Pearson Edexcel

Mark Scheme (Results)

January 2024

Pearson Edexcel International Advanced Subsidiary Level In Physics (WPH13)
Paper 01: Practical Skills in 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.

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:

- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.
( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.

Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.

ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Graphs

A mark given for axes requires both axes to be labelled with quantities and units, and drawn the correct way round. Sometimes a separate mark will be given for units or for each axis if the units are complex. This will be indicated on the mark scheme.

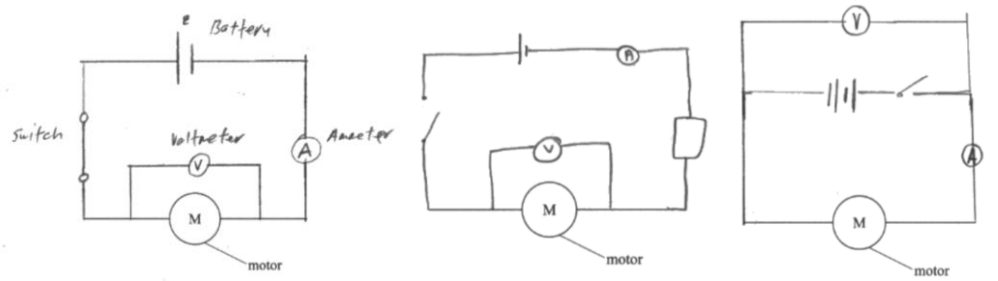
A mark given for choosing a scale requires that the chosen scale allows all points to be plotted, spreads plotted points over more than half of each axis of the available space and is not an awkward scale e.g., multiples of 3, 7 etc.

For WPH13 there are two marks available for plotting data points. Points should be plotted to within 1 mm.

- If all are within 1 mm, award 2 marks.
- If one point is 1+ mm out, award 1 mark.
- If two or more points are 1+ mm out, award 0 marks.

For a line mark there must be a thin continuous line which is the best-fit line for the candidate's results.

Question Number	Answer		Mark
1(a)(i)	• 0.001 kg (accept 1 g)	**(1)**	**1**
1(a)(ii)	• Use of percentage uncertainty = (half) resolution / measurement × 100% • Percentage uncertainty = 0.024% (e.c.f. from 1(a)(i)) Use of full resolution scores 1 mark only, if percentage uncertainty is correct. Example of calculation Percentage uncertainty = 0.0005 kg / 2.070 kg × 100% = 0.024%	**(1)** **(1)**	**2**
1(b)	**EITHER** • Check for zero error • (Correct the value) to eliminate systematic error MP2 dependent on MP1 **OR** • Repeat measurement in different places and calculate a mean • To reduce the effects of random error MP2 dependent on MP1 **OR** • Do not use excessive force when tightening the jaws • As this could introduce a random error MP2 dependent on MP1	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**2**
1(c)(i)	• Use of $\rho = \frac{m}{V}$ • Density = 0.777 (g cm^{-3}) rounded to 3 s.f. Example of calculation Density = $\frac{2070\text{ g}}{21\text{ cm} \times 4.27\text{ cm} \times 29.7\text{ cm}}$ = 0.777 (g cm^{-3})	**(1)** **(1)**	**2**
1(c)(ii)	**EITHER** • The measurements (of thickness and mass) are larger • So, the percentage uncertainty is smaller (for the same uncertainty) MP2 dependent on MP1 **OR** • For a single sheet, the measurements (of thickness and mass) are smaller **Or** for a single sheet, the measurement (of thickness and mass) is too small • So, the percentage uncertainty is larger (for the same uncertainty) MP2 dependent on MP1	**(1)** **(1)** **(1)** **(1)**	**2**
	Total for question 1		**9**

