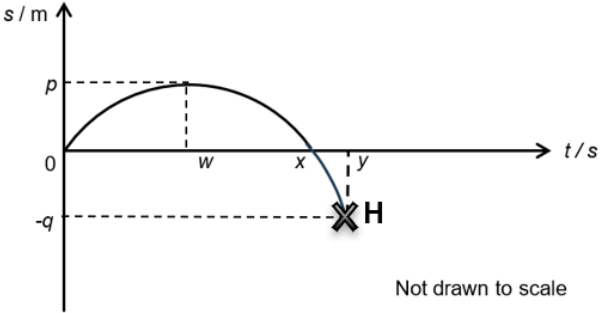
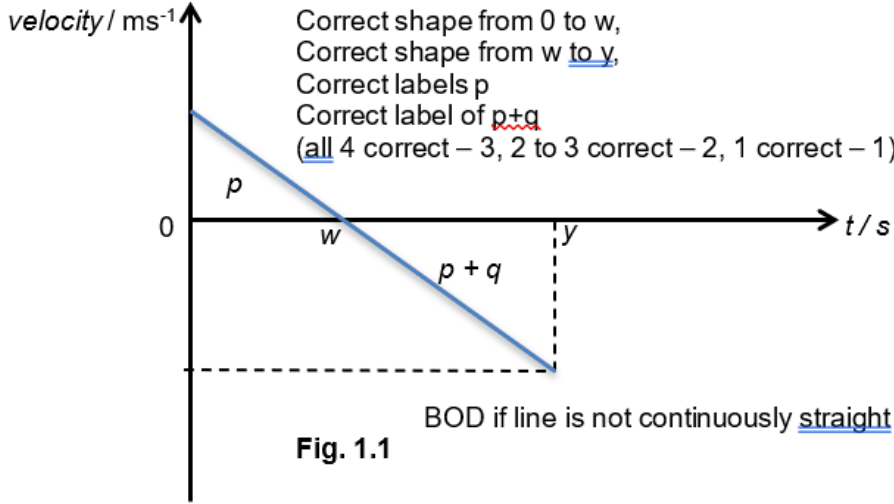
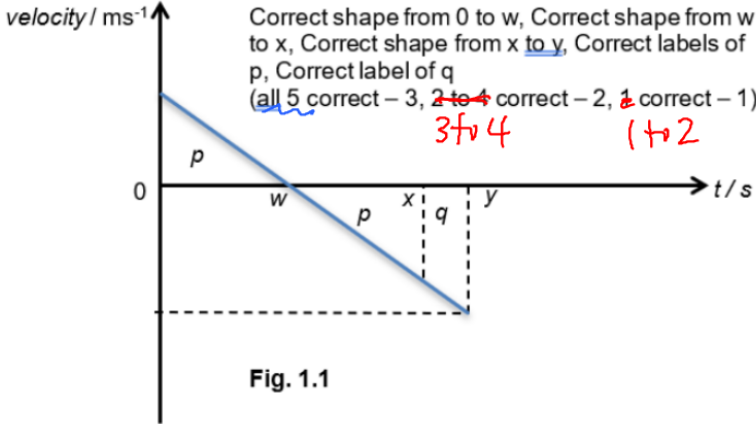


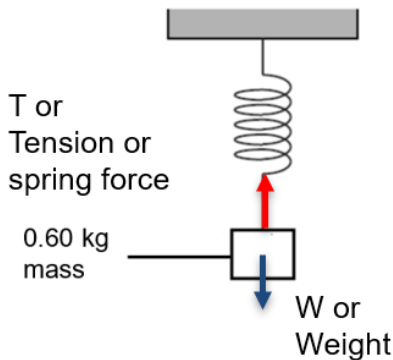
# 2023 S4 Physics Prelim Exam Paper 2 mark scheme & markers' comments

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |
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| 1(a) | <p>w to x: displacement <u>decreases at an increasing rate / decreases non-uniformly</u> in the <u>negative / downwards</u> direction.</p> <p>x to y: displacement <u>increases at an increasing rate / increases non-uniformly</u> in the <u>negative / downwards</u> direction.</p> <p>All 4 points - 2 marks, 2-3 points - 1 mark, otherwise - 0</p>                                                                                                                                                                                                                                                                                                      |   |
| (b)  |  <p>H must be marked on graph<br/>(BOD if marked at -q)</p> <p>Fig. 1.1</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1 |
| (c)  |  <p>Correct shape from 0 to w,<br/>Correct shape from w to y,<br/>Correct labels p<br/>Correct label of p+q<br/>(all 4 correct - 3, 2 to 3 correct - 2, 1 correct - 1)</p> <p>BOD if line is not continuously <u>straight</u></p> <p>Fig. 1.1</p><br> <p>Correct shape from 0 to w, Correct shape from w to x, Correct shape from x to y, Correct labels of p, Correct label of q<br/>(all 5 correct - 3, 2 to 4 correct - 2, 1 correct - 1)</p> <p>3 to 4 1 to 2</p> <p>Fig. 1.1</p> | 3 |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
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| Marker's comments | <p>a) Students need to know displacement is positive or negative based on position, but velocity is positive or negative based on direction.</p> <p>When the question asks for direction of motion of object, it is moving downwards or towards the negative direction. Many candidates did not answer the question - addressing the change in displacement and the rate but they wrote about velocity and acceleration.</p> <p>They need to know that we can't tell the rate of change of velocity from the graph given.</p> <p>b) Height is a distance. In order to know the height, marking out displacement at zero will not help even though that corresponds to the top of his head.</p> <p>c) Many candidate did not label the area under the graph and some label wrongly. This area must be formed with the time axis. NOTE that if you are using the second answer, all 5 correct, 2 marks,</p> |  |
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|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                     |        |
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| 2(a)              | 80 J<br>(minus 1 mark for wrong or no unit)                                                                                                                                                                                                                                                                                                                                                                                         | 1      |
| (bi)              | Weight                                                                                                                                                                                                                                                                                                                                                                                                                              | 1      |
| (bii)             | Any diagonal straight line with a less steep gradient.                                                                                                                                                                                                                                                                                                                                                                              | 1      |
|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                     |        |
| (c)               | $E_K \text{ gained} = E_P \text{ lost}$ or $\frac{1}{2} m v^2 = m g h$ or $v = \sqrt{2gh}$ or $v = 2 \times 10 \times 3.25$<br>$v = 8.06 \text{ m/s}$ (3 s.f.) or $8.1 \text{ m/s}$ (2 s.f.)<br><br>minus 1 mark for no or wrong unit                                                                                                                                                                                               | 1<br>1 |
| Marker's comments | <p>a) Common mistake is reading values off wrongly due to incorrect scale. Many were not aware that there are only 4 small divisions between 1.0 m.</p> <p>bi) Many students chose mass as their answer, which is incorrect. Some students are still unsure of the difference between mass and weight. 'Force' was accepted even though the gradient gives a specific quantity (from <math>mgh/h = mg</math>), which is weight.</p> |        |

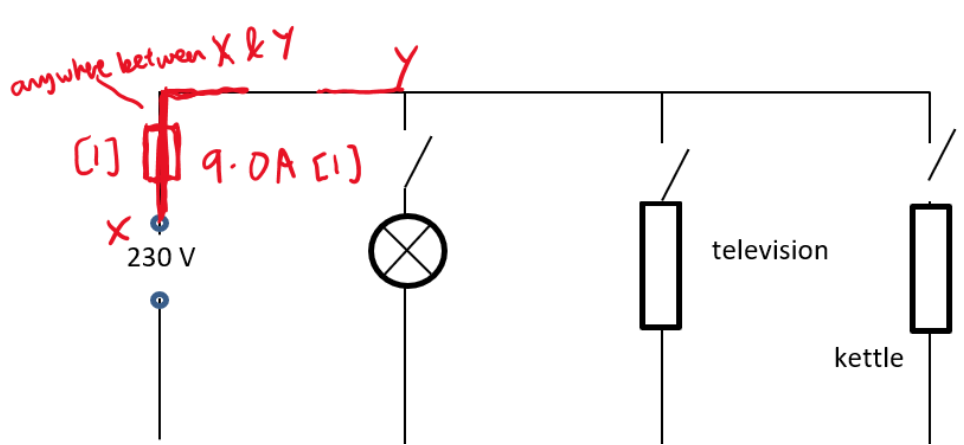
