



# Mark Scheme (Results)

Summer 2024

Pearson Edexcel GCSE  
In Physics (1PH0)  
Paper 1F

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## General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

| Question number | Answer                                               | Additional guidance                                               | Mark                     |
|-----------------|------------------------------------------------------|-------------------------------------------------------------------|--------------------------|
| <b>1 (a)</b>    | transverse (1)<br><br>speed (1)<br><br>frequency (1) | must be in correct order.<br><br>allow any recognisable spelling. | <b>3</b><br><b>A01.1</b> |

| Question number | Answer                                                                                              | Additional guidance                                      | Mark                     |
|-----------------|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------|
| <b>1 (b)</b>    | (visible) light (1)<br><br>gamma (rays) (1)<br><br>radio (waves) (1)<br><br>ultraviolet (waves) (1) | $\gamma$ (rays)<br><br>allow microwaves<br><br>UV (rays) | <b>4</b><br><b>A03.3</b> |

**Total for question 1 =7 marks**

| Question number | Answer | Additional guidance | Mark                     |
|-----------------|--------|---------------------|--------------------------|
| <b>2(a)</b>     | blue   |                     | <b>1</b><br><b>A03.2</b> |

| Question number | Answer                                 | Additional guidance                                                               | Mark                     |
|-----------------|----------------------------------------|-----------------------------------------------------------------------------------|--------------------------|
| <b>2 (b)</b>    | diminished/smaller (1)<br><br>real (1) | accept<br>recognisable<br>spellings e.g. reel<br><br>do not credit not<br>virtual | <b>2</b><br><b>A02.2</b> |

| Question number | Answer                                                                        | Additional guidance | Mark                         |
|-----------------|-------------------------------------------------------------------------------|---------------------|------------------------------|
| <b>2 (c)</b>    | shorter / less / smaller (1)<br><br>greater / larger / more /<br>stronger (1) | lower<br><br>higher | <b>2</b><br><br><b>A01.1</b> |

| Question number | Answer                                                                                                                                              | Additional guidance                                                                                                                                                                                      | Mark                     |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>2 (d)</b>    | an explanation linking<br><br>blurred / fuzzy/ distorted (1)<br><br>rays are reflected in different<br>directions / randomly (from<br>mirror S) (1) | allow reverse<br>arguments<br><br>(reflection in<br>mirror) S is<br>diffuse<br><br>allow light for<br>rays<br>(reflection in<br>mirror) R is<br>specular<br><br>rays reflected<br>from R are<br>parallel | <b>2</b><br><b>A03.2</b> |

**Total for question 2 =7 marks**

| Question number | Answer                   | Additional guidance                      | Mark                     |
|-----------------|--------------------------|------------------------------------------|--------------------------|
| <b>3(a)</b>     | gravitational attraction | gravity<br>gravitational field<br>/force | <b>1</b><br><b>AO1.1</b> |

| Question number | Answer                                                                  | Additional guidance                                                                                                                                                                                                                                                                                                              | Mark                     |
|-----------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>3 (b)(i)</b> | $\frac{10 \times 46}{(100)}$ (1)<br><br>(time=) 4.6 (billion years) (1) | accept<br>4 600 000 000<br>$4.6 \times 10^9$<br><br>award one mark<br>for power of ten<br>error<br><br>award one mark<br>for answer of 5.4<br>or 5 400 000 000<br>or $5.4 \times 10^9$<br>(has found time<br>remaining with<br>no power of ten<br>error)<br><br>award full marks<br>for the correct<br>answer without<br>working | <b>2</b><br><b>AO2.1</b> |

| Question number | Answer                                                                                                                                                                                                           | Additional guidance                                                                                                                  | Mark                                |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| <b>3(b)(ii)</b> | <p>a description to include any <b>two</b> from</p> <p>{volume/ diameter/radius/ size} changes (1)</p> <p>(Sun becomes ) a red giant (1)</p> <p>cools down (1)</p> <p>(eventually becomes) a white dwarf (1)</p> | <p>ignore explode / implode</p> <p>do not accept red super giant / supernova</p> <p>lose heat (energy)</p> <p>accept black dwarf</p> | <p><b>2</b></p> <p><b>AO2.1</b></p> |

