F

# GCSE (9–1)

# Physics A (Gateway)

**J249/02:** Paper 2 (Foundation Tier)

General Certificate of Secondary Education

## Mark Scheme for June 2019

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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.

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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.

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

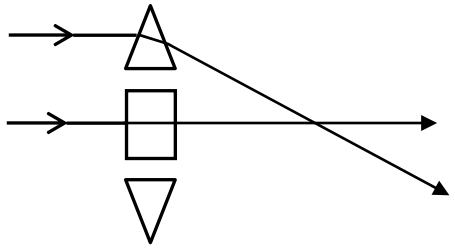
| | Assessment Objective |
|---|---|
| **AO1** | **Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.** |
| AO1.1 | Demonstrate knowledge and understanding of scientific ideas. |
| AO1.2 | Demonstrate knowledge and understanding of scientific techniques 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 | D ✓ | 1 | 1.2 | |
| 3 | D ✓ | 1 | 1.1 | |
| 4 | C ✓ | 1 | 1.1 | |
| 5 | B ✓ | 1 | 2.1 | |
| 6 | B ✓ | 1 | 1.1 | |
| 7 | C ✓ | 1 | 1.2 | |
| 8 | B ✓ | 1 | 1.1 | |
| 9 | B✓ | 1 | 2.1 | |
| 10 | B ✓ | 1 | 1.1 | |
| 11 | C ✓ | 1 | 2.1 | |
| 12 | D ✓ | 1 | 1.2 | |
| 13 | A ✓ | 1 | 2.1 | |
| 14 | D ✓ | 1 | 2.2 | |
| 15 | A ✓ | 1 | 1.1 | |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 16 | (a) | (i) | 40 (°C) ✓ | 1 | 2.2 | |
| | | (ii) | **Any one from:**<br>Difference is much too high / difference should be lower than the previous result AW ✓<br><br>End temperature is too low ✓ | 1 | 3.2a | **ALLOW** does not follow the trend/pattern<br><br>**IGNORE** not stirring/thermometer touching the bottom / start temperature / boiling temperature |
| | (b) | | All points plotted correctly ✓<br><br>Appropriate straight line of best fit ✓ | 2 | 2×2.2 | **ALLOW** tolerance of ± half a square<br><br>**DO NOT ALLOW** straight line from top to bottom<br>**ALLOW** ECF for mis-plotted data points |
| | (c) | | (As thickness of the insulation increases) temperature difference falls / ORA ✓ | 1 | 3.1a | |
| | (d) | | As thickness increases rate decreases / AW / ORA ✓ | 1 | 3.2b | **ALLOW** as thickness increases tea cools slower / takes longer to cool ORA |
| | (e) | | **Any two from:**<br>Keep starting temperatures the same ✓<br><br>Keep room temperature the same ✓<br><br>Stir tea before taking measurements ✓<br><br>Use a lid / add (same) insulation underneath the cup / cover whole cup in (same) thickness insulation ✓<br><br>Repeat <u>and</u> average | 2 | 2×3.3b | |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 17 | (a) | (i) | **Any one from:**<br>Ratio of 1:1 at a height of 40 cm ✓<br><br>ratio (seems to) increase by 0.1 when height decreases by 20 cm (until ratio is 1:1) / AW ✓ | 1 | 3.2a | **ALLOW** when drop height was 40 cm, bounce height was the same / bounce ratio coming closer to 1:1 each time / bounce height cannot be higher than drop height |
| | | (ii) | Some of the energy from the KE store is transferred to other energy stores as ball hits the ground AW ✓ | 1 | 2.1 | **ALLOW** ball will lose energy (when it hits the ground) |
| | (b) | | **Any two from:**<br>Lower head to read bounce height / take bounce height readings at eye level / AW ✓<br><br>Take multiple readings and <u>average</u> them ✓<br><br>Take readings at other intervals (eg. 90, 70, 50) ✓ | 2 | 2×3.3b | **ALLOW** second person to read bounce height / idea of video camera and play back<br><br>**ALLOW** drop from greater heights |
| | (c) | (i) | (Mass = 60 ÷ 1000 =) 0.06 (kg) ✓ | 1 | 1.2 | |
| | | (ii) | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 0.48 (J) award 2 marks**<br><br>Energy = 0.06 × 0.8 × 10✓<br><br>Energy = 0.48 (J) ✓ | 2 | 2×2.1 | **ALLOW ECF** from **(c)(i)**<br><br>E = (c)(i) × 10 × 0.8 ✓<br><br>E = answer to (c)(i) × 8 ✓<br>**ALLOW** E = 60 × 10 × 0.8 = 480 (J) for one mark |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 18 | (a) | (i) | Ray from prism: straight line (by eye) towards focal point ✓<br><br>Ray from block: continues straight ✓ | 2 | 2×1.2 | **IGNORE** ray in prism<br><br>**IGNORE** other rays<br><br> |
| | | (ii) | (in long sight) rays focused behind retina / eye (ball) / AW ✓<br><br>Convex lens refracts light inwards / focuses light on the retina / AW ✓ | 2 | 2×1.1 | **ALLOW** near object focussed behind the retina / eye (ball) or eye (ball) is too short<br><br>**ALLOW** converges / meet for focuses |
