AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.3

# Forces and elasticity

## Mark schemes and examiner comments

| | |
|---|---|
| Tier | **Foundation** |
| Question groups | **24** |
| 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.

### 4.5.3 Forces and elasticity

**Answer 01 · Mark scheme**

June 2003 | 3451F | Original Q3 | Legacy

The full source mark scheme begins on page 43. Follow original question 3 in that document.

**Answer 02 · Mark scheme**

June 2003 | 3451F | Original Q13 | Legacy

The full source mark scheme begins on page 43. Follow original question 13 in that document.

**Answer 03 · Mark scheme**

June 2003 | 3462F3 | Original Q3 | Legacy

The full source mark scheme begins on page 65. Follow original question 3 in that document.

### 4.5.3 Forces and elasticity

**Answer 04 · Mark scheme**



**Question 1**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | **B** or bungee cords | | 1 |
| | **C** or springs or playground ride | | 1 |
| | | each additional answer loses **1** mark<br>minimum mark zero | |
| | will go back to original shape/size | | 1 |
| (b)(i) | newton | | 1 |
| (ii) | 0 – 5 (N) or 5 | accept1-5 (N)<br>do **not** accept 4 | 1 |
| (iii) | 16 (cm) | | 1 |
| (iv) | 2.5 (N) | accept answer between 2.4 and 2.6 inclusive | 1 |
| total | | | 7 |

### 4.5.3 Forces and elasticity

**Answer 04 · Mark scheme**

January 2008 | PHY2F | Original Q1 | Legacy

**PHY2F**

4.5.3 Forces and elasticity

Answer 05 · Mark scheme



## Question 2

| question | answers | extra information | mark |
|---|---|---|---|
| **2**(a)(i) | **B** | | 1 |
| **2**(a)(ii) | microphone | | 1 |
| **2**(b)(i) | frequency | | 1 |
| **2**(b)(ii) | amplitude | | 1 |
| **2**(c) | electromagnet | do **not** accept just 'magnet'<br><br>accept solenoid<br><br>accept coil | 1 |
| **2**(d)(i) | (sound will) get less / get quieter / stop / go silent | accept faint buzzing noise | 1 |
| **2**(d)(ii) | **either**<br><br>sound cannot travel through a vacuum<br><br>**or**<br><br>no particles / molecules to vibrate | <br><br>accept sound requires a medium<br><br><br><br>accept fewer particles to transfer the sound<br><br>accept only the vibration of the wires / parts (will transfer the sound) | 1 |
| **Total** | | | **7** |

### 4.5.3 Forces and elasticity

**Answer 05 · Mark scheme**

June 2010 | PHY3F | Original Q2 | Legacy

**PHY3F**

Answer 06 · Mark scheme



## Question 6

| question | answers | extra information | mark |
|---|---|---|---|
| 6(a) | letter C clearly marking a compression | accept C at any point in a compression<br><br>if more than one letter C marked all must be correct | 1 |
| 6(b)(i) | straight continuous line drawn from loudspeaker to metal to sound sensor<br><br>angle I = angle R | judge by eye<br><br>judge by eye<br><br>ignore any arrows on lines | 1<br><br>1 |
| 6(b)(ii) | less sound reflected<br><br>**or**<br><br>(some) sound passes through the glass | accept energy for sound<br><br>accept (some) sound absorbed by the glass | 1 |
| 6(b)(iii) | makes the sound louder | | 1 |
| 6(b)(iv) | 340 | $v = f \times \lambda$<br><br>allow **1** mark for correct substitution<br>ie $850 \times 0.4$<br><br>provided no subsequent step shown | 2 |
| 6(c) | echo | | 1 |
| 6(d)(i) | from 250 Hz to 750 Hz | | 1 |

**Question 6 continues on the next page**

**PH1FP**

**Question 6 continued**

| question | answers | extra information | mark |
|---|---|---|---|
| **6(d)(ii)** | curtains reduce (percentage of) sound reflected more( than carpet)<br><br>for all frequencies (shown) | accept curtains absorb more sound (than carpet)<br><br>accept for both marks an answer in terms of walls having a larger (surface) area to reflect sound and curtains reducing the amount of reflected sound more (than carpet)<br><br>answers less noisy or walls / curtains have a larger area gain **1** mark only<br><br>do **not** accept curtains are cheaper | 1<br><br>1 |
| **Total** | | | **11** |

### 4.5.3 Forces and elasticity

**Answer 06 · Mark scheme**

June 2012 | PH1FP | Original Q6 | Legacy

**PH1FP**

4.5.3 Forces and elasticity

Answer 07 · Mark scheme

June 2012 | PH2FP | Original Q7 | Legacy

## Question 7

| question | answers | extra information | mark |
|---|---|---|---|
| 7(a)(i) | **B C** | either order | 1 |
| 7(a)(ii) | elastic potential (energy) | accept strain for elastic | 1 |
| 7(b)(i) | measured / recorded the length of the spring (and not extension)<br><br>extension does not equal zero when force = 0 | mark both parts together<br>accept measured **A**–**C** (and not **B**–**C**)<br>accept did not work out/measure the extension<br><br>accept line should pass through the origin | 1<br><br>1 |
| 7(b)(ii) | point marked at 5.5 (N)<br><br>up to that point force and extension are (directly) proportional | accept any point between 5.0 and 5.6 inclusive<br><br>accept it's at the end of the straight part (of the graph line)<br>accept past that point force and extension are no longer (directly) proportional<br>accept the line starts to curve | 1<br><br>1 |
| 7(c) | 1.8 | allow **1** mark for correct substitution, ie 25 x 0.072 provided no subsequent step shown<br>an answer 1800 gains **1** mark<br>an incorrect conversion from mm to m with a subsequent correct calculation gains **1** mark | 2 |
| **Total** | | | **8** |

