



Mark Scheme (Results)

Summer 2023

Pearson Edexcel GCE
In Physics (8PH0)
Paper 01: Core Physics I

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General Marking Guidance

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

Mark scheme notes

Underlying principle

The mark scheme will clearly indicate the concept that is being rewarded, backed up by examples. It is not a set of model answers.

1. Mark scheme format

- 1.1 You will not see 'wtte' (words to that effect). Alternative correct wording should be credited in every answer unless the MS has specified specific words that must be present. Such words will be indicated by underlining e.g. 'resonance'
- 1.2 Bold lower case will be used for emphasis e.g. '**and**' when two pieces of information are needed for 1 mark.
- 1.3 Round brackets () indicate words that are not essential e.g. "(hence) distance is increased".
- 1.4 Square brackets [] indicate advice to examiners or examples e.g. [Do not accept gravity] [ecf].

2. Unit error penalties

- 2.1 A separate mark is not usually given for a unit but a missing or incorrect unit will normally mean that the final calculation mark will not be awarded.
- 2.2 This does not apply in 'show that' questions or in any other question where the units to be used have been given, for example in a spreadsheet.
- 2.3 The mark will not be awarded for the same missing or incorrect unit only once within one clip in open.
- 2.4 Occasionally, it may be decided not to insist on a unit e.g. the candidate may be calculating the gradient of a graph, resulting in a unit that is not one that should be known and is complex.
- 2.5 The mark scheme will indicate if no unit error is to be applied by means of [no ue].

3. Significant figures

- 3.1 Use of too many significant figures in the theory questions will not prevent a mark being awarded if the answer given rounds to the answer in the MS.
- 3.2 Too few significant figures will mean that the final mark cannot be awarded in 'show that' questions where one more significant figure than the value in the question is needed for the candidate to demonstrate the validity of the given answer.
- 3.3 The use of one significant figure might be inappropriate in the context of the question e.g. reading a value off a graph. If this is the case, there will be a clear indication in the MS.
- 3.4 The use of $g = 10 \text{ m s}^{-2}$ or 10 N kg^{-1} instead of 9.81 m s^{-2} or 9.81 N kg^{-1} will mean that one mark will not be awarded. (but not more than once per clip). Accept 9.8 m s^{-2} or 9.8 N kg^{-1}
- 3.5 In questions assessing practical skills, a specific number of significant figures will be required e.g. determining a constant from the gradient of

a graph or in uncertainty calculations. The MS will clearly identify the number of significant figures required.

4. Calculations

- 4.1 Bald (i.e. no working shown) correct answers score full marks unless in a 'show that' question.
- 4.2 If a 'show that' question is worth 2 marks, then both marks will be available for a reverse working; if it is worth 3 marks then only 2 will be available.
- 4.3 **use** of the formula means that the candidate demonstrates substitution of physically correct values, although there may be conversion errors e.g. power of 10 error.
- 4.4 **recall** of the correct formula will be awarded when the formula is seen or implied by substitution.
- 4.5 The mark scheme will show a correctly worked answer for illustration only.

SECTION A

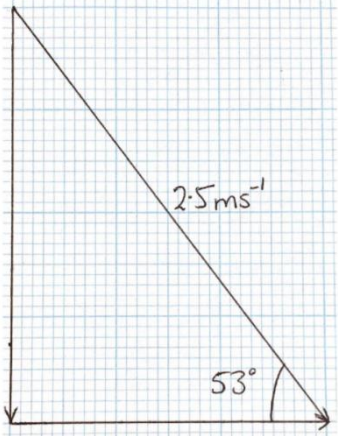
| Question Number | Answer | Mark |
|-----------------|--|------|
| 1 | <p>C Incorrect Answers: A – this answer is incorrect, there is no force upwards on the ball B – this answer is incorrect, there is no force upwards on the ball D – this answer is incorrect, there is also a downward air resistance force as the ball is moving upwards</p> | 1 |
| 2 | <p>C – power, time, work done Incorrect Answers: A – displacement is a vector B – momentum is a vector D – acceleration is a vector</p> | 1 |
| 3 | <p>B Incorrect Answers: A – this answer is incorrect C – this answer is incorrect D – this answer is incorrect</p> | 1 |
| 4 | <p>D Incorrect Answers: A – doubling the length doubles the resistance, the cross sectional area also halves which doubles the resistance as well B – doubling the length doubles the resistance, the cross sectional area also halves which doubles the resistance as well C – doubling the length doubles the resistance, the cross sectional area also halves which doubles the resistance as well</p> | 1 |
| 5 | <p>B Incorrect Answers: A – normal force and friction are different types of forces and not in opposite directions C – weight and normal force on the road, are in the same direction and are different types of force. D – weight and normal force on the car are different types of force and are both on the same object.</p> | 1 |
| 6 | <p>D $\frac{mgh}{VIt}$ Incorrect Answers: A – this answer is incorrect B – this answer is incorrect C – this answer is incorrect</p> | 1 |

