AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.6.3.2

# Reaction time

## Mark schemes and examiner comments

| | |
|---|---|
| Tier | **Foundation** |
| Question groups | **13** |
| Available paper years | **2003–2025** |

## 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.

### 4.5.6.3.2 Reaction time

**Answer 01 · Mark scheme** June 2003 | 3451F | Original Q5 | Legacy

The full source mark scheme begins on page 22. Follow original question 5 in that document.

**Answer 02 · Mark scheme** June 2003 | 3462F3 | Original Q5 | Legacy

The full source mark scheme begins on page 44. Follow original question 5 in that document.

**Answer 03 · Mark scheme** June 2006 | 3451 | Original Q15 | Legacy

The full source mark scheme begins on page 61. Follow original question 15 in that document.

**Answer 04 · Mark scheme** June 2006 | 3462 | Original Q13 | Legacy

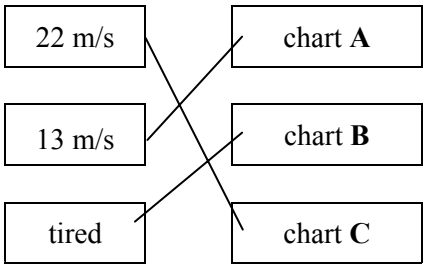
The full source mark scheme begins on page 81. Follow original question 13 in that document.

4.5.6.3.2 Reaction time

Answer 05 · Mark scheme



**Question 3**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | constant | | 1 |
| (ii) | heat | | 1 |
| (b)(i) | 3 links correct<br><br> | allow **1** mark for 1 correct link<br><br>if more than one line is drawn from a condition mark all lines from that condition incorrect | 2 |
| (ii) | increased | | 1 |
| total | | | 5 |

### 4.5.6.3.2 Reaction time

**Answer 05 · Mark scheme**

January 2008 | PHY2F | Original Q3 | Legacy

**PHY2F**

**4.5.6.3.2 Reaction time**

**Answer 06 · Mark scheme** June 2008 | PHY2F | Original Q1 | Legacy

**Question 1**

| | answers | extra information | mark |
|---|---|---|---|
| (a) | 53 (m) | | 1 |
| (b)(i) | Similar shape curve drawn above existing line going through (0,0) | allow **1** mark for any upward smooth curve or straight upward line above existing line going through (0,0) | 2 |
| (ii) | rain on road<br><br>car brakes in bad condition | | 1<br><br>1 |
| (c)(i) | all three lines correctly labelled<br><br>top line – C<br>middle line – B<br>bottom line – A | allow **1** mark for one correctly labelled<br><br>accept 1.2<br>accept 0.9<br>accept 0.7 | 2 |
| (ii) | any **two** from:<br>• (table has) both variables are together<br>• both (variables) could/ would affect the reaction time<br>• cannot tell original contribution<br>• need to measure one (variable) on its own<br>• need to control one of the variables | <br>accept tired and music as named variables<br><br><br>accept cannot tell which variable is affecting the drive (the most)<br>accept need to test each separately | 2 |
| total | | | 9 |

### 4.5.6.3.2 Reaction time

**Answer 06 · Mark scheme**

June 2008 | PHY2F | Original Q1 | Legacy

**PHY2F**

**June 08**

4.5.6.3.2 Reaction time

Answer 07 · Mark scheme



**Question 3**

| question | answers | extra information | mark |
|---|---|---|---|
| **3**(a) | **R**<br><br>has the greatest speed / velocity | reason cannot score if **R** is not chosen<br><br>accept it is going at 28 m/s<br><br>answer should be comparative | 1<br><br>1 |
| **3**(b)(i) | 3250 | allow **1** mark for correct substitution of 130 and 25<br><br>ie 130 × 25<br><br>accept 2600 or 3640 for **1** mark | 2 |
| **3**(b)(ii) | kg m/s | accept answer given in (b)(i) if no answer given here | 1 |
| **3**(c)(i) | increase it | accept make it slower<br>accept slow it down<br><br>accept make it longer<br><br>accept (reactions) would be slower<br><br>do **not** accept if the answer clearly refers to distance<br><br>comparative answers expected | 1 |
| **3**(c)(ii) | increase it | accept make it longer<br><br>do **not** accept if the answer clearly refers to time<br><br>comparative answers expected | 1 |
| **Total** | | | **7** |

### 4.5.6.3.2 Reaction time

**Answer 07 · Mark scheme**

January 2010 | PHY2F | Original Q3 | Legacy

**PHY2F**

4.5.6.3.2 Reaction time

Answer 08 · Mark scheme

June 2010 | PHY2F | Original Q3 | Legacy

## Question 3

| question | answers | extra information | mark |
|---|---|---|---|
| **3**(a) | distance travelled under the braking force | accept braking (distance) | 1 |
| **3**(b) | (directly) proportional<br>**or**<br>increase in the same ratio | accept a correct description using figures<br>eg if speed doubles then thinking distance doubles<br><br>accept for **1** mark positive correlation<br>accept for **1** mark as speed increases so does thinking distance<br>accept as one increases the other increases<br>accept as thinking distance increases speed increases | 2 |
| **3**(c)(i) | control variable | | 1 |
| **3**(c)(ii) | experiment done, student listens to music / ipod (etc)<br><br>experiment (repeated), student not listening to music | <br><br><br><br>for both marks to be awarded there must be a comparison | 1<br><br>1 |
| **3**(d) | increase it | accept an answer which implies reactions are slower<br><br>do **not** accept answers in terms of thinking distance only | 1 |
| **3**(e) | **Y** | | 1 |
| **Total** | | | **8** |

### 4.5.6.3.2 Reaction time

**Answer 08 · Mark scheme** June 2010 | PHY2F | Original Q3 | Legacy

**PHY2F**

4.5.6.3.2 Reaction time

Answer 09 · Mark scheme

June 2013 | PH2FP | Original Q6 | Legacy

## Question 6

| question | answers | extra information | mark |
|---|---|---|---|
| 6(a) | time<br><br>force | correct order only | 1<br><br>1 |
| 6(b) | The car tyres being badly worn | | 1 |
| 6(c)(i) | braking distance increases with speed<br><br>relevant further details, eg<br>• but not in direct proportion<br>• and increases more rapidly after 15 m/s<br>• double the speed, braking distance increases × 4 | accept positive correlation<br>do **not** accept stopping distance for braking distance<br><br>accept any speed between 10 and 20<br>accept numerical example | 1<br><br>1 |
| 6(c)(ii) | line drawn above existing line starting at the origin | as speed increases braking distance must increase<br>each speed must have a single braking distance | 1 |
| 6(d)(i) | reaction time / reaction (of driver) does not depend on speed (of car) | | 1 |

**Question 6 continues on the next page . . .**

**PH2FP**

**Question 6 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **6(d)(ii)** | (on the reduced speed limit roads) over the same period of time<br><br>monitor number of accidents before and after (speed limit reduced) | accept a specific time, eg 1 year<br><br>allow **1** mark only for record number of vehicles / cars using the (20 mph) roads **or** collect data on accidents on the (20 mph) roads<br><br>to score both marks the answer must refer to the roads with the reduced speed limit | 1<br><br>1 |
| **Total** | | | **9** |

### 4.5.6.3.2 Reaction time

**Answer 09 · Mark scheme**

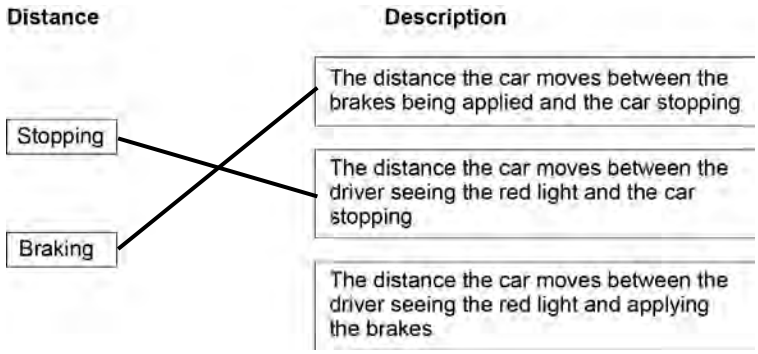
June 2013 | PH2FP | Original Q6 | Legacy

**PH2FP**

4.5.6.3.2 Reaction time

Answer 10 · Mark scheme

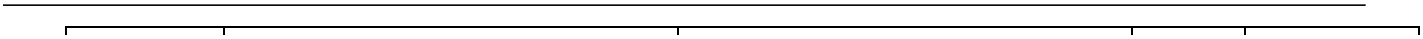
June 2017 | PH2FP | Original Q2 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 2(a) | <br>If more than one line goes from a 'distance' box, all those lines are incorrect | | 2 | AO1<br>2.1.3c |
| 2(b)(i) | 0.8s | | 1 | AO2<br>2.1.3c |
| 2(b)(ii) | increases thinking distance<br><br>so increases (overall) stopping distance | <br><br>takes longer to stop<br><br>more likely to have an accident is insufficient | 1<br><br>1 | AO1<br>2.1.3c, d |
| 2(b)(iii) | $\frac{1}{2} \times 750 \times 8^2$ | | 1 | AO2<br>2.2.1g |
| 2(b)(iv) | decrease(s)<br><br>increase(s) | correct order only | 1<br><br>1 | AO1<br>2.1.3e |
| Total | | | 8 | |

### 4.5.6.3.2 Reaction time

**Answer 10 · Mark scheme**

June 2017 | PH2FP | Original Q2 | Legacy



4.5.6.3.2 Reaction time

Answer 11 · Mark scheme

November 2021 | 8463/2F | Original Q8

## Question 8

| Question | Answers | Mark | AO/ Spec. Ref |
|---|---|---|---|
| 08.1 | **Level 2:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account. | 3–4 | AO1<br>4.5.6.3.3<br>4.5.6.3.4<br>4.1.1.2 |
| | **Level 1:** Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking. | 1–2 | |
| | No relevant content | 0 | |
| | **Indicative content**<br><br>Factors<br>• poor condition of tyres<br>• poor road surface<br>• wet or icy road<br>• poor/worn brakes<br>Explanation<br>• because of decreased friction<br><br>Factors<br>• increased mass of car/passengers<br>Explanation<br>• increases kinetic energy of car<br>• more work needs to be done to stop car<br>• increases momentum of the car<br><br>Factor<br>• road slopes downhill<br>Explanation<br>• (a component of) gravity opposes the braking force<br>• resultant (braking) force is reduced<br><br>allow answers in terms of reducing braking distance throughout<br><br>A single factor with no related explanation is insufficient to score a mark | | |

4.5.6.3.2 Reaction time

Answer 11 · Mark scheme



| | | | | |
|---|---|---|---|---|
| **08.2** | resultant force = mass × acceleration | | 1 | AO1<br>4.5.6.2.2 |
| **08.3** | 7200 = 1600 × *a*<br><br>$a = \frac{7200}{1600}$<br><br>*a* = 4.5 (m/s$^2$) | ignore negatives throughout | 1<br><br>1<br><br>1 | AO2<br>4.5.6.2.2 |
| **08.4** | 15 (m) 38 (m)<br><br>= 53 (m) | two correct values identified<br><br>allow the correct addition of a misread braking distance and /or a misread thinking distance taken from the graph | 1<br><br>1 | AO3<br>4.5.6.3.1 |
| **08.5** | $p = \frac{F}{A}$ | | 1 | AO1<br>4.5.5.1.1 |
| **08.6** | 120 000 = $\frac{60}{A}$<br><br>$A = \frac{60}{120\,000}$<br><br>*A* = 0.0005<br><br>*A* = 5 (.0) × 10$^{-4}$<br><br>m$^2$ | <br><br><br><br><br><br>allow an answer given to 2 sig figs from an incorrect calculation using the given data | 1<br><br>1<br><br>1<br><br>1<br><br>1 | AO2<br><br>AO2<br><br>AO2<br><br>AO2<br><br>AO1<br><br>4.5.5.1.1 |
| **Total** | | | **16** | |

