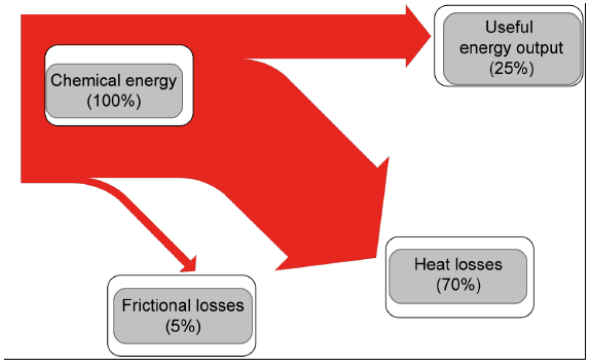
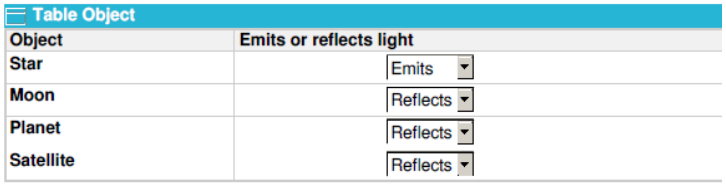
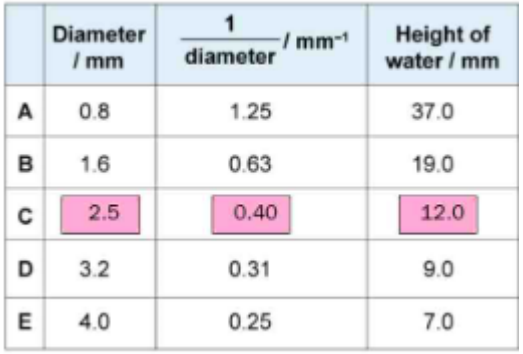
| Question | | Answers | Notes | Total | Crit |
|---|---|---|---|---|---|
| 1 | a | C | | 1 | A |
| | b | hollow fibres help to trap air<br><br>air is a poor conductor / good insulator<br>***or***<br>heat cannot be lost through convection | *WTTE* | 2 | A |
| | c | white fur ***and*** reduces (heat lost through infra-red) radiation<br><br>large <u>surface area</u> ***and*** increases (heat lost through) conduction ***or*** convection ***or*** radiation | | 2 | A |
| | d | Heat is required for evaporation or evaporation removes heat<br><br>high energy particles (in the liquid) escape the surface<br><br>leaving lower <u>energy</u> particles behind | *Accept fast moving for high energy* | 3 | A |
| 2 | a |  <br>two correct<br><br>all correct | | 2 | A |

| | | | | | |
|---|---|---|---|---|---|
| | **b** | gain in height = 1440(m)<br><br>gain in energy = mgh<br><br>(= 880 x 10 x 1440) = 12 672 000 (J) or 12.672 (MJ)<br><br>J ***or*** MJ ***or*** joule ***or*** mega joule | <br><br>*Seen or implied, ECF*<br><br>*Accept any correctly rounded value*<br><br>*Accept Nm*<br>*Do not accept j, unit must match number given* | **4** | A<br><br>D |
| | **c** | power = energy / time taken<br><br>16117 ***or*** 0.016117 ***or*** 16.117<br><br>W / $Js^{-1}$ ***or*** MW ***or*** kW | *Seen or implied*<br><br>*Accept correctly rounded values to 2 or 3 sig figs*<br><br>*Unit to be consistent with value in second marking point. Do not accept $MJs^{-1}$ or $kJs^{-1}$* | **3** | A |
| **3** | a |  <br>three correct – one mark<br><br>all four correct - two marks | | **2** | A |
| | b | orbital period of 1 day / 24 hours | *WTTE* | **1** | A |
| | c | weather forecasting ***or*** communications ***or*** television relay ***or*** navigation ***or*** GPS | *WTTE*<br>*Accept military intelligence*<br>*Do not accept reference to mobile phone use as this is given in the question* | **1** | A |
| | d | conversion of km to m<br><br>0.24<br><br>s | *Seen or implied*<br><br><br><br>*Award two marks max for 0.12s* | **3** | A |