| | (b) | | Black ✓<br><br>**AND**<br><br>**Any one from:**<br>Black because blue light absorbed by red paper ✓<br><br>Black because red paper only reflects red light ✓<br><br>Black because red paper absorbs all colours except red ✓<br><br>Black because no light reflected from paper ✓ | 2 | 2×2.2 | **ALLOW** dark without any colour |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 19 | (a) | | spoon A<br>**AND**<br>(More radiation emitted) at higher temperature / hotter objects (emit more radiation) / spoon A is hotter / AW / ORA✓ | 1 | 1.1 | **ALLOW** spoon A is heated (more) |
| | (b) | | **Any one from:**<br>Eye can only detect visible light / eye cannot detect IR ✓ | 1 | 1.1 | **ALLOW** see for detect<br>**ALLOW** spoon is not hot enough for a change in colour AW |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 20 | (a) | (i) | 2 (s) ✓ | 1 | 1.2 | |
| | | (ii) | 3 (cm) ✓ | 1 | 1.2 | |
| | | (iii) | the number of (complete) waves / oscillations in a / per second ✓ | 1 | 1.1 | **ALLOW** '2 waves in a second' ✓ |
| | (b) | | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 1.5 (m/s) award 3 marks**<br><br>Wave speed = frequency × wavelength / v = f × λ ✓<br><br>= 0.25 × 6 ✓<br><br>= 1.5 (m/s) ✓ | 3 | <br><br>1.2<br><br>2.1<br><br>2.1 | |
| | (c) | (i) | (transverse)<br>Wave movement shown  ✓ | 1 | 2.2 | |
| | | (ii) | Reflection at wall ✓ | 1 | 1.2 | **ALLOW** bounces back / comes back towards the hand |
| | | (iii) | The coils / slinky /spring are in the same place (as before the wave) / AW ✓ | 1 | 1.1 | The coils do not travel from one end to the other<br>Must have reference to coils / slinky / spring |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 21 | * | | 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>Detailed description of the procedure and the measurements (including a labelled diagram).<br>**AND**<br>Correct calculation of the change in thermal energy.<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>Detailed description of the procedure and the measurements (with a diagram).<br>**OR**<br>Description of the procedure and the measurements (with a diagram).<br>**AND**<br>Correct calculation of the change in thermal energy.<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>Basic description of the procedure and the measurements.<br>**OR**<br>Correct calculation of the change in thermal energy.<br><br>*There is an attempt at a logical structure with a line of* | **6** | **2×3.3a**<br>**2×2.2**<br>**2×2.1** | **AO3.3a Analyse information and ideas to develop experimental procedures**<br>• liquid placed in beaker<br>• heater immersed in liquid<br>• heater connected to power supply<br>• insulation arranged to reduce heat loss<br>• thermometer<br>• instrument(s) to determine energy e.g. stopwatch, circuit<br><br>**AO2.2 Apply knowledge and understanding of scientific enquiry, techniques and procedures - measurements**<br>• Explanation of obtaining mass of 200 g<br>• Initial temperature measured<br>• Temperature rise / change / temperature after measured<br>• Method to determine the energy e.g. use of joule meter / E = ItV method / power of heater and time.<br><br>**AO2.1 Apply knowledge and understanding of scientific ideas to calculate change in thermal energy**<br>• use of E = m x c x t<br>• E = 0.2 × 4 200 × 20<br>• E = 16 800 J |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| | | | *reasoning. The information is in the most part relevant.*<br><br>**0 marks**<br>*No response or no response worthy of credit.* | | | |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 22 | (a) | | **Any two from:**<br>Electron absorbs or gains energy / AW ✓<br><br>Electron becomes 'excited' / moves to a higher energy level / moves to outer path / AW ✓<br><br>Electron escapes / leaves the atom / AW ✓ | 2 | 2×1.1 | **ALLOW** atom becomes ionised / charged |
| | (b) | (ii) | **Any two from:**<br>Electromagnetic radiation is being absorbed by electrons not nucleus ✓<br><br>Alpha emitted from the nucleus / electrons not present in the nucleus / AW ✓<br><br>Alpha emitted from unstable radioactive nuclei ✓<br><br>Alpha does not have electrons / has protons and neutrons only / AW ✓ | 2 | 2×1.1 | |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 23 | (a) | | 25(g) ✓ | 1 | 1.2 | |
| | (b) | (i) | **C** ✓ | 1 | 2.2 | **ALLOW** answer from diagram if clear |
| | | (ii) | **Any four from:**<br><br>A is more hazardous / B is safer (for most of the time on the graph) ✓<br><br>A has a higher activity (for most of the time) ✓<br><br>B is more hazardous at the beginning ORA ✓<br><br>B has a higher activity at the beginning ORA ✓<br><br>A has a longer half-life / B has a shorter half-life ✓ | 4 | 4×3.1b | |