4.5.6.3.2 Reaction time

Answer 12 · Mark scheme

June 2023 | 8463/2F | Original Q2

## Question 2

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.1 | kinetic<br><br>thermal | this order only | 1<br><br>1 | AO1<br>4.5.6.3.4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.2 | (minimum braking) distance increases with increasing speed | allow positive correlation | 1 | AO2<br>4.5.6.3.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.3 | increases | | 1 | AO1<br>4.5.6.3.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.4 | 12.5 – 5.0 = 7.5 (m/s)<br><br>$t = \frac{7.5}{0.25}$<br><br>$t$ = 30 (s) | <br><br>this mark may be awarded if the change in velocity is incorrectly calculated<br><br>allow a correctly calculated answer using a change in velocity incorrectly calculated | 1<br><br>1<br><br>1 | AO2<br>4.5.6.1.5 |

4.5.6.3.2 Reaction time

Answer 12 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.5 | *F* = 1600 × 0.25<br><br>*F* = 400 (N) | | 1<br><br>1 | AO2<br>4.5.6.2.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.6 | initial height of the ruler above the person's hand | | 1 | AO3<br>4.5.6.3.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.7 | there will be more variation in distances | allow reaction times for distances<br><br>allow the three students tested are not typical | 1 | AO3<br>4.5.6.3.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.8 | carry out the experiment listening to music<br><br>then not listening to music (and compare the results) | <br><br>allow compare with original results | 1<br><br>1 | AO3<br>4.5.6.3.2 |

| Total Question 2 | 13 |
|---|---|

4.5.6.3.2 Reaction time

Answer 13 · Mark scheme

June 2025 | 8463/2F | Original Q4

## Question 4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.1 | car **X** has a smaller maximum acceleration | | 1 | AO3<br>4.5.6.2.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.2 | $F = 900 \times 2.5$<br><br>2250 (N) | <br><br>allow 2300 (N) | 1<br><br>1 | AO2<br>4.5.6.2.2 |

| Question | Answers | Mark | AO / Spec. Ref. |
|---|---|---|---|
| 04.3 | **Level 2:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account. | 3–4 | AO2 |
| | **Level 1:** Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking. | 1–2 | AO3 |
| | **No relevant content** | 0 | 4.5.1.4<br>4.5.6.1.5<br>4.5.6.2.1<br>4.5.6.2.2 |
| | **Indicative content**<br><br>• driving force increases<br>• driving force has a maximum value<br>• driving force is greater than air resistance<br>• there is a resultant forward force<br>• air resistance increases (as speed increases)<br>• resultant force decreases<br>• air resistance becomes equal to the driving force (at maximum speed)<br>• resultant force is zero<br><br>For **Level 2** answers must include how both driving force and air resistance change. | | |

4.5.6.3.2 Reaction time



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.4** | time | | 1 | AO1 4.5.6.3.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.5** | force | | 1 | AO1 4.5.6.3.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.6** | (thinking distance =) 20 **and** (braking distance = ) 60 | subsequent marks may be awarded if incorrect reading(s) are taken from the graph | 1 | AO2 4.5.6.3.1 |
| | stopping distance = 20 + 60 | | 1 | |
| | 80 (m) | | 1 | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.7** | the driver becoming tired | | 1 | AO1 4.5.6.3.2 4.5.6.3.3 |
| | driving on a wet road | | 1 | |

| **Total Question 4** | **14** |
|---|---|

**4.5.6.3.2 Reaction time**



ASSESSMENT and QUALIFICATIONS ALLIANCE

# Mark scheme June 2003

# GCSE

## Physics

## 3451

## Foundation

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**4.5.6.3.2 Reaction time**





# INFORMATION FOR 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 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 lines 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 / ; e.g. allow smooth / free movement.)

**3. Marking points**

**3.1 Marking of Quality of Written Communication**

Examiners are reminded of the need to assess QoWC by the following statement appearing in the appropriate parts of the mark scheme:

*The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*

The maximum marks available to a candidate whose answer is not well expressed will be (the number of marks available –1).

## 4.5.6.3.2 Reaction time





**3.2 Marking of lists**

This applies to questions requiring a set number of responses, but for which candidates 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 error/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)

| Candidate | Response | Marks awarded |
|---|---|---|
| 1 | 4,8 | 0 |
| 2 | green, 5 | 0 |
| 3 | red*, 5 | 1 |
| 4 | red*, 8 | 0 |

Example 2: Name two planets in the solar system. (2 marks)

| Candidate | Response | Marks awarded |
|---|---|---|
| 1 | Pluto, Mars, Moon | 1 |
| 2 | Pluto, Sun, Mars, Moon | 0 |

**3.3 Use of chemical symbols/formulae**

If a candidate 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.

**3.4 The marking of quantitative relationships**

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

**3.5 Marking procedure for calculations**

**3.5.1** Full marks can be given for a correct numerical answer, as shown in the column 'answers', 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.

### 4.5.6.3.2 Reaction time





**3.5.2** Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

**3.6 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.

**3.7 Errors carried forward**

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are 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.

**3.8 Phonetic spelling**

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

**3.9 Brackets**

(…..) is 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.

**3.10 Unexpected Correct Answers not in the Mark Scheme**

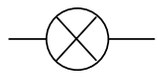
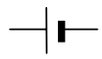
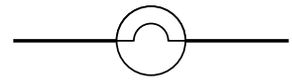
The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

### 4.5.6.3.2 Reaction time





**3451/F Q1**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | circuit symbol for a lamp correct   circuit symbol for a cell correct | accept  accept any standard of drawing providing circuit would work | 1 <br> 1 |
| | 2 lamps drawn in parallel with 3 cells | polarity of cells must be correct (+ to –) but cells may be either way around | 1 |
| (b) | 4.5 | | 1 |
| (c) | the same as | accept any clear indication of the correct answer | 1 |
| total | | | 5 |

### 4.5.6.3.2 Reaction time





**3451/F Q2**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | gas | | 1 |
| (b) | fuel burning stations produce electricity at any time / all the time | accept fuel available all the time | 1 |
| | wind generator can only produce when the wind is strong enough | accept it's not always windy | 1 |
| (c) | no fuel is burnt **or**<br>no fuel is used **or**<br>uses only energy from wind **or**<br>does not emit harmful gases / soot / smoke | do **not** accept wind is natural / environmentally friendly / renewable<br>answer must be in terms of wind, **not** negative of fuel burning<br><br>specific examples of gases $CO_2$, $SO_2$, acid rain and greenhouse gases can be accepted<br><br>ozone negates credit | 1 |
| total | | | 4 |

### 4.5.6.3.2 Reaction time





**3451/F Q3**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | microwaves | | 1 |
| (ii) | infra red | | 1 |
| (iii) | ultrasonic | | 1 |
| (b)(i) | B | | 1 |
| (ii) | A | | 1 |
| (c) | disturbance / vibration / movement<br><br>direction | accept motion / force<br><br>do **not** accept energy | 1<br><br>1 |
| (d) | sound wave | accept any clear indication of the correct answer | 1 |
| total | | | 8 |

### 4.5.6.3.2 Reaction time





**3451/F Q4**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | heat | | 1 |
| (ii) | temperature increases<br>**or**<br>(cause) convection (currents) | accept gets warmer<br>accept gets hotter | 1 |
| (iii) | 60% **or** 0.6 | 60 without % scores **1** mark<br>0.6 with a unit scores **1** mark<br>60 with incorrect unit scores **1** mark<br><br>**or** correct substitution $\frac{120}{200}$<br>for **1** mark | 2 |
| (b) | street<br><br>more (energy transferred as) light **or** less (energy transferred as) heat **or** useful energy output the highest | <br><br>can only score this mark if first mark scored<br><br>all efficiencies calculated correctly score 2nd mark point | 1<br><br>1 |
| total | | | 6 |

### 4.5.6.3.2 Reaction time





**3451/F Q5**

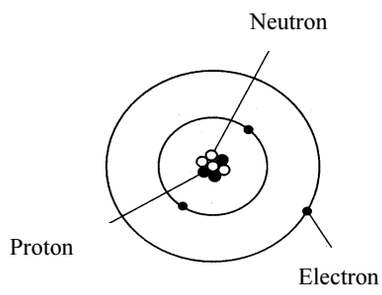
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | MN | accept 5.8, 8 seconds<br>must include unit | 1 |
| (b) | LM | accept 0.8, 5.8 seconds<br>must include unit | 1 |
| (c)(i) | 0.8 | | 1 |
| (ii) | drinking alcohol | | 1 |
| (d) | straight (by eye) line starting at 0.8 seconds<br><br>line drawn steeper than LM starting before L | <br><br>ignore lines going beyond 2 seconds but line must exceed 2.5 metres per second before terminating | 1<br><br>1 |
| total | | | 6 |

### 4.5.6.3.2 Reaction time





**3451/F Q6**

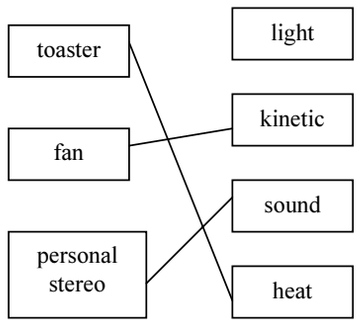
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | each correct label scores 1 mark<br><br> | | 3 |
| (ii) | neutron | | 1 |
| (iii) | 7<br><br>number of protons and neutrons **or** number of nucleons **or** number of particles in the nucleus | <br><br>accept number of particles in the centre only if first answer = 7 | 1<br><br>1 |
| (b)(i) | 50 ± 5 | | 1 |
| (ii) | 50 ± 5 | accept their (b)(i) | 1 |
| (iii) | less | accept any way of indicating the correct answer | 1 |
| total | | | 9 |

### 4.5.6.3.2 Reaction time





**3451/F Q7**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | each correct line scores 1 mark<br><br> | if more than 3 lines are drawn mark incorrect ones first, to a maximum of 3 lines | 3 |
| (b) | toaster | accept 1.2 kW | 1 |
| (c)(i) | 400 | | 1 |
| (ii) | £24 **or** 2400p | full credit for their (c)(i) × 6p<br><br>for full credit the correct numerical answer must have the correct unit<br><br>an answer of 24 or 2400 with no unit or the incorrect unit scores **1** mark<br><br>(c)(i) × 6 incorrectly evaluated scores **1** mark | 2 |
| (d) | 6 | allow 6000 for **1** mark<br><br>allow 3 × 2 for **1** mark | 2 |
| total | | | 9 |