| Question number | Answer                                                                                                                                                                   | Additional guidance                                                           | Mark                                |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------------|
| <b>3(c)</b>     | <p>description to include any <b>two</b> from:</p> <p>(two) isotopes/nuclei/atoms (1)</p> <p>fusing (1)</p> <p>release / emit energy (1)</p> <p>decrease in mass (1)</p> | <p>hydrogen</p> <p>joining / coming together</p> <p>allow heat for energy</p> | <p><b>2</b></p> <p><b>AO1.1</b></p> |

| Question number | Answer                                                                                                                                                                                                                                                                                                                               | Additional guidance                                                                                                                                                                 | Mark                                |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| <b>3(d)</b>     | <p>an explanation linking any <b>two</b> from</p> <p>(their) laboratory (equipment) is unlikely to be able to produce required conditions (1)</p> <p>need (very) high temperatures (1)</p> <p>need (very) high pressure (1)</p> <p>results had not been peer reviewed (1)</p> <p>no other scientist produced similar results (1)</p> | <p>requires much more equipment than available in a typical laboratory</p> <p>high (particle) speed / KE</p> <p>high (particle) [density</p> <p>not checked by other scientists</p> | <p><b>2</b></p> <p><b>A03.3</b></p> |

**Total for question 3 = 9 marks**

| Question number | Answer                                                                                                                                                                                                 | Additional guidance | Mark                     |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------|
| <b>4 (a)(i)</b> | <p>B 1s</p> <p>A is incorrect because this is before the driver reacts.</p> <p>C is incorrect because this is the braking time</p> <p>D is incorrect because 22 is a value of the initial velocity</p> |                     | <b>1</b><br><b>AO2.1</b> |

| Question number  | Answer                                                                                                                                                  | Additional guidance                                      | Mark                     |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------|
| <b>4 (a)(ii)</b> | <p>Any <b>one</b> from</p> <ul style="list-style-type: none"> <li>tiredness</li> <li>distraction</li> <li>drugs / alcohol</li> <li>(old) age</li> </ul> | <p>accept similar descriptions</p> <p>any named drug</p> | <b>1</b><br><b>AO1.1</b> |

| Question number   | Answer                                                                                                                                                                               | Additional guidance                                                                                                                                                                                                                                                                                                     | Mark                     |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>4 (a)(iii)</b> | <p>attempt to use the correct part of the graph (1)</p> <p>attempt to find area under graph(1)<br/> <math>\frac{1}{2} \times b \times h</math></p> <p>evaluation (1)<br/> 33 (m)</p> | <p>values of 22(<math>\pm 0.5</math>) and 4 or 22(<math>\pm 0.5</math>) and 3 seen</p> <p>0.5 x 4 x 22(<math>\pm 0.5</math>) or<br/> 0.5 x 3 x 22(<math>\pm 0.5</math>)</p> <p>accept values between 32 and 34 for 3 marks</p> <p>accept values between 43 and 45 for 2 marks</p> <p>accept values between 64.5 and</p> | <b>3</b><br><b>AO2.1</b> |

|  |  |                                                                                                                                   |  |
|--|--|-----------------------------------------------------------------------------------------------------------------------------------|--|
|  |  | 67.5 for 1 mark.<br><br>accept values between 86 and 90 for 1 mark<br><br>award full marks for the correct answer without working |  |
|--|--|-----------------------------------------------------------------------------------------------------------------------------------|--|

| Question number | Answer                                                                                                                                        | Additional guidance                                                                                                                                             | Mark                     |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>4b</b>       | an explanation linking any <b>two</b> from<br><br>shorter reaction time (of computer-controlled car) (1)<br><br>shorter thinking distance (1) | allow reverse arguments<br><br>computer (reaction time) not affected by other relevant factors<br><br>shorter distance (travelled) <b>before brakes applied</b> | <b>2</b><br><b>A03.1</b> |