### 4.5.3 Forces and elasticity

**Answer 07 · Mark scheme** June 2012 | PH2FP | Original Q7 | Legacy

**PH2FP**

**Answer 08 · Mark scheme** June 2014 | PH2FP | Original Q6 | Legacy

| | | | | |
|---|---|---|---|---|
| **6(a)(i)** | <table><tr><th>Wire</th><th>Plug terminal</th></tr><tr><td>Live</td><td>C</td></tr><tr><td>Neutral</td><td>A</td></tr><tr><td>Earth</td><td>B</td></tr></table> | all 3 correct for **2** marks<br><br>allow **1** mark for 1 correct | 2 | AO1<br><br>2.4.1f |
| **6(a)(ii)** | plastic<br>**or**<br>rubber | accept:<br>ABS<br>UF/urea formaldehyde<br>nylon<br>PVC | 1 | AO1<br><br>2.4.1f |
| **6(b)(i)** | 600 | allow **1** mark for correct substitution,<br>ie P = $\frac{30\,000}{50}$<br>provided no subsequent step | 2 | AO2<br><br>2.4.2b |
| **6(b)(ii)** | power is greater than 820 (W)<br><br>the lead /cable / wire <u>will</u> overheat / get (too) hot<br><br>so there is a risk of fire | power is 1200 W is insufficient<br><br>accept lead / cable will melt<br>may overheat / get hot is insufficient<br><br>accept causing a fire | 1<br><br>1<br><br>1 | AO3<br><br>2.4.2a |
| **6(c)** | X<br><br>any **one** from:<br>• most / more efficient<br><br>• smallest energy input (per second)<br><br>• cheapest to operate | mark only scores if X is chosen<br><br>mark is for the reason<br><br>accept smallest input (power) for same output (power)<br>accept wastes least energy<br>smallest (power) input is insufficient<br>uses least electricity is insufficient | <br><br>1 | AO3<br><br>2.4.2a |

### 4.5.3 Forces and elasticity

**Answer 08 · Mark scheme** June 2014 | PH2FP | Original Q6 | Legacy

| | | | |
|---|---|---|---|
| **Total** | | | **9** |

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|

**Answer 09 · Mark scheme** June 2015 | PH2FP | Original Q3 | Legacy

The full source mark scheme begins on page 82. Follow original question 3 in that document.

4.5.3 Forces and elasticity

Answer 10 · Mark scheme

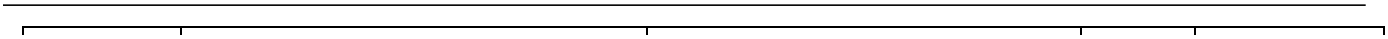
June 2017 | PH3FP | Original Q7 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 7(a) | any **two** from:<br>• The number of turns on the coil<br>• The strength of the magnet<br>• The (stiffness of the) elastic bands | do not accept number of coils<br>allow how tightly the turns are wrapped<br>allow distance between the magnet and coil / cone<br>allow strength/elasticity/tension for stiffness<br>ignore references to size of paper cone<br>change direction of current or magnet is insufficient | 2 | AO3<br>3.3.1c |
| 7(b)(i) | 1.3 (cm) | two values (1.4 and 2.7) correctly taken from the graph scores **1** mark | 2 | AO2<br>3.3.1b |
| 7(b)(ii) | any **two** from:<br>• (Below 1A) as the current increases the distance increases<br>• Above 1A the distance does not change (with current)<br>• Between 0.3A and 0.7A the relationship is linear | accept the maximum distance (that the cone can move) is 2.8 cm<br>accept between 0.6 cm and 2.2 cm the relationship is linear<br>ignore references to positive correlation and direct proportionality<br>a description of the shape of the graph is insufficient eg the line levels off after 1A. | 2 | AO3<br>3.3.1c |
| **Total** | | | **6** | |

### 4.5.3 Forces and elasticity

**Answer 10 · Mark scheme**

June 2017 | PH3FP | Original Q7 | Legacy



### 4.5.3 Forces and elasticity

**Answer 11 · Mark scheme** June 2018 | 8463/1F | Original Q1

| Question | Answers | Extra information | Mark | AO/ Spec. Ref |
|---|---|---|---|---|
| **01.1** | chemical<br>kinetic | in this order only | 1<br>1 | AO1 4.1.1.1 |
| **01.2** | $E_k = 0.5 \times 80 \times 12^2$<br>$E_k = 5760$ (J) | an answer of 5760 (J) scores **2** marks | 1<br>1 | AO2 4.1.1.2 |
| **01.3** | E = 0.040 × 480 × 50<br>E = 960 (J) | an answer of 960 (J) scores **2** marks | 1<br>1 | AO2 4.1.1.3 |
| **01.4** | increased | | 1 | AO1 4.3.2.1 |
| **Total** | | | **7** | |

### 4.5.3 Forces and elasticity

**Answer 11 · Mark scheme**

June 2018 | 8463/1F | Original Q1



4.5.3 Forces and elasticity

Answer 12 · Mark scheme

June 2018 | 8463/2F | Original Q11

| Question | Answers | Mark | AO/ Spec. Ref |
|---|---|---|---|
| 11.1 | **Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced. | 5–6 | AO1 4.5.3 |
| | **Level 2:** The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced. | 3–4 | |
| | **Level 1**: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear. | 1–2 | |
| | **No relevant content** | 0 | |
| | **Indicative content**<br>set up a clamp stand with a clamp<br>hang the spring from the clamp<br>use a second clamp and boss to fix a (half) metre ruler alongside the spring<br>record the metre ruler reading that is level with the bottom of the spring<br>hang a 2 N weight from the bottom of the spring<br>record the new position of the bottom of the spring<br>calculate the extension of the spring<br>measure the extension of the spring<br>add further weights to the spring so the force increases 2 N at a time up to 10 N<br>for each new force record the position of the bottom of the spring and calculate / measure the extension<br>**possible source of inaccuracy**<br>not fixing the ruler in position but simply holding the ruler next to the spring<br>not clamping the ruler vertical<br>misjudging the position of the bottom of the spring<br>parallax error<br>allow any other sensible suggestion that could reasonably lead to inaccuracy in the data<br>allow a description that would increase accuracy<br>repeating the measurements is insufficient | | |

Answer 12 · Mark scheme

June 2018 | 8463/2F | Original Q11

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **11.2** | to identify any anomalous results<br>**or**<br>to reduce the effect of random error | allow calculate an average for the spring constant<br><br>allow (more) accurate<br><br>to obtain an average is insufficient<br>to be able to draw a graph is insufficient | 1 | AO3<br>4.5.3 |
| **11.3** | both points plotted correctly<br><br>correct line of best fit drawn | <br><br>to pass through (0,0) and (10,20) | 1<br><br>1 | AO2<br>4.5.3 |
| **11.4** | force = spring constant × extension | allow F = ke | 1 | AO1<br>4.5.3 |
| **11.5** | <br><br>extension = 0.2<br><br>10 = k × 0.2<br><br>$k = \frac{10}{0.2}$<br><br>k = 50 | an answer of 50 scores **4** marks<br><br>allow 0.035 / 0.08 / 0.125 / 0.16<br><br>force value must match extension<br>this mark may be awarded if e is in cm<br><br>allow correct transformation of their chosen values<br>this mark may be awarded if e is in cm<br><br>an answer 0.5 scores **3** marks | <br><br>1<br><br>1<br><br>1<br><br>1 | <br><br>AO2<br><br>AO2<br><br>AO2<br><br>AO2<br>4.5.3 |

