Mark Scheme (Results)

Summer 2022

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 schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

    i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
    ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
    iii) organise information clearly and coherently, using specialist vocabulary when appropriate.

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. '<u>resonance</u>'
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.

Question Number	Answer	Mark
1	**B thermistor graph**	**1**
	Incorrect Answers: A – ohmic conductor graph C – filament lamp graph D – diode graph	
2	**C kg m^2 s^{-3} A^{-2}**	**1**
	Incorrect Answers: A – Ω is not a base unit B – V is not a base unit D – C is not a base unit	
3	**D 4 mm**	**1**
	Incorrect Answers: A – distance has been measured and has not been scaled. B – the displacement has not been scaled C – distance has been used	
4	**C** $v \propto \frac{1}{R}$	**1**
	A – this answer is incorrect B – this answer is incorrect D – this answer is incorrect	
5	**C ammeter reading decreases, voltmeter reading increases**	**1**
	A – the ammeter reading does not increase B – neither occurs D – the voltmeter reading does not decrease	
6	**B P and Q will have the same maximum velocity**	**1**
	A – the graph is incorrect C – the graph is incorrect	

	D – the graph is incorrect	
7	**C (2.5 × 4.3) + (2.5 × 9.81)**	**1**
	A – this answer is incorrect B – this answer is incorrect D – this answer is incorrect	
8	**D 1×10^{17} J**	**1**
	A – this answer is incorrect B – this answer is incorrect C – this answer is incorrect	

(Total for Multiple Choice Questions = 8 marks)

Question Number	Acceptable answers	Additional guidance	Mark
9	- Use of $\frac{1}{R_\mathrm{P}} = \frac{1}{R_1} + \frac{1}{R_2}$ for resistors in parallel **(1)** - Use of $R_\mathrm{T} = R_1 + R_2$ for resistors in series **(1)** - R_T = 47 Ω **(1)**	<u>Example Calculation</u> $\frac{1}{R_\mathrm{P}} = \frac{1}{30} + \frac{1}{40}$ R_P = 17 Ω R_T = 20+17+10 = 47 Ω	3

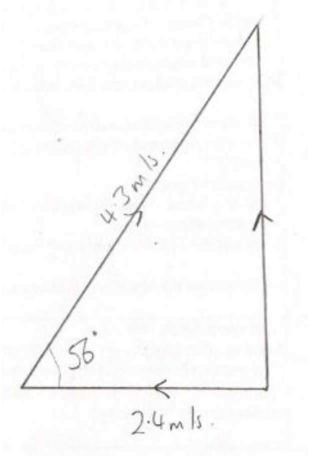
(Total for Question 9 = 3 marks)

Question Number	Acceptable answers	Additional guidance	Mark
10	• Use of distance = area under graph **(1)** • Use of scales on axes **(1)** • Distance in range 6.0 m – 6.2 m **(1)** MP3 dependent on MP1	Example of Calculation Distance (2 cm square) = 2.0 ms^{-1} × 0.20 s = 0.40 m Number of squares = 15 Distance = 15 × 0.40 m = 6.0 m	**3**

(Total for Question 10 = 3 marks)

Question Number	Acceptable answers	Additional guidance	Mark
11(a)	• Current (in the circuit) decreases **(1)** • P.d. across the LDR decreases **(1)** • Voltmeter reading increases **(1)** (MP3 dependent on MP1 or MP2)	Accept approaches using potential divider theory • Pd from supply divides in ratio of resistances of the two components, eg. $V_{\text{LDR}} = \frac{R_{\text{LDR}}}{R_{\text{R}} + R_{\text{LDR}}} \times V_{\text{Total}}$ • As R_R increases, but R_{LDR} stays constant • So voltmeter reading increases (MP3 dependent on MP1)	**3**
11(b)	• Use $V=IR$ to calculate current **(1)** • Use $V=IR$ with V = 6.5 V to calculate LDR resistance **(1)** • Light intensity = 185 (lux) (accept answers in range 180 lux -190 lux) **(1)** **OR** • Use of potential divider principle **(1)** • Use of $R_T = R_{LDR}$ + 4.5kΩ to calculate LDR resistance **Or** Use of V_{LDR} = 6.5 V to calculate LDR resistance **(1)** • Light intensity = 185 (lux) (accept answers in range 180 lux -190 lux) **(1)**	Example of Calculation. $2.5 \text{ V} = I \times 4.5\text{x}10^3 \ \Omega$ $I = 5.6 \times 10^{-4}$ A $6.5 \text{ V} = 0.56\text{x}10^{-3} \text{ A} \times R$ $R = 11700 \ \Omega$	**3**