| Question number | Answer                      | Additional guidance                                                   | Mark                     |
|-----------------|-----------------------------|-----------------------------------------------------------------------|--------------------------|
| <b>4(c)(i)</b>  | speed should be reduced (1) | slower<br><br>accept specified numerical reduction e.g. from 40 to 20 | <b>1</b><br><b>A03.1</b> |

| Question number | Answer                                                                                                                                | Additional guidance                                                                         | Mark                     |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------------------------|
| <b>4(c)(ii)</b> | any <b>one</b> from<br><br>friction (between wheel and road) is reduced (1)<br><br>braking distance would be longer (on wet road) (1) | allow reverse argument<br><br>idea that (road) more slippery / car could skid less traction | <b>1</b><br><b>A03.1</b> |

|  |                                                                     |                                                                                                                                 |  |
|--|---------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|--|
|  | (overall) stopping distance<br>would be longer (on wet road)<br>(1) | longer<br>(time/distance)<br>to stop<br><br>ignore crash /<br>collision/ accident<br><br>ignore changes to<br>thinking distance |  |
|--|---------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|--|

**Total for question 4 = 9 marks**

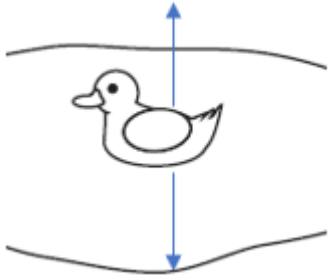
| Question number | Answer                                                                                     | Additional guidance | Mark                     |
|-----------------|--------------------------------------------------------------------------------------------|---------------------|--------------------------|
| <b>5(a)</b>     | B<br><br>A, C and D are incorrect because energy is transferred but air is not transferred |                     | <b>1</b><br><b>AO1.1</b> |

| Question number | Answer                                                                                | Additional guidance | Mark                     |
|-----------------|---------------------------------------------------------------------------------------|---------------------|--------------------------|
| <b>5(b)</b>     | A amplitude<br><br>B, C and D are incorrect because they are independent of intensity |                     | <b>1</b><br><b>AO1.1</b> |

| Question number | Answer                                                                                                                                           | Additional guidance                                                                                                                                                                                                                               | Mark                     |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>5(c)</b>     | substitution (1)<br>$330 = f \times 0.75$<br><br>rearrangement (1)<br>$(f =) \frac{330}{0.75}$<br><br>evaluation (1)<br>$(f =) 440 \text{ (Hz)}$ | substitution and rearrangement may be in either order.<br><br>$f = \frac{v}{\lambda}$<br><br>if no other marks scored then award 1 mark for an answer that rounds to 0.0023 or 250<br><br>award full marks for the correct answer without working | <b>3</b><br><b>AO2.1</b> |

| Question number | Answer                                                                                                                                                                                                              | Additional guidance | Mark                                |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------|
| <b>5(d)</b>     | <p>A 9cm</p> <p>B is incorrect because amplitude is measured from zero to the peak displacement</p> <p>C is incorrect because this is half the wavelength</p> <p>D is incorrect because this is the wavelength.</p> |                     | <p><b>1</b></p> <p><b>A02.1</b></p> |

| Question number | Answer                                                                                                                                                                                     | Additional guidance                                                                                                                                                       | Mark                                |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| <b>5(e)(i)</b>  | <p>a description to include:</p> <p>use (wave) speed = <math>\frac{\text{distance}}{\text{time}}</math></p> <p>(1)</p> <p>find relevant time (1)</p> <p>measure specified distance (1)</p> | <p>use <math>v = f \times \lambda</math></p> <p>count number of waves in specified time</p> <p>width / radius / circumference of pond</p> <p>do not accept wavelength</p> | <p><b>3</b></p> <p><b>A02.2</b></p> |

| Question number | Answer                                                                                                               | Additional guidance                                                                                        | Mark                     |
|-----------------|----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>5(e)(ii)</b> | arrow(s) up and/or down (1)<br><br> | judge by eye<br><br>need not be on duck<br>do not credit answers that imply duck (also) moves horizontally | <b>1</b><br><b>AO1.1</b> |