4.5.3 Forces and elasticity

Answer 12 · Mark scheme

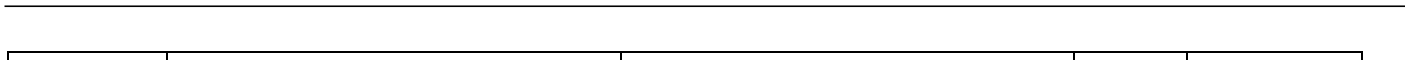
June 2018 | 8463/2F | Original Q11

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **11.6** | the line is straight<br><br>and passes through the origin | allow the line does not curve<br><br>this mark is dependent on scoring the first mark<br><br>allow a correct description of direct proportionality for **2** marks<br><br>ignore the line shows they are directly proportional | 1<br><br>1 | AO3<br>4.5.3 |
| **Total** | | | **16** | |

### 4.5.3 Forces and elasticity

**Answer 12 · Mark scheme**

June 2018 | 8463/2F | Original Q11



Answer 13 · Mark scheme

June 2019 | 8463/2F | Original Q3

## Question 3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **3.1** | both arrows pointing horizontally and to the right | judged by eye | 1 | AO1/1<br>4.7.1.2 |
| **3.2** | (two south) poles would repel<br><br>so the coat would not be held together | allow magnets would repel<br><br>allow so the coat would not fasten | 1<br><br>1 | AO1/1<br>AO2/1<br>4.7.1.1 |
| **3.3** | C | | 1 | AO1/1<br>4.7.2.1 |
| **3.4** | steel rod | | 1 | AO1/1<br>4.7.2.1 |
| **3.5** | electromagnet exerts a downwards force on the iron bar | allow electromagnet pulls the iron (bar) down(wards)<br>allow electromagnet attracts the iron (bar) | 1 | AO1/1<br>4.7.2.1 |
| **3.6** | 1.5 (cm) | | 1 | AO2/2<br>4.5.3 |
| **3.7** | <br><br>F = 0.18 × 1.5<br>OR<br>F = 0.18 × their 3.6<br><br>F = 0.27 (N) | an answer 0.27 (N) scores **2** marks<br><br><br><br>allow 0.18 × their 3.6 correctly calculated | <br><br>1<br><br><br>1 | AO2/1<br>4.5.3 |
| **3.8** | it increases<br><br>and reaches a maximum | <br><br>allow and then does not change<br><br>any change other than current causing strength to increase scores **0** | 1<br><br>1 | AO3/1a<br>4.7.2.1<br>WS3.5 |
| **Total** | | | **11** | |

Answer 14 · Mark scheme

November 2020 | 8463/2F | Original Q5

## Question 5

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **05.1** | (the north pole of the floating magnet is) repelled from the north pole (of the fixed magnet)<br><br>and attracted to the south pole (of the fixed magnet) | allow following a magnetic field line for **1 mark** if no other marks scored | 1<br><br>1 | AO3<br>4.7.1.1<br>4.7.1.2 |
| **05.2** | it was attracted (to the fixed magnet) | allow it sticks / joins to the (fixed) magnet<br><br>allow it becomes an induced magnet<br><br>allow it becomes magnetised | 1 | AO1<br>4.7.1.2 |
| **05.3** | **Level 2:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced. | | 3–4 | AO1<br>4.7.1.2 |
| | **Level 1**: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear. | | 1–2 | |
| | **No relevant content** | | 0 | |
| | **Indicative content:**<br><br>• mark where the compass points on the paper<br>• move the compass to the marked point<br>• repeat until you go back to the magnet<br>• join up the points<br>• add an arrow pointing from the north pole to the south pole<br>• repeat for positions (above and below the bar magnet) | | | |
| **05.4** | C B A | allow **1** mark for one letter in the correct box | 2 | AO2<br>4.7.2.1 |
| **05.5** | $E_e = 0.5 \times 200 \times 0.040^2$<br><br>$E_e = 0.16$ (J) | | 1<br><br>1 | AO2<br>4.5.3 |
| **Total** | | | **11** | |

4.5.3 Forces and elasticity

Answer 15 · Mark scheme

November 2021 | 8463/1F | Original Q7

## Question 7

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **07.1** | gravitational potential<br><br>kinetic | this order only | 1<br><br>1 | AO1<br>4.1.1.2<br>4.1.1.1 |
| **07.2** | kinetic energy = 0.5 × mass × speed$^2$<br>**or**<br>$E_k = ½mv^2$ | | 1 | AO1<br>4.1.1.2 |
| **07.3** | $5040 = 0.5 \times m \times 12^2$<br><br>$m = \frac{5040}{0.5 \times 12^2}$<br><br>m = 70 (kg) | | 1<br><br>1<br><br>1 | AO2<br>4.1.1.2 |
| **07.4** | the thermal energy increases. | | 1 | AO1<br>4.1.1.1 |
| **Total** | | | **7** | |

Answer 16 · Mark scheme

November 2021 | 8463/2F | Original Q9

## Question 9

| Question | Answers | Extra information | Mark | AO/ Spec. Ref |
|---|---|---|---|---|
| 09.1 | will return to its original shape/length<br><br>when the force is removed | <br><br>allow (when) the child gets off<br><br>the second mark is dependent on scoring the first mark | 1<br><br>1 | AO2<br>4.5.3 |

| | | | |
|---|---|---|---|
| 09.2 | **Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced. | 5–6 | AO1<br>4.5.3 |
| | **Level 2:** The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced. | 3–4 | |
| | **Level 1**: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear. | 1–2 | |
| | **No relevant content** | 0 | |
| | **Indicative content**<br><br>• set up a clamp stand with a clamp<br>• hang the spring from the clamp<br>• use a second clamp and boss to fix a (half) metre rule alongside the spring<br>• record the ruler reading that is level with the bottom of the spring<br>• hang a 1 N / a known weight from the bottom of the spring<br>• record the new position of the bottom of the spring<br>• calculate the extension of the spring<br>• measure the extension of the spring<br>• add further weights to the spring so the force increases 1 N at a time up to 5 N<br>• for each new force record the position of the bottom of the spring and calculate / measure the extension<br><br>Indicative content continues on the next page… | | |

| | | | | |
|---|---|---|---|---|
| | Risk Assessment<br><br>Hazard: Clamp (stand, boss and masses) might fall off desk<br>Risk: injury to feet<br>Precaution: Use clamp to fix apparatus to the bench **or**<br>Ensure that the slotted masses hang over the base/foot of the stand **or**<br>Ensure that the boss is screwed tightly into the stand and clamp **or**<br>Put (heavy) masses on the base/foot of the stand **or**<br>Stand up so that you can move out of the way<br><br>Hazard: Spring could break / come loose<br>Risk: damage eye<br>Precaution: Wear safety goggles<br><br>If a risk assessment / hazard is not given, the answer can still reach level 3, but not full marks.<br><br>Full marks may be awarded for alternative feasible methods. | | | |