(Total for Question 11 = 6 marks)

Question Number	Acceptable answers	Additional guidance	Mark
12(a)	• Correct combination of vectors drawn **(1)** • Both vectors drawn to scale **(1)** • Angle = 56° (range 55° - 58°) **(1)**		**3**
12(b)	• Angle θ will need to decrease **Or** (Component of boat) velocity along river must increase **(1)** • There is further to travel (relative to the water) **Or** (Component of boat) velocity across river decreases **(1)** • time increases (Dependent on either MP1 or MP2) **(1)**		**3**

(Total for Question 12 = 6 marks)

Question Number	Acceptable Answer		Additional guidance	Mark
13(a)	**Max 2** • Beam/sling/counterweight also gain kinetic energy • Beam/sling/rock also gain gravitational potential energy • Work done against friction so some energy transferred to surroundings	**(1)** **(1)** **(1)**		**2**
13(b)	• Use of trig to determine the vertical or horizontal component of the initial velocity • Use of equation(s) of motion to determine the time of flight • Use of s=ut for horizontal motion • s = 150 m	**(1)** **(1)** **(1)** **(1)**	Example Calculation $u_v = 41.5 \text{ ms}^{-1} \sin 30 = 20.8 \text{ ms}^{-1}$ $u_H = 41.5 \text{ ms}^{-1} \cos 30 = 35.9 \text{ ms}^{-1}$ $v = u + at$ $0 \text{ ms}^{-1} = 20.8 \text{ ms}^{-1} - 9.81 \text{ms}^{-2}\ t$ t (to max height) = 2.12s $s = 35.9 \text{ ms}^{-1} \times 2 \text{ x } 2.12\text{s}$ s = 152 m	**4**
13(c)	• Counterweight transfers less gravitational potential energy • So transfer of kinetic energy to rock is reduced • (When released) rock has smaller vertical (component of) velocity • Time of flight will be reduced • (And) horizontal (component) of velocity will be smaller	**(1)** **(1)** **(1)** **(1)** **(1)**	Additional Guidance. Accept references to force and acceleration for MP1 and MP2 eg Force on rock is decreased (so) acceleration of rock in sling is decreased	**5**

(Total for Question 13 = 11 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.

Indicative content
IC1 The student applies a force to the skateboard
IC2 By Newtons 3rd Law the skateboard also applies a force to the student
IC3 The two forces are equal in size but opposite in direction
IC4 The student accelerates according to Newtons 2nd Law
IC5 The skateboard decelerates according to Newton’s 2nd Law.
IC6 The skateboard has a higher (magnitude of) acceleration than the student as it has a smaller mass</td>
<td>The following table shows how the marks should be awarded for structure and lines of reasoning
<table>
<tr><th></th><th>Number of marks awarded for structure and lines of reasoning</th></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>
Total marks awarded is the sum of marks for indicative content and the marks for structure and lines of reasoning
<table>
<tr><th>IC points</th><th>IC mark</th><th>Max linkage mark</th><th>Max final mark</th></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)	• Use of $E_{grav} = mgh$ **(1)** • Use of $P = IV$ and $P = \frac{E}{t}$ **(1)** • Use of Efficiency $= \frac{\text{useful power output}}{\text{total power input}}$ **Or** • Use of Efficiency $= \frac{\text{useful energy output}}{\text{total energy input}}$ **(1)** • Efficiency = 0.74 **(1)**	Example of Calculation $E_P = 0.55 \text{ kg} \times 9.81 \text{ ms}^{-2} \times 0.20 \text{ m}$ $E_P = 1.08 \text{ J}$ Useful power $= \frac{1.08 \text{ J}}{15 \text{ s}} = 0.072 \text{ W}$ $P = 8.1 \text{ x } 10^{-3} \text{ A} \times 12 \text{ V}$ Input power = 0.0972 W Input energy = 0.0972 × 15 = 1.46 J Efficiency $= \frac{1.08 \text{ J}}{1.46 \text{ J}} = 0.74$	**4**
15(b)	• There is now a (greater) current in the voltmeter **(1)** • The current in the battery/circuit increases **Or** Energy/power is dissipated in the voltmeter **(1)** • Power/energy output from the battery increases **(1)** • Efficiency of the motor circuit decreases **(1)** (MP4 dependent on MP3)	Accept reference to the resistance in the circuit decreasing for MP1. Accept power input to circuit for MP3.	**4**

