marks. Both evaporation and change of state were common, insufficient answers for the first marking point. Less than half of the students scored 1 mark. The marking points were independent, so if the change of state was incorrect eg melting, the student could still score the second marking point.

**01.3** Around 91% of students scored 2 marks. In calculations where students are provided with the equation (grades 1-3) students are not expected to rearrange the equation. Some students incorrectly tried to convert the kg into g and scored 0 marks.

**01.4** Approximately 82% of students scored 3 marks. In calculations where students are provided with the equation (grades 1-3) students are not expected to rearrange the equation. Some students incorrectly tried to convert the kg into g and scored 0 marks for the calculation. Some students set out their calculation, but then multiplied the two values rather than dividing.

**Question 2 (Low demand)**

**02.1** About 67% of students identified the correct decay equation.

**02.2** More than three quarters of the students identified why alpha radiation is dangerous inside the human body.

### 4.4.1.3 The development of the model of the atom (common content with chemistry)





**02.3** Just below three quarters of students scored 2 marks. Most correct answers read the values from the graph as intended (460, 280) and students didn't need the tolerance given in the mark scheme.

**02.4** About 60% of students correctly estimated the mass remaining.

**02.5** Students found this question difficult, with around 55% of students scoring 2 marks and around 27% of students scoring 1 mark.

**Question 3 (Low demand)**

**03.1** Approximately 45% of students scored 1 mark for identifying a measuring instrument that could be used. About 9% of students scored 2 marks for describing an appropriate way to use it. Pythagoras was insufficient as the triangle described would not give the height of the zip wire.

**03.2** Students were often very successful in calculation, with around 91% scoring 2 marks.

**03.3** This question gave a good spread of marks. Over a fifth scored 3 marks, almost two fifths scored 2 marks and slightly below a quarter scored 1 mark. Gravitational potential energy or gravitational field strength were insufficient to score a mark.

**Question 4 (Low demand)**

**04.1** Over a third of students answered this question correctly.

**04.2** About 14% of students answered this question correctly.

**04.3** This question about the alpha particle scattering experiment discriminated well between students. Around 16% of students scored 3 marks, around 45% of students scored 2 marks and around 30% of students scored 1 mark.

**04.4** About 77% of students correctly identified what reproducible means. .

**Question 5 (Low demand)**

**05.1** The most common correct answers linked $CO_2$ to global warming. Around 38% of students scored 2 marks and around 35% scored 1 mark. Common incorrect answers were usually vague and mentioned air pollution without being specific. There were many students who incorrectly linked $CO_2$ with the ozone layer.

**05.2** Over half of the students scored 2 marks and over a third scored 1 mark. Insufficient answers included hydro and water. Answers using specification wording eg the tides were acceptable, as were terms like tidal, etc. Oil was insufficient as this was assumed to be non-renewable oil as opposed to palm oil or other biofuel oils.

**05.3** Around 83% of students scored 2 marks for this percentage calculation. An answer of 78 scored 1 mark even if spurious calculations followed.

**05.4** About 67% of students scored 2 marks. Quite a large number of misreads from the graph resulting in 0 marks and around 29% of students scored 0 marks.

**4.4.1.3 The development of the model of the atom (common content with chemistry)**





**05.5** Only around 5% of students scored 2 marks whilst half of the students scored 1 mark. Some students failed to make the connection between the time of day and sunrise. Some students talked vaguely about the energy stored by solar panels, confusing them with solar heating panels rather than solar photovoltaic panels.

**Question 6 (Low and Standard demand)**

**06.1** More than half of the students scored 2 marks. To score a mark a comparative statement was needed eg lower, not low mass of power source. A statement using the word 'better' would be insufficient.

**06.2** Around 64% of students scored 2 marks. Many students scored 1 mark for truncating and not rounding their answers, an answer of 26.08 would score only 1 mark for the substitution.

**06.3** This question discriminated well, with about 16% scoring 2 marks and more than half scoring 1 mark. 'Increases the battery's power output' was insufficient to score a mark. 'Battery lasts longer' was insufficient to score a mark.

**06.4** The quantities in the question are given in alphabetical order; there is no need for students to recall the equation in this order. Any correct rearrangement of the equation or use of the correct symbols for quantities was allowed. A mixture of symbols and words would also score the mark. Approximately 70% of students answered this question correctly.

**06.5** It was encouraging to see many Foundation tier students successfully rearranging the equation. Around 77% of students scored 3 marks.

**Question 7 (Low and Standard demand)**

**07.1** About 86% of students answered this question correctly.

**07.2** Approximately 83% of students answered this question correctly. Students should refer to the Physics specification for the accepted symbols for circuit components. Textbooks and revision guides do not necessarily use the specification symbols. The circles in the component symbol scored a mark even if shown as blobs rather than circles.

**07.3** Around 93% of students scored 2 marks. At grade 1-3, the equation is given and no rearrangement of the equation is needed. Students need to simply substitute and calculate the answer.

**07.4** Around 93% of students scored 2 marks. At grade 1-3, the equation is given and no rearrangement of the equation is needed. Students need to simply substitute and calculate the answer.

