Pearson Edexcel

Mark Scheme (Results)

November 2021

Pearson Edexcel GCE
In Physics (8PH0)
Paper 1: 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	Additional Guidance	Mark
1	**D is the only correct answer**	A is incorrect because coulombs is a derived unit and amperes is a base unit B is incorrect because joules is a derived unit C is incorrect because newtons is a derived unit and kilograms is a base unit	**1**
2	**B is the only correct answer**	A is incorrect because amplitude does increase C is incorrect because rate of collision does increase D is incorrect because rate of energy transfer does increase	**1**
3	**A is the only correct answer**	B is incorrect because speed has been divided by 2 C is incorrect because $E_K = 0.5\ mv^2$ D is incorrect because $E_K = 0.5\ mv^2$	**1**
4	**C is the only correct answer**	A is incorrect because the wrong trigonometric function has been used B is incorrect because the wrong trigonometric function has been used D is incorrect because the wrong algebraic equation has been used	**1**
5	**D is the only correct answer**	A is incorrect because the time has not been converted to seconds B is incorrect because $Q = It$ and time has not been converted to seconds C is incorrect because $Q = It$	**1**
6	**C is the only correct answer**	A is incorrect because the wrong trigonometric function has been used B is incorrect because the wrong trigonometric function has been used D is incorrect because the wrong forces have been used	**1**
7	**B is the only correct answer**	A is incorrect because this does not give the correct ratio C is incorrect because this does not give the correct ratio D is incorrect because this does not give the correct ratio	**1**
8	**A is the only correct answer**	B is incorrect because $P = mgh/t = mgv$ C is incorrect because $P = mgh/t = mgv$	**1**

		D is incorrect because $P = mgh/t = mgv$	

(Total for Multiple Choice Questions = 8 marks)

Question Number	Acceptable answers		Additional guidance	Mark
9	• Use moment = $F x$ • x = 0.49 m	**(1)** **(1)**	<u>Example of calculation</u> $6.5\text{ N} \times (0.75\text{ m} - x) = 3.5\text{ N}\, x$ $4.875\text{ Nm} - 6.5\, x = 3.5\, x$ $x = \dfrac{4.875\text{ Nm}}{10\text{ N}} = 0.488\text{ m}$	**2**

(Total for Question 9 = 2 marks)

Question Number	Acceptable answers		Additional guidance	Mark
10(a)	• Use of $\frac{1}{R}+\frac{1}{R_1}=\frac{1}{R_2}$ • R = 72 (Ω)	(1) (1)	Example of calculation $\frac{1}{R}=\frac{1}{120\ \Omega}+\frac{1}{180\ \Omega}=0.0139\ \Omega^{-1}$ $\therefore R=\frac{1}{0.0139\ \Omega^{-1}}=72.0\ \Omega$	2
10(b)	• Use of $V = IR$ • Use of $P=I^2R$ • Use of $P=\frac{E}{t}$ • E = 320 J ECF from (a) [show that answer gives 323 J] **Or** • Use of $V = IR$ to find I • Use of $V = IR$ to find terminal pd • Use of $W = VIt$ • E = 320 J ECF from (a) [show that answer gives 323 J]	(1) (1) (1) (1) (1) (1) (1) (1)	Example of calculation $I=\frac{9\text{ V}}{(72+2.5)\ \Omega}=0.121\text{ A}$ $P=(0.121\text{ A})^2\times 72\ \Omega=1.05\text{ W}$ $E=1.05\text{ W}\times 300\text{ s}=316\text{ J}$	4

(Total for Question 10 = 6 marks)

Question Number	Acceptable Answer		Additional guidance	Mark
11(a)	• Tangent drawn at t = 4.0 s • Gradient of tangent determined • a in the range 1.4 – 1.6 m s^{-2}	**(1)** **(1)** **(1)**	<u>Example of calculation</u> $a = \frac{(35.0-25.0)\text{m s}^{-1}}{(10.0-0.0)\text{ s}} = 1.50 \text{ m s}^{-2}$	**3**
11(b)	• Use of displacement = area under line • 1 square = 20 m **Or** area divided into regular shapes • *s* in the range 410 – 430 m	**(1)** **(1)** **(1)**	<u>Example of calculation</u> Number of squares = 42 1 square = 2 s × 5 m s^{-1} = 10 m s = 42 × 10 m = 420 m	**3**

