Mark Scheme (Results)

Summer 2023

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

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Summer 2023
Question Paper Log Number P71928A
Publications Code 8PH0_01_2306_MS

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 epen.

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 be 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 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

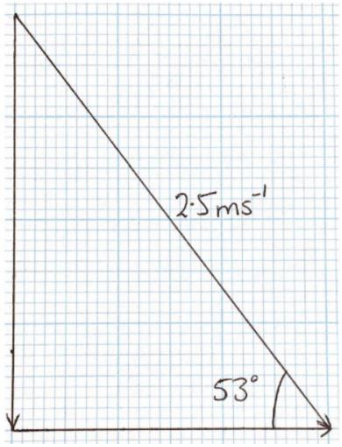
Question Number	Answer	Mark
1	**C** Incorrect Answers: A – this answer is incorrect, there is no force upwards on the ball B – this answer is incorrect, there is no force upwards on the ball D – this answer is incorrect, there is also a downward air resistance force as the ball is moving upwards	**1**
2	**C – power, time, work done** Incorrect Answers: A – displacement is a vector B – momentum is a vector D – acceleration is a vector	**1**
3	**B** Incorrect Answers: A – this answer is incorrect C – this answer is incorrect D – this answer is incorrect	**1**
4	**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	**1**
5	**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.	**1**
6	**D** $\frac{mgh}{VIt}$ Incorrect Answers: A – this answer is incorrect B – this answer is incorrect C – this answer is incorrect	**1**

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

(Total for Multiple Choice Questions = 8 marks)

Question Number	Acceptable answers		Additional guidance	Mark
9	• When variable resistor is 0 Ω voltmeter reading = 6.0 V • Use of principle of potential divider **Or** use of $V = IR$ • When variable resistor is 40 Ω voltmeter reading = 1.2 V	**(1)** **(1)** **(1)**	Example of calculation V = (10 Ω / 50 Ω) × 6 V = 1.2 V	**3**

(Total for Question 9 = 3 marks)

Question Number	Acceptable answers		Additional guidance	Mark
10(a)	• Height = area under the triangle • Height = 67.5 m	**(1)** **(1)**	Example of calculation height = (4.5 s × 30 m s^{-1}) / 2 height = 67.5 m	**2**
10(b)	• Straight horizontal line at −2 m s^{-1} • Ending at 38.5 s	**(1)** **(1)**	Example of calculation Time of descent = 67.5/2 = 33.8 s End of motion = 33.8 + 4.5 = 38.3 s	**2**
10(c)	• Scale to cover at least half of the grid either vertically or horizontally • Downward and horizontal velocity arrows **and** corresponding resultant velocity arrow drawn • Magnitude of velocity = 2.5 (m s^{-1}) • Angle to the horizontal = 53(°) [allow ±1°]	**(1)** **(1)** **(1)** **(1)**	Example  	**4**

(Total for Question 10 = 8 marks)

Question Number	Acceptable answers	Additional guidance	Mark
11(a)(i)	• Power source in series with coil of wire and ammeter **and** voltmeter correctly placed **Or** Ohmmeter in series with wire **(1)**	Allow power supply/cell/battery Wire must be clear Ignore extra components as long as circuit would still work	**1**
11(a)(ii)	• Measure temperature of water with a thermometer **(1)** • 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) **(1)**		**2**
11(b)	An explanation that makes reference to the following points: • Kinetic energy of (lattice) ions increases **Or (**Lattice) ions vibrate with greater amplitude **(1)** • The frequency of collisions between electrons and ions increases **(1)** • (Drift) velocity of electrons decreases, so current decreases (for the same p.d.) **(1)** • So resistance of nichrome wire increases **(1)** [Dependent upon MP1, MP2 or MP3]		**4**

(Total for Question 11 = 7 marks)