**07.5** About 23% of students answered this question correctly.

**07.6** About 38% of students answered this question correctly.

**07.7** Students can recall the equation in any correct rearrangement. The stem of the question lists the quantities in alphabetical order, so that there is no suggestion of the correct order.

Correct letters for quantities are acceptable in place of the quantity names. Voltage or p.d. were acceptable for potential difference. Approximately 57% of students answered this question correctly.

**07.8** The first mark is for the substitution into the correct equation. The second mark is for the correct rearrangement of the correct equation. The third mark is for the correct final answer. About 58% of students scored 3 marks for this question. Grade 4-5 calculation questions require either a unit change or a rearrangement of the equation.

**Question 8 (Low and Standard demand)**

**08.1** Around 63% of students answered this question correctly.

**08.2** Around 86% of students answered this question correctly. Some students gave a precaution instead of a risk, which was insufficient.

**08.3** Around 62% of students answered this question correctly, demonstrating that students still confuse the terms resolution and range.

**08.4** Around 96% of students answered this question correctly.

**08.5** Many students failed to substitute correctly into the equation that was printed on the Physics Equations Sheet. Many students multiplied the 3 values given in the question, which scored zero marks. The unit mark was independent, but a large number of students failed to recognise the correct unit from the box. More than a third of students scored 4 marks and around 16% of students scored 3 marks. A quarter of students scored 1 mark for either the correct unit or the correct substitution.

**Question 9 (Standard demand)**

**09.1** About 45% of students correctly identified the meaning of power input.

**09.2** Only a quarter of students scored this mark. Students can recall the equation in any correct rearrangement. The stem of the question lists the quantities in alphabetical order, so that there is no suggestion of the correct order. Correct letters for quantities are acceptable in place of the quantity names. Voltage or p.d. were acceptable for potential difference.

**09.3** Around 13% of students scored 3 marks and about 81% scored zero. Students found this question difficult to answer, presumably due to their inability to recall the correct equation in the preceding question.

**09.4** More than half of students answered this correctly. Some students failed to score the mark by writing input for both the denominator and the numerator.

**09.5** Students who successfully recalled the equation in **09.4** were likely to score all 3 marks for this question. Only around 15% of students scored zero.

**09.6** Many students restated the stem, rather than going the extra stage in the reasoning and linking to efficiency because thermal energy is also transferred by the light bulb. A number of students believed that knowing the rate at which the bulbs emitted visible light was a

safety concern related to the household electrics. Only around 1% of students scored 2 marks, about 16% of students scored 1 mark and around 73% of students scored zero marks.

**Question 10 (Standard demand)**

**10.1** This question produced a good spread of marks. A mean score of 2.1 was achieved by students on the Foundation tier. Students who had experience of a similar practical benefitted from this as they were able to describe a method in sufficient detail to achieve Level 2. To achieve Level 3, a student needed to indicate that several values of number of layers were used, referring to the interval of 8 layers (as the graph showed) or that the experiment should be done with no layers. A control variable was also needed, either the initial temperature of the water, or the volume of water in each experiment. Some students gained no credit by describing different required practical methods. Around 2% of students scored 6 marks, around 15% of students scored 4 marks and about a fifth of students scored 2 marks. Around 10% of students didn't attempt the question.

**10.2** Many students stated that it wasn't necessary to use both as it would be confusing. The datalogger would produce too much data was a common insufficient answer. A number of students stated that using a normal thermometer would be more appropriate, scoring zero marks. Less than 1% of students scored 2 marks and less than a fifth of students scored 1 mark.

**Question 11 (Standard demand)**

**11.1** Over two-fifths of students scored 3 marks for this question. It wasn't necessary to give the answer to an appropriate number of significant figures, so answers of 0.502, 0.50 and 0.5 were all creditworthy. Some students calculated the jump height to be unlikely values; students should be encouraged to consider whether it is likely that someone can jump a height of 4.92 m, a commonly seen answer achieved by multiplying the 2 values given (41 × 0.12). Less than half of the students scored zero marks.

**11.2** A common incorrect answer was $E_k$ = mass × speed, since these were the quantities given in the question. A number of students also left out the 0.5 value even if they remembered that speed should be squared. Velocity was allowed instead of speed in the equation. Correct symbols were acceptable for the quantities in the equation. About 30% of students answered this question correctly.

**11.3** Despite being asked to recall the equation in 11.2, most students simply multiplied or divided the 2 values given in the question (3.0 and 270), scoring 0 marks. Only around 19% of students scored 3 marks.

**11.4** Some students commented on muscle mass and strength which were insufficient to score marks. Clear comparisons, including at least one difference and one similarity, were needed to score 4 marks. This question discriminated well between students; around 6% of students scored 4 marks, around 29% of students scored 2 marks and around 13% of students scored zero.

### 4.4.1.3 The development of the model of the atom (common content with chemistry)





**11.5** Some students failed to score a mark because they simply restated the question, 'the scientist wanted the highest muscle power reading' without adding any value. The answer either needed to refer to the effect of repetition on performance (improvement or worsening) or that it was the maximum (or peak) muscle power that the scientist was investigating. A fifth of students answered this question correctly.

### 4.4.1.3 The development of the model of the atom (common content with chemistry)





**Use of statistics**

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

**Mark Ranges and Award of Grades**

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.