



# **Mark Scheme (Results)**

Summer 2017

Pearson Edexcel International GCSE  
in Physics (4PH0) Paper 1PR

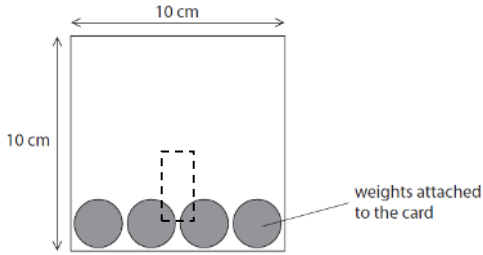
Pearson Edexcel International GCSE  
in Science (Double Award) (4SC0) Paper 1PR

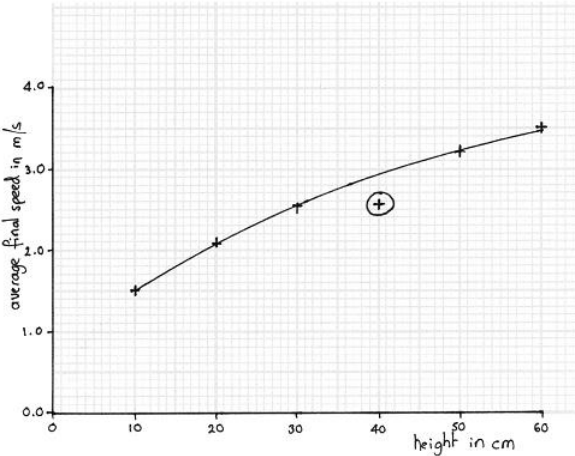
| Question number | Answer                                                                                                                                                                                                                                   | Notes | Marks |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|
| 1 (a) (i)       | <p>C – Holmes;</p> <p><b>The only correct answer is C</b></p> <p>A is not correct because it's a planet</p> <p>B is not correct because it's a galaxy</p> <p>D is not correct because it's a moon</p>                                    |       | 1     |
| (ii)            | <p>B – Hoag's Object;</p> <p><b>The only correct answer is B</b></p> <p>A is not correct because it's a planet</p> <p>C is not correct because it's a comet</p> <p>D is not correct because it's a moon</p>                              |       | 1     |
| (b)             | <p>B – Milky Way;</p> <p><b>The only correct answer is B</b></p> <p>A is not correct because it's a different galaxy</p> <p>C is not correct because it's a different galaxy</p> <p>D is not correct because it's a different galaxy</p> |       | 1     |

Total for question 1 = 3 marks

| Question number | Answer                                                                                                                                                                                                        | Notes                                                                                                                                                                                                                                                                                              | Marks |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 2 (a)           | clear recognition that stationary is the horizontal sections;<br><br>3.5 (minutes);                                                                                                                           | seen on graph or in working<br>e.g. use of 1.5 or 2<br>allow 3½                                                                                                                                                                                                                                    | 2     |
| (b)             | A;<br>idea of line having smallest gradient;                                                                                                                                                                  | allow 'line is shallowest' / 'least steep' etc.<br>allow calculated speeds                                                                                                                                                                                                                         | 2     |
| (c) (i)         | (average) speed = distance (moved) / time (taken);                                                                                                                                                            | allow in standard symbols or in words e.g.<br>$s = d/t$ OR $v = s/t$                                                                                                                                                                                                                               | 1     |
| (ii)            | substitution;<br>evaluation;<br>matching unit;<br><br>e.g.<br>(speed =) 200 / 60<br>(speed =) 3.3<br><br>m/s                                                                                                  | must match units used in calculation<br><br>allow 3, 3.33, 3.333 etc.<br>condone 3.34<br><br><b>200 metres per minute</b> receives 3 marks<br><b>12 km/h</b> (condone kph) receives 3 marks<br>200 m/s receives 2 marks<br><br>allow any suitable unit of speed for 1 mark if no other mark scored | 3     |
| (d)             | any 2 of:<br><br>speed of car;<br>mass / weight of car;<br>road / weather conditions;<br><br>road slope / angle;<br>condition / type / age of tyres;<br>condition / age of brakes;<br>wind speed / direction; | ignore references to reaction time, thinking distance, stopping distance etc.<br><br>road surface, rain, ice, snow etc.<br>ignore fog, mist etc.                                                                                                                                                   | 2     |