|  |                                                                                                                                                                                                                                                     |  |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <p>ii) Very well done.</p> <p>c) Common mistake is to equate <math>\frac{1}{2} v^2 = 80</math>, where 80 is the value of <math>E_p</math>. Some used the gradient, which they thought was mass, in their calculations. Method mark was awarded.</p> |  |
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|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 3(a)              | It is the <u>point through which its whole weight appears to act</u> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1           |
| 3(b)              |  <p>T drawn on spring or starting from spring and labelled [1]</p> <p>W drawn from c.g. (eye test) and labelled [1]</p> <p>Add one more mark for definition of c.g.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2           |
| (c)               | <p>Upwards force / Tension / Spring force increases.</p> <p>Since the mass is in equilibrium (or Net force is zero) with an additional downwards force applied, the upwards force/tension must have increased.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1<br>1      |
| (d)               | <p><u>Upwards tension is more than downwards weight.</u></p> <p><u>Or As there is a net upwards force,</u></p> <p>from <u><math>F = ma</math></u></p> <p>mass will <u>accelerate upwards</u>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1<br>1<br>1 |
| Marker's comments | <p>a) Many cited 'on the object' and were penalised, as the c.g. may not be on the object. Many students clearly has not put in the effort to memorise their definitions, which is such a waste.</p> <p>b) Tension quite often incorrectly identified as normal reaction force. Marks were not awarded if the force drawn does not touch the top surface of the mass and does not pass along the vertical straight portion of spring. Weight must be drawn from the centre of gravity of the mass, vertically downwards.</p> <p>c) Many students were able to correctly conclude that the tension will increase. However, many cited Newton's Third Law as the cause, which indicates poor understanding of the laws of motion. An action and reaction pair of forces act on different bodies. In this situation, we are focusing on the forces acting on the mass only. Instead, students are to conclude that for an object to be in equilibrium, the resultant force on it must be zero. So the total upward force on mass = total downward force on mass.</p> <p>d) This question requires the use of Newton's 2nd Law to explain the immediate effect the change had on the mass. Saying that the mass 'moves at high speed', 'springs up', 'bounces up quickly', does not imply that the object is accelerating. Students need to choose their words and phrases carefully. Many students also went on to explain what will subsequently happen, which is not required.</p> |             |

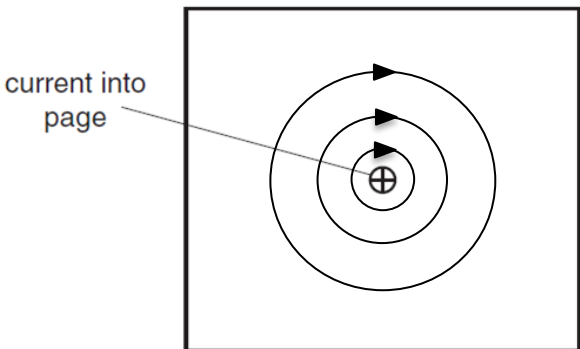


|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |        |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
|                   | angle of incidence drawn between incident ray and normal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1      |
|                   | 2 rays each joining rays R and S respectively, converge at image, obeying laws of reflection<br>Correct image position and labelled with letter <i>I</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 2      |
| marker's comments | (i) was generally well done with a small number of students drawing the normal perpendicular to the ground instead.<br><br>(ii) large number of students were unable to do this question correctly as they failed to recognise that the image formed is behind the mirror.<br>this led to them force fitting the reflected light rays to converge in front of the mirror, ignoring the laws of reflection.<br><br>1m for image behind mirror<br>1 m for both light rays obeying the laws of reflection<br>(subtract 1 mark for failure to draw arrows or not using dotted lines for the construction lines) |        |
| (b)(i)            | <div data-bbox="342 856 482 984" data-label="Image"> </div> <p>Note: the image is inverted</p> <div data-bbox="371 1014 1287 1281" data-label="Image"> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1      |
| (ii)              | Larger / bigger in size / magnified<br>Further from the lens / image distance is larger                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1<br>1 |
| Marker's comments | (i) this question was quite poorly done as students failed to visualise the orientation of the object and hence the image (as shown in the picture)<br><br>(ii) a significant number of students did not address the idea of the difference in the image.                                                                                                                                                                                                                                                                                                                                                   |        |
