F

# GCSE (9–1)

# Physics A (Gateway)

**J249/01:** Paper 1 (Foundation Tier)

General Certificate of Secondary Education

## Mark Scheme for June 2019

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

© OCR 2019

Annotations available in RM Assessor

| Annotation | Meaning |
|---|---|
| | Correct response |
| | Incorrect response |
| | Omission mark |
| | Benefit of doubt given |
| | Contradiction |
| | Rounding error |
| | Error in number of significant figures |
| | Error carried forward |
| | Level 1 |
| | Level 2 |
| | Level 3 |
| | Benefit of doubt not given |
| | Noted but no credit given |
| | Ignore |

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

| Annotation | Meaning |
|---|---|
| / | alternative and acceptable answers for the same marking point |
| ✓ | Separates marking points |
| **DO NOT ALLOW** | Answers which are not worthy of credit |
| **IGNORE** | Statements which are irrelevant |
| **ALLOW** | Answers that can be accepted |
| **( )** | Words which are not essential to gain credit |
| **__** | Underlined words must be present in answer to score a mark |
| **ECF** | Error carried forward |
| **AW** | Alternative wording |
| **ORA** | Or reverse argument |

**Subject-specific Marking Instructions**

## INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

## USE OF ANNOTATIONS

- If a question part has only one mark (including of course all of section A) then no ticks are needed. Just enter 0 / 1 / # in Assessor
- If the question part has more than one mark, indicate where each mark is gained by the use of ticks in the appropriate place. Do not use crosses.
- If the mark scheme states, for example

  **FIRST CHECK THE ANSWER ON ANSWER LINE**
  **If answer = 0.5 ($m/s^2$) award 2 marks**

  Then if the answer is correct, do not put multiple ticks. Just put a single tick next to the [mark total] bracket for that question part.

- For the LOR question (21a), indicate 6, 5, 4, 3, 2, 1, 0 marks by L3, L3^, L2, L2^, L1, L1^ and X. This is the only place where a cross is to be used. Avoid using highlights and suchlike in this question.

The breakdown of Assessment Objectives for GCSE (9-1) in Physics A:

| | **Assessment Objective** |
|---|---|
| **AO1** | **Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.** |
| AO1.1 | Demonstrate knowledge and understanding of scientific ideas. |
| AO1.2 | Demonstrate knowledge and understanding of scientific techniques and procedures. |
| **AO2** | **Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.** |
| AO2.1 | Apply knowledge and understanding of scientific ideas. |
| AO2.2 | Apply knowledge and understanding of scientific enquiry, techniques and procedures. |
| **AO3** | **Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.** |
| **AO3.1** | Analyse information and ideas to interpret and evaluate. |
| AO3.1a | Analyse information and ideas to interpret. |
| AO3.1b | Analyse information and ideas to evaluate. |
| **AO3.2** | Analyse information and ideas to make judgements and draw conclusions. |
| AO3.2a | Analyse information and ideas to make judgements. |
| AO3.2b | Analyse information and ideas to draw conclusions. |
| **AO3.3** | Analyse information and ideas to develop and improve experimental procedures. |
| AO3.3a | Analyse information and ideas to develop experimental procedures. |
| AO3.3b | Analyse information and ideas to improve experimental procedures. |

**For answers to Section A if an answer box is blank ALLOW correct indication of answer e.g. circled or underlined.**

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 1 | | | C ✓ | 1 | 1.1 | |
| 2 | | | B ✓ | 1 | 2.2 | |
| 3 | | | A ✓ | 1 | 1.1 | |
| 4 | | | B ✓ | 1 | 2.2 | |
| 5 | | | A ✓ | 1 | 2.2 | |
| 6 | | | C ✓ | 1 | 2.1 | |
| 7 | | | C ✓ | 1 | 1.1 | |
| 8 | | | B ✓ | 1 | 2.1 | |
| 9 | | | A ✓ | 1 | 1.1 | |
| 10 | | | C ✓ | 1 | 2.1 | |
| 11 | | | B ✓ | 1 | 1.1 | |
| 12 | | | B ✓ | 1 | 1.2 | |
| 13 | | | C ✓ | 1 | 2.1 | |
| 14 | | | B ✓ | 1 | 2.1 | |
| 15 | | | B ✓ | 1 | 1.1 | |

For Section B, grey shading in the left-hand column indicates an overlap question: 22 & 23 here are identical to 16 & 17 in J249/03