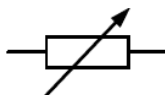
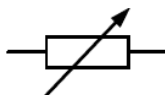
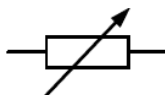
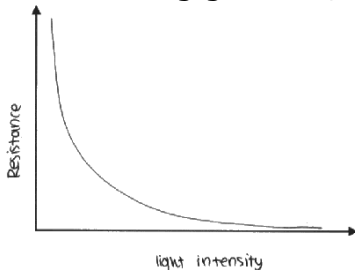
Total for question 2 = 10 marks

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Notes                                                                                                   | Marks |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|-------|
| 3 (a)           | <p>X drawn at the horizontal centre AND <u>below</u> the vertical centre (by eye);</p> <p>i.e.</p>  <p>The diagram shows a square card with a width of 10 cm and a height of 10 cm. Four grey circles representing weights are attached to the bottom edge. A dashed rectangle is drawn below the horizontal center of the card, indicating the area where the 'X' should be placed. A label 'weights attached to the card' points to one of the circles.</p> | <p>allow any clear symbol in place of the X</p> <p>X must be in the area marked by the dashed lines</p> | 1     |
| (b)             | <p>A – the final speed of the card;</p> <p><b>The only correct answer is A</b></p> <p>B is not correct because it's the independent variable</p> <p>C is not correct because it's a control variable</p> <p>D is not correct because it's a control variable</p>                                                                                                                                                                                                                                                                               |                                                                                                         | 1     |
| (c) (i)         | <p>correct value;<br/>given to 2 decimal places;</p> <p>e.g.<br/>3.3966...<br/>3.40</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <p>allow any value given to 2 d.p.</p> <p>3.39 gains 1 mark only</p>                                    | 2     |

| (ii)         | <p>suitable linear scale chosen (&gt;50% of grid used);<br/>axes labelled with quantities and unit;<br/>plotting correct to nearest half square (minus one for each plotting error);;</p>  | <p>ignore orientation</p> <p>ignore final point<br/>i.e. two plotting errors = no marks for plotting</p> <table><thead><tr><th>height in cm</th><th>average final speed in m/s</th></tr></thead><tbody><tr><td>10.0</td><td>1.39</td></tr><tr><td>20.0</td><td>1.97</td></tr><tr><td>30.0</td><td>2.43</td></tr><tr><td>40.0</td><td>2.45</td></tr><tr><td>50.0</td><td>3.09</td></tr><tr><td>60.0</td><td>3.40</td></tr></tbody></table> | height in cm | average final speed in m/s | 10.0 | 1.39 | 20.0 | 1.97 | 30.0 | 2.43 | 40.0 | 2.45 | 50.0 | 3.09 | 60.0 | 3.40 | 4 |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------------|------|------|------|------|------|------|------|------|------|------|------|------|---|
| height in cm | average final speed in m/s                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |                            |      |      |      |      |      |      |      |      |      |      |      |      |   |
| 10.0         | 1.39                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |                            |      |      |      |      |      |      |      |      |      |      |      |      |   |
| 20.0         | 1.97                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |                            |      |      |      |      |      |      |      |      |      |      |      |      |   |
| 30.0         | 2.43                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |                            |      |      |      |      |      |      |      |      |      |      |      |      |   |
| 40.0         | 2.45                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |                            |      |      |      |      |      |      |      |      |      |      |      |      |   |
| 50.0         | 3.09                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |                            |      |      |      |      |      |      |      |      |      |      |      |      |   |
| 60.0         | 3.40                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |                            |      |      |      |      |      |      |      |      |      |      |      |      |   |
| (iii)        | (40.0,2.45) identified clearly;                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1            |                            |      |      |      |      |      |      |      |      |      |      |      |      |   |
| (iv)         | line (curve) of best fit acceptable, ignoring anomalous point;                                                                                                                                                                                                               | i.e. smooth curve within 1 small square of each point<br>ignore parts of curve outside plotted points if extrapolated                                                                                                                                                                                                                                                                                                                     | 1            |                            |      |      |      |      |      |      |      |      |      |      |      |      |   |
| (v)          | idea that (average final) speed increases with height;<br><br>idea that relationship is non-linear;                                                                                                                                                                          | allow RA<br>ignore 'positive correlation'<br>ignore references to line being curved<br>allow<br><b>not</b> proportional<br>allow idea of gradient changing                                                                                                                                                                                                                                                                                | 2            |                            |      |      |      |      |      |      |      |      |      |      |      |      |   |