| | | |
|---|---|---|
| 7 | <p>The correct answer is D</p> <p>Incorrect Answers:</p> <p>A – emf is a constant</p> <p>B – emf is a constant</p> <p>C – as resistance increases, the terminal p.d. increases</p> | 1 |
| 8 | <p>A $\frac{6^2}{2 \times 9.81}$</p> <p>Incorrect Answers:</p> <p>B – this answer is incorrect</p> <p>C – this answer is incorrect</p> <p>D – this answer is incorrect</p> | 1 |

(Total for Multiple Choice Questions = 8 marks)

| Question Number | Acceptable answers | Additional guidance | Mark |
|-----------------|---|---|------|
| 9 | <ul style="list-style-type: none"> <li data-bbox="360 284 1189 316">• When variable resistor is 0 Ω voltmeter reading = 6.0 V (1) <li data-bbox="360 355 1189 419">• Use of principle of potential divider Or use of $V = IR$ (1) <li data-bbox="360 459 1189 491">• When variable resistor is 40 Ω voltmeter reading = 1.2 V (1) | <p data-bbox="1220 284 1496 308"><u>Example of calculation</u></p> <p data-bbox="1220 316 1608 347">$V = (10 \Omega / 50 \Omega) \times 6 \text{ V} = 1.2 \text{ V}$</p> | 3 |

(Total for Question 9 = 3 marks)

| Question Number | Acceptable answers | Additional guidance | Mark |
|-----------------|---|---|------|
| 10(a) | <ul style="list-style-type: none"> • Height = area under the triangle (1) • Height = 67.5 m (1) | <p>Example of calculation</p> <p>height = $(4.5 \text{ s} \times 30 \text{ m s}^{-1}) / 2$</p> <p>height = 67.5 m</p> | 2 |
| 10(b) | <ul style="list-style-type: none"> • Straight horizontal line at -2 m s^{-1} (1) • Ending at 38.5 s (1) | <p>Example of calculation</p> <p>Time of descent = $67.5 / 2 = 33.8 \text{ s}$</p> <p>End of motion = $33.8 + 4.5 = 38.3 \text{ s}$</p> | 2 |
| 10(c) | <ul style="list-style-type: none"> • Scale to cover at least half of the grid either vertically or horizontally (1) • Downward and horizontal velocity arrows and corresponding resultant velocity arrow drawn (1) • Magnitude of velocity = $2.5 \text{ (m s}^{-1}\text{)}$ (1) • Angle to the horizontal = 53° [allow $\pm 1^\circ$] (1) | <p>Example</p>  | 4 |