| | | | | |
|---|---|---|---|---|
| **09.3** | force = spring constant × extension | | 1 | AO1<br>4.5.3 |

| | | | | |
|---|---|---|---|---|
| **09.4** | 5.00 0.125<br><br>$k = \frac{5.00}{0.125}$<br><br>$k$ = 40 (N/m) | allow any correct pair of values from the graph<br><br>allow a misread value(s) from the graph<br><br>allow a correct calculation using their incorrect value(s) | 1<br><br>1<br><br>1 | AO2<br>4.5.3 |

| | | | | |
|---|---|---|---|---|
| **09.5** | the line is straight<br><br>and passes through the origin | allow the line does not curve<br>allow a constant gradient | 1<br><br>1 | AO3<br>4.5.3 |

| | | | | |
|---|---|---|---|---|
| **09.6** | $e$ = 0.20 m<br><br>$E_e = 0.5 \times 13 \times 0.20^2$<br><br>$E_e$ = 0.26 (J) | <br><br>allow an incorrectly / not converted value of e<br><br>use of two incorrectly/not converted values scores a máximum of 1 mark | 1<br><br>1<br><br>1 | AO2<br>4.5.3 |

| | | | |
|---|---|---|---|
| **Total** | | | **17** |

Answer 17 · Mark scheme

June 2022 | 8463/1F | Original Q1

## Question 1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.1** | gravitational potential<br>kinetic | this order only | 1<br>1 | AO1<br>4.1.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.2** | $E_e = 0.5 \times 120\,000 \times 0.015^2$<br>$E_e = 13.5$ (J) | | 1<br>1 | AO2<br>4.1.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.3** | $E = 540$ (J) | allow their answer from question **01.2** x 40 | 1 | AO2<br>4.1.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.4** | $E_k = 0.45 \times 600$<br>$E_k = 270$ (J) | | 1<br>1 | AO2<br>4.1.2.2 |

### 4.5.3 Forces and elasticity

**Answer 17 · Mark scheme**



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.5** | energy is transferred to the surroundings | | 1 | AO2 4.1.1.1 |

| | | |
|---|---|---|
| **Total Question 1** | | **8** |

Answer 18 · Mark scheme

June 2022 | 8463/2F | Original Q4

## Question 4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.1** | centre of mass | | 1 | AO1 4.5.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.2** | weight is directly proportional to mass | | 1 | AO1 4.5.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.3** | reading from balance = 1.1 kg<br><br>mass = $\frac{1.1}{5}$ = 0.22 kg | <br><br>allow correct calculation using incorrectly read value from the balance | 1<br><br>1 | AO2 4.5.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.4** | weight = 0.22 × 9.8<br><br>2.156 (N) | allow ecf from question **04.3**<br><br>allow correct answer to 2 or 3 sig figs | 1<br><br>1 | AO2 4.5.1.3 |

Answer 18 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.5** | 0.015 m | | 1 | AO2<br>4.5.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.6** | spring constant = $\frac{6.0}{0.015}$<br><br>400 (N/m) | allow ecf from question **04.5** | 1<br><br>1 | AO2<br>4.5.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.7** | returns to its original length/shape | allow returns to 3.5 cm | 1 | AO3<br>4.5.3 |

| | | |
|---|---|---|
| **Total Question 4** | | **10** |

Answer 19 · Mark scheme

June 2023 | 8463/1F | Original Q6

## Question 6

<table>
<tr><th>Question</th><th>Answers</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>06.1</td><td>
<table>
<tr><th>Energy store</th><th>Less than at A</th><th>The same as at A</th><th>More than at A</th></tr>
<tr><td>The student's gravitational potential energy</td><td>✓</td><td></td><td></td></tr>
<tr><td>The student's kinetic energy</td><td></td><td></td><td>✓</td></tr>
<tr><td>The bungee cord's elastic potential energy</td><td></td><td></td><td>✓</td></tr>
</table>
additional tick in a row negates the mark for that row
</td><td>1<br>1<br>1</td><td>AO1<br>4.1.1.1</td></tr>
</table>

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.2 | $E_e = 0.5 \times 78.4 \times 25^2$<br>$E_e = 24\ 500$ (J) | | 1<br>1 | AO2<br>4.1.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.3 | greatest spring constant | allow needs largest force (per metre) to stretch the cord | 1 | AO3<br>4.1.1.2 |

### 4.5.3 Forces and elasticity

**Answer 19 · Mark scheme**

June 2023 | 8463/1F | Original Q6

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.4** | A<br><br>greatest extension before snapping | <br><br>MP2 dependent on scoring MP1 | 1<br><br>1 | AO3<br>4.1.1.2 |

| | |
|---|---|
| **Total Question 6** | **8** |

Answer 20 · Mark scheme

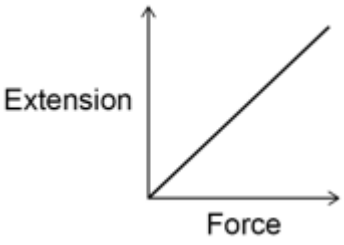
June 2023 | 8463/2F | Original Q1

## Question 1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.1** | 1.5 cm | | 1 | AO1<br>4.5.3<br>RPA6 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.2** | any **one** from:<br>• clamp the stand to the desk<br>• wear safety goggles / glasses<br>• stand up / away from apparatus<br>• limit the total mass used<br>• have masses over the base of the stand | | 1 | AO1<br>4.5.3<br>RPA6 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.3** | $W = 0.050 \times 9.8$<br><br>$W = 0.49$ (N) | <br><br>do **not** accept 0.50 (N) alone | 1<br><br>1 | AO2<br>4.5.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.4** |  | | 1 | AO1<br>4.5.3<br>RPA6 |

4.5.3 Forces and elasticity

Answer 20 · Mark scheme

June 2023 | 8463/2F | Original Q1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.5 | $k = \frac{2.0}{0.080}$<br><br>$k$ = 25 (N/m) | | 1<br><br>1 | AO2<br>4.5.3<br>RPA6 |

| Total Question 1 | 7 |
|---|---|

Answer 21 · Mark scheme

June 2024 | 8463/1F | Original Q3

## Question 3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.1** | stretched length – original length | | 1 | AO2<br>4.1.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.2** | $E_e = 0.5 \times 800 \times 7.5^2$<br>$E_e = 22\,500$ (J) | | 1<br>1 | AO2<br>4.1.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.3** | kinetic energy = $0.5 \times 240 \times 15^2$<br>kinetic energy = 27 000 (J) | | 1<br>1 | AO2<br>4.1.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.4** | $E_p = m \times g \times h$ | | 1 | AO1<br>4.1.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.5** | $24\,000 = 240 \times 9.8 \times h$<br>$h = \frac{24\,000}{(240 \times 9.8)}$<br>$h = 10.2$ (m) | <br><br>allow 10 (m)<br>allow a correct answer given to more than 3 s.f. | 1<br>1<br>1 | AO2<br>4.1.1.2 |