## 4.5.6.3.2 Reaction time





**3451/F Q8**

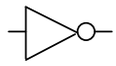
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | point where the rays cross | do not credit if ambiguous | 1 |
| (ii) | converging (lens) | do **not** accept convex | 1 |
| (b)(i) | point where the rays appear to diverge from | this should appear to be within 10mm in front of the back of the arrows on the approximate centre line<br><br>need not be accurately constructed using a ruler | 1 |
| (ii) | diverging (lens) | do **not** accept concave | 1 |
| (c) | converging<br>film<br>smaller than<br>nearer to | accept any clear indication of the correct response e.g. ticking, ringing, writing in after a mistake | 1<br>1<br>1<br>1 |
| (d)(i) | (image) bigger than object / enlarge | accept just 'made bigger' | 1 |
| (ii) | it / real image can be put on a screen<br>**or** real image on the opposite side of the lens to the object | accept 'not an imaginary or virtual image'<br><br>assume 'it' refers to a real image<br><br>do **not** credit 'it can be seen' | 1 |
| (e) | **either** (the converging lens is) thick in the middle<br>thin(ner) at the edge<br><br>**or** (both) sides bend outwards (1)<br>in the middle (1)<br><br>**or** one side bends in the middle (1)<br>more than the other side bends inwards (in the middle) (1) | thickest in the middle gains **2** marks<br><br>convex gains **2** marks<br><br>suitable diagrams gains **2** marks | 1<br>1 |
| total | | | 12 |

### 4.5.6.3.2 Reaction time





**3451/F Q9**

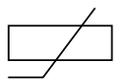
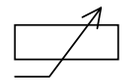
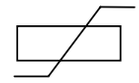
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | off<br>off<br>on | all correct | 1 |
| (ii) | AND (gate) | accept and (gate) | 1 |
| (iii) | on<br>on<br>on | all correct | 1 |
| (iv) | OR (gate) | accept or (gate) | 1 |
| (b)(i) | 1 0 **or** 0 1<br>0 1 1 0 | do **not** credit on / off responses | 1 |
| (ii) |  | accept mirror image<br>accept <br>accept with either or both parts shaded<br>accept line through as shading | 1 |
| (c) | | accept off for 0 and on for 1 throughout | |
| | 0<br>0 | both correct | 1 |
| | 0<br>1 | both correct | 1 |
| | 1<br>1 | both correct | 1 |
| | 1<br>1 | both correct | 1 |

### 4.5.6.3.2 Reaction time





**3451/F Q9 continued**

| | | | |
|---|---|---|---|
| (d)(i) |  | accept mirror image **or** inverted<br><br>do **not** credit<br> **or** <br><br>or similar | 1 |
| (ii) | resistance decreases / increases / changes<br><br>current (through it) increases / decreases / changes<br><br>**or**<br><br>temperature changes / increases / decreases (1)<br><br>resistance changes / decreases / increases (1)<br>(NTC thermistor)<br><br>both marks independent but must be compatible to score **2** marks | accept 'voltage across it decreases' for **2** marks but only if it is made clear that this refers to a thermistor in series | 1<br><br>1 |
| total | | | 13 |

### 4.5.6.3.2 Reaction time





**3451/F Q10**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | friction | accept any way of indicating the correct answer | 1 |
| (ii) | gravity | accept any way of indicating the correct answer | 1 |
| (b)(i) | accelerates **or** speed / velocity increases | accept faster and faster (**1** mark)<br><br>do **not** accept faster pace / falls faster or suggestions of a greater but constant speed | 1 |
| | downwards / falls | accept towards the Earth / ground<br><br>this may score in part (b)(ii) if it does not score here and there is no contradiction between the two parts | 1 |
| (ii) | constant speed / velocity **or** terminal velocity / speed **or** zero acceleration | stays in the same place negates credit | 1 |
| total | | | 5 |

### 4.5.6.3.2 Reaction time





**3451/F Q11**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | X – mantle | | 1 |
| | Y – inner core | do **not** accept solid core | 1 |
| (ii) | different to the crust **or** contains a lot of (heavy) metals | accept iron and nickel for metals | 1 |
| | higher (average) density **or** denser | density higher than 5500 ($kg/m^3$) gets **2** marks | 1 |
| (b) | animals were able to move from one continent to the other | | 1 |
| | (when bridge broke) animals evolved differently | accept animals adapted differently | 1 |
| (c)(i) | earthquakes occur at the boundary between plates **or** earthquakes occur where plates push against each other | | 1 |
| | there are no plate boundaries running through Britain | accept Britain is not near the edge of a plate | 1 |
| (ii) | convection currents (in the mantle) **or** heat released by (natural) radioactive processes | | 1 |
| total | | | 9 |

## 4.5.6.3.2 Reaction time





**3451/F Q12**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | outside the Earth<br>**or**<br>not from the Earth | accept alien<br>accept life from / on another planet / space<br>accept our planet for Earth | 1 |
| (ii) | radio telescope(s) | do **not** accept telescopes<br>do **not** accept satellite dishes<br>do **not** accept radio receivers **or** transmitters | 1 |
| (b)(i) | galaxies | do **not** accept stars | 1 |
| (ii) | any **one** from:<br>the pulses were regular<br>pulses from space are usually random<br>(scientists) thought technology had been used to produce the pulses<br>neutron stars were unknown<br>signals from a single point | <br>accept signals / beats for pulses<br>accept noise for random pulses<br>idea of regular but not continuous | 1 |
| (iii) | neutron star is (the matter / mass) left behind<br>after a star / red giant explodes (as a super nova) | <br>accept after a super nova (explosion)<br>neutron star causing super nova gets no credit | 1<br>1 |
| (c)(i) | carried on the balloon / equipment | accept carried by a rocket / aircraft / satellite<br>birds negates credit | 1 |
| (ii) | on comets or meteors | accept meteorites / shooting stars<br>accept returning space craft<br>accept solar wind<br>ignore asteroids<br>accept ufo<br>do **not** accept solar flares<br>do **not** accept satellites | 1 |
| total | | | 8 |

### 4.5.6.3.2 Reaction time





**3451/F Q13**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | silver is a (good) reflector of <u>heat</u> (radiation) **or** silver reflects the heat (radiation) | fact<br>heat = infra red<br>ignore references to light<br>accept shiny for silver<br>good radiator negates the mark<br>ignore references to good conductor<br>do **not** accept bounce back | 1 |
| | less heat is lost through the board **or** more heat is retained by the shirt | explanation<br>accept both sides of shirt heated<br>reflects heat back up gets **1** mark only<br>ignore mention of friction | 1 |
| (b) | metal soleplate | accept soleplate / bottom / metal<br>do **not** accept outside / case | 1 |
| (c) | plastic **or** rubber | accept any named plastic<br>do **not** accept wood | 1 |
| | it is a (good) insulator **or** it is a poor conductor | ignore mention of heat if in conjunction with electricity | 1 |
| (d) | **Quality of written communication**<br>*The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* | *Maximum of **2** marks if ideas not well expressed.* | |
| | pulls iron bolt down **or** attracts the iron bolt **or** moves bolt out of plunger | answers in terms of charges attracting or repelling gain no credit | 1 |
| | plunger pushed / moved to the right (by spring) **or** plunger released | | 1 |
| | push switch opens / goes to off / goes to right | accept circuit is broken<br>for maximum credit the points must follow a logical sequence<br>3 correct points but incorrect sequence scores **2** marks only<br>ignore reset action | 1 |
| total | | | 8 |

## 4.5.6.3.2 Reaction time





**3451/F Q14**

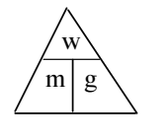
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | any **one** from:<br><br>the ground<br>the air<br>radon (gas)<br>building materials<br>buildings<br>rocks / granite<br>food<br>cosmic rays **or** solar rays<br><br>X-rays<br>nuclear weapons testing<br>nuclear power stations / accidents | <br><br>do **not** accept mobile phones<br><br><br><br><br><br><br>accept from outer space<br>accept sun but **not** sunlight<br>accept medical uses | 1 |
| (ii) | 2 | allow $\frac{1200}{60\times10}$ **or** $\frac{1200}{600}$ **or** 120<br>for **1** mark | 2 |
| (b) | <br><br><br>alpha: the count rate is (greatly) reduced by the card **or**<br>the card absorbs alphas but not betas<br><br>beta: the count rate is (greatly) reduced by the metal **or**<br>the thin metal absorbs alphas and betas **or** the thin metal absorbs all of the radiation (from the source)<br><br>gamma: would pass through the thin metal but count rate is background **or** no radiation passing through **or**<br>a higher reading would be recorded **or** to reduce the count to 2 would require much more than 3 mm of metal | answers must be comparative<br><br>accept converse answers throughout<br><br>accept paper for the card<br><br><br>accept aluminium for the metal<br><br><br><br><br>accept aluminium for the metal<br><br><br>accept lead / aluminium for the metal | <br><br><br>1<br><br><br>1<br><br><br><br><br>1 |
| total | | | 6 |

### 4.5.6.3.2 Reaction time





**3451/F Q15**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | weight = mass × g.f.s. | accept w = m × g<br>accept gravity for gfs<br>accept  provided<br>subsequent use of Δ correct<br>do **not** accept N = kg × N/kg | 1 |
| (ii) | 675 | 75 × 9 for **1** mark | 2 |
| (iii) | g.(f.s.) is higher (on Earth than Venus) | accept gravity for g.f.s.<br>do **not** accept g.f.s. is lower unless answer states on Venus | 1 |
| (iv) | orbit time for Jupiter is <u>longer</u> / longest (than for the other planets) | do **not** give any credit for an answer that includes a comparison of diameter **or** a comparison of g.f.s. | 1 |
| (b) | **Quality of written communication**<br>*The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*<br>any **two** from:<br>dust <u>and</u> gas **or** remnants of a super nova<br>pulled together by (force of) <u>gravity</u><br>nuclear fusion starts | *Maximum of **1** mark if ideas not well expressed.*<br>accept hydrogen for dust and gas<br>do **not** accept hydrogen burns<br>although candidates may include more detail these points are essential to score the credit | 2 |
| total | | | 7 |

## 4.5.6.3.2 Reaction time





**3451/F Q16**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | upright with the contacts at the bottom and still in place and unbent | no need for labels but incorrect label(s) cancel the mark<br><br>accept a freehand drawing<br><br>no need for details such as correct dimensions | 1 |
| | one blob of mercury touching <u>both</u> contacts | do **not** award mark if contacts bent to touch | 1 |
| (b)(i) | (X is a) battery | do **not** credit cell<br>accept (set of) cells<br>accept power supply<br>do **not** accept power pack | 1 |
| | (Y is a) LED | **or** light emitting diode | 1 |
| (ii) | longer (time) | do **not** accept 'slower time' | 1 |
| (iii) | any **two** from:<br><br>current less<br><br>(so) rate of flow of charge less **or** less coulombs per second<br><br>(so) discharge is slower | <br><br>do **not** accept current slower<br><br><br><br>accept capacitor has charge for longer **or** charge lasts longer **or** (so total of) electrons take longer to travel round circuit | 2 |
| (c) | 4200 | <br><br>translation correct (= 4000) but percentage addition incorrect gains **1** mark<br><br>translation incorrect but 5% addition is correct gains **1** mark<br><br>accept 422.1 **or** 42.2 **or** 6.3 for **1** mark | 2 |
| | ohms **or** Ω | <br><br>4.2 kilohms **or** 4.2 kΩ gains all **3** marks | 1 |
| total | | | 10 |

### 4.5.6.3.2 Reaction time





**3451/F Q17**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | point at which its mass (seems to) act<br>**or** point at which gravity (seems to) act | accept …its weight acts<br><br>accept correct statements if the intent is clear<br>e.g. … if suspended, the centre of gravity will be directly under the point of suspension<br>e.g. … (if the object is symmetrical), the centre of gravity is on the **or** an axis (of symmetry)<br><br>do **not** credit just 'it is a point' | 1 |
| (b) | **Quality of written communication**<br>*The answer to this question requires good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*<br><br>any **five** from:<br><br>clamp (steel) rod (horizontally)<br>hang plastic / sheet by rod through (one) hole<br>hang plumb line from rod<br>mark ends of plumb line on the sheet and use the ruler to draw a straight line<br>repeat with other hole<br>centre of mass is where the lines cross<br>check by balancing at this point | *maximum of **4** marks if ideas not well expressed*<br><br>**no** marks if method quite unworkable<br><br>maximum of **3** marks if no 'repeat with other hole' | 5 |
| (c)(i) | (turning) effect **or** moment<br>force<br>distance | all three correct<br>accept weight<br>accept length | 1 |
| (ii) | 17.6<br><br>Nm **or** newton metre(s) | allow 44 × 0.4 **or** 0.4 × 44 for **1** mark<br><br>do **not** accept N/m **or** N/cm<br><br>1760 Ncm gains all **3** marks | 2<br><br>1 |
| total | | | 10 |

**4.5.6.3.2 Reaction time**



ASSESSMENT and QUALIFICATIONS ALLIANCE

# Mark scheme June 2003

# GCSE

## Science: Double Award Co-ordinated

## 3462

## Paper 3F

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**4.5.6.3.2 Reaction time**





# INFORMATION FOR 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 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 lines 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 / ; e.g. allow smooth / free movement.)