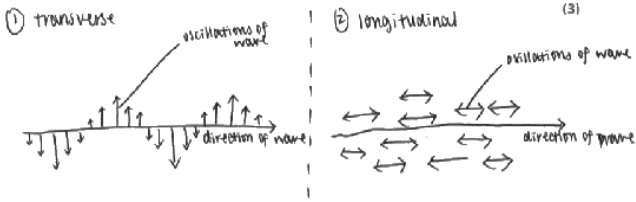
|     |                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                               |   |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| (d) | <p>any two of:</p> <p>MP1. move scale closer to card / use a ruler and place it nearer the light gate;</p> <p>MP2. measure height at eye level / parallax;</p> <p>MP3. drop using a clamp / eq;</p> <p>MP4. make sure scale is vertical / perpendicular to ground / use a set square;</p> <p>MP5. idea of accounting for zero error;</p> | <p>ignore references to precision, human error, repeats<br/>allow 'ruler' for scale</p> <p>allow idea of consistent release mechanism</p> <p>allow put light gate at zero</p> | 2 |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|

Total for question 3 = 14 marks

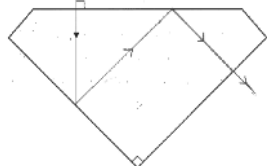
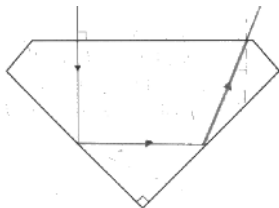
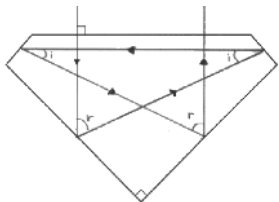
| Question number        | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Notes                                                                                      | Marks          |                |                                                                                   |                   |                                                                                   |      |                                                                                   |      |                                                                                   |                        |                                                                                   |                                                                                                                                                                                                                                                                                         |   |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|----------------|----------------|-----------------------------------------------------------------------------------|-------------------|-----------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------|------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 4 (a)                  | <p>1 mark for each correct line; ; ; ; ;</p> <table><tr><th>Name of component</th><th>Circuit symbol</th></tr><tr><td>fixed resistor</td><td></td></tr><tr><td>variable resistor</td><td></td></tr><tr><td>cell</td><td></td></tr><tr><td>lamp</td><td></td></tr><tr><td>fuse / circuit breaker</td><td></td></tr></table> | Name of component                                                                          | Circuit symbol | fixed resistor |  | variable resistor |  | cell |  | lamp |  | fuse / circuit breaker |  | <p>symbols do not need to have connecting wires shown at each side</p> <p><u>arrow</u> can be any direction but must be diagonal only</p> <p>ignore 'battery'</p> <p>allow filament lamp symbol </p> | 4 |
| Name of component      | Circuit symbol                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                            |                |                |                                                                                   |                   |                                                                                   |      |                                                                                   |      |                                                                                   |                        |                                                                                   |                                                                                                                                                                                                                                                                                         |   |
| fixed resistor         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                            |                |                |                                                                                   |                   |                                                                                   |      |                                                                                   |      |                                                                                   |                        |                                                                                   |                                                                                                                                                                                                                                                                                         |   |
| variable resistor      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                            |                |                |                                                                                   |                   |                                                                                   |      |                                                                                   |      |                                                                                   |                        |                                                                                   |                                                                                                                                                                                                                                                                                         |   |
| cell                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                            |                |                |                                                                                   |                   |                                                                                   |      |                                                                                   |      |                                                                                   |                        |                                                                                   |                                                                                                                                                                                                                                                                                         |   |
| lamp                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                            |                |                |                                                                                   |                   |                                                                                   |      |                                                                                   |      |                                                                                   |                        |                                                                                   |                                                                                                                                                                                                                                                                                         |   |
| fuse / circuit breaker |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                            |                |                |                                                                                   |                   |                                                                                   |      |                                                                                   |      |                                                                                   |                        |                                                                                   |                                                                                                                                                                                                                                                                                         |   |
| (b) (i)                | voltage = current x resistance;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | allow in standard symbols or in words e.g.<br>$V = I \times R$                             | 1              |                |                                                                                   |                   |                                                                                   |      |                                                                                   |      |                                                                                   |                        |                                                                                   |                                                                                                                                                                                                                                                                                         |   |
| (ii)                   | <p>substitution OR rearrangement; evaluation;</p> <p>e.g.<br/><math>R = V/I = 8.0/0.50</math><br/><math>R = 16 \text{ (ohms)}</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | either seen                                                                                | 2              |                |                                                                                   |                   |                                                                                   |      |                                                                                   |      |                                                                                   |                        |                                                                                   |                                                                                                                                                                                                                                                                                         |   |
| (c)                    | <p>axes labelled with resistance and {light intensity / light / intensity / brightness};</p> <p>resistance decreasing as light intensity increases;<br/>curve of decreasing gradient;<br/>e.g.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <p>ignore units and orientation<br/>allow 'dark' and 'light' labels<br/>DOP</p> <p>DOP</p> | 3              |                |                                                                                   |                   |                                                                                   |      |                                                                                   |      |                                                                                   |                        |                                                                                   |                                                                                                                                                                                                                                                                                         |   |