| | | (iii) | **Maximum two from:**<br><br>One absorber placed between detector and isotope A ✓<br><br>(Idea of) change absorber and repeat experiment ✓<br><br>Measures (background) count with no source✓<br><br>**Maximum two from:**<br><br>Drop in count rate with cardboard indicates alpha ✓<br><br>Drop in count rate with aluminium indicates beta ✓<br><br>Drop in count rate with lead OR cardboard and aluminium / all materials are penetrated indicates gamma ✓ | 4 | 2×2.2<br><br>2×1.2 | May be described or drawn in a diagram<br><br>**ALLOW** stopped / absorbed for drop in count rate |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| | (c) | (i) | Nuclei join (in fusion) ✓ | 1 | 1.1 | **ALLOW** fuse / combine |
| | | (ii) | **Any two from:**<br>High temperature ✓<br><br>High pressure ✓<br><br>Large gravitational forces (due to large mass) ✓ | 2 | 2×2.1 | **IGNORE** heat |
| | | (iii) | The sun will expand / become a red giant / (ultimately) become a white dwarf ✓ | 1 | 1.1 | **ALLOW** fusion of helium / heavier elements |
| | (d) | | **Any one from:**<br><br>supplies of uranium are large enough / will not run out to consider it renewable / AW ✓<br><br>Uranium is not being replaced / used quicker than it is being replaced to consider it non-renewable | 1 | 2.1 | |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 24 | (a) | | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 0.8 (kWh) award 3 marks** | 3 | | |
| | | | Recall (Energy transferred =) power × time ✓ | | 1.2 | **ALLOW** correct equation in any form<br>**ALLOW** 200 x 4 or 200 x 4 x 60 x 60 or 200 x14400 or 200 x 4 x 60 or 0.2 x 4 x 60 x 60 or 0.2 x 14400 or 0.2 x 4 x 60 for one mark |
| | | | 0.2 × 4 ✓ | | 2.1 | **ALLOW** 800 or 2 880 000 or 2880 or 48 000 or 48 for two marks |
| | | | (Energy =) 0.8 (kWh) ✓ | | 2.1 | |
| | (b) | | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 38.28 (W) award 3 marks** | 3 | | |
| | | | Recall (Power =) potential difference x current ✓ | | 1.2 | **ALLOW** correct equation in any form |
| | | | 12 × 3.19 ✓ | | 2.1 | |
| | | | (P =) 38.28 (W) ✓ | | 2.1 | **ALLOW** 38.3 (W) or 38 (W) |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 25 | (a) | | As speed increases, (thinking) distance increases / ORA ✓<br><br>**BUT**<br>(thinking) distance is (directly) proportional to speed / as speed doubles, (thinking) distance doubles / linear relationship through the origin ✓ ✓ | **2** | **3.1a**<br><br>**3.2b** | **ALLOW** numerical values from graph, e.g. at 15 (m/s), td = 10m but at 30 (m/s) td = 20(m).<br><br>**ALLOW** numerical values from graph, e.g. at 15 (m/s), td = 10 (m) but at 30 (m/s) td = 2×10 = 20 (m) for 2 marks |
| | (b) | (i) | 16 (m) ✓ | **1** | **3.1a** | |
| | | (ii) | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 0.67 (s) award 3 marks**<br><br>Rearrangement to give Time = distance / speed ✓<br><br>Time = 16 / 24 ✓<br><br>Time = 0.67 (s) (2 decimal places) ✓ | **3** | <br><br>**1.2**<br><br>**2.1**<br><br>**2.1** | <br><br><br><br>**ALLOW ECF** from **(b)(i)**<br><br>**ALLOW** 0.6 or 0.7 or 0.66(6…) (s) for 2 marks<br>**ALLOW** one mark for any calculated answer to 2dp |
| | (c) | (i) | (Driver under influence of) alcohol / drugs / tired / (named) distraction / ill / <u>old</u>-age / intoxication / high(er) speed ✓ | **1** | **1.1** | **IGNORE** just age<br>**ALLOW** increase in driver's reaction time |
| | | (ii) | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 26 (m) award 2 marks**<br><br>(Stopping distance =) braking (distance) + thinking (distance) OR 16 OR 10 ✓<br><br>(sd =) 26 (m) ✓ | **2** | **2×2.2** | |

| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| | (d) | | **Maximum 2 marks from:**<br>Higher speed increases braking distance ✓<br>**BUT**<br>Double speed quadruples braking distance / braking distance is (directly) proportional to the speed squared AW ✓ ✓<br><br>**Maximum 2 marks from:**<br>(Idea that) higher speed (car has) more KE ✓<br>**BUT**<br>Double speed quadruples KE / KE is (directly) proportional to the speed squared / AW ✓✓ | 3 | 2.1<br><br>3.1a x2<br><br>2.1<br><br>3.1a x2 | **ALLOW** numerical values from graph, e.g. at 10 (m/s), bd = 7.5 (m) but at 20 (m/s) bd = 30 (m).<br>**ALLOW** numerical values from graph, e.g. at 10 (m/s), bd = 7.5 (m) but at 20 (m/s) bd = 4×7.5 (= 30m) for 2 marks |

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

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**Head office**
**Telephone: 01223 552552**
**Facsimile: 01223 552553**

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