**3. Marking points**

**3.1 Marking of Quality of Written Communication**

Examiners are reminded of the need to assess QoWC by the following statement appearing in the appropriate parts of the mark scheme:

*The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*

The maximum marks available to a candidate whose answer is not well expressed will be (the number of marks available –1).

## 4.5.6.3.2 Reaction time





**3.2 Marking of lists**

This applies to questions requiring a set number of responses, but for which candidates 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 error/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)

| Candidate | Response | Marks awarded |
|---|---|---|
| 1 | 4,8 | 0 |
| 2 | green, 5 | 0 |
| 3 | red*, 5 | 1 |
| 4 | red*, 8 | 0 |

Example 2: Name two planets in the solar system. (2 marks)

| Candidate | Response | Marks awarded |
|---|---|---|
| 1 | Pluto, Mars, Moon | 1 |
| 2 | Pluto, Sun, Mars, Moon | 0 |

**3.3 Use of chemical symbols/formulae**

If a candidate 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.

**3.4 The marking of quantitative relationships**

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

**3.5 Marking procedure for calculations**

**3.5.1** Full marks can be given for a correct numerical answer, as shown in the column 'answers', 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.

### 4.5.6.3.2 Reaction time





**3.5.2** Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

**3.6 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.

**3.7 Errors carried forward**

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are 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.

**3.8 Phonetic spelling**

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

**3.9 Brackets**

(…..) is 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.

**3.10 Unexpected Correct Answers not in the Mark Scheme**

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

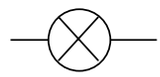
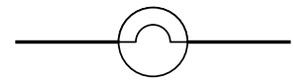
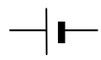
### 4.5.6.3.2 Reaction time





**Double Award**
**Foundation Tier 3462/3F**

**3462/3F Q1**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | circuit symbol for a lamp correct  | accept  accept any standard of drawing providing circuit would work | 1 |
| | circuit symbol for a cell correct  | | 1 |
| | 2 lamps drawn in parallel with 3 cells | polarity of cells must be correct (+ to –) but cells may be either way around | 1 |
| (b) | 4.5 | | 1 |
| (c) | the same as | accept any clear indication of the correct answer | 1 |
| total | | | 5 |

### 4.5.6.3.2 Reaction time





**3462/3F Q2**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | gas | | 1 |
| (b) | fuel burning stations produce electricity at any time / all the time | accept fuel available all the time | 1 |
| | wind generator can only produce when the wind is strong enough | accept it's not always windy | 1 |
| (c) | no fuel is burnt **or**<br>no fuel is used **or**<br>uses only energy from wind **or**<br>does not emit harmful gases / soot / smoke | do **not** accept wind is natural / environmentally friendly / renewable<br>answer must be in terms of wind, **not** negative of fuel burning<br><br>specific examples of gases $CO_2$, $SO_2$, acid rain and greenhouse gases can be accepted<br><br>ozone negates credit | 1 |
| total | | | 4 |

### 4.5.6.3.2 Reaction time





**3462/3F Q3**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | microwaves | | 1 |
| (ii) | infra red | | 1 |
| (iii) | ultrasonic | | 1 |
| (b)(i) | B | | 1 |
| (ii) | A | | 1 |
| (c) | disturbance / vibration / movement<br><br>direction | accept motion / force<br><br>do **not** accept energy | 1<br><br>1 |
| (d) | sound wave | accept any clear indication of the correct answer | 1 |
| total | | | 8 |

### 4.5.6.3.2 Reaction time





**3462/3F Q4**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | heat | | 1 |
| (ii) | temperature increases<br>**or**<br>(cause) convection (currents) | accept gets warmer<br>accept gets hotter | 1 |
| (iii) | 60% **or** 0.6 | 60 without % scores **1** mark<br>0.6 with a unit scores **1** mark<br>60 with incorrect unit scores **1** mark<br><br>**or** correct substitution $\frac{120}{200}$<br>for **1** mark | 2 |
| (b) | street<br><br>more (energy transferred as) light **or** less (energy transferred as) heat **or** useful energy output the highest | <br><br>can only score this mark if first mark scored<br><br>all efficiencies calculated correctly score 2nd mark point | 1<br><br>1 |
| total | | | 6 |

### 4.5.6.3.2 Reaction time





**3462/3F Q5**

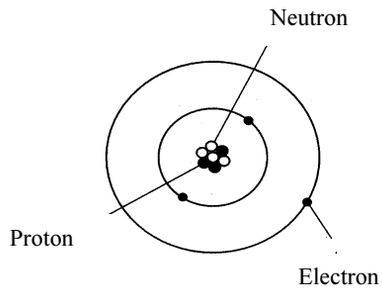
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | MN | accept 5.8, 8 seconds<br>must include unit | 1 |
| (b) | LM | accept 0.8, 5.8 seconds<br>must include unit | 1 |
| (c)(i) | 0.8 | | 1 |
| (ii) | drinking alcohol | | 1 |
| (d) | straight (by eye) line starting at 0.8 seconds<br><br>line drawn steeper than LM starting before L | <br><br>ignore lines going beyond 2 seconds but line must exceed 2.5 metres per second before terminating | 1<br><br>1 |
| total | | | 6 |

### 4.5.6.3.2 Reaction time





**3462/3F Q6**

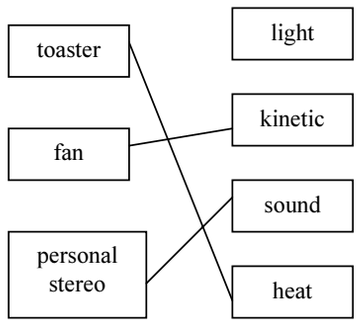
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | each correct label scores 1 mark<br><br> | | 3 |
| (ii) | neutron | | 1 |
| (iii) | 7<br><br>number of protons and neutrons **or** number of nucleons **or** number of particles in the nucleus | <br><br>accept number of particles in the centre only if first answer = 7 | 1<br><br>1 |
| (b)(i) | 50 ± 5 | | 1 |
| (ii) | 50 ± 5 | accept their (b)(i) | 1 |
| (iii) | less | accept any way of indicating the correct answer | 1 |
| total | | | 9 |

### 4.5.6.3.2 Reaction time





**3462/3F Q7**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | each correct line scores 1 mark<br><br> | if more than 3 lines are drawn mark incorrect ones first, to a maximum of 3 lines | 3 |
| (b) | toaster | accept 1.2 kW | 1 |
| (c)(i) | 400 | | 1 |
| (ii) | £24 **or** 2400p | full credit for their (c)(i) × 6p<br><br>for full credit the correct numerical answer must have the correct unit<br><br>an answer of 24 or 2400 with no unit or the incorrect unit scores **1** mark<br><br>(c)(i) × 6 incorrectly evaluated scores **1** mark | 2 |
| (d) | 6 | allow 6000 for **1** mark<br><br>allow 3 × 2 for **1** mark | 2 |
| total | | | 9 |

### 4.5.6.3.2 Reaction time





**3462/3F Q8**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | friction | accept any way of indicating the correct answer | 1 |
| (ii) | gravity | accept any way of indicating the correct answer | 1 |
| (b)(i) | accelerates **or** speed / velocity increases | accept faster and faster (**1** mark)<br><br>do **not** accept faster pace / falls faster or suggestions of a greater but constant speed | 1 |
| | downwards / falls | accept towards the Earth / ground<br><br>this may score in part (b)(ii) if it does not score here and there is no contradiction between the two parts | 1 |
| (ii) | constant speed / velocity **or** terminal velocity / speed **or** zero acceleration | stays in the same place negates credit | 1 |
| total | | | 5 |

## 4.5.6.3.2 Reaction time





**3462/3F Q9**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | X – mantle | | 1 |
| | Y – inner core | do **not** accept solid core | 1 |
| (ii) | different to the crust **or** contains a lot of (heavy) metals | accept iron and nickel for metals | 1 |
| | higher (average) density **or** denser | density higher than 5500 ($kg/m^3$) gets **2** marks | 1 |
| (b) | animals were able to move from one continent to the other | | 1 |
| | (when bridge broke) animals evolved differently | accept animals adapted differently | 1 |
| (c)(i) | earthquakes occur at the boundary between plates **or** earthquakes occur where plates push against each other | | 1 |
| | there are no plate boundaries running through Britain | accept Britain is not near the edge of a plate | 1 |
| (ii) | convection currents (in the mantle) **or** heat released by (natural) radioactive processes | | 1 |
| total | | | 9 |

### 4.5.6.3.2 Reaction time





**3462/3F Q10**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | outside the Earth<br>**or**<br>not from the Earth | accept alien<br>accept life from / on another planet / space<br>accept our planet for Earth | 1 |
| (ii) | radio telescope(s) | do **not** accept telescopes<br>do **not** accept satellite dishes<br>do **not** accept radio receivers **or** transmitters | 1 |
| (b)(i) | galaxies | do **not** accept stars | 1 |
| (ii) | any **one** from:<br>the pulses were regular<br>pulses from space are usually random<br>(scientists) thought technology had been used to produce the pulses<br>neutron stars were unknown signals from a single point | <br>accept signals / beats for pulses<br>accept noise for random pulses<br>idea of regular but not continuous | 1 |
| (iii) | neutron star is (the matter / mass) left behind<br>after a star / red giant explodes (as a super nova) | <br>accept after a super nova (explosion)<br>neutron star causing super nova gets no credit | 1<br>1 |
| (c)(i) | carried on the balloon / equipment | accept carried by a rocket / aircraft / satellite<br>birds negates credit | 1 |
| (ii) | on comets or meteors | accept meteorites / shooting stars<br>accept returning space craft<br>accept solar wind<br>ignore asteroids<br>accept ufo<br>do **not** accept solar flares<br>do **not** accept satellites | 1 |
| total | | | 8 |