| 6a(i)             | The helicopter gains electrons from the air / electrons are transferred from the air to the helicopter.<br>The helicopter has excess electrons / has more negative charges than positive charges.                                                                                                                                                                                                                                                                                                                                                                                                           | 1<br>1 |
| (ii)              | The <u>excess electrons</u> will flow to the ground / out of the helicopter.<br>The helicopter will be earthed / neutral / no longer live / the helicopter now has zero potential / is no longer at live potential / there is no potential difference between the helicopter and soldier B / ground.                                                                                                                                                                                                                                                                                                        | 1<br>1 |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |        |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| (b)               | $Q = It$ or $32\,000 \times 15 \times 10^{-3}$<br>$= 480\text{ C}$                                                                                                                                                                                                                                                                                                                                                                                                                            | 1<br>1 |
| Marker's comments | <p>(i) Some students wasted time explaining why electrons are transferred to the helicopter by friction which is not what the question is asking. A few students confused charging by friction with charging by induction. Students should note that the object to be charged (in this case the helicopter) is initially neutral.</p> <p>(ii) The term 'neutrally charged' is incorrect because being neutral means not charged. It's like saying someone is deadly alive or lively dead.</p> |        |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |        |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| 7(a)              | Current is the <u>rate of flow of (electric) charge</u> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1      |
| (b)               | <p>Switches and fuses should be connected to the live wire. We can deduce where the live wire is by looking at where the switches are. Since the switches are connected to the top wire, we can deduce that the top wire is the live wire. Since the fuse is to control the total current, it should be connected between X and Y shown in the diagram below.</p>  <p>A fuse rating of 10 A is also accepted.<br/>Fuse ratings that are not whole numbers e.g. 8.8 A are not accepted.</p> | 2      |
| (c)               | <p>Current through the kettle = <math>8.70 - 1.70 = 7.00\text{ A}</math><br/>Resistance of the kettle, <math>R = V / I</math> or <math>230 / 7.00</math><br/><math>= 32.9\ \Omega</math> or <math>33\ \Omega</math></p>                                                                                                                                                                                                                                                                                                                                                       | 1<br>1 |
| (d)               | <p>Total power <math>P = VI = 230 \times 8.70 = 2001\text{ W} = 2.00\text{ kW}</math><br/>Total <math>E = Pt</math> or <math>2.00 \times 3 = 6.00\text{ kW h}</math><br/>Cost = <math>6.00 \times 28 = 168\text{ cents}</math> or <math>\\$1.68</math></p>                                                                                                                                                                                                                                                                                                                    | 1<br>1 |
| Marker's comments | <p>(a) <u>Rate of flow of charge per unit time</u> is not acceptable because it means charge / time x time (double rate).</p> <p><u>Rate of flow of charges</u> is strictly incorrect because it means number of charges / time e.g. <math>1000\text{ electrons} / 10\text{ s} = 100\text{ s}^{-1}</math> which is not current.</p>                                                                                                                                                                                                                                           |        |

|  |                                                                                                                                                                                                                                |  |
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|  | (b) Some students did not realise that fuse ratings are whole numbers. A few students forgot the symbol of a fuse. Fortunately, the question is asking for the location of the fuse rather than the actual symbol of the fuse. |  |
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| 8(a)              |  <p>At least three circles centred on wire (no crossings), distance gets further.<br/>Arrow showing clockwise direction on at least one circle</p> | 1<br>1 |