Total for question 4 = 10 marks

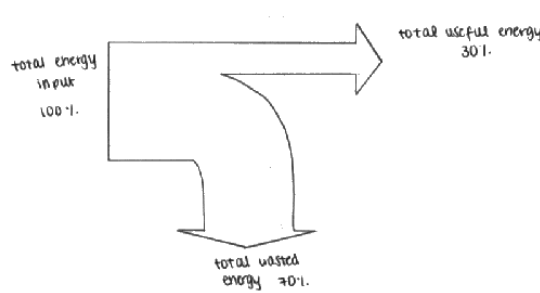
| Question number | Answer                                                                                                                                                                                                                     | Notes                                                                                                                                                                                                                        | Marks |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 5 (a)           | <p>D;</p> <p><b>The only correct answer is D</b></p> <p>A is not correct because it's the wavelength</p> <p>B is not correct because it's half the wavelength</p> <p>C is not correct because it's twice the amplitude</p> |                                                                                                                                                                                                                              | 1     |
| (b)             | <p>evidence of frequency being number of waves per unit time;<br/>evaluation;<br/>matching unit;</p> <p>e.g.<br/>(f =) 18/12<br/>(f =) 1.5<br/>Hz</p>                                                                      | <p>explicit or implied by working</p> <p>must match units used in calculation</p> <p>allow hertz, <math>s^{-1}</math>, (waves) per second</p> <p>allow any suitable unit of frequency for 1 mark if no other mark scored</p> | 3     |
| (c)             | <p>any 1 of:<br/>named part of the EM spectrum;<br/>light;<br/>(waves on a) rope / string;<br/>(waves on a) slinky <b>if appropriately described</b>;</p>                                                                  | <p>allow 'EM waves'</p> <p>allow (secondary) seismic wave</p>                                                                                                                                                                | 1     |

|     |                                                                                                                                                                                                                                                                                                                                                                     |                                     |   |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|---|
| (d) | <p>vibrations / oscillations / disturbance;<br/>         (are) parallel or perpendicular to direction<br/>         of energy transfer / wave<br/>         (travel/movement);<br/>         correct identification of <u>both</u> types;<br/>         e.g.</p>  <p>gets 3 marks</p> | allow suitably<br>labelled diagrams | 3 |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|---|