## 4.5.6.3.2 Reaction time





**3462/3F Q11**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | silver is a (good) reflector of <u>heat</u> (radiation) **or** silver reflects the heat (radiation) | fact<br>heat = infra red<br>ignore references to light<br>accept shiny for silver<br>good radiator negates the mark<br>ignore references to good conductor<br>do **not** accept bounce back | 1 |
| | less heat is lost through the board **or** more heat is retained by the shirt | explanation<br>accept both sides of shirt heated<br>reflects heat back up gets **1** mark only<br>ignore mention of friction | 1 |
| (b) | metal soleplate | accept soleplate / bottom / metal<br>do **not** accept outside / case | 1 |
| (c) | plastic **or** rubber | accept any named plastic<br>do **not** accept wood | 1 |
| | it is a (good) insulator **or** it is a poor conductor | ignore mention of heat if in conjunction with electricity | 1 |
| (d) | **Quality of written communication**<br>*The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* | *Maximum of **2** marks if ideas not well expressed.* | |
| | pulls iron bolt down **or** attracts the iron bolt **or** moves bolt out of plunger | answers in terms of charges attracting or repelling gain no credit | 1 |
| | plunger pushed / moved to the right (by spring) **or** plunger released | | 1 |
| | push switch opens / goes to off / goes to right | accept circuit is broken<br>for maximum credit the points must follow a logical sequence<br>3 correct points but incorrect sequence scores **2** marks only<br>ignore reset action | 1 |
| total | | | 8 |

### 4.5.6.3.2 Reaction time





**3462/3F Q12**

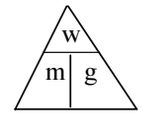
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | any **one** from:<br><br>the ground<br>the air<br>radon (gas)<br>building materials<br>buildings<br>rocks / granite<br>food<br>cosmic rays **or** solar rays<br><br>X-rays<br>nuclear weapons testing<br>nuclear power stations / accidents | <br><br>do **not** accept mobile phones<br><br><br><br><br><br><br>accept from outer space<br>accept sun but **not** sunlight<br>accept medical uses | 1 |
| (ii) | 2 | allow $\frac{1200}{60\times10}$ **or** $\frac{1200}{600}$ **or** 120<br>for **1** mark | 2 |
| (b) | <br><br><br>alpha: the count rate is (greatly) reduced by the card **or**<br>the card absorbs alphas but not betas<br><br>beta: the count rate is (greatly) reduced by the metal **or**<br>the thin metal absorbs alphas and betas **or** the thin metal absorbs all of the radiation (from the source)<br><br>gamma: would pass through the thin metal but count rate is background **or** no radiation passing through **or**<br>a higher reading would be recorded **or** to reduce the count to 2 would require much more than 3 mm of metal | answers must be comparative<br><br>accept converse answers throughout<br><br>accept paper for the card<br><br><br>accept aluminium for the metal<br><br><br><br><br>accept aluminium for the metal<br><br><br>accept lead / aluminium for the metal | <br><br><br>1<br><br><br>1<br><br><br><br><br>1 |
| total | | | 6 |

### 4.5.6.3.2 Reaction time





**3462/3F Q13**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | weight = mass × g.f.s. | accept w = m × g<br>accept gravity for gfs<br>accept  provided<br>subsequent use of Δ correct<br>do **not** accept N = kg × N/kg | 1 |
| (ii) | 675 | 75 × 9 for **1** mark | 2 |
| (iii) | g.(f.s.) is higher (on Earth than Venus) | accept gravity for g.f.s.<br>do **not** accept g.f.s. is lower unless answer states on Venus | 1 |
| (iv) | orbit time for Jupiter is <u>longer</u> / longest (than for the other planets) | do **not** give any credit for an answer that includes a comparison of diameter **or** a comparison of g.f.s. | 1 |
| (b) | **Quality of written communication**<br>*The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*<br>any **two** from:<br>dust <u>and</u> gas **or** remnants of a super nova<br>pulled together by (force of) <u>gravity</u><br>nuclear fusion starts | *Maximum of **1** mark if ideas not well expressed.*<br>accept hydrogen for dust and gas<br>do **not** accept hydrogen burns<br>although candidates may include more detail these points are essential to score the credit | 2 |
| total | | | 7 |

Version 1.0: 0906

ASSESSMENT and QUALIFICATIONS ALLIANCE

# General Certificate of Secondary Education

# Physics 3451/F
*Specification B*

# Mark Scheme

## *2006 examination - June series*

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' 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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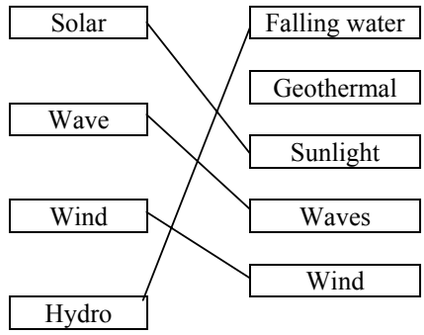
**4.5.6.3.2 Reaction time**





# Physics (Specification B)
# Foundation Tier 3451/F

**3451/F Q1**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 4 correct lines drawn<br><br> | **1** mark for each correct line<br><br>if more than 4 lines are drawn mark incorrect ones first. Mark only 4 lines | 4 |
| (b) | 4 | | 1 |
| (c)(i) | nuclear | | 1 |
| (ii) | (natural) gas | do **not** accept natural | 1 |
| total | | | 7 |

### 4.5.6.3.2 Reaction time





**3451/F Q2**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | ultra violet | | 1 |
| (ii) | kill the cells | accept destroys the cells<br>accept makes cells cancerous<br>accept damage cells<br>accept harms cells<br>accept changes DNA<br>accept cause cells to mutate<br>accept skin cells for cells<br>accept cause cancer<br>do **not** accept skin for cells<br>do **not** accept burns the cells | 1 |
| (b)(i) | the sunbed uses an alternating current (a.c.) supply | | 1 |
| (ii) | 10.8 | accept **1** mark for correct substitution of power in W or kW and time in hours or seconds | 2 |
| total | | | 5 |

### 4.5.6.3.2 Reaction time





**3451/F Q3**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | M | | 1 |
| (ii) | K | | 1 |
| (iii) | J | | 1 |
| (iv) | O | | 1 |
| (b)(i) | billions of years | | 1 |
| (ii) | red giant | any answer in terms of explosion or supernova is **incorrect** | 1 |
| | contracts / shrinks to | incorrect reference to black hole negates **1** mark | 1 |
| | white dwarf | | 1 |
| total | | | 8 |

### 4.5.6.3.2 Reaction time





**3451/F Q4**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | A and C | **both** answers must be correct<br><br>in either order | 1 |
| (ii) | A and B | **both** answers must be correct<br><br>in either order | 1 |
| (iii) | same number of protons plus neutrons<br>**or**<br>same number of nucleons | accept number of particles in nucleus the same<br><br>do **not** accept they add up to 6 unless qualified | 1 |
| (b)(i) | any **two** from:<br>• boron - 12<br>• carbon - 14<br>• oxygen - 15<br>• lead - 209 | **both** required<br><br>both name **and** number must be given | 1 |
| (ii) | any **two** from:<br>• boron - 11<br>• carbon - 12<br>• oxygen - 16<br>• lead - 207 | **both** required<br><br>both name **and** number must be given | 1 |
| (c) | alpha | | 1 |
| total | | | 6 |

### 4.5.6.3.2 Reaction time





**3451/F Q5**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | (good) insulator | accept does not conduct (electricity)<br>accept does not conduct heat or electricity<br>do **not** accept does not conduct heat<br>outside is tough is insufficient | 1 |
| (b) | fuse | | 1 |
| (c) | connect the green and yellow / earth wire<br>swap the brown and blue wires round | accept wires must be connected to screws | 1<br>1 |
| total | | | 4 |

**3451/F Q6**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | fossils<br>water | answers can be in either order | 1<br>1 |
| (b) | increased | | 1 |
| (c) | radio telescope | | 1 |
| total | | | 4 |

**4.5.6.3.2 Reaction time**





**3451/F Q7**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | electrical | | 1 |
| | kinetic | accept movement | 1 |
| (ii) | heat | answers can be in either order | 1 |
| | sound | | 1 |
| (b)(i) | 360 | accept **1** mark for correct substitution | 2 |
| (ii) | watt | | 1 |
| (c) | the stairlift is not moving<br>the stairlift is moving at constant speed | **both** answers are required for the mark | 1 |
| total | | | 8 |

**3451/F Q8**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | (up) further<br>**or**<br>(up) faster | any reference to downwards movement loses credit<br>accept <u>with</u> more force<br>accept motion would increase | 1 |
| (ii) | down | accept the opposite way<br>accept drop | 1 |
| (b)(i) | direct current | | 1 |
| (ii) | Z | | 1 |
| total | | | 4 |

### 4.5.6.3.2 Reaction time





**3451/F Q9**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | level of radiation (detected) will not change | ignore reference to particles | 1 |
| | if thickness of aluminium changes | accept for **both** marks a specific example eg if the aluminium gets thicker the level of radiation detected stays the same.<br><br>accept for **1** mark gamma will pass through aluminium | 1 |
| | QoWC for 2 points in a sensible sequence | | 1 |
| (b) | S W T V | all in correct order<br><br>accept **2** marks for 2 correct<br><br>accept **1** mark for 1 correct | 3 |
| total | | | 6 |

**4.5.6.3.2 Reaction time**





**3451/F Q10**

<table>
<tr><th>question</th><th>answers</th><th>extra information</th><th>mark</th></tr>
<tr><td>(a)</td><td>thermistor(s)<br>LDR(s)<br>switch(es)<br>LED(s)<br>buzzer(s)<br>motor(s)</td><td>1 mark each<br>or light dependent resistor(s)<br>or light emitting diode(s)</td><td>6</td></tr>
<tr><td>(b)(i)</td><td><table><tr><th>1st input</th><th>2nd input</th><th>Output</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td><td>all correct</td><td>1</td></tr>
<tr><td>(ii)</td><td><table><tr><th>Input</th><th>Output</th></tr><tr><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td></tr></table></td><td>both correct</td><td>1</td></tr>
<tr><td>(iii)</td><td><table><tr><th>1st input</th><th>2nd input</th><th>Output</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td><td>all correct</td><td>1</td></tr>
<tr><td>(c)(i)</td><td></td><td>do not credit any attempt which could equally well be a poorly drawn attempt at the symbol for a cell</td><td>1</td></tr>
<tr><td>(ii)</td><td>charge<br><br>increases</td><td>accept ‘electrons’<br>accept ‘energy<br>or gets bigger/larger</td><td>1<br><br>1</td></tr>
<tr><td>total</td><td></td><td></td><td>12</td></tr>
</table>

### 4.5.6.3.2 Reaction time





**3451/F Q11**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | A | | 1 |
| (ii) | B | | 1 |
| (iii) | mass is larger | credit if the response is clear by some other means<br>e.g. it is ringed | 1 |
| | wire is shorter | credit if the response is clear by some other means<br>e.g. it is ringed | 1 |
| (b) | moment | | 1 |
| | distance | | 1 |
| (c)(i) | 1 | | 1 |
| (ii) | 5 | | 1 |
| (iii) | any **two** from<br>• remove slotted mass(es)<br>• slide (slotted) masses / weights nearer pivot<br>• slide forcemeter away from the pivot<br>• slide rod to the left | <br><br>**or** ….. to the left<br><br>**or** ….. to the right<br><br>**or** …. so that the slotted masses side is shorter<br>**or** …. so that the forcemeter side is longer | 2 |
| (d) | centre of the rectangle | accept *2*mm tolerance any direction | 1 |
| | centre of the circle | accept *2*mm tolerance any direction | 1 |
| | on centre line<br>and 10mm above base | accept *2*mm tolerance any direction | 1 |
| total | | | 13 |