**Total for question 5 = 10 marks**

| Question number | Answer                                             | Additional guidance                                                                                              | Mark                     |
|-----------------|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>6(a)</b>     | X: electron (1)<br>Y: neutron (1)<br>Z: proton (1) | accept recognisable spellings.<br><br>accept Y and Z in the wrong order for 1 mark independent of any mark for X | <b>3</b><br><b>AO1.1</b> |

| Question number | Answer                                                                                                            | Additional guidance | Mark                     |
|-----------------|-------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------|
| <b>6(b)</b>     | D it does not change<br>A, B and C are incorrect because the number of nucleons does not change in gamma emission |                     | <b>1</b><br><b>AO1.1</b> |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                            | Additional guidance                                                             | Mark                     |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|--------------------------|
| <b>6(c)(i)</b>  | any <b>one</b> from:<br><br>keep a safe distance (1)<br><br>point the source away from people (1)<br><br>handle the source with tongs/at a distance (1)<br><br>limit exposure time/return source to store (asap) (1)<br><br>use shielding (1)<br><br>use of gloves / mask (1)<br><br>protective clothing (1)<br><br>wear a film badge/monitor (1) | (store in) lead-lined box<br><br>use of screen<br><br>PPE<br><br>ignore goggles | <b>1</b><br><b>AO1.2</b> |

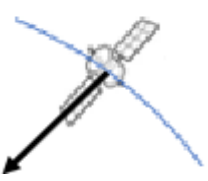
| Question number | Answer                                | Additional guidance                                                                                                               | Mark                     |
|-----------------|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>6(c)(ii)</b> | the activity varies (slightly)<br>(1) | numbers / counts / results / measurements are different<br><br>no pattern<br><br>increases and decreases<br><br>ignore random(ly) | <b>1</b><br><b>AO1.1</b> |

| Question number  | Answer | Additional guidance                                                                                             | Mark                     |
|------------------|--------|-----------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>6(c)(iii)</b> | 21 (1) | $\frac{21+23+19+22}{4}$<br>or $\frac{85}{4}$<br>accept 21.3 or 21.2 or 21.25<br><br>do not accept 21.5 (median) | <b>1</b><br><b>AO3.2</b> |

| Question number | Answer                                                                                                                                                         | Additional guidance                                                                                                                                                       | Mark                     |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>6(d)(i)</b>  | an explanation linking any <b>two</b> from<br><br>readings fall (to almost zero) (1)<br><br>radiation is (all) absorbed (1)<br><br>after a few cm (of air) (1) | accept graph / activity / measurements for readings<br><br>stopped by air<br><br>in a short distance (in air)<br><br>reverse arguments must include beta <b>and</b> gamma | <b>2</b><br><b>AO2.1</b> |

| Question number | Answer                   | Additional guidance                                                                               | Mark                     |
|-----------------|--------------------------|---------------------------------------------------------------------------------------------------|--------------------------|
| <b>6(d)(ii)</b> | background radiation (1) | or words to that effect<br>accept named examples<br><br>ignore reference to original alpha source | <b>1</b><br><b>AO2.1</b> |