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| **16** | **(a)** | **(i)** | 50 (m) ✓ | **1** | **2.2** | |
| | | **(ii)** | 60 (s) ✓ | **1** | **2.2** | |
| | | **(iii)** | **Any one from:**<br>Tape measure/ Measuring tape ✓<br>Trundle wheel ✓ | **1** | **1.1** | **ALLOW** Metre ruler / metre stick / metre wheel / surveyors' wheel<br>**DO NOT ALLOW** ruler<br>**ALLOW** Fitbit/smartphone app |
| | **(b)** | **(i)** | C ✓<br>It has the steepest line/gradient/slope / greatest change in distance per second / AW ✓ | **2** | **2.2**<br>**1.1** | **ALLOW** calculation of all 4 speeds<br>**NOT** 'highest distance change in shortest amount of time' |
| | | **(ii)** | B ✓<br>The line is horizontal/flat /distance does **not** change/AW ✓ | **2** | **2.2**<br>**1.1** | |
| | **(c)** | | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 0.5 ($m/s^2$) award 2 marks**<br><br>$v$ = 20 ÷ 40 ✓<br>$v$ = 0.5 ($m/s^2$) ✓ | **2** | **2.1**<br>**2.1** | Mp2 dependent on correct substitution for mp1 |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 17 | (a) | (i) | The voltmeter is in series ✓<br><br>The ammeter is in parallel ✓<br><br>One of the cells is connected the wrong way round / AW ✓ | 3 | 3.2b<br><br>3.2b<br><br>3.2b | **ALLOW** reverse arguments:<br>E.g. voltmeter should be in parallel ✓<br>E.g. ammeter should be in series ✓<br><br>**ALLOW** The cells/batteries are incorrectly connected / facing each other |
| | | (ii) | **Any one from:**<br>Put the voltmeter in parallel with the resistor ✓<br><br>Put the ammeter in series ✓<br><br>Turn around one of the cells/AW ✓ | 1 | 3.3b | **ALLOW** swap the meters over or AW |
| | (b) | | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 200 Ω award 4 marks**Unit conversion 20(mA) = 0.02(A)/20x$10^{-3}$ (A) ✓<br><br>$R$ = 4.0 ÷ 0.02 ✓<br><br>$R$ = 200 ✓<br><br>Ω ✓ | 4 | 1.2<br><br>2.1<br><br>2.1<br><br>1.2 | If final unit is kΩ or V/mA, this unit conversion is not needed so mp1 is subsumed into mp2<br><br>**ECF** incorrect or absent conversion of mA to A<br>e.g. a bald answer of 0.2 gains mp2 & mp3 unless the unit is kΩ or V/mA, when all 4 marks are awarded.<br><br>Mark unit independently<br>**ALLOW** ohm(s) or V/A or V/mA if consistent with working |
| | (c) | | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 75 (C) award 3 marks**<br>Charge flow = current × time / $Q = It$ ✓<br><br>$Q$ = 2.5 x 30 ✓<br><br>$Q$ = 75 (C) ✓ | 3 | 1.2<br><br>2.1<br><br>2.1 | Mp1 can be assumed if correct substitution follows<br><br>No **ECF** from incorrect equation |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 18 | (a) | | **Any three from:**<br>Measure original length (using the ruler) ✓<br><br>Add the 2N weight ✓<br><br>Measure the extended length and use<br>Extension = extended length – original length ✓<br><br>Use $k = F \div x$ to determine $k$ ✓ | 3 | 1.2 x3 | **ALLOW** measure the extension/how far it stretched |
| | (b) | | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 400 (Pa) award 2 marks**<br><br>$P = 2 \div 0.005$ ✓<br><br>$P = 400$ (Pa) ✓ | 2 | 2.1<br><br>2.1 | |
| | (c) | | Two (or more) forces (are needed) ✓<br><br>Acting in different directions ✓ | 2 | 1.1<br><br>1.1 | Multiple forces are implied by the use of certain verbs e.g. squash, twist, squeeze<br><br>**ALLOW** the marking points shown on a diagram<br>Idea of second force can be implied by fixing one end/part of the material<br>**ALLOW** clear use of tension or compression for both marks |
| | (d) | | Plastic – stays deformed (when force is removed) ✓<br><br>Elastic – returns to original shape (when force removed) ✓ | 2 | 1.1<br><br>1.1 | **ALLOW** permanently changed |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 19 | (a) | (i) | Bar C drawn to the correct height of 12s ✓ | 1 | 1.2 | |
| | | (ii) | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 12 (s) award 2 marks**<br><br>14 + 10 + 12 = 36 / (14 + 10 + 12)/3 without the 36 ✓<br><br>36 ÷ 3 = 12 (s) ✓ | 2 | 3.1a<br><br>1.2 | **ECF** from **(a)(i)**<br><br>**ECF** from mp1 above |