**4.5.6.3.2 Reaction time**





**3451/F Q12**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 0.05 (A) | ignore incorrect units if given<br>accept 'the same' / 'the same as K' / 'the same as the other ammeter'<br>do **not** accept 'same as the other meter' | 1 |
| (b)(i) | any **two** from:<br>• two cells are joined + to + | answers in terms of current gain no marks<br>accept one cell in the wrong way<br>accept two cells are joined back-to-back<br>accept two cells are joined – to –<br>accept battery for cell<br>do **not** accept answers in terms of all the cells or in terms of energy only | 2 |
| | • some of the cells potential difference is across the diode / ammeters / wires **or** the pd of the cells is shared by all components | accept voltage for pd<br>do **not** accept using up pd | |
| | • the other components have a resistance | accept a named component / components / wire has a resistance | |
| | • cells not fully charged **or** cells partially run down | do **not** accept voltage of cells is less than 1.5 unless explained<br>do **not** accept cells are not as powerful unless explained | |
| | • cells have an internal resistance | | |
| (ii) | the diode has a (very) high resistance (in the reverse direction) | | 1 |
| | a diode only conducts / allows current to flow in one direction | accept little / no current flows<br>do **not** accept blocks / cuts flow | 1 |

**Continued**

**4.5.6.3.2 Reaction time**





**3451/F Q12**

| question | answers | extra information | mark |
|---|---|---|---|
| (c) | **QoWC** for the use of the word resistance | annotate Q✓ Q✗<br>accept resistant | 1 |
| | accept increase / change / decrease throughout question but a contradiction loses **one** mark with change as neutral | | |
| | as the pd / current increases / changes | accept voltage for pd<br>must be correctly linked to at least one of the following points accept | 1 |
| | the temperature of the filament increases / changes | lamp / bulb for filament<br>accept filament becomes hotter | 1 |
| | increasing / changing the **resistance** of the lamp | | 1 |
| | | accept for **1** mark only the filament lamp does not obey Ohm's law | |
| total | | | 9 |

### 4.5.6.3.2 Reaction time





**3451/F Q13**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 0.5 | | 1 |
| | hertz | accept Hz but **not** HZ / hz / hZ<br><br>accept (waves) per second **or** / sec **or** / s **or** $s^{-1}$ **or** $sec^{-1}$ | 1 |
| (b) | any **one** from:<br><br>• any named part of the electromagnetic spectrum<br>• S – waves / secondary waves<br>• wave on a rope | <br><br><br>do **not** accept seismic waves / earthquake<br><br>do **not** accept slinky unless clearly described | 1 |
| (c) | transverse – disturbance / vibration is perpendicular to the direction of energy transfer / wave travel | accept a correctly labelled diagram | 1 |
| | longitudinal – disturbance / vibration is parallel to the direction of energy transfer / wave travel | accept a correctly labelled diagram<br><br>part explanation of the difference between transverse **and** longitudinal gains **1** mark | 1 |
| (d)(i) | TIR shown | needs to stay inside water jet<br><br>ignore number of reflections **or** arrow heads<br><br>lines straight by eye | 1 |
| (ii) | bigger than | any indication of correct answer | 1 |
| total | | | 7 |

**4.5.6.3.2 Reaction time**





**3451/F Q14**

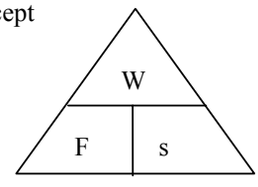
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | W | | 1 |
| | has only two states<br>**or**<br>is either on or off | accept discrete values only<br><br>do **not** credit answer purely in terms of shape | 1 |
| (b) | any **one** from: | | 1 |
| | • higher quality | accept clearer<br><br>do **not** accept easier to read<br><br>ignore faster<br><br>accept <u>less</u> distortion **or** <u>less</u> weakening of signal strength<br><br>do **not** accept no distortion / weakening on its own | |
| | • increased carrying capacity | accept more information can be sent **or** more channels | |
| | • errors can be rectified | | |
| total | | | 3 |

### 4.5.6.3.2 Reaction time





**3451/F Q15**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | all points plotted accurately | accept **1** mark for 5 correct plots<br>± ½ small square on stopping distance | 2 |
| | line of best fit must be continuous | accept attempt at a reasonable curve<br>does not need to go through 0 0<br>do **not** accept a straight line<br>do **not** accept dot-to-dot | 1 |
| (ii) | 4 to 6 (metres) | accept ecf from (a)(i)<br>accept **1** mark for value taken correctly from graph at 25mph **or** correct method shown | 2 |
| (b)(i) | 0.7 (s) | incorrect unit = 0 marks | 1 |
| (ii) | constant speed / velocity | accept (continued as) 30mph<br>accept did not change / stayed the same<br>accept no acceleration | 1 |
| (iii) | 3.3(s) | penalise incorrect unit once only | 1 |
| (iv) | reaction time <u>increases</u> / is <u>longer</u> **or** thinking distance <u>increases</u> | do **not** accept reaction time slower **or** reactions are slower | 1 |
| | stopping distance / it <u>increases</u> | do **not** accept travels at constant speed for longer | 1 |
| (c)(i) | work done =<br>force (applied) × distance (moved) | accept W = F × s or W = F × d<br>accept <br><br>provided subsequent method is correct | 1 |

**Continued**

### 4.5.6.3.2 Reaction time



*Physics B* – AQA GCSE Mark Scheme, 2006 June series

**3451/F Q15**

| question | answers | extra information | mark |
|---|---|---|---|
| (ii) **E** | 2100 | accept 2.1 kilo<br>accept **1** mark for using 7000 N | 2 |
| (iii) | 2100 (joules) | accept their (c)(ii) | 1 |
| total | | | 14 |

**4.5.6.3.2 Reaction time**





**3451/F Q16**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | refraction | | 1 |
| (ii) | it changes speed<br>**or**<br>change in density | accept it speeds up<br><br>do **not** accept it slows down<br><br>do **not** accept air is more dense than glass | 1 |
| (b)(i) | sound / waves <u>diffract</u><br><br>through the gap (in the wall)<br>**or**<br>over the wall<br>**or**<br>because the gate is open | do **not** accept reflection<br><br>this only scores if first marking point is given<br><br>accept for **1** mark only sound / waves go through the gap and <u>spread out</u> **or** diagram showing wave fronts spreading out from open gates<br><br>if diagram is labelled as diffraction both marks can be scored | 1<br><br>1 |
| (ii) | less diffraction | accept no diffraction<br><br>accept gates <u>absorb</u> sound / noise / waves<br><br>accept gates <u>reflect</u> sound / noise / waves<br><br>do **not** accept rebounds / stops / blocks out | 1 |
| total | | | 5 |

**4.5.6.3.2 Reaction time**





**3451/F Q17**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | both rays brought to a focus at F on the right | do **not** have to be continued beyond F | 1 |
| | lines have been drawn **accurately** with a ruler | only credit if 1st mark credited<br>do **not** credit if contradictory arrow(s) added | 1 |
| (b) | rays seem to come from a focus at G on the left and continued to the right of the lens | this mark is for the current idea of divergence | 1 |
| | lines have been drawn **accurately** with a ruler | only credit if 1st mark credited<br>do **not** credit if contradictory arrow(s) added | 1 |
| (c) | …lens…<br>…image…<br>…object…<br>…image…<br>...object…<br>…lens… | lens as 1st and 6th words (1)<br>image and object in the correct order 2nd and 3rd words (1)<br>image and object in correct order 4th and 5th words (1) | max 3 |
| (d)(i) | correct statement about real image<br>real rays intersect / cross to form a real image<br>**or** a real image can be formed on a screen<br>**or** real image is (always) on the opposite side (of the lens)<br>**or** real image is (always) upside down (to the object) | may be credited from a correct diagram | 1 |
| | correct statement about virtual / imaginary image<br>virtual / imaginary rays intersect / cross to form a virtual image<br>**or** a virtual / imaginary image cannot<br>**or** virtual / imaginary image is (always) on the same side (of the lens)<br>**or** virtual / imaginary image is (always) same way up (as the object) | may be credited from a correct diagram | 1 |

**Continued**

### 4.5.6.3.2 Reaction time





**3451/F Q17**

| question | answers | extra information | mark |
|---|---|---|---|
| (ii) | **either**<br>image needs to fall on / affect the film<br><br>**or** image needs to fall on / affect the light sensors / charged coupled devices (CCDs) (in a digital camera / mobile phone)<br><br>**or** image needs to cause a chemical reaction (in / on the film) | | 1 |
| total | | | 10 |

**4.5.6.3.2 Reaction time**





**3451/F Q18**

<table>
<tr><th>question</th><th>answers</th><th>extra information</th><th>mark</th></tr>
<tr><td>(a)</td><td>AND (gate)<br><br>OR (gate)<br><br>NOT (gate)<br><br>LED or light emitting diode</td><td>accept ‘and’<br><br>accept ‘or’<br><br>accept ‘not’ or invert gate<br><br>accept ‘led’</td><td>1<br><br>1<br><br>1<br><br>1</td></tr>
<tr><td>(b)(i)</td><td>NOT (gate) and AND (gate)</td><td>both in either order or ‘(the) gates’<br><br>any additions lose the mark</td><td>1</td></tr>
<tr><td>(ii)</td><td><table><tr><th>Switch for fire</th><th>Tilt switch</th><th>Signal to relay</th></tr><tr><td>0</td><td>0</td><td>…0…</td></tr><tr><td>0</td><td>1</td><td>…0…</td></tr><tr><td>1</td><td>0</td><td>…1…</td></tr><tr><td>1</td><td>1</td><td>…0…</td></tr></table></td><td>all correct<br><br>allow off or no<br>off no<br>on yes<br>off no</td><td>1</td></tr>
<tr><td>(iii)</td><td>(relay) acts as / is a switch<br><br>either<br>small current from the electronic / control circuit / system (1)<br><br>large current through the output / (electric) fire (1)<br><br>or<br><br>full current through electronic control system (1)<br><br>may damage components / lead to overheating / electric shock (1)<br><br>QoWC for correct use of the scientific term ‘current’</td><td>accept implication that it works as a switch e.g. ‘turns on fire’<br><br>or ‘small current through the coil (of the relay)’<br><br>do not accept small current is turned into a large current<br><br>annotate Q✓ Q✗<br><br>if answer in terms of voltage isolation / voltage/ p.d. accept QoWC mark for correct use</td><td>1<br><br>1<br><br>1<br><br>1</td></tr>
<tr><td>total</td><td></td><td></td><td>10</td></tr>
</table>