**Total for question 6 = 10 marks**

| Question number | Answer                                                                                                                                                                                                                                         | Additional guidance | Mark                     |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------|
| <b>7 (a)(i)</b> |  <p>B</p> <p>A is incorrect because the force of gravity acts towards the centre</p> <p>C and D are incorrect because the force does not act tangentially</p> |                     | <b>1</b><br><b>AO1.1</b> |

| Question number  | Answer                                                                                                                                                                      | Additional guidance                                                                                                                        | Mark                     |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>7 (a)(ii)</b> | <p>an explanation linking any <b>two</b> from</p> <p>velocity is changing (1)</p> <p>direction is changing (1)</p> <p>there is a resultant force (on the satellite) (1)</p> | <p>velocity / acceleration is a vector</p> <p>accept unbalanced forces</p> <p>the direction of the velocity is changing scores 2 marks</p> | <b>2</b><br><b>AO1.1</b> |

| Question number | Answer                                                                                                                                                                                                                                                                                       | Additional guidance              | Mark                                |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-------------------------------------|
| <b>7 (b)</b>    | <p>an explanation linking any <b>two</b> from</p> <p>improves clarity (of images) (1)</p> <p>light (from distant objects) is (very) faint (1)</p> <p>idea that atmosphere absorbs/scatters light (1)</p> <p>(HST) is above the atmosphere (1)</p> <p>light pollution (on/from Earth) (1)</p> | <p>accept air for atmosphere</p> | <p><b>2</b></p> <p><b>A01.1</b></p> |

| Question number | Answer                                                                                                                              | Additional guidance                                                                                                                                                          | Mark                                |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| <b>7 (c)</b>    | <p>a description to include</p> <p>time (to complete orbit) increases as height increases (1)</p> <p>relationship is linear (1)</p> | <p>accept positive correlation</p> <p>accept reverse argument</p> <p>(can draw) a straight line (through the points)</p> <p>accept directly proportional in this context</p> | <p><b>2</b></p> <p><b>A03.1</b></p> |

| Question number | Indicative content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Mark                                     |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| <b>*7(d)</b>    | <p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p>May be shown in a diagram.</p> <p>Objects</p> <ul style="list-style-type: none"> <li>• fixed stars are not part of solar system</li> <li>• additional planets are in solar system</li> <li>• these include Neptune and Uranus</li> <li>• asteroids / minor planets / comets are in solar system</li> <li>• planets have their own moons</li> <li>• the Sun is a star and is very much larger than the planets</li> </ul> <p>Arrangement of objects in Solar System</p> <ul style="list-style-type: none"> <li>• Earth not at the centre</li> <li>• Sun is in the centre</li> <li>• Earth between Venus and Mars</li> <li>• Moon (still) orbits Earth.</li> <li>• planets orbit the Sun.</li> <li>• asteroids / comets orbit Sun</li> <li>• orbits are not circular</li> <li>• (relative) distance between planets and Sun much larger</li> <li>• stars are very large distance from Solar System.</li> </ul> | <b>6</b><br><b>AO1.1</b><br><b>AO3.1</b> |

| Level   | Mark | Descriptor                                                                                                                                                                                                                                                         |
|---------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | 0    | <ul style="list-style-type: none"> <li>• No rewardable material.</li> </ul>                                                                                                                                                                                        |
| Level 1 | 1-2  | <ul style="list-style-type: none"> <li>• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1)</li> <li>• Presents an explanation with some structure and coherence. (AO1)</li> </ul> |
| Level 2 | 3-4  | <ul style="list-style-type: none"> <li>• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1)</li> </ul>                                |

|         |     |                                                                                                                                                                                                                                                                                                                      |
|---------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         |     | <ul style="list-style-type: none"> <li>Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)</li> </ul>                                                                                                                                                                    |
| Level 3 | 5-6 | <ul style="list-style-type: none"> <li>Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1)</li> <li>Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)</li> </ul> |

| Level   | Mark | Additional Guidance                                                                    | General additional guidance – the decision within levels<br>e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level. |
|---------|------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | 0    | No rewardable material.                                                                |                                                                                                                                                                                                                       |
| Level 1 | 1–2  | <u>Additional guidance</u><br>Facts about either objects or arrangement                | <u>Possible candidate responses</u><br>The Earth is not at the centre. There are additional planets                                                                                                                   |
| Level 2 | 3–4  | <u>Additional guidance</u><br>Partially complete comparison of objects and arrangement | <u>Possible candidate responses</u><br>Earth is a planet. Neptune is another planet. All the planets orbit the Sun.                                                                                                   |
| Level 3 | 5–6  | <u>Additional guidance</u><br>Detailed comparison of objects and arrangement           | <u>Possible candidate responses</u><br>All the planets including the Earth go round the Sun. The moon goes round the Earth. The stars are a long way from the Solar System and are not part of it.                    |