15(c)	- Use of $p = mv$ **(1)** - Use of principle of conservation of momentum **(1)** - $v = 5.2 \text{ ms}^{-1}$ **(1)**	<u>Example of calculation.</u> $0.55 \text{ kg} \times 5.4 \text{ ms}^{-1} =$ $(0.55 \text{ kg} \times 2.1 \text{ ms}^{-1}) + (0.35 \text{ kg} \times v)$ $2.97 = 1.16 + 0.35v$ $v = 5.2 \text{ ms}^{-1}$	**3**

(Total for Question 15 = 11 marks)

Question Number	Acceptable answers	Additional guidance	Mark
16	**Either** • As x increases, the (clockwise) moment of the load about P increases **(1)** • (For equilibrium) the clockwise moment and the anticlockwise moment about P must be equal **(1)** • So F_Q must increase (to increase the anticlockwise moment) MP3 dependent on MP2. **(1)** • (For equilibrium) the resultant vertical force must be zero **Or** As x increases, the (anticlockwise) moment of the load about Q decreases **(1)** • As F_Q increases F_P must decrease **(1)**		

	OR • As x increases, the (anticlockwise) moment of the load about Q decreases **(1)** • (For equilibrium) the clockwise moment and the anticlockwise moment about Q must be equal **(1)** • So F_P must decrease (to decrease the clockwise moment) **(1)** MP3 dependent on MP2 • (For equilibrium) the resultant vertical force must be zero **Or** As x increases, the (clockwise) moment of the load about P increases **(1)** • As F_P decreases F_Q must increase **(1)**		**5**

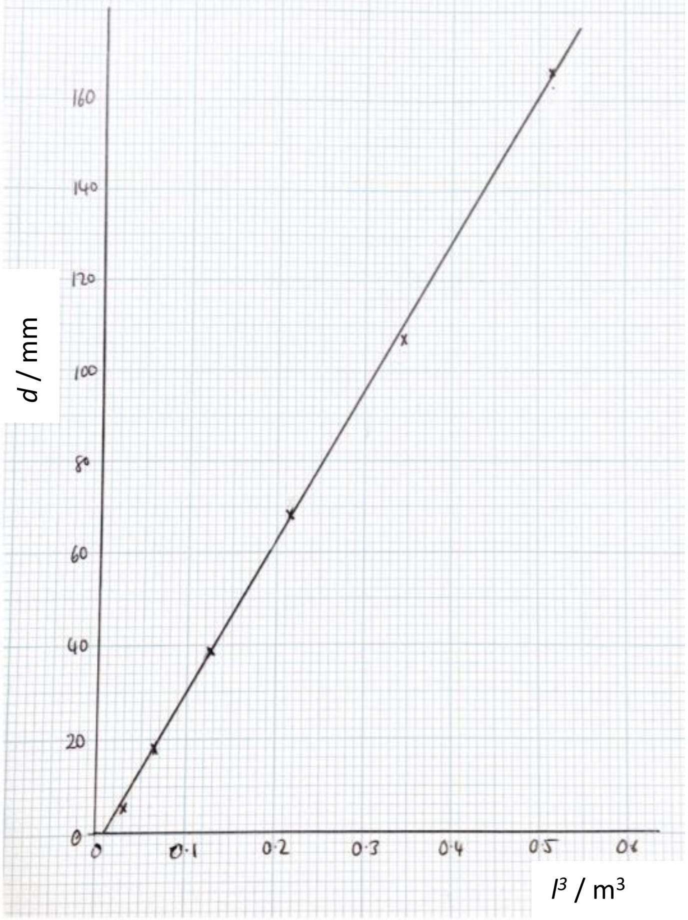
(Total for Question 16 = 5 marks)