4.5.3 Forces and elasticity

Answer 21 · Mark scheme

June 2024 | 8463/1F | Original Q3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 03.6 | energy is transferred to the surroundings<br><br>work is done against air resistance | | 1<br><br>1 | AO1<br>4.1.2.1 |

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

Answer 22 · Mark scheme

June 2024 | 8463/2F | Original Q7

## Question 7

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **07.1** | $W = 25\,000 \times 9.8$<br>$= 245\,000$ (N) | | 1<br>1 | AO2<br>4.5.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **07.2** | $p = \frac{1\,960\,000}{49}$<br>$= 40\,000$<br>Pa | | 1<br>1<br>1 | AO2<br>AO2<br>AO1<br>4.5.5.1.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **07.3** | B | | 1 | AO1<br>4.5.5.1.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **07.4** | $a = \frac{1.3 - 0.7}{5.0}$<br>$= 0.12$ (m/s$^2$) | | 1<br>1 | AO2<br>4.5.6.1.5 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **07.5** | $\frac{0.21}{0.84} \times 100$<br>25% | | 1<br>1 | AO2<br>4.5.3 |

Answer 22 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **07.6** | force (applied to the spring) = spring constant × extension<br>**or**<br>$F = k \times e$ | | 1 | AO1<br>4.5.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **07.7** | $336 = k \times 0.21$<br><br>$\frac{336}{0.21} = k$<br><br>$k = 1600$ (N/m) | | 1<br><br>1<br><br>1 | AO2<br>4.5.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **07.8** | $v^2 - 0 = 2 \times 9.8 \times 0.95$<br><br>$v^2 = 18.62$<br><br>$v = 4.3150\ldots$<br><br>$= 4.3$ (m/s) | <br><br>allow $v = \sqrt{(18.62)}$<br><br><br><br>allow an answer correctly rounded to 2 significant figures from an incorrect calculation which uses the values in the question | 1<br><br>1<br><br>1<br><br>1 | AO2<br>4.5.6.1.5 |

| Total Question 7 | 18 |
|---|---|

Answer 23 · Mark scheme

June 2025 | 8463/1F | Original Q6

## Question 6

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.1 | $E_e = 0.5 \times 5.6 \times 0.35^2$<br><br>$E_e = 0.343$ (J) | <br><br>allow 0.34 (J) | 1<br><br>1 | AO2<br>4.1.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.2 | $E_p = mgh$ | | 1 | AO1<br>4.1.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.3 | $0.294 = m \times 9.8 \times 0.60$<br><br>$m = \frac{0.294}{9.8 \times 0.60}$<br><br>$m = 0.050$ (kg) | | 1<br><br>1<br><br>1 | AO2<br>4.1.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.4 | elastic potential energy decreases | | 1 | AO1<br>4.1.1.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.5 | kinetic energy decreases | | 1 | AO1<br>4.1.1.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.6** | gravitational potential energy increases | | 1 | AO2<br>4.1.1.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.7** | air resistance opposes the motion of the toy<br><br>energy is transferred to the surroundings | | 1<br><br>1 | AO2<br>4.1.1.1<br>4.1.2.1 |

| **Total Question 6** | **11** |
|---|---|

Answer 24 · Mark scheme

June 2025 | 8463/2F | Original Q9

## Question 9

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **09.1** | force (applied to spring)<br>**or**<br>weight (of the masses) | allow mass (hung from spring) | 1 | AO1<br>4.5.3<br>RPA6 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **09.2** | stand could tip over **and** hurt/hit the student<br>**or**<br>masses could fall off **and** hurt/hit the student | | 1 | AO1<br>4.5.3<br>RPA6 |
| | clamp base of stand to desk | allow rotate base/clamp<br>allow place some masses on the base of the clamp stand<br>allow student should stand up<br>allow limit the mass hung on spring | 1 | |
| | **OR** | | | |
| | spring could snap **and** hurt the student (1) | | | |
| | wear goggles (1) | allow limit the mass hung on spring | | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **09.3** | any **two** from:<br>• ensure the ruler is vertical<br>• clamp the ruler (close to the spring)<br>• attach a pointer to bottom of the spring<br>• use a ruler with a better resolution | allow move ruler so it is in line with spring | 2 | AO3<br>4.5.3<br>RPA6 |

Answer 24 · Mark scheme

June 2025 | 8463/2F | Original Q9

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **09.4** | the spring length is not proportional to the force<br><br>**or**<br><br>the unstretched/initial length of the spring is not zero | <br><br><br><br><br>allow student has plotted/measured spring length instead of extension | 1 | AO3<br>4.5.3<br>RPA6 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **09.5** | the spring is inelastically deformed<br><br>(so) the extension is no longer proportional to the force | <br><br>allow the spring has reached/passed its limit of proportionality<br><br>allow no longer obeys Hooke's law | 1<br><br>1 | AO3<br>4.5.3<br>RPA6 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **09.6** | force = spring constant × extension | | 1 | AO1<br>4.5.3<br>RPA6 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **09.7** | $4.0 = k \times 0.064$<br><br>$\frac{4.0}{0.064} = k$<br><br>$k = 62.5$ (N/m) | <br><br><br><br>allow 63 (N/m) | 1<br><br>1<br><br>1 | AO2<br>4.5.3<br>RPA6 |

| Total Question 9 | 12 |
|---|---|

ASSESSMENT and QUALIFICATIONS ALLIANCE

# Mark scheme June 2003

# GCSE

## Physics

3451

Foundation

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Kathleen Tattersall: *Director General*

# 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).

**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.

**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**

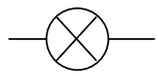
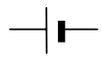
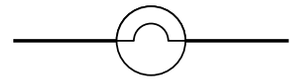
The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner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

### 4.5.3 Forces and elasticity





**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 |

**3451/F Q2**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | gas | | 1 |
| (b) | fuel burning stations produce electricity at any time / all the time<br><br>wind generator can only produce when the wind is strong enough | accept fuel available all the time<br><br>accept it's not always windy | 1<br><br>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 |