| Question number | Answer                                                                                                                                   | Additional guidance                                                                                                                                                                                                                                                                                     | Mark                     |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>8 (b)</b>    | substitution (1)<br>$(v^2) = \frac{950 \times 2}{35}$ evaluation of $v^2$ (1)<br>54(.29)<br>evaluation of $v$ (1)<br>( $v =$ ) 7.4 (m/s) | accept values that round to 7.3(m/s) or 7.4(m/s)<br>accept answer of 7 (one sig. fig.)<br>award 2 marks for an answer that rounds to 54 (m/s)<br>if no other mark scored allow 1 mark for an answer that rounds to 0.23 (m/s) (use of mass in g)<br>award full marks for correct answer without working | <b>3</b><br><b>AO2.1</b> |

| Question number | Answer                        | Additional guidance                                                                                                                                                                                                                                | Mark                     |
|-----------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>8(c)(i)</b>  | thermal (energy/store)<br>(1) | energy dissipated<br>energy wasted<br>energy lost<br><br>energy transferred to surroundings<br><br>energy transferred due to friction<br><br>energy transferred due to air resistance<br><br>allow heat (energy)<br>ignore sound/not useful energy | <b>1</b><br><b>AO2.1</b> |

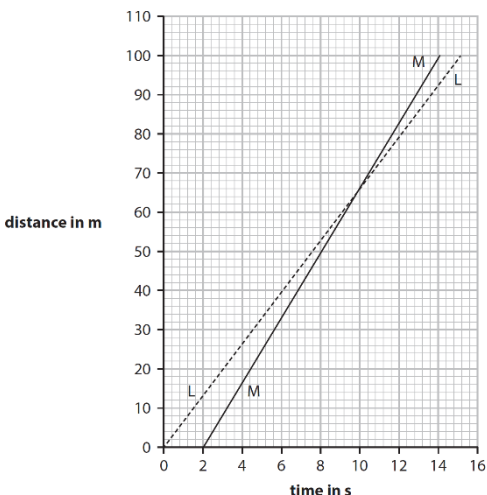
| Question number  | Answer     | Additional guidance | Mark                     |
|------------------|------------|---------------------|--------------------------|
| <b>8 (c)(ii)</b> | 30 (J) (1) | accept -30          | <b>1</b><br><b>AO2.1</b> |

| Question number             | Answer                                                                            | Additional guidance                                                                                                                                                                                                                 | Mark                     |
|-----------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>8</b><br><b>(c)(iii)</b> | substitution (1)<br>$\frac{950}{980} \times 100$<br>evaluation (1)<br>0.97 OR 97% | allow answers that round to 0.97 or 97% for 2 marks<br><br>allow 1 mark for answers that round to 97 or 0.97%<br><br>allow 1 mark for answers of 0.96 or 96% (truncated)<br><br>award full marks for correct answer without working | <b>2</b><br><b>A02.1</b> |

| Question number | Answer                                                                                             | Additional guidance                   | Mark                     |
|-----------------|----------------------------------------------------------------------------------------------------|---------------------------------------|--------------------------|
| <b>8 (d)</b>    | any <b>two</b> from<br>reduce air resistance (1)<br><br>lubricate (wheels) (1)<br><br>push off (1) | be more<br>aerodynamic<br>crouch down | <b>2</b><br><b>AO1.1</b> |