Version 1.0: 0906

ASSESSMENT and QUALIFICATIONS ALLIANCE

## General Certificate of Secondary Education

# Science: Double Award 3462/3F
*Specification B*

# Mark Scheme

## *2006 examination - June series*

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' 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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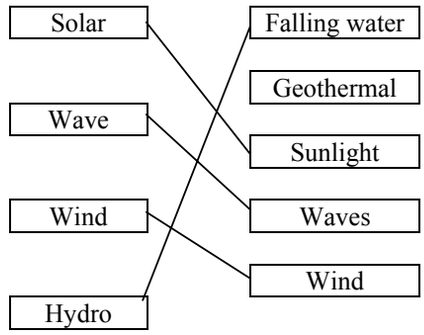
**4.5.6.3.2 Reaction time**



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2006 June series

# Double Award (Co-ordinated)
# Foundation Tier 3462/3F

**3462/3F Q1**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 4 correct lines drawn<br><br> | **1** mark for each correct line<br><br>if more than 4 lines are drawn mark incorrect ones first. Mark only 4 lines | 4 |
| (b) | 4 | | 1 |
| (c)(i) | nuclear | | 1 |
| (ii) | (natural) gas | do **not** accept natural | 1 |
| total | | | 7 |

### 4.5.6.3.2 Reaction time





**3462/3F Q2**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | ultra violet | | 1 |
| (ii) | kill the cells | accept destroys the cells<br>accept makes cells cancerous<br>accept damage cells<br>accept harms cells<br>accept changes DNA<br>accept cause cells to mutate<br>accept skin cells for cells<br>accept cause cancer<br>do **not** accept skin for cells<br>do **not** accept burns the cells | 1 |
| (b)(i) | the sunbed uses an alternating current (a.c.) supply | | 1 |
| (ii) | 10.8 | accept **1** mark for correct substitution of power in W or kW and time in hours or seconds | 2 |
| total | | | 5 |

### 4.5.6.3.2 Reaction time



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2006 June series

**3462/3F Q3**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | M | | 1 |
| (ii) | K | | 1 |
| (iii) | J | | 1 |
| (iv) | O | | 1 |
| (b)(i) | billions of years | | 1 |
| (ii) | red giant | any answer in terms of explosion or supernova is **incorrect** | 1 |
| | contracts / shrinks to | incorrect reference to black hole negates **1** mark | 1 |
| | white dwarf | | 1 |
| total | | | 8 |

### 4.5.6.3.2 Reaction time





**3462/3F Q4**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | A and C | **both** answers must be correct<br><br>in either order | 1 |
| (ii) | A and B | **both** answers must be correct<br><br>in either order | 1 |
| (iii) | same number of protons plus neutrons<br>**or**<br>same number of nucleons | accept number of particles in nucleus the same<br><br>do **not** accept they add up to 6 unless qualified | 1 |
| (b)(i) | any **two** from:<br>• boron - 12<br>• carbon - 14<br>• oxygen - 15<br>• lead - 209 | **both** required<br><br>both name **and** number must be given | 1 |
| (ii) | any **two** from:<br>• boron - 11<br>• carbon - 12<br>• oxygen - 16<br>• lead - 207 | **both** required<br><br>both name **and** number must be given | 1 |
| (c) | alpha | | 1 |
| total | | | 6 |

### 4.5.6.3.2 Reaction time



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2006 June series

**3462/3F Q5**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | (good) insulator | accept does not conduct (electricity)<br>accept does not conduct heat or electricity<br>do **not** accept does not conduct heat<br>outside is tough is insufficient | 1 |
| (b) | fuse | | 1 |
| (c) | connect the green and yellow / earth wire | accept wires must be connected to screws | 1 |
| | swap the brown and blue wires round | | 1 |
| total | | | 4 |

**3462/3F Q6**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | fossils | answers can be in either order | 1 |
| | water | | 1 |
| (b) | increased | | 1 |
| (c) | radio telescope | | 1 |
| total | | | 4 |

### 4.5.6.3.2 Reaction time





**3462/3F Q7**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | electrical | | 1 |
| | kinetic | accept movement | 1 |
| (ii) | heat | answers can be in either order | 1 |
| | sound | | 1 |
| (b)(i) | 360 | accept **1** mark for correct substitution | 2 |
| (ii) | watt | | 1 |
| (c) | the stairlift is not moving<br>the stairlift is moving at constant speed | **both** answers are required for the mark | 1 |
| total | | | 8 |

**3462/3F Q8**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | (up) further<br>**or**<br>(up) faster | any reference to downwards movement loses credit<br>accept <u>with</u> more force<br>accept motion would increase | 1 |
| (ii) | down | accept the opposite way<br>accept drop | 1 |
| (b)(i) | direct current | | 1 |
| (ii) | Z | | 1 |
| total | | | 4 |

**4.5.6.3.2 Reaction time**



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2006 June series

**3462/3F Q9**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | level of radiation (detected) will not change | ignore reference to particles | 1 |
| | if thickness of aluminium changes | accept for **both** marks a specific example eg if the aluminium gets thicker the level of radiation detected stays the same.<br><br>accept for **1** mark gamma will pass through aluminium | 1 |
| | QoWC for 2 points in a sensible sequence | | 1 |
| (b) | S W T V | all in correct order<br><br>accept **2** marks for 2 correct<br><br>accept **1** mark for 1 correct | 3 |
| total | | | 6 |

**4.5.6.3.2 Reaction time**





**3462/3F Q10**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 0.05 (A) | ignore incorrect units if given<br>accept 'the same' / 'the same as K' / 'the same as the other ammeter'<br>do **not** accept 'same as the other meter' | 1 |
| (b)(i) | any **two** from:<br>• two cells are joined + to + | answers in terms of current gain no marks<br>accept one cell in the wrong way<br>accept two cells are joined back-to-back<br>accept two cells are joined – to –<br>accept battery for cell<br>do **not** accept answers in terms of all the cells or in terms of energy only | 2 |
| | • some of the cells potential difference is across the diode / ammeters / wires **or** the pd of the cells is shared by all components | accept voltage for pd<br>do **not** accept using up pd | |
| | • the other components have a resistance | accept a named component / components / wire has a resistance | |
| | • cells not fully charged **or** cells partially run down | do **not** accept voltage of cells is less than 1.5 unless explained<br>do **not** accept cells are not as powerful unless explained | |
| | • cells have an internal resistance | | |
| (ii) | the diode has a (very) high resistance (in the reverse direction) | | 1 |
| | a diode only conducts / allows current to flow in one direction | accept little / no current flows<br>do **not** accept blocks / cuts flow | 1 |

**Continued**

**4.5.6.3.2 Reaction time**



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2006 June series

**3462/3F Q10**

| question | answers | extra information | mark |
|---|---|---|---|
| (c) | **QoWC** for the use of the word resistance | annotate Q✓ Q✗<br>accept resistant | 1 |
| | accept increase / change / decrease throughout question but a contradiction loses **one** mark with change as neutral | | |
| | as the pd / current increases / changes | accept voltage for pd<br>must be correctly linked to at least one of the following points accept | 1 |
| | the temperature of the filament increases / changes | lamp / bulb for filament<br>accept filament becomes hotter | 1 |
| | increasing / changing the **resistance** of the lamp | accept for **1** mark only the filament lamp does not obey Ohm's law | 1 |
| total | | | 9 |

### 4.5.6.3.2 Reaction time





**3462/3F Q11**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 0.5 | | 1 |
| | hertz | accept Hz but **not** HZ / hz / hZ<br><br>accept (waves) per second **or** / sec **or** / s **or** $s^{-1}$ **or** $sec^{-1}$ | 1 |
| (b) | any **one** from:<br><br>• any named part of the electromagnetic spectrum<br>• S – waves / secondary waves<br>• wave on a rope | <br><br><br>do **not** accept seismic waves / earthquake<br><br>do **not** accept slinky unless clearly described | 1 |
| (c) | transverse – disturbance / vibration is perpendicular to the direction of energy transfer / wave travel | accept a correctly labelled diagram | 1 |
| | longitudinal – disturbance / vibration is parallel to the direction of energy transfer / wave travel | accept a correctly labelled diagram<br><br>part explanation of the difference between transverse **and** longitudinal gains **1** mark | 1 |
| (d)(i) | TIR shown | needs to stay inside water jet<br><br>ignore number of reflections **or** arrow heads<br><br>lines straight by eye | 1 |
| (ii) | bigger than | any indication of correct answer | 1 |
| total | | | 7 |

**4.5.6.3.2 Reaction time**



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2006 June series

**3462/3F Q12**

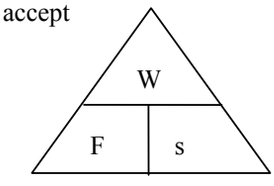
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | W | | 1 |
| | has only two states<br>**or**<br>is either on or off | accept discrete values only<br><br>do **not** credit answer purely in terms of shape | 1 |
| (b) | any **one** from: | | 1 |
| | • higher quality | accept clearer<br><br>do **not** accept easier to read<br><br>ignore faster<br><br>accept <u>less</u> distortion **or** <u>less</u> weakening of signal strength<br><br>do **not** accept no distortion / weakening on its own | |
| | • increased carrying capacity | accept more information can be sent **or** more channels | |
| | • errors can be rectified | | |
| total | | | 3 |

### 4.5.6.3.2 Reaction time





**3462/3F Q13**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | all points plotted accurately | accept **1** mark for 5 correct plots<br>± ½ small square on stopping distance | 2 |
| | line of best fit must be continuous | accept attempt at a reasonable curve<br>does not need to go through 0 0<br>do **not** accept a straight line<br>do **not** accept dot-to-dot | 1 |
| (ii) | 4 to 6 (metres) | accept ecf from (a)(i)<br>accept **1** mark for value taken correctly from graph at 25mph **or** correct method shown | 2 |
| (b)(i) | 0.7 (s) | incorrect unit = 0 marks | 1 |
| (ii) | constant speed / velocity | accept (continued as) 30mph<br>accept did not change / stayed the same<br>accept no acceleration | 1 |
| (iii) | 3.3(s) | penalise incorrect unit once only | 1 |
| (iv) | reaction time increases / is longer **or** thinking distance increases | do **not** accept reaction time slower **or** reactions are slower | 1 |
| | stopping distance / it increases | do **not** accept travels at constant speed for longer | 1 |
| (c)(i) | work done =<br>force (applied) × distance (moved) | accept W = F × s or W = F × d<br>accept <br>provided subsequent method is correct | 1 |
| (ii) | 2100 | accept 2.1 kilo<br>accept **1** mark for using 7000 N | 2 |
| (iii) | 2100 (joules) | accept their (c)(ii) | 1 |
| total | | | 14 |

**4.5.6.3.2 Reaction time**



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2006 June series

**3462/3F Q14**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | refraction | | 1 |
| (ii) | it changes speed<br>**or**<br>change in density | accept it speeds up<br><br>do **not** accept it slows down<br><br>do **not** accept air is more dense than glass | 1 |
| (b)(i) | sound / waves <u>diffract</u><br><br>through the gap (in the wall)<br>**or**<br>over the wall<br>**or**<br>because the gate is open | do **not** accept reflection<br><br>this only scores if first marking point is given<br><br>accept for **1** mark only sound / waves go through the gap and <u>spread out</u> **or** diagram showing wave fronts spreading out from open gates<br><br>if diagram is labelled as diffraction both marks can be scored | 1<br><br>1 |
| (ii) | less diffraction | accept no diffraction<br><br>accept gates <u>absorb</u> sound / noise / waves<br><br>accept gates <u>reflect</u> sound / noise / waves<br><br>do **not** accept rebounds / stops / blocks out | 1 |
| total | | | 5 |

4.5.6.3.2 Reaction time

Answer 12 · Examiner comments — June 2023 | 8463/2F | Original Q2

**02.1**

22 % of students scored 1 mark and 61 % of students scored both marks for identifying the energies

**02.2**

The majority of the students identified the correct relationship between the speed and the braking distance. Those that didn't described the graph rather than mentioning braking distance or speed, or used incorrect phrases eg 'directly proportional'.