| | | (iii) | Lift B ✓<br><br>Takes the least time (power is work done ÷ time taken)/AW ✓ | 2 | 3.1b<br><br>1.2 | <br><br>If A chosen and correct explanation (for B) given, award mp2 but not mp1 |
| | (b) | (i) | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 4166.7 (W) award 4 marks**<br><br>*P* = *E* ÷ *t* / power = work done ÷ time taken ✓<br><br>*P* = 50000 ÷ 12 ✓<br><br>*P* = 4166.666667 (W) ✓<br><br>*P* = 4166.7 (W) (1dp)✓ | 4 | 1.2<br><br>2.1<br><br>2.1<br><br>1.2 | **ALLOW** energy (transferred) ÷ time taken<br><br><br>**ALLOW** 4166.7 for 2 marks if more dp not given<br><br>**ECF** own calculated power to 1 dp |
| | | (ii) | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 3000 (J) award 3 marks**<br><br>Work done = force × distance ✓<br><br>*W* = 750 x 4 ✓<br><br>*W* = 3000 (J) ✓ | 3 | 1.2<br><br>2.1<br><br>2.1 | |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 20 | (a) | | One straight line between the middle of the two poles ✓ | 3 | 1.2 | Ignore any field lines not between the labelled poles<br>Allow dotted lines. Straight line by eye (rulers not used) |
| | | | At least 2 correctly curved lines between the edges of the poles, one above and one below✓ | | 1.2 | Concave smooth curves |
| | | | Arrows on field lines going N to S ✓ | | 1.2 | Any wrong arrow loses this mark |
| | (b) | | **Any one from:**<br>Induced magnets lose their magnetism (when away from a magnetic field)/AW ORA✓<br><br>Permanent magnets retain their magnetism (when away from a magnetic field)/AW ✓ | 1 | 1.1 | |
| | (c) | | **Mistakes:**<br>When a voltage flows through them a magnetic field is created. ✓ | 2 | 3.1b | Must circle 'voltage, or 'flows through', or whole sentence |
| | | | The magnetic field can be increased by decreasing the number of turns…… ✓ | | 3.1b | Should circle 'decreasing (the number of turns)' but NOT the increasing current bit.<br>If a candidate circles 'magnetic field can be increased' and then circles all or part of the increasing current bit, award 1 mark only for this sentence. |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 21 | (a) | * | Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.<br><br>**Level 3 (5–6 marks)**<br><br>States that there is no clear trend.<br>**AND**<br>Detailed identification of at least two problems with the experiment with suggestions of detailed improvements.<br><br>*There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.*<br><br>**Level 2 (3–4 marks)**<br><br>Recognises that the average speeds are similar.<br>**AND**<br>Identifies at least one problem with the experiment with a suggested improvement.<br><br>*There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*<br><br>**Level 1 (1–2 marks)**<br><br>Refers to data from the table.<br>**AND**<br>Suggests an improvement to the experiment or identifies one problem with the experiment.<br><br>*There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.*<br><br>**0 marks**<br>*No response or no response worthy of credit.* | **6** | **2×3.1a**<br>**2×3.2a**<br>**2×3.3b** | **AO3.1a Analyse information and ideas to describe trend in results**<br>For example:<br>• No obvious/discernible trend<br>• As loads increased time ≈ the same<br>• As loads increased speeds ≈ the same<br>• 20N and 60N mean speeds the same<br>• 20N and 60N times the same<br>• 40N and 80N mean speeds the same<br>• 40N and 80N times the same<br><br>**AO3.2a Analyse information and ideas to make judgements and identify problems with the experiment**<br>For example:<br>• Only 4 loads tested<br>• Ramp distance too short<br>• No repeated readings<br>• Mass/weight of trolley ignored<br>• Reaction times an issue for short times<br><br>**AO3.3b Analyse information and ideas to improve experimental procedures**<br>For example:<br>• Test more loads<br>• Include mass/weight