**Total for question 8 = 11 marks**

| Question number | Answer | Additional guidance                                                                                                                                  | Mark                     |
|-----------------|--------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>9 (a)(i)</b> | 66 (m) | <p>allow values between 64 and 68 inclusive</p> <p>allow values between 32 and 36 as the distance L has to run after M overtakes in this context</p> | <b>1</b><br><b>A03.2</b> |

| Question number  | Answer                                                                     | Additional guidance                                                                                                                                                                                                                                                                                                                                                                   | Mark                     |
|------------------|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>9 (a)(ii)</b> | <p>select (1)</p> $v = \frac{x}{t}$ <p>evaluation (1)</p> <p>6.6 (m/s)</p> | <p>allow any identifiable distance from graph divided by any identifiable time from graph</p> <p>e.g.</p> $\frac{100}{15.2}$  <p>allow values that round to between 6.5 (m/s) and 6.7 (m/s) for example 6.666 (m/s) or 6.579 (m/s)</p> <p>award full marks for correct answer without working</p> | <b>2</b><br><b>A02.1</b> |

| Question number | Answer                                                                                                                    | Additional guidance                                                                                                                                                                                | Mark                     |
|-----------------|---------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>9 (b)(i)</b> | substitution (1)<br><br>$(t =) \frac{10 - 6.2}{2.5}$<br><br><br><br><br><br><br>evaluation (1)<br>$(t =) 1.5 \text{ (s)}$ | $\frac{3.8}{2.5}$<br><br>allow $\frac{6.2 - 10}{2.5}$ or $\frac{3.8}{2.5}$<br><br>$1.52 \text{ (s)}$<br><br>allow $-1.5(2) \text{ (s)}$<br><br>award full marks for correct answer without working | <b>2</b><br><b>AO2.1</b> |

| Question number  | Answer                                                                                                                                          | Additional guidance                                                                                                                                                                     | Mark                     |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>9 (b)(ii)</b> | substitution OR rearrangement (1)<br><br>$(-)10^2 = 2 \times (-) 4.4 \times x$<br><br><br><br><br>evaluation (1)<br><br>$(x = ) 11 \text{ (m)}$ | $(x) = \frac{v^2 - u^2}{2 \times a}$<br><br>$(x =) \frac{(-)10^2}{2 \times (-) 4.4}$<br><br>allow values that round to 11 (m) e.g. 11.36 (m)<br><br>ignore negative sign in answer line | <b>2</b><br><b>AO2.1</b> |

|  |  |                                                                                                    |  |
|--|--|----------------------------------------------------------------------------------------------------|--|
|  |  | accept 1.1(36)<br>for one mark<br><br>award full marks<br>for correct<br>answer without<br>working |  |
|--|--|----------------------------------------------------------------------------------------------------|--|

| Question number | Indicative content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Mark                     |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>*9(c)</b>    | <p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive, and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p><b>measurement of distance using a rule or similar to find</b></p> <ul style="list-style-type: none"> <li>• height of the ramp</li> <li>• travelled length of ramp / distance x to Y</li> <li>• width of card (if used)</li> <li>• distance between light gates (if used)</li> <li>• distance between dots on tape (if used)</li> </ul> <p><b>measurement of time such as</b></p> <ul style="list-style-type: none"> <li>• use of ticker-tape</li> <li>• use of a single light gate connected to electronic timer with a card fixed to the trolley</li> <li>• use of two light gates connected to electronic timer with a means of interrupting the light beams</li> <li>• use of (manually operated) stop clock /watch / timer</li> </ul> | <b>6</b><br><b>AO1.2</b> |

|  |                                                                                                                                                                                                                                    |  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <b>determination of speed</b> <ul style="list-style-type: none"><li>• detail about which distance and time measurements are being used</li><li>• repeat and average</li><li>• repeat using different heights of the ramp</li></ul> |  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