Question Number	Acceptable answers		Additional guidance	Mark
12(a)	• Calculates area • Use of $R = \frac{\rho l}{A}$ • l = 10 m	(1) (1) (1)	Example of calculation Cross sectional area = $\pi\frac{(0.28 \times 10^{-3}\ \text{m})^2}{4} = 6.2 \times 10^{-8}\ \text{m}^2$ 80 Ω = (4.9 × 10^{-7} Ω m × l) / 6.2 × 10^{-8} m^2 l = 10.1 m	3
12(b)	**EITHER** • Percentage uncertainty calculated for either I or V • Percentage uncertainties for I and V added • Lower limit of R = 74 Ω **Or** uncertainty in R = 8 Ω • Conclusion consistent with calculated value of lower limit **OR** • (Upper/lower) limit of V calculated **and** (upper/lower) limit of I calculated • Minimum value of R calculated **Or** maximum value of R calculated • Lower limit of R = 75 Ω • Conclusion consistent with calculated value of lower limit	(1) (1) (1) (1) (1) (1) (1) (1)	Example of calculation $\%U_I$ = (0.01 A / 0.12 A) × 100 = 8.3 % $\%U_V$ = (0.1 V / 9.8 V) × 100 = 1.0 % R = 9.8 V / 0.12 A = 82 Ω $\%U_R$ = 8.3 % + 1.0 % = 9.3 % Lower limit of R = 82 Ω × (1 − 0.093) = 74 Ω 80 Ω is within limit, so agree with experimental results	4

(Total for Question 12 = 7 marks)

Question Number	Acceptable Answer		Additional guidance	Mark
13(a)(i)	• Working leading to $W = 245$ (N)	**(1)**	Example of calculation $W = 25.0 \text{ kg} \times 9.81 \text{m s}^{-2} = 245 \text{ N}$	**1**
13(a)(ii)	• Use of moment of force = Fx • Use of the principle of moments • Support force = 170 N (ecf from (a)(i))	**(1)** **(1)** **(1)**	Example of calculation 245 N × 2.5 m = F × 3.6 m F = 170 N Show that value gives 174 N	**3**
13(b)	• 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	**(1)** **(1)** **(1)**	Example of calculation 245 N × (2.5 – 1.4) m = 550 N × x x = 0.49 m < 1.4 m so tips **Or** 245 N × (2.5 – 1.4) m = 270 Nm 550 N × 1.4 m = 770 Nm 770 Nm > 270 Nm so it tips	**3**

(Total for Question 13 = 7 marks)

<table>
<tr><th>Question Number</th><th>Acceptable Answer</th><th>Additional guidance</th><th>Mark</th></tr>
<tr>
<td>*14</td>
<td>
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.

The following table shows how the marks should be awarded for structure and lines of reasoning
<table>
<tr><td></td><td>Number of marks awarded for structure and lines of reasoning</td></tr>
<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>
</table>
Indicative content

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)

IC2 (So) current in battery increases

IC3 p.d. across internal resistance increases

IC4 Terminal p.d. of battery decreases and bulbs get dimmer

IC5 (More) energy/power transferred in battery

IC6 So thermal energy increases in battery
</td>
<td>
Total marks awarded is the sum of marks for indicative content and the marks for structure and lines of reasoning
<table>
<tr><td>IC points</td><td>IC mark</td><td>Max linkage mark</td><td>Max final mark</td></tr>
<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>
</table>
</td>
<td>6</td>
</tr>
</table>

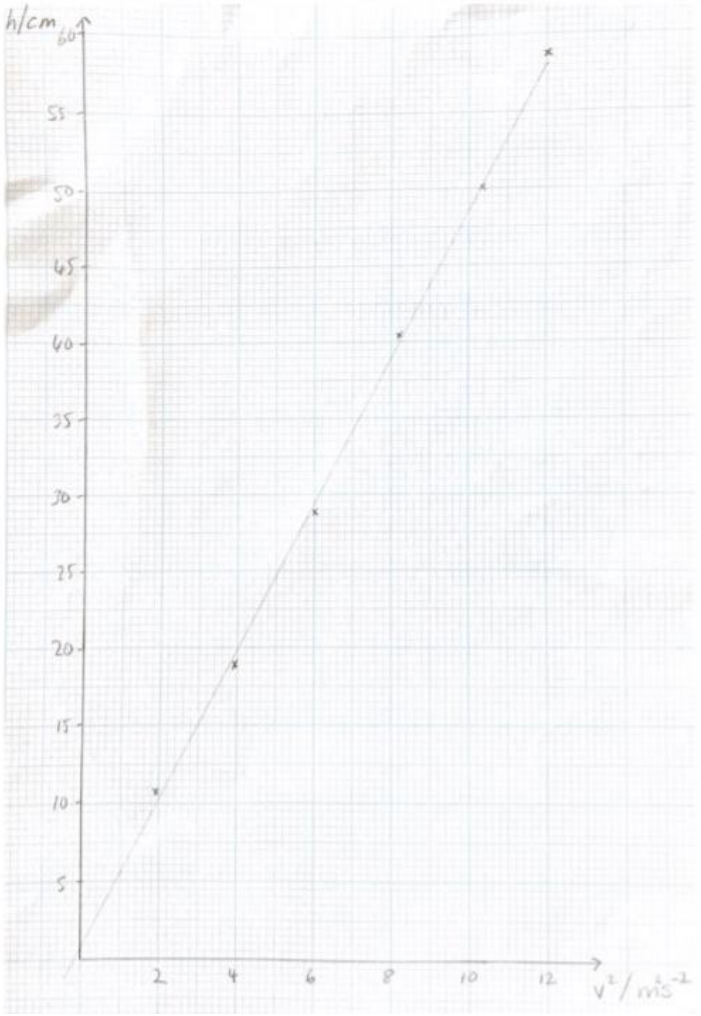
(Total for Question 14 = 6 marks)