<table>
<tr><td></td><td>e</td><td>in the past galaxies would be closer together<br><br>which is evidence for the big bang model or a description of the big bang model</td><td>WTTE</td><td>2</td><td>A</td></tr>
<tr><td>4</td><td>a</td><td>How does the current flowing through the coil affect the strength of the electromagnet / magnetic field?</td><td>WTTE</td><td>1</td><td>B</td></tr>
<tr><td></td><td>b</td><td>Table Object<br><table><tr><th>Quantity</th><th>Independent</th><th>Dependent</th><th>Control</th></tr><tr><td>Current</td><td>☒</td><td>☐</td><td>☐</td></tr><tr><td>Diameter of the iron rod</td><td>☐</td><td>☐</td><td>☒</td></tr><tr><td>Number of turns</td><td>☐</td><td>☐</td><td>☒</td></tr><tr><td>Total length taken up by the turns</td><td>☐</td><td>☐</td><td>☒</td></tr><tr><td>Total weight of paper clips supported by the electromagnet</td><td>☐</td><td>☒</td><td>☐</td></tr><tr><td>Size of the paper clips</td><td>☐</td><td>☐</td><td>☒</td></tr></table><br>Independent: only current chosen<br><br>Dependent: only total weight of paperclips chosen<br><br>Control variables:<br>two control variables correct<br><br>all control variables correct</td><td></td><td>4</td><td>B</td></tr>
<tr><td></td><td>c</td><td>If: the current increases<br><br>Then:<br>the weight of the papers clips supported will increase<br>or<br>the strength of the electromagnet will increase<br><br>Because: the electromagnetic field is stronger</td><td>Do not award the second mark and third marks unless the first is given</td><td>3</td><td>B</td></tr>
<tr><td></td><td>d</td><td>D<br><br>to measure size of the current<br><br>or<br><br>B<br><br>to weigh (the total mass of) the paper clips</td><td></td><td>2</td><td>B</td></tr>
<tr><td></td><td>e</td><td>B<br><br>greatest range</td><td></td><td>2</td><td>B</td></tr>
</table>

<table>
<tr>
<td>5</td>
<td>a</td>
<td>Table Object<br>
<table>
<tr><th>Length of coil/ cm</th><th>Number of paperclips picked up</th></tr>
<tr><td>1.0</td><td>6</td></tr>
<tr><td>2.0</td><td>3</td></tr>
<tr><td>3.0</td><td>2</td></tr>
<tr><td>4.0</td><td>1</td></tr>
<tr><td>5.0</td><td>1</td></tr>
<tr><td>6.0</td><td>1</td></tr>
</table>
<br>Raw data table<br>header and units<br><br>data recorded correctly<br><br>data recorded in ascending or descending numerical order</td>
<td>Accept weight of paperclips / g, turns cm$^{-1}$<br><br>Ignore additional information or processed</td>
<td>3</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>Table Object<br>
<table>
<tr><th>Turns per centimetre/ cm$^{-1}$</th><th>Weight of paperclips picked up/N</th></tr>
<tr><td>6.0</td><td>1.2</td></tr>
<tr><td>3.0</td><td>0.6</td></tr>
<tr><td>2.0</td><td>0.4</td></tr>
<tr><td>1.5</td><td>0.2</td></tr>
<tr><td>1.2</td><td>0.2</td></tr>
<tr><td>1.0</td><td>0.2</td></tr>
</table>
<br>Processed data table<br>Terms per centimetre (no units needed) and weight / N<br><br>correct number of turns per centimetre recorded for all data<br><br>correct total weight of paper clips recorded for all data<br><br>complete set of data and all data recorded to 1 dp</td>
<td>unit needed for weight<br><br>Do not accept spacing</td>
<td>4</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>this would lead to more accurate data<br><br>(because) small pins produce a more precise measure of weight supported</td>
<td></td>
<td>2</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>d</td>
<td>Graph has straight line<br><br>(which goes) through the origin<br><br>(indicating that) the relationship is proportional</td>
<td></td>
<td>4</td>
<td>C</td>
</tr>
</table>