(Total for Question 11 = 6 marks)

Question Number	Acceptable answers		Additional guidance	Mark
12(a)(i)	• Calculation of mean • Use of half range **Or** maximum difference from the mean • % uncertainty = 1.4%	(1) (1) (1)	<u>Example of calculation</u> $\bar{d} = \frac{(1.40+1.44+1.42+1.41)\ \text{mm}}{4} = 1.42\ \text{mm}$ $\%U = \frac{(1.44 - 1.40)\ \text{mm}/2}{1.42\ \text{mm}} \times 100\% = 1.41\%$	3
12(a)(ii)	• Use of $A = \pi r^2$ • Use of $R = \frac{\rho l}{A}$ • ρ = 6.9 × 10^{-7} (Ω m), so wire is made from stainless steel	(1) (1) (1)	<u>Example of calculation</u> $A = \pi\left(\frac{1.42 \times 10^{-3}\text{m}}{2}\right)^2 = 1.58 \times 10^{-6}\ \text{m}^2$ $\rho = \frac{0.72\ \Omega \times 1.58 \times 10^{-6}\ \text{m}^2}{1.65\ \text{m}} = 6.9 \times 10^{-7}\ \Omega\ \text{m}$	3
12(b)	• Use of $P = \frac{V^2}{R}$ • Use of resistance per unit length • l = 9.3 m	(1) (1) (1)	<u>Example of calculation</u> $P = \frac{(230\ \text{V})^2}{65\ \text{W}} = 813.8\ \text{m}$ $l = \frac{813.8\ \text{m}}{87.5\ \Omega\ \text{m}^{-1}} = 9.30\ \text{m}$	3

(Total for Question 12 = 9 marks)

Question Number	Acceptable answers		Additional guidance	Mark
13(a)	• Use of $p = mv$ • Use of momentum conservation • v = 4.1 m s^{-1}	(1) (1) (1)	Example of calculation $p_i = (66 + 52)\text{ kg} \times 5.6\text{ m s}^{-1}$ $p_f = (66\text{ kg})v + (52\text{ kg} \times 7.5\text{ m s}^{-1})$ $\therefore v = \frac{(661 - 390)\text{ kg m s}^{-1}}{66\text{ kg}} = 4.11\text{ m s}^{-1}$	3
13(b)	An explanation that makes reference to the following points: • (Male skater exerts a force on female skater), so according to N3 • Female skater will exert an (equal and) opposite force on male skater • There is now a resultant force on male skater • Male skater decelerates according to N1/N2 **Or** male skater's velocity decreases according to N1/N2	(1) (1) (1) (1)		4
13(c)	An explanation that makes reference to the following points: • Male skater does work as he pushes female skater **Or** Energy transfers from the male skater as he pushes female skater • So there is an increase in kinetic energy	(1) (1)		2

	[MP2 dependent on MP1]		

(Total for Question 13 = 9 marks)

Question Number	Acceptable answers	Additional guidance	Mark
14(a)(i)	• $v \sin\theta$ = 2.2 (m s^{-1}) **(1)**	<u>Example of calculation</u> $v \sin\theta = 2.6\text{ m s}^{-1} \times \sin 57° = 2.18\text{ m s}^{-1}$	1
14(a)(ii)	• Use of $v = u + at$ **(1)** • Use of $v \cos\theta$ **(1)** • Use of $s = ut + \frac{1}{2}at^2$ **(1)** • Number of body lengths = range/body length **(1)** • 12.7 body lengths, so not twenty lengths **(1)**	<u>Example of calculation</u> $t = \frac{(0 - 2.2)\text{m s}^{-1}}{-9.8\text{ m s}^{-2}} = 0.224\text{ s}$ $v \cos\theta = 2.6\text{ m s}^{-1} \times \cos 57° = 1.42\text{ m s}^{-1}$ $s = 1.42\text{ m s}^{-1} \times 2 \times 0.224\text{ s} = 0.636\text{ m}$ $\text{number of lengths} = \frac{0.636\text{ m}}{0.05\text{ m}} = 12.7$	5
14(b)	An explanation that makes reference to the following points: • Energy released does not change, so same final velocity **(1)** • Same increase in velocity over longer time means a smaller acceleration **(1)** • Smaller force exerted by legs during jump **(1)** • So smaller force on ground **(1)** MP3 and MP4 dependent upon MP2	<u>Alternative explanation.</u> • Energy released does not change so work done does not change • Work done = Force x displacement • As legs are longer, force exerted by legs during jump is smaller • So smaller force on ground	4