Question Number	Acceptable answers		Additional guidance	Mark
15(a)(i)	• Use of $p = mv$ • $p = 5.4$ (kg m s^{-1})	**(1)** **(1)**	Example of calculation $p = 0.012$ kg × 450 m $s^{-1} = 5.4$ kg m s^{-1}	**2**
15(a)(ii)	• Use of principle of conservation of linear momentum • Use of ½ $mv^2 = mgh$ • $h = 0.24$ m (ecf from (a)(i))	**(1)** **(1)** **(1)**	Example of calculation 5.4 kg m $s^{-1} = (2.5$ kg + 0.012 kg) × v $v = 2.1$ m s^{-1} ½ $mv^2 = mgh$ ½ (2.1 m $s^{-1})^2 = 9.81$ m $s^{-2} \times h$ $h = 0.24$ m	**3**
15(b)	An explanation that makes reference to the following points: • The final momentum/velocity of the bullet is negative **Or** The final momentum/velocity of the bullet is in the opposite direction • The change in momentum of the bullet is greater • The (change in) momentum of the steel block is greater (because momentum is conserved) • So steel block has greater initial velocity **Or** steel block has greater initial E_K • So gains greater E_P (and moves through a greater maximum vertical height) [Dependent upon MP4]	**(1)** **(1)** **(1)** **(1)** **(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)	• 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)	An explanation that makes reference to the following points: • 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. **(1)** • Axes with labels & units **(1)** • Scales **(1)** • Plots **(1)** • Line of best fit **(1)** **h / cm** | **v^2/ m^2 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	 **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 • Use of gradient = $\frac{1}{2g}$ • g in range 10.0 – 10.9 (m s^{-2}) and relevant comment	**(1)** **(1)** **(1)**	Example of calculation Gradient = (0.580 – 0.005) / 12.0 = 0.0479 g = 1 / (2 × 0.0479) = 10.4 m s^{-2}	**3**

(Total for Question 16 = 12 marks)

Question Number	Acceptable answers		Additional guidance	Mark
17(a)	• Use of $\sigma = F / A$ • Use of $E = \sigma / \varepsilon$ and $\varepsilon = \Delta x / x$ • $\Delta x = 1.6 \times 10^{-3}$ m	**(1)** **(1)** **(1)**	Example of calculation $\sigma = (12 \times 10^3 \text{ N}) / (6 \times 3.1 \times 10^{-4} \text{ m}^2)$ $\sigma = 6.45 \times 10^6$ Pa $\varepsilon = 6.45 \times 10^6 \text{ Pa} / 200 \times 10^9 \text{ Pa} = 3.23 \times 10^{-5}$ $\Delta x = 3.2 \times 10^{-5} \times 50 \text{ m} = 1.61 \times 10^{-3}$ m	**3**
17(b)(i)	• Weight of people = 19 kN – 12 kN • Use of $W = mg$ • Mass of people = 710 kg	**(1)** **(1)** **(1)**	Example of calculation Weight of people = 19kN – 12 kN $7 \times 10^3 \text{ N} / 9.81 \text{ N kg}^{-1} = 714$ kg	**3**
17(b)(ii)	An explanation that makes reference to the following points: • 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 **MAX 2 from:** • 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	**(1)** **(1)** **(1)** **(1)**		**3**
17(c)	• 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.	**(1)** **(1)** **(1)**		**3**

(Total for Question 17 = 12 marks)

TOTAL FOR SECTION B = 24 MARKS

TOTAL FOR PAPER = 80 MARKS

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