Total for question 5 = 8 marks

| Question number | Answer                                                                                                                                                                                                                                                                                        | Notes                                                                                                                                                                                                                                                                                                                                                  | Marks |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 6 (a)           | <p>MP1. any internal reflection at <b>first surface</b>;</p> <p>MP2. approximately correct angle of reflection at <b>first surface</b>;</p> <p>MP3. ray reflects from second surface and emerges parallel to incident ray (by eye);</p>                                                       | <p>ignore arrows</p>  <p>gets MP1 only</p>  <p>gets MP1 and MP2</p>  <p>gets MP1 and MP3</p> | 3     |
| (b) (i)         | $\sin(c) = 1/n$ ;                                                                                                                                                                                                                                                                             | allow in standard symbols or in words                                                                                                                                                                                                                                                                                                                  | 1     |
| (ii)            | <p>substitution;<br/>rearrangement;<br/>evaluation;</p> <p>e.g.<br/> <math>\sin(24^\circ) = 1/n</math><br/> <math>(n =) 1/\sin(24^\circ)</math><br/> <math>(n =) 2.5</math> </p>                                                                                                              | <p>can be in either order</p> <p><math>(n =) 2.459, 2.46</math><br/>condone 2.45</p>                                                                                                                                                                                                                                                                   | 3     |
| (c)             | <p>any sensible use;</p> <p>e.g.</p> <ul style="list-style-type: none"> <li>optical fibres in {communication / sending information / decorative lamps}</li> <li>endoscopes</li> <li>safety reflector</li> <li>prism in {binoculars / telescope / camera / periscope / rangefinder}</li> </ul> | <p>allow 'broadband' for communication</p> <p>allow described use of endoscope<br/>e.g. bicycle/car reflector, cat's eye</p>                                                                                                                                                                                                                           | 1     |

Total for question 6 = 8 marks

| Question number | Answer                                                                                                                                                                                                                                                             | Notes                                                                                                                                                                                   | Marks |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 7 (a)           | D – kinetic to electrical;<br><br><b>The only correct answer is D</b><br><br>A is not correct because it's the wrong energy transfer<br><br>B is not correct because it's the wrong energy transfer<br><br>C is not correct because it's the wrong energy transfer |                                                                                                                                                                                         | 1     |
| (b)             | any 2 <b>methods</b> :<br>hydroelectric;<br>photovoltaic (panels / cells);<br><br>geothermal;<br>biomass;<br>tidal;<br>waves;                                                                                                                                      | allow solar (panels / cells / farm)                                                                                                                                                     | 2     |
| (c) (i)         | any 1 of:<br>sound;<br>thermal;                                                                                                                                                                                                                                    | ignore 'noise'<br>allow 'heat'                                                                                                                                                          | 1     |
| (ii)            | Sankey diagram giving:<br>MP1. one input and more than one output;<br><br>MP2. two correct labels;<br><br>MP3. roughly correct proportions;<br><br>e.g.<br>                     | allow<br>output arrows in either direction<br>output arrows in same direction<br>2 from:<br>• input/kinetic/total<br>• useful/electrical<br>• wasted/heat/thermal/sound<br>judge by eye | 3     |

Total for question 7 = 7 marks

| Question number | Answer                                                                                                      | Notes                                                                                                     | Marks |
|-----------------|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-------|
| 8 (a)           | faster;<br>expands;<br>decreases;<br>convection;                                                            | must be in this order                                                                                     | 4     |
| (b) (i)         | gravitational (potential) energy =<br>mass x g x height;                                                    | allow in standard<br>symbols or in words<br>e.g.<br>$GPE = m \times g \times h$<br>reject 'gravity' for g | 1     |
| (ii)            | substitution;<br><br>evaluation;<br><br>e.g.<br>(GPE =) $50 \times 10 \times 80$<br>(GPE =) 40 000 (joules) | allow use of $g=9.8 / 9.81$<br><br><br><br>allow 40 kJ, 39 200,<br>39 240 (J)                             | 2     |
| (iii)           | same answer as (b)(ii);                                                                                     | allow 40 000 (J)                                                                                          | 1     |