(Total for Question 10 = 8 marks)

| Question Number | Acceptable answers | Additional guidance | Mark |
|-----------------|---|--|----------|
| 11(a)(i) | <ul style="list-style-type: none"> • Power source in series with coil of wire and ammeter and voltmeter correctly placed Or Ohmmeter in series with wire <p style="text-align: right;">(1)</p> | Allow power supply/cell/battery Wire must be clear Ignore extra components as long as circuit would still work | 1 |
| 11(a)(ii) | <ul style="list-style-type: none"> • Measure temperature of water with a thermometer • Stir the water Or Keep thermometer near to coil Or Allow time to ensure coil is at thermal equilibrium Or Use small current (so electrical heating of wire is minimised) <p style="text-align: right;">(1)</p> | | 2 |
| 11(b) | An explanation that makes reference to the following points: <ul style="list-style-type: none"> • Kinetic energy of (lattice) ions increases Or (Lattice) ions vibrate with greater amplitude • The frequency of collisions between electrons and ions increases • (Drift) velocity of electrons decreases, so current decreases (for the same p.d.) • So resistance of nichrome wire increases <p style="text-align: right;">(1)</p> <p style="text-align: right;">(1)</p> <p style="text-align: right;">(1)</p> <p style="text-align: right;">(1)</p> <p>[Dependent upon MP1, MP2 or MP3]</p> | | 4 |

(Total for Question 11 = 7 marks)

| Question Number | Acceptable answers | Additional guidance | Mark |
|-----------------|--|--|------|
| 12(a) | <ul style="list-style-type: none"> • Calculates area (1) • Use of $R = \frac{\rho l}{A}$ (1) • $l = 10 \text{ m}$ (1) | <p><u>Example of calculation</u></p> <p>Cross sectional area = $\pi \frac{(0.28 \times 10^{-3} \text{ m})^2}{4} = 6.2 \times 10^{-8} \text{ m}^2$</p> <p>$80 \Omega = (4.9 \times 10^{-7} \Omega \text{ m} \times l) / 6.2 \times 10^{-8} \text{ m}^2$</p> <p>$l = 10.1 \text{ m}$</p> | 3 |
| 12(b) | <p>EITHER</p> <ul style="list-style-type: none"> • Percentage uncertainty calculated for either I or V (1) • Percentage uncertainties for I and V added (1) • Lower limit of $R = 74 \Omega$ Or uncertainty in $R = 8 \Omega$ (1) • Conclusion consistent with calculated value of lower limit (1) <p>OR</p> <ul style="list-style-type: none"> • (Upper/lower) limit of V calculated and (upper/lower) limit of I calculated (1) • Minimum value of R calculated Or maximum value of R calculated (1) • Lower limit of $R = 75 \Omega$ (1) • Conclusion consistent with calculated value of lower limit (1) | <p><u>Example of calculation</u></p> <p>$\%U_I = (0.01 \text{ A} / 0.12 \text{ A}) \times 100 = 8.3 \%$</p> <p>$\%U_V = (0.1 \text{ V} / 9.8 \text{ V}) \times 100 = 1.0 \%$</p> <p>$R = 9.8 \text{ V} / 0.12 \text{ A} = 82 \Omega$</p> <p>$\%U_R = 8.3 \% + 1.0 \% = 9.3 \%$</p> <p>Lower limit of $R = 82 \Omega \times (1 - 0.093) = 74 \Omega$</p> <p>$80 \Omega$ is within limit, so agree with experimental results</p> | 4 |

(Total for Question 12 = 7 marks)

| Question Number | Acceptable Answer | Additional guidance | Mark |
|-----------------|---|---|------|
| 13(a)(i) | <ul style="list-style-type: none"> Working leading to $W = 245 \text{ (N)}$ | <p>(1) <u>Example of calculation</u> $W = 25.0 \text{ kg} \times 9.81 \text{ m s}^{-2} = 245 \text{ N}$</p> | 1 |
| 13(a)(ii) | <ul style="list-style-type: none"> Use of moment of force = Fx Use of the principle of moments Support force = 170 N (ecf from (a)(i)) | <p>(1) <u>Example of calculation</u> $245 \text{ N} \times 2.5 \text{ m} = F \times 3.6 \text{ m}$ $F = 170 \text{ N}$</p> <p>(1) Show that value gives 174 N</p> | 3 |
| 13(b) | <ul style="list-style-type: none"> When plank tips, support force at rock = 0 Or When plank tips, clockwise moment is greater than anticlockwise moment Use of principle of moments If person is at the end, clockwise moment = 770 N, anticlockwise moment due to weight is 270 Nm < 770 Nm so student is correct Or Starts to tip when person is 0.49 m to the right of the wall, 0.49 m < 1.4 m so student is correct | <p>(1) <u>Example of calculation</u> $245 \text{ N} \times (2.5 - 1.4) \text{ m} = 550 \text{ N} \times x$ $x = 0.49 \text{ m} < 1.4 \text{ m}$ so tips</p> <p>(1) Or $245 \text{ N} \times (2.5 - 1.4) \text{ m} = 270 \text{ Nm}$ $550 \text{ N} \times 1.4 \text{ m} = 770 \text{ Nm}$ $770 \text{ Nm} > 270 \text{ Nm}$ so it tips</p> | 3 |