| Level   | Mark | Descriptor                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | 0    | <ul style="list-style-type: none"> <li>No rewardable material.</li> </ul>                                                                                                                                                                                                                                                                                                                                               |
| Level 1 | 1-2  | <ul style="list-style-type: none"> <li>Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1)</li> <li>Presents a description which is not logically ordered and with significant gaps. (AO1)</li> </ul>                                                                                                      |
| Level 2 | 3-4  | <ul style="list-style-type: none"> <li>Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1)</li> <li>Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)</li> </ul> |
| Level 3 | 5-6  | <ul style="list-style-type: none"> <li>Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1)</li> <li>Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)</li> </ul>                                                                 |

| Level   | Mark | Additional Guidance                                                                                                                                                                       | General additional guidance – the decision within levels<br><br>e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.                            |
|---------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | 0    | No rewardable material.                                                                                                                                                                   |                                                                                                                                                                                                                                                      |
| Level 1 | 1–2  | <u>Additional guidance</u><br><br>Limited description of measurement of distance and time                                                                                                 | <u>Possible candidate responses</u><br><br>Measure the distance down the ramp. determine the time it took.                                                                                                                                           |
| Level 2 | 3–4  | <u>Additional guidance</u><br><br>Partial description including <b>two</b> from<br><br>measurement of a relevant distance<br><br>measurement of relevant time<br><br>calculation of speed | <u>Possible candidate responses</u><br><br>Use the light gates to measure the time it took to go down.<br><br>Measure the distance down the ramp with a ruler.                                                                                       |
| Level 3 | 5–6  | <u>Additional guidance</u><br><br>Detailed description of measurements of relevant distances and associated times to find speed                                                           | <u>Possible candidate responses</u><br><br>Use light gates to measure the time to go from X to Y<br>Use a ruler to measure the distance between the light gates.<br>Divide distance between the light gates by the time taken to travel from X to Y. |

**Total for question 9 = 13 marks**



|  |                                               |                                                        |  |
|--|-----------------------------------------------|--------------------------------------------------------|--|
|  | activity decreases rapidly/decays rapidly (1) | accept<br>decays before<br>use / does not<br>last long |  |
|--|-----------------------------------------------|--------------------------------------------------------|--|

| Question      | Answer                                                                                                                                                                                                                                        | Additional guidance                                                                                                                                                      | Mark                                |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| <b>10 (c)</b> | <p>any two from</p> <p>irradiation does not make an object radioactive (1)</p> <p>irradiation can be stopped by shielding (1)</p> <p>irradiation source is outside the object (1)</p> <p>irradiation stops when the source is removed (1)</p> | <p>ORA</p> <p>ORA</p> <p>source of contamination is in or on the object</p> <p>effect of contamination is continuous</p> <p>allow you can move away from irradiation</p> | <p><b>2</b></p> <p><b>AO1.1</b></p> |

| Question        | Answer                                                                      | Additional guidance                                                                                                                                                                                  | Mark                                |
|-----------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| <b>10(d)(i)</b> | <p>correct use of the graph (1)</p> <p>110 to 130 (hours) inclusive (1)</p> | <p>horizontal line in range 48-52 Bq to line for either isotope</p> <p>allow two horizontal lines showing halving of the activity</p> <p>award full marks for the correct answer without working</p> | <p><b>2</b></p> <p><b>AO2.1</b></p> |



| Question                    | Answer                                                                                                                                                                                                                                                                                                      | Additional guidance                                                                                                                  | Mark                     |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>10</b><br><b>(d)(ii)</b> | <p><b>one</b> suggestion from:</p> <p>(Q) has longer half-life (1)</p> <p>(Q) does not decay as quickly/<br/>takes longer to decay (1)</p> <p>(Q) (maintains) a higher (level<br/>of) activity (1)</p> <p>(Q) gives a higher <u>dose</u> (1)</p> <p>(Q) emits more ionising (type<br/>of) radiation (1)</p> | <p>allow reverse arguments</p> <p>activity decreases more slowly</p> <p>(always) more (radio)active /<br/>more decays per second</p> | <b>1</b><br><b>AO2.2</b> |

**Total for question 10 = 11 marks**

**Total for paper = 100 marks**