Question Number	Acceptable answers	Additional guidance	Mark
17(a)	• Ensure the metre rule is vertical using a set square placed in contact with the floor. **(1)** • Use set square held against metre rule to take the readings on the metre rule **(1)**	A labelled diagram can score full marks Accept references to reading at eye level for MP2.	**2**
17(b)(i)	• Use of half range **Or** Use of maximum deviation from the mean **(1)** • 0.4 (%) **(1)**	Example of Calculation. ½ range = (6.29 mm - 6.24 mm) / 2 = 0.025 mm %U = (0.025 mm / 6.26 mm) x 100 %U = 0.40 %	**2**

17(b)(ii)

- Correct values for l^3 to 3 sf **(1)**
- Axes with labels & units **(1)**
- Scales **(1)**
- Plots **(1)**
- Line of best fit **(1)**

l/m	***d/mm***	***l^3 / m^3***
0.300	6	0.027(0)
0.400	18	0.064(0)
0.500	39	0.125
0.600	68	0.216
0.700	107	0.343
0.800	166	0.512



MP1: accept 2 or 3 sf's in table for first 2 values
MP3: scales only in 1,2,5 and must cover at least half of paper

MP4: a 1 mm square tolerance, check all points

5

17(b)(iii)	- Determine gradient **(1)** - Using a large triangle **(1)** - Use of gradient $= \frac{4W}{Ebt^3}$ **(1)** - $E = 9.2 \times 10^9$ (Pa) (in range $8.9 - 9.3 \times 10^9$ (Pa)) **(1)** - Identifies wood consistent with their value for *E* **(1)**	Example Calculation. $gradient = \frac{(160 \times 10^{-3}) - 0}{0.50 - 0.01}$ Gradient = 0.327 $0.327 = \frac{4 \times 5.6\ (\mathrm{N})}{E\ x\ 0.0302\ (\mathrm{m}) \times (6.26x10^{-3}\ (\mathrm{m}))^3}$ $E = 9.2 \times 10^9$ Pa	**5**

(Total for Question 17 = 14 marks)

Question Number	Acceptable answers		Additional guidance	Mark
18(a)(i)	• Use of $\rho = \frac{m}{V}$ • $V = 8.1 \text{ x } 10^{-6}$ (m^3)	**(1)** **(1)**	<u>Example of Calculation.</u> $V = \frac{0.043 \text{ kg}}{5300 \text{ kgm}^{-3}}$ $V = 8.1 \times 10^{-6} \text{ m}^3$	**2**
18(a)(ii)	• Use of $A = \pi r^2$ and $V = Al$ • Use of $R = \frac{\rho l}{A}$ • $R = 2.5\ \Omega$ (ecf from (a)(i))	**(1)** **(1)** **(1)**	Show that value gives 2.50 Ω <u>Example of Calculation.</u> $A = \pi(6 \times 10^{-3} \text{ mm})^2 = 1.13 \times 10^{-4} \text{ m}^2$ $8.1 \times 10^{-6} \text{ m}^3 = (1.13 \times 10^{-4} \text{ m}^3)\, l$ $l = 0.0716 \text{ m}$ $R = \frac{(4.0 \times 10^{-3}\ \Omega \text{ m})(0.0716 \text{ m})}{(1.13 \times 10^{-4} \text{ m}^3)}$ $R = 2.54\ \Omega$	**3**
18(b)	• Makes a cylinder of longer length **Or** Makes a cylinder of smaller radius/area • As $R = \frac{\rho l}{A}$, this change will increase the resistance [MP2 dependent on MP1]	**(1)** **(1)**		**2**

(Total for Question 18 = 7 marks)

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