(Total for Question 13 = 7 marks)

| Question Number | Acceptable Answer | Additional guidance | Mark | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---------------------|--|---|---|--|---|--|---|--|-----------|---------|------------------|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *14 | <p>This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning. Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.</p> <p>The following table shows how the marks should be awarded for structure and lines of reasoning</p> <table border="1" data-bbox="349 411 1095 788"> <thead> <tr> <th></th> <th>Number of marks awarded for structure and lines of reasoning</th> </tr> </thead> <tbody> <tr> <td>Answer shows a coherent and logical structure with linkage and fully sustained lines of reasoning demonstrated throughout</td> <td>2</td> </tr> <tr> <td>Answer is partially structured with some linkages and lines of reasoning</td> <td>1</td> </tr> <tr> <td>Answer has no linkage between points and is unstructured</td> <td>0</td> </tr> </tbody> </table> <p>Indicative content</p> <p>IC1 The resistance of the circuit decreases (as more bulbs are added) Or there are more paths for the current (as more bulbs are added)</p> <p>IC2 (So) current in battery increases</p> <p>IC3 p.d. across internal resistance increases</p> <p>IC4 Terminal p.d. of battery decreases and bulbs get dimmer</p> <p>IC5 (More) energy/power transferred in battery</p> <p>IC6 So thermal energy increases in battery</p> | | Number of marks awarded for structure and lines of reasoning | Answer shows a coherent and logical structure with linkage and fully sustained lines of reasoning demonstrated throughout | 2 | Answer is partially structured with some linkages and lines of reasoning | 1 | Answer has no linkage between points and is unstructured | 0 | <p>Total marks awarded is the sum of marks for indicative content and the marks for structure and lines of reasoning</p> <table border="1" data-bbox="1220 288 1809 767"> <thead> <tr> <th>IC points</th> <th>IC mark</th> <th>Max linkage mark</th> <th>Max final mark</th> </tr> </thead> <tbody> <tr> <td>6</td> <td>4</td> <td>2</td> <td>6</td> </tr> <tr> <td>5</td> <td>3</td> <td>2</td> <td>5</td> </tr> <tr> <td>4</td> <td>3</td> <td>1</td> <td>4</td> </tr> <tr> <td>3</td> <td>2</td> <td>1</td> <td>3</td> </tr> <tr> <td>2</td> <td>2</td> <td>0</td> <td>2</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> </tbody> </table> | IC points | IC mark | Max linkage mark | Max final mark | 6 | 4 | 2 | 6 | 5 | 3 | 2 | 5 | 4 | 3 | 1 | 4 | 3 | 2 | 1 | 3 | 2 | 2 | 0 | 2 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 6 |
| | Number of marks awarded for structure and lines of reasoning | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Answer shows a coherent and logical structure with linkage and fully sustained lines of reasoning demonstrated throughout | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Answer is partially structured with some linkages and lines of reasoning | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Answer has no linkage between points and is unstructured | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| IC points | IC mark | Max linkage mark | Max final mark | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | 4 | 2 | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | 3 | 2 | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 3 | 1 | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 2 | 1 | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 2 | 0 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 1 | 0 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