### 4.5.3 Forces and elasticity





**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 |

### 4.5.3 Forces and elasticity





**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 |

### 4.5.3 Forces and elasticity





**3451/F Q5**

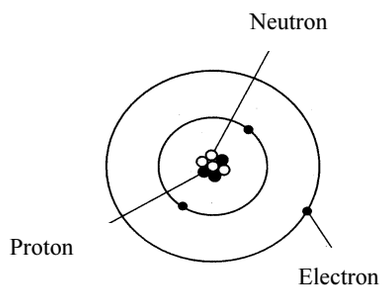
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | MN | accept 5.8, 8 seconds<br>must include unit | 1 |
| (b) | LM | accept 0.8, 5.8 seconds<br>must include unit | 1 |
| (c)(i) | 0.8 | | 1 |
| (ii) | drinking alcohol | | 1 |
| (d) | straight (by eye) line starting at 0.8 seconds<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 |

### 4.5.3 Forces and elasticity





**3451/F Q6**

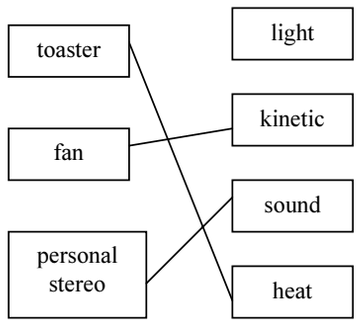
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | each correct label scores 1 mark<br><br> | | 3 |
| (ii) | neutron | | 1 |
| (iii) | 7<br><br>number of protons and neutrons **or** number of nucleons **or** number of particles in the nucleus | <br><br>accept number of particles 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 |

### 4.5.3 Forces and elasticity





**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 |

## 4.5.3 Forces and elasticity





**3451/F Q8**

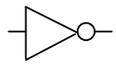
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | point where the rays cross | do not credit if ambiguous | 1 |
| (ii) | converging (lens) | do **not** accept convex | 1 |
| (b)(i) | point where the rays appear to diverge from | this should appear to be within 10mm in front 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 |

### 4.5.3 Forces and elasticity

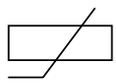
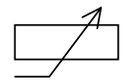
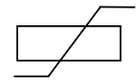




**3451/F Q9**

| 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 |

**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<br><br>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 |

### 4.5.3 Forces and elasticity





**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 |

### 4.5.3 Forces and elasticity





**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 |

### 4.5.3 Forces and elasticity





**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 |

### 4.5.3 Forces and elasticity





**3451/F Q13**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | silver is a (good) reflector of heat (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 |

**3451/F Q14**

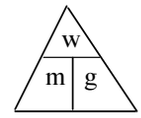
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | any **one** from: | | 1 |
| | the ground | do **not** accept mobile phones | |
| | the air | | |
| | radon (gas) | | |
| | building materials | | |
| | buildings | | |
| | rocks / granite | | |
| | food | | |
| | cosmic rays **or** solar rays | accept from outer space<br>accept sun but **not** sunlight | |
| | X-rays | accept medical uses | |
| | nuclear weapons testing | | |
| | nuclear power stations / accidents | | |
| (ii) | 2 | allow $\frac{1200}{60\times10}$ **or** $\frac{1200}{600}$ **or** 120<br>for **1** mark | 2 |
| (b) | | answers must be comparative<br>accept converse answers throughout | |
| | alpha: the count rate is (greatly) reduced by the card **or**<br>the card absorbs alphas but not betas | accept paper for the card | 1 |
| | 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) | accept aluminium for the metal | 1 |
| | 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 | accept aluminium for the metal<br>accept lead / aluminium for the metal | 1 |
| total | | | 6 |

### 4.5.3 Forces and elasticity





**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 |

## 4.5.3 Forces and elasticity





**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>accept a freehand drawing<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>current less<br>(so) rate of flow of charge less **or** less coulombs per second<br>(so) discharge is slower | <br>do **not** accept current slower<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 | translation correct (= 4000) but percentage addition incorrect gains **1** mark<br>translation incorrect but 5% addition is correct gains **1** mark<br>accept 422.1 **or** 42.2 **or** 6.3 for **1** mark | 2 |
| | ohms **or** Ω | 4.2 kilohms **or** 4.2 kΩ gains all **3** marks | 1 |
| total | | | 10 |

**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 |

ASSESSMENT and QUALIFICATIONS ALLIANCE

# Mark scheme June 2003

# GCSE

## Science: Double Award Co-ordinated

## 3462

## Paper 3F

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# 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).

**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.

**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.

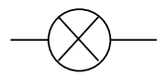
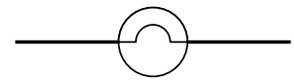
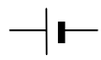
### 4.5.3 Forces and elasticity





**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 |

### 4.5.3 Forces and elasticity





**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 |

### 4.5.3 Forces and elasticity





**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 |

### 4.5.3 Forces and elasticity





**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 |

## 4.5.3 Forces and elasticity





**3462/3F Q5**

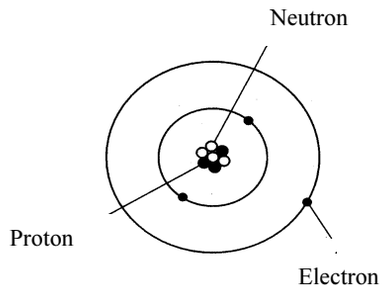
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | MN | accept 5.8, 8 seconds<br>must include unit | 1 |
| (b) | LM | accept 0.8, 5.8 seconds<br>must include unit | 1 |
| (c)(i) | 0.8 | | 1 |
| (ii) | drinking alcohol | | 1 |
| (d) | straight (by eye) line starting at 0.8 seconds<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 |

### 4.5.3 Forces and elasticity





**3462/3F Q6**

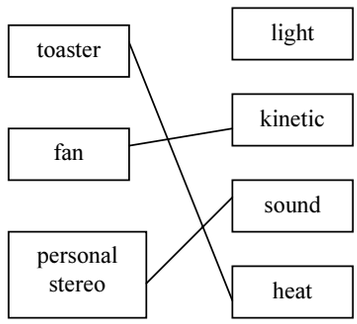
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | each correct label scores 1 mark<br><br> | | 3 |
| (ii) | neutron | | 1 |
| (iii) | 7<br><br>number of protons and neutrons **or** number of nucleons **or** number of particles in the nucleus | <br><br>accept number of particles 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 |

### 4.5.3 Forces and elasticity





**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 |

### 4.5.3 Forces and elasticity





**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 |

## 4.5.3 Forces and elasticity





**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 |

### 4.5.3 Forces and elasticity





**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 |

**3462/3F Q11**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | silver is a (good) reflector of heat (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 |

## 4.5.3 Forces and elasticity





**3462/3F Q12**

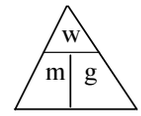
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | any **one** from:<br><br>the ground<br>the air<br>radon (gas)<br>building materials<br>buildings<br>rocks / granite<br>food<br>cosmic rays **or** solar rays<br><br>X-rays<br>nuclear weapons testing<br>nuclear power stations / 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 |