Total for question 8 = 8 marks

| Question number | Answer                                                                                                                                                                                                                                                                 | Notes                                                                                                                                                                                                                | Marks |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 9 (a)           | <p>downward arrow labelled weight;</p> <p>upward arrow of equal length to downward arrow (by eye);</p>                                                                                                                                                                 | <p>ignore starting position of arrows</p> <p>horizontal arrows allow <u>force</u> of gravity</p> <p>ignore label on upward force</p>                                                                                 | 2     |
| (b) (i)         | pressure difference = height x density x g                                                                                                                                                                                                                             | <p>allow in standard symbols or in words e.g.</p> <p><math>p = h \times \rho \times g</math></p> <p>condone d for density</p>                                                                                        | 1     |
| (ii)            | <p>substitution;</p> <p>answer seen in pascals / conversion to kPa;</p> <p>e.g.</p> <p>(P =) <math>48 \times 1030 \times 10</math></p> <p>(P =) 490 000 (Pa)</p>                                                                                                       | <p>allow use of <math>g=9.8</math></p> <p>allow <math>\div 1000</math> seen anywhere</p> <p>1 mark max for RA</p> <p>allow 494 400, 500 000 (Pa)</p>                                                                 | 2     |
| (c) (i)         | 600 (kPa);                                                                                                                                                                                                                                                             | <p>allow 594.4, 594, 590 (kPa)</p> <p>ecf from (b)(ii)</p>                                                                                                                                                           | 1     |
| (ii)            | <p>substitution into <math>p_1V_1 = p_2V_2</math>;</p> <p>rearrangement;</p> <p>evaluation;</p> <p>e.g.</p> <p><math>100 \times 24 = 600 \times V_2</math></p> <p><math>V_2 = 100 \times 24 / 600</math></p> <p>(<math>V_2 =</math>) 4.0 (<math>\text{m}^3</math>)</p> | <p>ecf from (c)(i)</p> <p>-1 for POT error</p> <p>allow 2 marks max for use of 500 (kPa) as final pressure, giving <math>4.8 \text{ m}^3</math></p> <p>allow answers in range 4.0 - 4.1(<math>\text{m}^3</math>)</p> | 3     |

Total for question 9 = 9 marks

| Question number | Answer                                                                                                                                                                                                                                                                                                   | Notes                                                                                                                                                                                                                               | Marks |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 10 (a)          | <p>any suitable method, e.g.</p> <p>place plotting compass near magnet;</p> <p>note direction of compass;</p> <p>move compass to different position (and repeat);</p> <p>OR</p> <p>place magnet <b>under</b> paper / plastic;</p> <p>use of iron filings;</p> <p>tap paper gently (to reveal shape);</p> | <p>allow suitably clear diagrams</p> <p>reject for one mark 'charges'</p> <p>allow using multiple compasses</p> <p>allow steel dust, iron powder for iron filings</p>                                                               | 3     |
| (b)             | <p>MP1. field line connecting one pole to the other;</p> <p>MP2. at least two complete field lines, but none touching / crossing;</p> <p>MP3. field line are more concentrated near the poles;</p>                                                                                                       | <p>ignore direction of field lines throughout</p> <p>allow small gap where field line joins magnet</p> <p>ignore field lines inside the magnet</p> <p>ignore field lines that start outside the pole region</p> <p>judge by eye</p> | 3     |
| (c) (i)         | <p>C – out of the page;</p> <p><b>The only correct answer is C</b></p> <p>A is not correct because it's the wrong direction</p> <p>B is not correct because it's the wrong direction</p> <p>D is not correct because it's the wrong direction</p>                                                        |                                                                                                                                                                                                                                     | 1     |

|       |                                                                                                                 |                                                         |   |
|-------|-----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|---|
| (ii)  | (change that would reverse) direction of (magnetic) field;<br>(change that would reverse) direction of current; | e.g. swap the magnets round<br>e.g. reverse the voltage | 2 |
| (iii) | force decreases;<br>(because) magnetic field becomes non-uniform / weaker;                                      | DOP<br>allow 'field lines get further apart'            | 2 |

Total for question 10 = 11 marks

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                       | Notes                                                                                                                                                     | Marks |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 11 (a)          | <p>MP1. ammeter connected in <u>series</u> with filament lamp;</p> <p>MP2. voltmeter connected in <u>parallel</u> with filament lamp;</p> <p>MP3. suitable <b>method</b> of varying the voltage (e.g. by using variable resistor or using <b>variable</b> power supply);</p>                                                                                 | <p>marks are for how components are connected so ignore circuit symbols throughout</p> <p>allow voltmeter connected in parallel with lamp and ammeter</p> | 3     |
| (b)             | <p>any 4 of:</p> <p>MP1. read ammeter / voltmeter <b>OR</b> record current / voltage;</p> <p>MP2. current is measured for more than one voltage;</p> <p>MP3. repeat readings and calculate average (mean);</p> <p>MP4. plot graph;</p> <p>MP5. suitable experimental precaution, e.g. check meters for zero error / switch off current between readings;</p> |                                                                                                                                                           | 4     |