(Total for Question 14 = 6 marks)

| Question Number | Acceptable answers | Additional guidance | Mark |
|-----------------|--|--|------|
| 15(a)(i) | <ul style="list-style-type: none"> • Use of $p = mv$ (1) • $p = 5.4 \text{ (kg m s}^{-1}\text{)}$ (1) | <u>Example of calculation</u> $p = 0.012 \text{ kg} \times 450 \text{ m s}^{-1} = 5.4 \text{ kg m s}^{-1}$ | 2 |
| 15(a)(ii) | <ul style="list-style-type: none"> • Use of principle of conservation of linear momentum (1) • Use of $\frac{1}{2} mv^2 = mgh$ (1) • $h = 0.24 \text{ m}$ (ecf from (a)(i)) (1) | <u>Example of calculation</u> $5.4 \text{ kg m s}^{-1} = (2.5 \text{ kg} + 0.012 \text{ kg}) \times v$ $v = 2.1 \text{ m s}^{-1}$ $\frac{1}{2} mv^2 = mgh$ $\frac{1}{2} (2.1 \text{ m s}^{-1})^2 = 9.81 \text{ m s}^{-2} \times h$ $h = 0.24 \text{ m}$ | 3 |
| 15(b) | <p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> • The final momentum/velocity of the bullet is negative Or The final momentum/velocity of the bullet is in the opposite direction (1) • The change in momentum of the bullet is greater (1) • The (change in) momentum of the steel block is greater (because momentum is conserved) (1) • So steel block has greater initial velocity Or steel block has greater initial E_k (1) • So gains greater E_p (and moves through a greater maximum vertical height) [Dependent upon MP4] (1) | | 5 |

(Total for Question 15 = 10 marks)
TOTAL FOR SECTION A = 56 MARKS

SECTION B

| Question Number | Acceptable answers | Additional guidance | Mark |
|-----------------|--|-------------------------------------|----------|
| 16(a) | <ul style="list-style-type: none"> • Use of a metre rule (1) • Use of a set square to ensure the rule is vertical • Or Use of plumbline to ensure that the rule is vertical (1) | Allow use of a spirit level for MP2 | 2 |
| 16(b)(i) | <p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> • Comparison of $h = \frac{v^2}{2g}$ with $y = mx + c$ (1) • Gradient = $\frac{1}{2g}$ which is constant (1) | | 2 |

16(b)(ii)

- Values of v^2 given to 3 s.f.
- Axes with labels & units
- Scales
- Plots
- Line of best fit

| h / cm | $v^2 / \text{m}^2 \text{s}^{-2}$ |
|-----------------|----------------------------------|
| 10.8 | 1.90 |
| 18.9 | 3.92 |
| 28.7 | 6.00 |
| 40.3 | 8.18 |
| 49.8 | 10.37 |
| 58.7 | 11.97 |

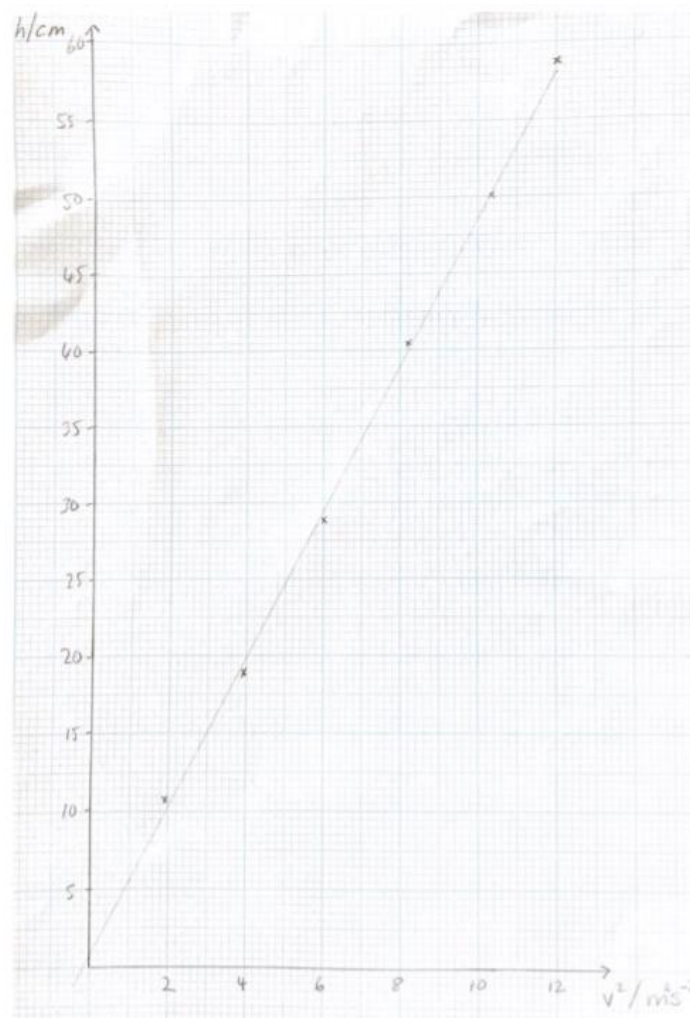
(1)