| (b)(i)            | X = <u>north</u> / N pole; Y = <u>south</u> / S pole                                                                                                                                                                                | 1      |
| (ii)              | Steel is a hard magnetic material / hard to magnetise and/or demagnetise<br>The bell will not ring continuously / takes longer to start ringing / ring once / ring with a lower frequency.<br>(do not accept: will not ring at all) | 1<br>1 |
| Marker's comments | The question is asking about why the bell will not work <u>well</u> , not whether the bell will work at all. So answers that say the steel bar will not be attracted at all is not acceptable.                                      |        |

## Section B

|         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 9(a)(i) | It is the <u>amount of thermal energy required to change a unit mass of substance from liquid to gaseous state without a change in temperature.</u><br><br>All 4 correct – 2 marks, 2 to 3 correct – 1 mark, 0 otherwise                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2 |
| (a)(ii) | This is because in vaporisation, extra energy is needed to enable the vapour to expand against the atmospheric pressure.<br>OR<br>Latent heat of vaporisation is used to move the molecules far apart to change it from liquid to gaseous state whereas latent heat of fusion is used to move the molecules slightly apart to change it from solid to liquid state.<br>OR<br>Latent heat of vaporisation is used to (almost) completely overcome the forces of attraction between particles whereas latent heat of fusion is used only to partially overcome the forces of attraction between particles.<br>OR<br>Latent heat of vaporisation is used to (almost) completely break the bonds between particles whereas latent heat of fusion is used only to partially break the bonds between particles. | 1 |
| (b)(i)  | Heat required                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                   |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|                   | <p>= heat gained by milk + heat gained by glass<br/>         = <math>m_m c_m \Delta \theta_m + m_g c_g \Delta \theta_g</math> or <math>0.200 \times 4000 \times (50.0 - 15.0) + 0.100 \times 840 \times (50.0 - 15.0)</math><br/>         = 30940<br/>         = 30.9 kJ (3 s.f.) (shown)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p>1</p> <p>1</p> |
| (b)(ii)           | <p>Heat required = heat supplied by steam in cooling and condensing<br/>         + heat supplied by water in cooling<br/> <math>30940 = m_w c_w \Delta \theta_w + m_w /_w + m_w c_w \Delta \theta_w</math> OR<br/> <math>30940 = (m)(2010)(130.0 - 100.0) + (m)(2.26 \times 10^6) + (m)(4200)(100.0 - 50.0)</math><br/> <br/> <math>m = 30940 / (60300 + 2260000 + 210000)</math><br/>         = 0.012 kg (2 s.f.) or 0.0122 (kg) (3 s.f.)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <p>1</p> <p>1</p> |
| (c)               | <p>Radiation and Conduction</p> <p>Any two of the bulleted reasons:</p> <ul style="list-style-type: none"> <li>• Milk is a poor absorber of radiant heat / infrared radiation.<br/>OR Milk is a good reflector of radiant heat / infrared radiation.</li> <li>• Air is a poor conductor of heat.</li> <li>• Most of the energy given out by the lamp is used to heat/is lost to the surrounding air.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <p>1</p> <p>2</p> |
| Marker's comments | <p>9ai) A number of students left out key phrases/words (e.g. thermal, unit mass, without a change in temperature) from this definition. Some students confused this definition with the definition of specific heat capacity.</p> <p>aii) This part is poorly done. Most students' explanation did not include the difference in the forces of attraction between particles for boiling and melting. Their answers merely stated that more energy is required to change the substance from liquid to gaseous than from solid to liquid.</p> <p>bi) This part is well done. Most students are able to show with clear workings how to calculate thermal energy of 30.9 kJ.</p> <p>bii) In forming the mathematical equation, many students left out some components of the heat supplied to the steam or water. A number of them assumed that water and steam have the same specific heat capacity.</p> <p>c) Although the students' answers mentioned that convection cannot occur, they still stated convection as one of the possible modes of heat transfer. A number of them explained that there was heat lost to "surroundings" instead of "surrounding air."</p> |                   |

| 10(a)                                  | The number of complete oscillations/waves per second.                                                                                                                                                                                                                                                                                                             | 1 |                                                       |             |            |              |                                                              |                                                       |                                        |                          |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-------------------------------------------------------|-------------|------------|--------------|--------------------------------------------------------------|-------------------------------------------------------|----------------------------------------|--------------------------|