14(c)	• Vertical velocity component increases by factor of 1.2, so time in air increases by a factor of 1.2 **(1)** • Horizontal component of velocity increases by factor of 1.2, **(1)** • Horizontal distance travelled increases by a factor of 1.2×1.2 = 1.44 **(1)** • So jump length would increase by 44%, not by 100% **(1)** **OR** • (20% increase in *v* means that) new jump velocity = 1.2 *v* **(1)** • Use of expressions for time to greatest height and horizontal distance **(1)** • Jump length is proportional to v^2 **(1)** • New jump length = 1.44 × original jump length, so not double the length **(1)**	<u>Example of calculation</u> $u \rightarrow 1.2u$ $t \rightarrow 1.2t$ $s = ut$ $\therefore s \rightarrow 1.2u \times 1.2t$ $s \rightarrow 1.44s$	**4**

(Total for Question = 14 marks)

<table>
<tr><th>Question Number</th><th>Acceptable answers</th><th>Additional guidance</th><th>Mark</th></tr>
<tr><td>15(a)(i)</td><td>• Use of $\Delta F = k\Delta x$ (1)
• 45 (N m^{-1}) [accept 0.45 N cm^{-1}] (1)</td><td><u>Example of calculation</u>
$k = \frac{2.5\text{ N}}{5.5 \times 10^{-2}\text{ m}} = 45.45\text{ N m}^{-1}$</td><td>2</td></tr>
<tr><td>15(a)(ii)</td><td>• Use of $w = mg$ (1)
• Use of vertical component of spring forces (1)
• Use of $\Delta F = k\Delta x$ (1)
• $\Delta x = 0.050$ m [accept 5.0 cm] (ECF from (a)(i)) (1)</td><td><u>Example of calculation</u>
$w = 0.400\text{ kg} \times 9.8\text{ N kg}^{-1} = 3.92\text{ N}$
$2T\cos 30° = 3.92\text{ N} \therefore F = \frac{3.92\text{ N}}{2\cos 30°} = 2.26\text{ N}$
$\Delta x = \frac{2.26\text{ N}}{45.45\text{ N m}^{-1}} = 0.0498\text{ m}$</td><td>4</td></tr>
<tr><td>*15(b)</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.