| | | | | | |
|---|---|---|---|---|---|
| | | ***Any reasonable further point, for example [max 1]***<br>• (if) current is a control variable<br>• equation suggests that relationship between magnetic force and turns per centimetre is directly proportional<br>• each increase of 1 turn $cm^{-1}$ allows an additional 0.25(N) to be supported | | | |
| | **e** | ***shape:*** (the line of would be straight and so) no change<br><br>***gradient:*** would be different (as it represents a different quantity) | *Accept gradient would be constant* | **2** | C |
| **6** | **a** |  <br><br>Height = 12±0.5 ***and*** diameter = 2.5±0.5<br><br>0.4 accept value in range 0.3-0.5 | *Ignore sig fig errors*<br><br>*ECF* | **2** | C |
| | **b** | point plotted<br><br>line of best fit added<br><br>*x*- axis: inverse / 1 / diameter ***and*** *y*-axis: height (of liquid)<br><br>***Units:*** $mm^{-1}$ ***and*** mm | *ECF from part a*<br><br>*Approximately equal distribution of points above and below the line*<br><br>*Do not award a mark for diameter alone* | **4** | C |
| | **c** | two points from line of best fit $\Delta y \geq 20$<br><br>evidence of gradient calculation<br><br>final value = 30±5 | *Ignore any unit if present* | **3** | C |

<table>
<tr><td></td><td>d</td><td>height is inversely proportional to diameter<br><br>(so) for a tree of this height, the diameter of the capillary tubes (inside the tree) would have be extremely small (for capillary action alone)</td><td></td><td>2</td><td>A</td></tr>
<tr><td>7</td><td></td><td>
<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Research question (RQ)</td><td>simple research question</td><td></td><td></td><td></td></tr>
<tr><td>Variables (V)</td><td>some variables implied</td><td>IV or DV and one CV identified</td><td>IV and DV and one CV identified</td><td></td></tr>
<tr><td>Equipment (E)</td><td>equipment suggested but not relevant</td><td>equipment to measure IV or DV</td><td>equipment to measure IV and DV</td><td></td></tr>
<tr><td>Method (M)</td><td>attempt at method, insufficient detail and not likely to give relevant data</td><td>method described, could be followed, will produce relevant data</td><td></td><td></td></tr>
<tr><td>Data (D)</td><td>refer to different increments or trials</td><td>at least five increments or three trials</td><td>at least five increments and three trials</td><td>at least five increments, three trials and plans to calculate mean</td></tr>
</table>
</td><td></td><td>13</td><td>B</td></tr>
<tr><td>8</td><td>a</td><td>iron</td><td></td><td>1</td><td>A</td></tr>
<tr><td></td><td>b</td><td>Key:<br> 

<br><br>one correct<br><br>all three correct</td><td></td><td>2</td><td>D</td></tr>
<tr><td></td><td>c</td><td>Accept any two reasonable points, for example [max 2]<br>• less noise<br>• less energy wasted<br>• less wear and tear / maintenance for train or track</td><td></td><td>2</td><td>D</td></tr>
</table>

<table>
<tr><td></td><td></td><td>

- speed can be higher than conventional trains
- less affected by weather

</td><td></td><td></td><td></td></tr>
<tr><td></td><td>d</td><td>increase in number of passengers will increase weight or there will be an increased load<br><br>this will decrease the distance between the magnets<br><br>(hence) the size of the repelling force will increase</td><td></td><td>3</td><td>D</td></tr>
<tr><td>9</td><td></td><td>
<table>
<tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>Economic advantages and disadvantages compared to driving</td><td>an economic advantage or disadvantage is implied</td><td>an economic advantage or disadvantage is compared to driving</td><td>an economic advantage and disadvantage are compared to driving</td><td>an economic advantage and disadvantage and an additional advantage or disadvantage are compared to driving</td></tr>
<tr><td>Environmental advantages and disadvantages</td><td>an environmental advantage or disadvantage is implied</td><td>an environmental advantage or disadvantage is compared to driving</td><td>an environmental advantage and disadvantage are compared to driving</td><td>an environmental advantage and disadvantage and an additional advantage or disadvantage are compared to driving</td></tr>
<tr><td>Comfort</td><td>a comfort advantage or disadvantage is implied</td><td>a comfort advantage or disadvantage is compared to driving</td><td>a comfort advantage and disadvantage are compared to driving</td><td></td></tr>
<tr><td>Safety</td><td>a simple statement about safety</td><td>a comparative statement about safety using data from the table</td><td></td><td></td></tr>
<tr><td>Concluding appraisal</td><td>a concluding statement</td><td>a concluding appraisal</td><td></td><td></td></tr>
</table>
</td><td>15</td><td>D</td></tr>
</table>