| (b)                                    | Any one difference below or any logical answer:                                                                                                                                                                                                                                                                                                                   | 1 |                                                       |             |            |              |                                                              |                                                       |                                        |                          |
|                                        | <table><tr><th>Radio waves</th><th>Sound waves</th></tr><tr><td>transverse</td><td>longitudinal</td></tr><tr><td>does not need medium to travel / can travel through vacuum /</td><td>needs medium to travel / cannot travel through vacuum</td></tr><tr><td>travel at <math>3.0 \times 10^8</math> m/s in air</td><td>travel at 330 m/s in air</td></tr></table> |   | Radio waves                                           | Sound waves | transverse | longitudinal | does not need medium to travel / can travel through vacuum / | needs medium to travel / cannot travel through vacuum | travel at $3.0 \times 10^8$ m/s in air | travel at 330 m/s in air |
|                                        | Radio waves                                                                                                                                                                                                                                                                                                                                                       |   | Sound waves                                           |             |            |              |                                                              |                                                       |                                        |                          |
|                                        | transverse                                                                                                                                                                                                                                                                                                                                                        |   | longitudinal                                          |             |            |              |                                                              |                                                       |                                        |                          |
|                                        | does not need medium to travel / can travel through vacuum /                                                                                                                                                                                                                                                                                                      |   | needs medium to travel / cannot travel through vacuum |             |            |              |                                                              |                                                       |                                        |                          |
| travel at $3.0 \times 10^8$ m/s in air | travel at 330 m/s in air                                                                                                                                                                                                                                                                                                                                          |   |                                                       |             |            |              |                                                              |                                                       |                                        |                          |
|                                        |                                                                                                                                                                                                                                                                                                                                                                   |   |                                                       |             |            |              |                                                              |                                                       |                                        |                          |