## 4.5.3 Forces and elasticity





**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 |

### 4.5.3 Forces and elasticity



GCSE

# Additional Science / Physics

PH2FP

Mark scheme

4408/4403
June 2015

Version/Stage: 1.0: Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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

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PMT



## Mark Scheme

## Information to Examiners

### 1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

### 2. Emboldening

**2.1** In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

**2.2** A bold **and** is used to indicate that both parts of the answer are required to award the mark.

**2.3** Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

**2.4** Any wording that is underlined is essential for the marking point to be awarded.

### 3. Marking points

#### 3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

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

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

| Student | Response | Marks awarded |
|---|---|---|
| 1 | Neptune, Mars, Moon | 1 |
| 2 | Neptune, Sun, Mars, Moon | 0 |

**3.2 Use of chemical symbols / formulae**

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

**3.3 Marking procedure for calculations**

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

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

**3.4 Interpretation of 'it'**

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

**3.5 Errors carried forward**

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

**3.6 Phonetic spelling**

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

**3.7 Brackets**

(.....) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

**3.8 Accept / allow**

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

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

Ignore of insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

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

## 4. Quality of Communication and levels marking

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

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

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

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

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

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

### 4.5.3 Forces and elasticity







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

### 4.5.3 Forces and elasticity





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

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

### 4.5.3 Forces and elasticity







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

### 4.5.3 Forces and elasticity







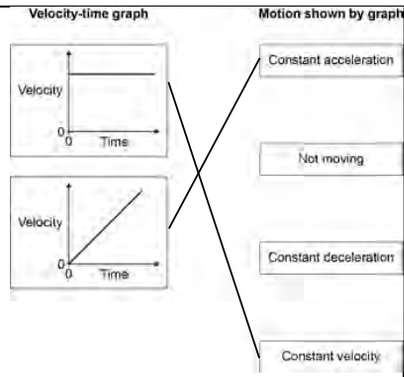
| Question | Answers | Extra information | Mark | AO / Spec. ref. | ID |
|---|---|---|---|---|---|
| **4(a)(i)** | (3-pin) plug | do **not** accept plug socket | 1 | AO1 2.4.1d | **E** |
| **4(a)(ii)** | live and neutral | | 1 | AO1 2.4.1e | **A** |
| **4(a)(iii)** | double | | 1 | AO1 2.4.1j | **G**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

### 4.5.3 Forces and elasticity







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

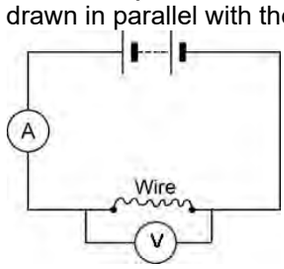
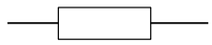
| Question | Answers | Extra information | Mark | AO / Spec. ref. | ID |
|---|---|---|---|---|---|
| **6(a)** | cell damage *or* cancer | accept kills/mutates cells<br><br>radiation poisoning is insufficient<br>ionising is insufficient | 1 | AO3<br>2.5.2g | **E** |
| **6(b)(i)** | any **one** from:<br>•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

### 4.5.3 Forces and elasticity



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

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

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

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

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |

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

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

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

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

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

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

Answer 12 · Examiner comments

June 2018 | 8463/2F | Original Q11

## Question 11 (Standard demand)

**11.1** This question related to one of the required practical activities. Students were asked to describe a method and to include causes of inaccuracy. Many students wrote at length about safety issues, reducing risks, repeating results and removing anomalies which were not asked for in this question. Most students drew a labelled diagram which was helpful, and then described what they had drawn, which wasn't necessary. Only a minority of the students appreciated that the force increased in steps of 2N, up to a maximum of 10N, and an extension was measured for each force. Even fewer mentioned a cause of inaccuracy. Some students appreciated that a range of weights were needed to obtain a table of results and made a relevant comment about measuring the extension. Those students working at level 1 hung a single mass on a spring and measured its length giving no indication how the extension would be determined.

**11.2** Students were asked why more than one pair of data was collected. Few students stated that it was so anomalous results could be found or to reduce random error. Most students who gained the mark stated that the accuracy of the results would be increased. Several students suggested that several data points would enable a mean to be calculated but did not state that it would be the mean of the spring constant.

**11.3** 43% of students plotted the two missing points correctly and drew a line of best fit that passed between (0, 0) and (10, 20). A significant number only plotted the two points or drew a line without having plotted the missing data. It was evident that many students did not use a ruler to draw a straight line.

**11.4** 24% were able to write the correct equation.

**11.5** Nearly 70% of the students scored zero. Only 4 % of the students were able to score 4 marks by using the correct equation, choosing relevant data from the table and converting centimetres to metres. The students who correctly found the average force and extension and substituted into the correct equation scored full marks.

**11.6** Students were asked to show how a given set of data or a graph demonstrated that two variables were directly proportional.
It was expected that students would state that the graph was straight and passed through (0, 0). Only a very small number did so. More of the students gained both marks for stating that as one variable doubled, so did the other. Students were given some credit for stating that every time the force increased by 2N the extension increased by approximately 4cm. This was accepted as an alternative to the graph being linear. Many students just stated that as the force increased so did the extension.

Answer 13 · Examiner comments

June 2019 | 8463/2F | Original Q3

## Question 3 (Low demand)

**03.1** Only 11% of the students scored this mark. Although the arrows were generally in the circles as requested, the majority of incorrect answers had arrows pointing towards each pole of the magnet or both arrows pointing away from the magnet.

**03.2** Students were asked to explain why the coat must not have two south poles facing each other. The first mark was for stating that two south poles would repel and the second mark was for stating what that would mean for the coat e.g. it would not fasten. 85 % of the students did score the first marking point.

**03.3** Just under half of the students recognised that the arrows should point in the same direction and made the correct choice.

**03.4** Most of the students knew that steel is a magnetic material, with 95% scoring this mark.

**03.5** This was well answered with students explaining that the iron bar was attracted to the electromagnet causing the spring to stretch. A number of students who did not score the mark described the electromagnet stretching the spring.

**03.6** Students were expected to use the graph to calculate the spring extension between the currents of 0.6 A to 1.2 A. While 65% of the students scored the mark, most of the others simply subtracted the two current values.

**03.7** Just over 77% of the students scored both marks. However this was sometimes due to error carried forward from part 03.6.

**03.8** Very few of the students scored both marks. Approximately 50% scored 1 mark. A significant number of the students gave an answer in terms of the spring reaching its elastic limit. Some students appeared to misinterpret the graph, saw the gradient decrease, and stated incorrectly that the electromagnet was decreasing in strength. For the second mark students were expected to state that the electromagnet reached a maximum strength or that the strength levelled off - only 4% of the students did this.