**02.3**

84% of students knew that braking distance increases when a road becomes icy.

**02.4**

This 3-mark question required students to calculate the change in velocity then use this correctly to determine the time taken. Many students failed to show how they calculated the change in velocity and could not be awarded any marks.

Answer 12 · Examiner comments — June 2023 | 8463/2F | Original Q2

**02.5**

86 % scored 2 marks for calculating the resultant force. Common mistakes involved dividing instead of multiplying, or calculating 1600 x $0.25^2$, the squared apparently being inferred from the unit of deceleration ($m/s^2$).

**02.6**

77% of students were able to identify the control variable for the investigation.

**02.7**

Many students correctly stated that there would be a greater number of results, which could lead to a change in the mean. But some simply stated that different people have different reaction times. Credit was also given for those that stated the reaction times of 3 children tested may not be representative of the whole class. However, some only answered by saying 'only 3 children were tested' which was insufficient to get the mark.

**02.8**

30 % scored 1 mark and only 33 % scored 2 marks. Rather than describing a change to the experiment students would state how they thought music would affect the reaction time, or why music would affect the reaction time.
Many who got 1 mark suggested they did the experiment with music on but did not say to compare with previous results or do it with music off.

**4.5.6.3.2 Reaction time**



Questions matter

GCSE

# Physics

8463/2F

## Report on the examination

Version: 1.0
June 2025

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### 4.5.6.3.2 Reaction time



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Report on the examination – GCSE - Physics – 8463/2H – June 2025

## General comments

Students should pay attention to the number of options that need to be ticked when doing multiple choice questions. They should make sure they cross out wrong options when they change their minds, as marks cannot be awarded where there are multiple ticks instead of one.

Many students demonstrated good maths skills, although there are always issues with rearrangements. Formula triangles are not always helpful. Students who had correctly written down an equation in a previous question and then tried to use a formula triangle often scored no marks, because they don't understand how to use them. If they had substituted into the equation from the equations sheet they would have scored the 1st mark.

Students had access to the equations sheet for this examination series. A minority of the students however did not use them to find the appropriate equation.

## 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, not just on questions that may have been targeted at the level at which they are working.

### 01.1

Over 90 % of the students knew that a protractor is used to measure angles. The phonetic spelling of protractor was allowed.

### 01.2

Almost 70% of the students scored all four marks for completing the graph. Despite a clear instruction a significant number did not label the y-axis. A number of the students did not use a ruler to draw the line of best fit.

### 01.3

Most of the students correctly identified the relationship between the angle of incidence and the angle of reflection.

### 01.4

Half of the students knew which measurement was the amplitude of a wave. Most of the others thought the vertical distance between a peak and a trough was the amplitude.

### 01.5

About 80 % of the students knew which line showed the wavelength of the wave. The most common incorrect answer was the distance showing half the wavelength.

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**4.5.6.3.2 Reaction time**



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## 01.6

Over 90 % of the students correctly calculated the wavelength. Those who did not achieve full marks mainly did so by not choosing the correct unit for wavelength, with Pa being a popular incorrect choice.

## 01.7

This was well answered, with most of the students scoring both marks. A few inverted the equation and thus calculated the period incorrectly.

## 02.1

Most of the students correctly calculated the weight of coal.

## 02.2

Just over 90% of the students were able to use the work done equation correctly. Those that did not get full marks tended to put an additional step into the calculation by dividing the answer 68 000 000 by 4; the number of engines in total.
Occasionally a student would attempt to convert the number calculated into standard form. Whilst not being penalised, this was not required.

## 02.3

Well answered by most students. As with part 02.2, occasionally a student would attempt to convert the number calculated into standard form.

## 02.4

Nearly 90% of the students could identify that friction was a contact force.

## 02.5

Most of the students identified the correct distance-time graph for constant speed.

## 02.6

This was the 1st calculation that was more challenging for many students. A common error was to use only one of the quoted velocities to calculate the acceleration rather than using the difference between the velocities. However just over 80 % did score full marks, with 10 % scoring zero or not attempting the question.

## 03.1

Approximately 60% of the students scored both marks. Often students did not know the correct word for a natural satellite. However, many correctly identified ‘star’ for the second word.

## 03.2

Most of the students knew that we are part of the Milky Way galaxy.

## 03.3

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**4.5.6.3.2 Reaction time**





Only about 40 % of the students knew that the Sun will eventually become a black dwarf. The most popular wrong answer was that it would become a black hole.

## 03.4

Just fewer than 40 % of the students knew that a very distant galaxy moves faster than a nearer galaxy.

## 03.5

About 70 % of the students knew that an increase in the wavelength of light from a distant galaxy is called red-shift.

## 03.6

About 60 % of the students selected the correct word to describe the beginning of the universe.

## 03.7

Almost 80 % of the students knew that the universe is expanding.

## 04.1

Just over 70 % of the students were able to make the connection between the mass of a vehicle and how it would affect the maximum acceleration.

## 04.2

Over 90 % of the students scored full marks for calculating the resultant force using F = ma. However, some of the students thought that the value of acceleration needed to be squared and then multiplied by mass.

## 04.3

This level of response question proved too challenging for many. Only just over 1 % of the students scored full marks. Most identified that the driving force would increase, but fewer recognised that as this happened the air resistance would also increase, with many stating that the air resistance would decrease as the cars speed increased.

## 04.4

Most of the students knew that the thinking distance is affected by the driver's reaction time.

## 04.5

Just fewer than 70 % of the students were aware that the braking distance is the distance travelled under the braking force.

## 04.6

Only just over 20 % of the students scored full marks for using the graph of distance against speed to find the stopping distance. The correct distances were often identified from the graph. However, these were then either subtracted from each other, divided or multiplied rather than added.

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**4.5.6.3.2 Reaction time**



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## 04.7

Nearly 80 % of the students identified factors that would increase the stopping distance of a car. Despite two being emboldened twice in the question, some students only ticked one box.

## 05.1

The principal focus was correctly identified by just over 60 % of the students.

## 05.2

About 80 % of the students knew that the change in direction of light as it enters a lens is called refraction.

## 05.3

Nearly 70 % the students recognised the shape of a convex lens.

## 05.4

Under a half of the students managed to correctly measure the object height and image height. This may have been due to a lack of skill or a lack of equipment.

## 05.5

This was much more successfully answered than part 05.4 with nearly 90 % of the students scoring both marks. These students used their values from part 05.4 to calculate magnification.

## 05.6

Just fewer than 50 % of the students knew that magnification is a ratio, but almost the same number thought it is a power.

## 05.7

This was a challenging question. Most of the students that did score a mark were awarded only the first mark point. This was for explaining that white light is transmitted through colourless glass. A lot of the students think of white light as an entity in itself rather than the result of the colours of the visible light combined. Few used the word transmitted but rather described it as passing through or goes through.
For the 2nd and 3rd mark points many of the students decided that white light was reflected or refracted, reinforcing the misconception that white light is a single entity rather than being made up of a combination of wavelengths. The idea that filters would absorb different wavelengths of light seemed to be difficult for the students to express, with very few achieving the third mark.

## 06.1

Only just over 30 % of the students could identify two magnetic materials from the list, with about 60 % being able to identify one. Again, a number of students ticked just one box or more than two boxes.

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**4.5.6.3.2 Reaction time**





## 06.2
Just over 70 % of the students correctly named the iron nails as induced magnets.

## 06.3
Just fewer than 40 % of the students knew the direction of the magnetic field.

## 06.4
Nearly 80 % of the students recognised the shape of the magnetic field around a current carrying wire.

## 06.5
Very few of the students could give two changes that would increase the magnetic field strength. 'Increasing the current' was a common correct response. Many of the students answered 'increasing the number of coils' as such they were implying the wire was already coiled and not answering the question asked, which was about the straight wire shown in Figure 10.

## 07.1
Nearly 60 % of the students understood what is meant by the moment of a force. The most common incorrect option was 'The direction of the force.'

## 07.2
The correct resultant moment was selected by just over 80 % of the students.

## 07.3
Students generally answered this well, identifying position 7 and on which side of the balance the tag should be placed. Some indicated this on the diagram which was an accepted alternative response, provided what was written did not contradict it.

## 07.4
Some students wrote the equation for the moment of a force in words and then in symbols. This risks not gaining the mark if either is incorrect. Also, correct use of symbols should be stressed, especially when they are given in the question. It was surprising that some of the students scored zero or did not attempt to write down an equation despite having the equations sheet.

## 07.5
Almost three quarters of the students were able to rearrange the equation and then calculate the distance between the pivot and the tag on the balance.

## 08.1
Most of the students found this level of response question difficult to answer. Only just over 1 % gave a level 2 answer. Many of the students scored 2, 1 or 0 marks. Of those that scored a mark the most common response was light travels faster than sound. Many also tried to describe light and sound as transverse and longitudinal waves, with the majority getting this

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confused. Very few identified acceptable similarities. Common answers that did not gain credit included light travels at the speed of light, sound travels at the speed of sound, light can be seen and sound cannot be seen.

## 08.2

Just fewer than 80 % of the students choose the correct equation for calculating speed.

## 08.3

This question required students to rearrange the equation. About three quarters of the students scored all three marks.

## 09.1

About 65 % of the students correctly stated the independent variable in this investigation.

## 09.2

Just over 40 % of the students scored both marks for identifying a risk of harm and a suitable safety precaution to reduce the risk. Too few students connected a hazard, such as a falling weight, becoming a risk of harm when it hit or hurt the student.

## 09.3

Students were expected to clearly describe two improvements to the arrangement shown that would improve the accuracy of the results. Many had difficulty describing their ideas clearly and answers were often too vague to gain credit.

## 09.4

Almost 40 % of the students scored this mark usually by explaining that the spring length was not 0 cm rather than describing the relationship between spring length and force.

## 09.5

This was not successfully answered, with only about 2 % of the students scoring both marks and a further 13 % scoring one mark. The 1st mark point was for stating or giving a clear description of inelastic deformation. Of those who were awarded marks most of them described how the spring had reached or passed its limit of proportionality.

## 09.6

Over 90 % of the students selected the correct equation.

## 09.7

Nearly 80 % of the students scored all three marks. Those that did not often rearranged the equation incorrectly.

## 10.1

Only about 5% of the students correctly calculated the uncertainty correctly from either the range or the mean.

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**4.5.6.3.2 Reaction time**





## 10.2

Just over 40 % of the students identified that a random error had caused the variation in this investigation. A greater proportion of the students thought there was a systematic error but this would not have accounted for the variation in the results.

## 10.3

This mark was awarded for a clear description of variation in the way the ball was dropped. For example, through different heights, at different speeds, or a different delay each time. Common answers giving reaction time or human error were too vague, to be awarded marks unless qualified.

## 10.4

Just fewer than 30 % of the students scored all three marks. Many of the students took only one value from the graph rather than a corresponding pair of values and so scored 0. Those that used a pair of correct values often then used them the wrong way round when calculating the gradient.

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4.5.6.3.2 Reaction time



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## Mark Ranges and Award of Grades

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

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