(1)

(1)

(1)

(1)



MP1 allow 4 s.f. for final two values in table

MP3: scales only in 1,2, or 5 and must cover at least half of paper

5

| | | | | |
|-------------------|---|-----|--|----------|
| 16(b)(iii) | • Use of large triangle | (1) | <u>Example of calculation</u> Gradient = $(0.580 - 0.005) / 12.0 = 0.0479$ $g = 1 / (2 \times 0.0479) = 10.4 \text{ m s}^{-2}$ | 3 |
| | • Use of gradient = $\frac{1}{2g}$ | (1) | | |
| | • g in range 10.0 – 10.9 (m s^{-2}) and relevant comment | (1) | | |

(Total for Question 16 = 12 marks)

| Question Number | Acceptable answers | Additional guidance | Mark |
|-----------------|---|--|------|
| 17(a) | <ul style="list-style-type: none"> Use of $\sigma = F / A$ Use of $E = \sigma / \varepsilon$ and $\varepsilon = \Delta x / x$ $\Delta x = 1.6 \times 10^{-3} \text{ m}$ | <p>(1) <u>Example of calculation</u> $\sigma = (12 \times 10^3 \text{ N}) / (6 \times 3.1 \times 10^{-4} \text{ m}^2)$ $\sigma = 6.45 \times 10^6 \text{ Pa}$ $\varepsilon = 6.45 \times 10^6 \text{ Pa} / 200 \times 10^9 \text{ Pa} = 3.23 \times 10^{-5}$ $\Delta x = 3.2 \times 10^{-5} \times 50 \text{ m} = 1.61 \times 10^{-3} \text{ m}$</p> | 3 |
| 17(b)(i) | <ul style="list-style-type: none"> Weight of people = 19 kN – 12 kN Use of $W = mg$ Mass of people = 710 kg | <p>(1) <u>Example of calculation</u> Weight of people = 19kN – 12 kN $7 \times 10^3 \text{ N} / 9.81 \text{ N kg}^{-1} = 714 \text{ kg}$</p> | 3 |
| 17(b)(ii) | <p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> From 5 s to 6.5 s lift accelerates upwards and from 6.5 s to 27.5 s lift travels upwards at constant speed and from 27.5 s to 29 s lift decelerates to rest <p>MAX 2 from:</p> <ul style="list-style-type: none"> From 5 s to 6.5 s there is resultant force upward Or From 5 s to 6.5 s the tension is greater than the weight From 6.5 s to 27.5 s resultant force is zero Or From 6.5 s to 27.5 s tension is equal to weight From 27.5 s to 29 s resultant force is downwards Or From 27.5 s to 29 s tension is less than weight | <p>(1)</p> <p>(1)</p> <p>(1)</p> | 3 |
| 17(c) | <ul style="list-style-type: none"> The tension in each of the remaining cables would increase Or Total force remains the same, but the total cable area decreases (The area of each cable doesn't change) so the stress in each cable would increase With an increased stress, the strain of each cable would increase so the extension would be greater. | <p>(1)</p> <p>(1)</p> <p>(1)</p> | 3 |

(Total for Question 17 = 12 marks)

TOTAL FOR SECTION B = 24 MARKS

TOTAL FOR PAPER = 80 MARKS