4.5.3 Forces and elasticity

Answer 17 · Examiner comments — June 2022 | 8463/1F | Original Q1

**Question 1 (Low demand)**

**01.1** About 40% of students answered this question correctly.

**01.2** Approximately 80% of students answered this question correctly. The most common mistake was to not square the extension. This would then just score a mark for the substitution, if correct.

**01.3** Students were required to multiply their answer to question **01.2** by 40. However, many students did not answer this correctly. Many students tried to calculate the elastic potential energy using the equation, scoring zero marks. About 60% of students answered this question correctly.

**01.4** About 65% of students scored 2 marks on this question. However, a number of students didn't score any marks as they did not appear to be able to calculate a percentage, which is one of the mathematical skills stated in the specification.

**01.5** Approximately 60% of students answered this question correctly.

Answer 18 · Examiner comments — June 2022 | 8463/2F | Original Q4

**Question 4 (Low demand)**

04.1 The correct answer was chosen by approximately 65% of the students.

04.2 The correct answer was chosen by approximately 70% of the students.

04.3 Approximately 80% of the answers were correct. Most errors occurred due to misreading the balance or dividing by a number other than five.

04.4 This was well answered. A significant number of the students gained both marks by correctly using an incorrect answer to part 04.3.

04.5 Just over 60% of the students were able to calculate the extension of the spring correctly.

04.6 Students who did not choose the correct value in part 04.5 were still able to score both marks for this part question. However, many of the students used values different to their choice in part 04.5 or tried a wrong conversion and so scored zero.

### 4.5.3 Forces and elasticity

**Answer 18 · Examiner comments** June 2022 | 8463/2F | Original Q4

04.7 This was generally well answered although some statements were in terms of the movement of the spring, rather than it reverting back to its original length / shape.

**Answer 19 · Examiner comments** June 2023 | 8463/1F | Original Q6

**Question 6 (Low Demand)**

**06.1** This question discriminated well with 24% of students scoring 3 marks, 39 % scoring 2 marks and 30% scoring 1 mark, for comparing the energy stores.

**06.2** 82% of students scored 2 marks for this calculation. The most common mistake was to forget to square the extension.

**06.3** 34% of students gave the correct reason.

**06.4** While 39% of students chose cord A, only 34% of students gave a correct reason. ‘Greater extension’ was insufficient unless also linked to ‘snapping’.

**Answer 20 · Examiner comments** June 2023 | 8463/2F | Original Q1

**01.1**

76% of students correctly identified the extension of the spring.

**01.2**

56% of students scored this mark. The most common correct responses were ‘wear goggles’ or stand up/back from the equipment. Incorrect responses would often describe a dangerous situation rather than a safety precaution to be taken.

**01.3**

93 % of students scored 2 marks for calculating the weight. It was clear that some students did not have calculators for the exam. This was a major disadvantage.

**01.5**

92 % of students scored 2 marks and 2.5 % scored 1 mark for this calculation of the spring constant..

Answer 21 · Examiner comments

June 2024 | 8463/1F | Original Q3

**Question 3 (Low / Standard demand)**

**03.1** 53% of students scored a mark for this question showing how the extension of a bungee cord should be calculated.

**03.2** 90% of students scored both marks for correctly calculating the elastic potential energy.

**03.3** 90% of students scored both marks for correctly calculating the maximum kinetic energy.

**03.4** 95% of students chose the correct equation. However, in this exam series students were provided with a Physics Equations Sheet.

**03.5** 56% of students scored all 3 marks for this standard demand calculation question.
For 3 mark calculations, these general principles apply:
The 1st mark is for the substitution.
The 2nd mark is for the rearrangement.
The 3rd mark is for the answer.
In straightforward calculations, no working needs to be shown, but students should be encouraged to do so just in case the final answer is incorrect.
If the answer is correct, 3 marks can score.

**03.6** 27% of students scored 2 marks for this question, while 59% scored 1 mark. This question tested understanding of energy dissipation in energy transfers. A lot of students only ticked one box, ignoring the rubric of the question.

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### 4.5.3 Forces and elasticity

**Answer 22 · Examiner comments** June 2024 | 8463/2F | Original Q7

**07.1**
Only a few students failed to gain 2 marks in this calculation of weight. Some had not substituted correctly, others tried to convert mass to grams.

**07.2**
58% of students scored all 3 marks for this calculation of pressure. The unit of area being $m^2$ seemed to confuse some students into squaring 49. Those scoring 2 marks tended to give an incorrect unit.

**07.3**
61% of students knew that the pressure in a fluid causes a force normal to the surface.

**07.4**
Students were expected to calculate the change in velocity to find the acceleration. Many did not calculate the change but just used one of the velocities given in the question. 78% scored both marks.

**07.5**
A percentage calculation which proved to be too difficult for many students. A common answer was 75% instead of 25%.

**07.6**
Even though all students had access to the Physics Equations Sheet, 3% did not write down any equation. 7% quoted the wrong equation.

**07.7**
Well answered calculation of spring constant with 77% getting all 3 marks. Some students struggled to rearrange the equation. Some tried to use the elastic potential energy equation.

**07.8**
24% of students gained all 4 marks for this velocity calculation. Those who didn't usually did not show a full substitution into the equation, and calculated 2*as*, thinking this was the final answer.

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**Answer 22 · Examiner comments** June 2024 | 8463/2F | Original Q7

**08.1**76% of students gave an incorrect value of resolution for the protractor. Answers of 10, 90 and 180 degrees were commonly seen.

### 4.5.3 Forces and elasticity

**Answer 23 · Examiner comments** June 2025 | 8463/1F | Original Q6

#### 06.1
Nearly 90 % of the students scored 2 marks on this calculation of elastic potential energy.

#### 06.2
The vast majority of the students identified the correct equation for gravitational potential energy.

#### 06.3
Just over half of the students scored 3 marks on this calculation of mass using the gravitational potential energy equation.

#### 06.4
About 65 % of the students understood that the elastic potential energy of the spring decreased.

#### 06.5
About 80 % of the students understood that the kinetic energy of the toy decreased.

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**Answer 23 · Examiner comments** June 2025 | 8463/1F | Original Q6

#### 06.6
Just over 60 % of the students understood that the gravitational potential energy of the toy increased.

#### 06.7
Just over 30 % of the students chose two correct reasons for the toy eventually stopping. About 50% of the students scored 1 mark. Many students did not read the instructions for the question and only ticked one box.

Questions matter

# GCSE
# Physics
## 8463/2F

## Report on the examination

Version: 1.0
June 2025

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### 4.5.3 Forces and elasticity



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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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## 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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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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## 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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## 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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## 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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## Mark Ranges and Award of Grades

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