|                                        |                                                                                                                                                                                                                                                                                                                                                                   |   |                                                       |             |            |              |                                                              |                                                       |                                        |                          |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |              |                        |                     |                      |               |  |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------|------------------------|---------------------|----------------------|---------------|--|
|                        | <table><tr><td>cannot be heard</td><td>can be heard</td></tr><tr><td>cannot travel in solid</td><td>can travel in solid</td></tr><tr><td>electromagnetic wave</td><td>mechanic wave</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | cannot be heard | can be heard | cannot travel in solid | can travel in solid | electromagnetic wave | mechanic wave |  |
| cannot be heard        | can be heard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |              |                        |                     |                      |               |  |
| cannot travel in solid | can travel in solid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |              |                        |                     |                      |               |  |
| electromagnetic wave   | mechanic wave                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                 |              |                        |                     |                      |               |  |
| (c)(i)                 | $3.0 \times 10^8 \text{ m s}^{-1}$ or $3 \times 10^8 \text{ m s}^{-1}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1               |              |                        |                     |                      |               |  |
| (ii)                   | $\lambda_{\text{max}} = v / f_{\text{min}}$ OR $(3 \times 10^8) / (890 \times 10^6)$<br>$= 0.337 \text{ m}$ [1]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1<br>1          |              |                        |                     |                      |               |  |
| (d)                    | Since each signal is separated by 25 kHz,<br>the bandwidth of each phone is $20 + 25 = 45 \text{ kHz}$ .<br><br>No. of hand phones = $(915 - 890) \times 10^6 / (45 \times 1000) = 555$ or 556<br><br>OR<br><br>$= (960 - 935) \times 10^6 / (45 \times 1000) = 555$ or 556                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1               |              |                        |                     |                      |               |  |
| (e)                    | $t_{\text{max}} = E / P_{\text{min}} = 75\,000 / 1.5 = 50\,000 \text{ s}$ or 13.8 h or 14 h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1               |              |                        |                     |                      |               |  |
| (f)(i)                 | 3 wavelength = 2.5 m<br>wavelength = $2.5 / 3 = 0.83 \text{ m}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1               |              |                        |                     |                      |               |  |
| (ii)                   | 1. The speed of the sound wave increases as it enters from air to water.<br>2. The frequency remains constant<br>3. Since $v = f\lambda$ , $\lambda$ increases<br><br>(all 3 points mentioned – 2 m, 1 to 2 points mentioned – 1 m, otherwise zero)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 2               |              |                        |                     |                      |               |  |
| Marker's comments      | 10(a) Some students stated 'wavelength' or 'period' instead of 'oscillation'.<br>Some also stated 'per unit time' which is not acceptable as it may be referred to as per minute or per hour.<br><br>(b) Generally well done. However, some students stated that radio waves have higher frequency than sound waves or radio waves cannot be heard but sound waves can be heard. These are generally not true as EM waves all have different frequencies and ultrasound cannot be heard too.<br><br>(ci) Some students have forgotten the value and do guessing.<br><br>(cii) Generally well done. Even though some students substitute using the wrong maximum frequency.<br><br>(d) Very badly done. Students are not able to figure out the bandwidth and the range of frequency.<br><br>(e) Generally well done.<br><br>(fi) Some students divide the length by the wrong number of wavelengths.<br><br>(fii) Quite well done. however, some students did not state the wave equation to explain why the wavelength changes. |                 |              |                        |                     |                      |               |  |
| 11E(ai)                | It is the <u>product of the force</u> and the <u>perpendicular distance from the line-of-action of force to the pivot</u> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1               |              |                        |                     |                      |               |  |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| (a)(ii)           | <p>Moment = <math>F \times d</math> (no marks as it was defined in part (i))</p> <p>= <math>0.20 \times 3.1</math></p> <p>= 0.62 N cm</p> <p>Accept range from 0.60 to 0.64</p> <p>Minus 1 mark for wrong or no unit</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1<br>1              |