of the trolley<br>• Use a longer ramp<br>• Have a smaller angle of ramp<br>• Start higher up the ramp<br>• Electronic timing method<br>• Repeat readings and take a mean |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| | (b) | | **EITHER**<br>$v^2 - u^2 = 2as$ (no mark – on formula sheet)<br>$u = 0$ ✓<br>$a = v^2 \div 2s$ ✓<br>$a = 2^2 \div (2 \times 2.0)$ ✓<br>$a = 1.0/1$ (m/s$^2$) ✓<br>**OR**<br>mean $v$ = ½ (0 + 2 m/s) = 1 m/s ✓<br>$t = s$/mean $v$ = 2 m / 1 m/s = 2 s ✓<br>$a = \Delta v/t$ ✓<br>= (2 m/s - 0)/2 s = 1 (m/s$^2$) ✓ | **4** | **2.1**<br>**2.1**<br>**2.1**<br>**2.1** | If no working shown and answer = 1 (m/s$^2$), award all 4 marks.<br>If wrong physics used, then award marks as appropriate for either approach. |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 22 | (a) | (i) | 40 (g) ✓ | 1 | 3.2b | |
| | | (ii) | Mass before = mass after / Mass is conserved AW ✓<br><br>Explanation in terms of particle rearrangement / conservation of numbers of particles✓ | 2 | 1.1 x2 | **ALLOW** no mass is lost<br>**ALLOW** matter for mass<br><br>**ALLOW** atoms/molecules for particles |
| | (b) | | **Any one from:**<br>Original properties return if change is reversed for physical changes ✓<br><br>Chemical change can't be reversed (easily) OR physical change easily reversible✓<br><br>The substance after the change is the same as the substance before the change for physical changes ORA ✓ | 1 | 1.1 | <br><br><br><br>**ALLOW** in a chemical change particles join together in a different way |
| | (c) | (i) | **Any three from:**<br><br>Measure start/initial temperatures ✓<br><br>Turn on the heaters / heat water ✓<br><br>Measurements to determine energy or mass of water ✓<br><br>For a set time✓<br><br>Measure the final/end temperatures ✓ | 3 | 2.2 x3 | **IGNORE** put thermometer or heater in beaker<br><br>Initial can be implied<br><br><br><br>**ALLOW** for a fixed temperature change<br><br>**ALLOW** for a fixed temperature change, measure time |
| | | (ii) | **Any one from:**<br>Beakers are different sizes OR different volumes /mass of liquid in A and B ✓<br><br>Beakers are not insulated / no lids✓ | 1 | 3.3a | <br><br><br><br>**ALLOW** Heater is not fully in the water |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| | | (iii) | **Any two from:**<br>Use beakers of the same size / same volume✓<br><br>Use same mass or volume of liquid✓<br><br>Stir water / keep distance from thermometer to heater fixed✓<br><br>Insulate the beakers or put the beakers on an insulating material ✓<br><br>Put a lid on the beakers ✓<br><br>Make sure the heater is fully inserted into the liquid ✓ | **2** | **3.3b** | |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 23 | (a) | | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 0.28 (A) award 4 marks** | | | |
| | | | Rearrange equation current = power ÷ potential difference/ I = P ÷ V ✓ | 4 | **1.2** | |
| | | | I = 65 ÷ 230 ✓ | | **2.1** | |
| | | | I = 0.2826086 ✓ | | **2.1** | **NOTE** If answer not to 2 sig figs max 3 marks |
| | | | I = 0.28 (A) ✓ | | **1.2** | **ALLOW** one mark for any calculated answer to 2sf |
| | **(b)** | | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 117000 (or 116000) (J) award 4 marks** | | | **ALLOW ECF** from **(a)** |
| | | | E = P x t ✓ | 4 | **1.2** | E = Q x V or I x t x V |
| | | | Unit conversion 30 minutes = 1800 seconds ✓ | | **1.2** | |
| | | | E = 65 x 1800 ✓ | | **2.1** | E = 0.28 ×1800 × 230<br>**ALLOW ECF for incorrect time conversion**<br>**ALLOW** three marks for 1950 (J) |
| | | | E = 117000 (J) ✓ | | **2.1** | E = 116000 (J) ✓ |

**OCR (Oxford Cambridge and RSA Examinations)**
**The Triangle Building**
**Shaftesbury Road**
**Cambridge**
**CB2 8EA**

**OCR Customer Contact Centre**

**Education and Learning**
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

**www.ocr.org.uk**

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Cambridge Assessment