Total for question 11 = 7 marks

| Question number | Answer                                                                                                                                                                                                                                                                                    | Notes                                                                                                               | Marks |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-------|
| 12 (a) (i)      | smoke (particles) in air (in smoke cell)<br>OR pollen (grains) on water<br>OR dust (particles) in air;                                                                                                                                                                                    |                                                                                                                     | 1     |
| (ii)            | MP1. large (observed) particles move randomly;<br><br>MP2. (because) tiny / small particles are hitting them;<br><br>MP3. tiny / small particles are not visible (by eye);                                                                                                                | allow named large particle e.g. smoke, pollen, dust<br>allow named tiny particle e.g. air, water<br>allow invisible | 3     |
| (b)             | MP1. (particles) collide with <b>walls</b> (of container);<br>MP2. idea that force is produced (by bombarding molecules);<br><br>MP3. pressure is force on an area;                                                                                                                       | bombard, hit, impact upon<br>allow Newton's Laws / momentum argument<br>allow $p = F / A$                           | 3     |
| (c) (i)         | pressure = force / area;                                                                                                                                                                                                                                                                  | allow in standard symbols or in words e.g.<br>$p = F / A$                                                           | 1     |
| (ii)            | substitution;<br>rearrangement;<br>evaluation;<br><br>e.g.<br>$193,000 = F / 0.013$<br>(F =) $193,000 \times 0.013$<br>(F =) 2500 (N)                                                                                                                                                     | -1 for POT error<br><br>allow 2510, 2509<br><br>2.509 (N) gets 2 marks<br>2.509 kN gets 3 marks                     | 3     |
| (iii)           | area decreases;<br><br>with any 2 of:<br><ul style="list-style-type: none"> <li>particles move faster / have more KE;</li> <li>particles hit (tyre) wall more frequently / with more force / harder;</li> <li>pressure increases (and force of vehicle weight stays the same);</li> </ul> | allow molecules for particles throughout<br><br>reject if incorrect reference to volume increasing                  | 3     |

Total for question 12 = 14 marks

| Question number | Answer                                                                                                                                                                                                                                                  | Notes                                                                                                                        | Marks |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-------|
| 13 (a)          | <p>B – 143;</p> <p><b>The only correct answer is B</b></p> <p>A is not correct because it's the number of protons</p> <p>C is not correct because it's the number of nucleons</p> <p>D is not correct because it's the number of nucleons + protons</p> |                                                                                                                              | 1     |
| (b) (i)         | <p>1 mark for each correct label;;</p> <p>e.g.</p> <p>largest circle labelled as <u>parent</u> (nucleus)</p> <p>either second largest circle labelled as <u>daughter</u> (nucleus)</p>                                                                  |                                                                                                                              | 2     |
| (ii)            | <p>MP1. more neutrons released (in fission);</p> <p>MP2. neutrons can be absorbed by other (uranium) <b>nuclei</b>;</p> <p>MP3. causing further fissions / splitting;</p>                                                                               | <p>allow 2 / 3 neutrons released</p> <p>allow 'collides', 'hits', 'enters' for 'absorbed'</p> <p>allow 'process repeats'</p> | 3     |
| (c)             | <p>absorb <u>neutrons</u>;</p> <p>to vary / control {<b>rate</b> of reaction / energy output};</p>                                                                                                                                                      | <p>allow slow down / speed up reaction</p> <p>allow 'prevent overheating'</p> <p>ignore 'stop reaction'</p>                  | 2     |

|         |                                                                                                                                                                                         |                                                                                                            |   |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|---|
| (d) (i) | slow down <u>neutrons</u> ;                                                                                                                                                             | allow reduce<br>(kinetic) energy of<br><u>neutrons</u>                                                     | 1 |
| (ii)    | any 2 of:<br>graphite (ends) did not absorb neutrons;<br>more (uranium nuclei underwent) fission;<br><br>increased {rate of reaction / amount of<br>energy produced / rate of fission}; | allow more<br>'neutrons absorbed<br>by (uranium)<br>nuclei'<br>allow 'caused a<br>large chain<br>reaction' | 2 |

Total for question 13 = 11 marks