| (b)(i)            | <ol style="list-style-type: none"> <li>1. Let metal <u>swing/suspend freely</u> from A as the pivot and</li> <li>2. <u>let it come to rest/stop swinging.</u></li> <li>3. With <u>a plumb line</u> hanging from A, <u>mark out two crosses on metal sheet to draw a straight line/or trace plumb line on metal sheet.</u></li> <li>4. <u>Repeat process using C.</u></li> <li>5. <u>Intersection of two lines is the centre of gravity.</u></li> </ol> <p>Syllabus page 27.</p> <p>All 5 points – 3 marks, 3-4 points – 2 marks, 1-2 points – 1 mark, 0 otherwise</p>                                                                                                                                                                                                                                                                                                                                                   | 3                   |
| (c)(i)            | <p>Wood in Fig 11.4</p> <p>The line of action of weight passes through the pivot/perpendicular distance from line of action of weight to pivot is zero (allow ecf for not mentioning line of action if mistake is made in part a)</p> <p>there is no moments created by the weight/moment of weight is zero.</p> <p>(do not accept moments are balanced as there is only one force)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1<br><br>1<br><br>1 |
| (c)(ii)           | <p>It is <u>as stable as Fig 11.3.</u></p> <p>There is <u>no change to the vertical height of the c.g. and the perpendicular distance from the line-of-action of the weight</u> to the base when the blocks of wood are tilted anti-clockwise as shown.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1                   |
| Marker's comments | <p>ai) Surprisingly not as well done as expected. Students must memorise definitions.</p> <p>aii) Some students do not understand the meaning of “perpendicular distance from line-of-action of force to the pivot”. Hence they measure direct distance between c.g. and pivot.</p> <p>b) Some students left it blank. If they have time, they should always try to write something. The word “freely” is missing from many answers. It is critical for this experiment to work as intended.</p> <p>ci) Many candidates wasted time and space writing on Fig. 11.2 and 11.3. And thus may miss out on important concepts / keywords to explain Fig. 11.4.</p> <p>cii) The two factors affecting stability are “height of c.g.” and “base area”. The weight of the object does not play a part here. In fact, sometimes when weight is increased, it can raise the height of the c.g. from the base. See N2016/P1/Q8</p> |                     |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| 11O(a)            | Power = $I^2R$ or $150^2 \times 0.30 \times 2$ (since there are 2 cables)<br>= 13500 W or 14000 W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1<br>1 |
| (b)(i)            | Cables have <u>higher resistance</u> because they need to be longer to reach homes that are further from the power station<br>and hence <u>more power wasted</u> ( $P = I^2R$ )<br><b>Do not accept</b> <u>more current</u> is transmitted in the cables because the 2 cables are connected directly to each house from the power station.<br>There is no main cable which then splits into multiple cables that are connected in parallel.                                                                                                                                                                                                                                                                                                                                                                                                                | 1<br>1 |
| (ii)              | - Since $P = VI$<br>- Higher voltage means lower current<br>- Hence less power wasted<br>(all 3 points mentioned – 2 m, either 2 points mentioned – 1 m, otherwise zero)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |        |
| (iii)             | thicker cables are needed<br>more costly                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1<br>1 |
| (c)               | There needs to be a <u>changing magnetic field / flux in the secondary coil</u><br>In order to <u>induce a current in the secondary coil</u> (by electromagnetic induction)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1<br>1 |
| Marker's comments | a) Most students missed out the fact that there are two cables.<br>We cannot use " $P = VI$ " because the V here is not the potential difference between two points on the cable (hence not 230V, but you can find using $V = IR$ ).<br><br>bi) Note the context of the question here specifically as explained in the "Do not accept" comment.<br><br>bii) Reasonably well done, although some students analysed wrongly by using $V = IR$ .<br><br>biii) As they can choose to use thicker cables, giving the answer that they have to use rare materials or expensive materials to reduce resistivity is not accepted as the sole answer.<br><br>c) Many candidates missed out the "where" after "changing magnetic flux"<br><br>For the transformer to function fully, there must be an induced current in the secondary coil. See textbook, page 436. |        |