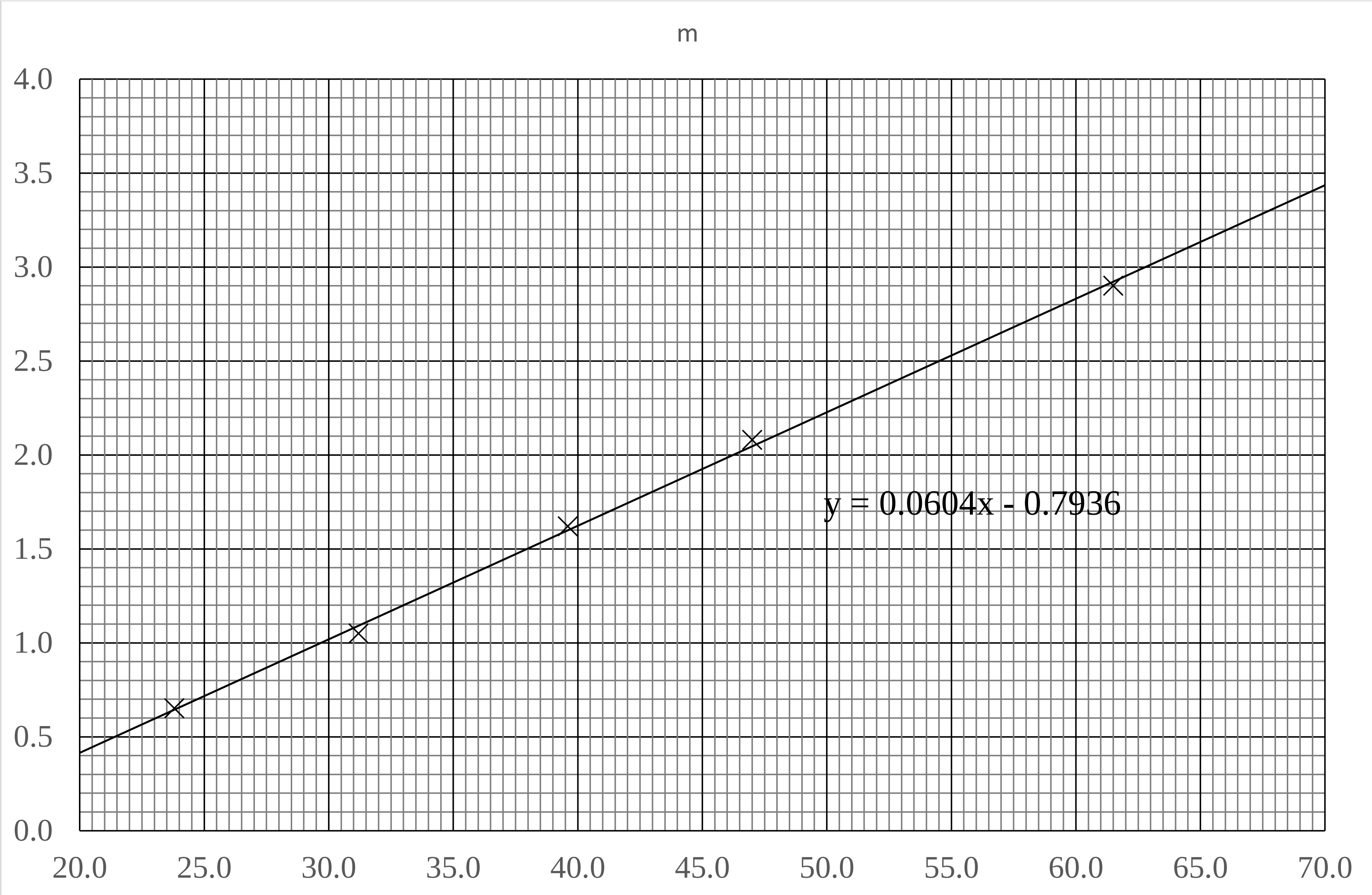
The following table shows how the marks should be awarded for indicative content.

• There is an upthrust on the rock (as the rock displaces water)
• Hence the net downward force on the rock is reduced
• F decreases to a minimum once the rock is fully submerged
• The rock pushes downwards on the water
• So there is an extra force on the balance
• Hence R increases to a maximum once the rock is fully submerged</td><td><table><tr><th>IC points</th><th>IC mark</th><th>Max linkage mark availabl e</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 15 = 12 marks)

Question Number	Acceptable answers		Additional guidance	Mark
16(a)	• Comparison with $y = mx + c$ • Gradient is $1/f$ and constant [allow reference to *m* for "gradient"]	**(1)** **(1)**	$m = \frac{v}{f} - 1$ $m = \frac{1}{f}v - 1$	**2**
16(b)(i)	• m = 1.05 to 3 SF • Axis labels and unit • Scales • Plots • Line of best fit	**(1)** **(1)** **(1)** **(2)** **(1)**	Example of calculation $m = \frac{h_i}{h_o} = \frac{2.15\text{ cm}}{2.04\text{ cm}} = 1.054$	**6**
16(b)(ii)	• Uses large triangle • To determine gradient • f in the range 16.5 – 17.4 cm to 2/3 SF	**(1)** **(1)** **(1)**	Example of calculation Gradient = 0.0588 cm^{-1} $f = \frac{1}{\text{gradient}} = \frac{1}{0.0588\text{ cm}^{-1}} = 17.01\text{ cm}$	**3**
16(c)	An explanation that makes reference to the following points: • Only a real image will be produced on a screen • The object cannot be closer than *f* for a real image • Because light diverges after passing through the lens **OR** • If object closer than *f* rays still diverge after passing though lens • So a virtual image is formed • which cannot be seen on a screen.	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**		**3**

(Total for Question 16 = 14 marks)


m
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
65.0
70.0
y = 0.0604x - 0.7936

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