Question Number	Answer		Mark
2(a)	• Diagram includes battery (accept cell), switch, ammeter and voltmeter • Ammeter in series and voltmeter in parallel with motor (Accept voltmeter in parallel with the battery if no other resistance components are added) Examples of suitable diagrams 	(1) (1)	2
2(b)(i)	• Clamp/fix the metre rule in position • Ensure the metre rule is vertical using a set square • Place the metre rule close to the mass **Or** read the height from bottom of the mass **Or** attach a marker to the mass • Take measurements perpendicular to the scale, e.g. using set square	(1) (1) (1) (1)	4
2(b)(ii)	• Random error will cause variation/anomalies in the values (accept suitable examples of random error e.g. reaction time, parallax error when measuring height) • (Repeat readings) allow a mean to be calculated to give a (more) accurate value	 (1) (1)	2
2(c)	**EITHER** • power input = VI **Or** power of motor = VI • useful power output = mgh / t **Or** power of lifting mass = mgh / t (accept power of lifting mass = Fv **and** $F = mg$ and $v = h/t$) • efficiency = power of lifting mass / power of motor **Or** efficiency = (mgh / t) / (VI) (accept efficiency = useful power output / power input, if quantities defined) MP3 dependent on MP1 **and** MP2 **OR** • energy input = VIt **Or** energy transferred to motor = VIt • useful energy output = mgh **Or** energy transferred to lifting mass = mgh (accept energy transferred to lifting mass = Fh **and** $F = mg$) • efficiency = energy transferred to lifting mass / energy transferred to motor **Or** efficiency = (mgh) / (VIt) (accept efficiency = useful energy output / energy input, if quantities defined) MP3 dependent on MP1 **and** MP2	 (1) (1) (1) (1) (1) (1)	3
	Total for question 2		**11**

Question Number	Answer		Mark
3(a)	• Laser light may cause damage/irritation to the eye **Or** laser light may temporarily dazzle the student • Do not look (directly) into the laser beam **Or** stand behind the laser **Or** wear dark lens safety glasses (accept light absorbing glasses) **Or** avoid reflective surfaces	**(1)** **(1)**	**2**
3(b)(i)	**EITHER** • Measure the distance between the centres of (adjacent) minima • Repeat for different pairs (of adjacent minima) and calculate a mean value **OR** • Measure the distance between the centres of multiple minima • Divide the distance by the number of gaps between minima	**(1)** **(1)** **(1)** **(1)**	**2**
3(b)(ii)	**EITHER** • Increase the distance between the hair and the screen **Or** use a laser with a longer wavelength • As this will increase the separation between minima MP2 dependent on MP1 **OR** • Use a measuring device with a higher resolution (accept named device e.g., vernier caliper) • As this will reduce the uncertainty in the measurement MP2 dependent on MP1	**(1)** **(1)** **(1)** **(1)**	**2**
3(c)(i)	• Calculation of mean • Mean value of d = 79.2 (μm) rounded to 3 s.f. <u>Example of calculation</u> Mean value of $d = \frac{76 + 84.4 + 77.1}{3} = 79.2$ μm	**(1)** **(1)**	**2**
3(c)(ii)	• Use of half range for uncertainty (accept difference to furthest from the mean) • Percentage uncertainty = 5.3% (furthest from the mean gives 6.5%) (e.c.f. from 3(c)(i) for both value and range) <u>Example of calculation</u> Uncertainty = half range = $\frac{84.4 - 76}{2} = 4.2$ μm Percentage uncertainty = $\frac{4.2}{79.2} \times 100 = 5.3\%$	**(1)** **(1)**	**2**
3(d)	**EITHER** • Upper limit = 192 MPa • The upper limit is below 210 MPa so the suggestion is **not** correct MP2 dependent on MP1 **OR** • Percentage difference = 14% • As the percentage difference is greater than 6%, the suggestion is **not** correct MP2 dependent on MP1 <u>Example of calculation</u> Upper limit = 181 × 1.06 = 192 MPa	**(1)** **(1)** **(1)** **(1)**	**2**
	Total for question 3		**12**

Question Number	Answer	Mark
4(a)	**MAX 4 (FROM ONLY 2 PAIRS)** • Cannot measure to the centre of the filament bulb **(1)** • So, measure the diameter of bulb separately and add the radius to the measurement of *d* **(1)** • Parallax error when measuring *d* (using the metre rule) **(1)** • Use a set square between the ruler and the sensor/bulb **Or** ensure eyes are perpendicular to the metre rule when taking measurements **(1)** • Background light will affect the readings on the light meter **(1)** • So, conduct the investigation in a dark room **Or** cover the apparatus to block background light **Or** measure and subtract the intensity of the background light **(1)**	**4**
4(b)(i)	**EITHER** • $I = k\frac{1}{d^2}$ is in the form $y = mx$ **(1)** • So, the gradient is *k* which is a constant **(1)** **OR** • $I = k\frac{1}{d^2}$ is in the form $y = mx + c$ **(1)** • So, the gradient is *k* which is a constant and there is no value for *c* **(1)**	**2**

4(b)(ii)

- Correct values of $\frac{1}{d^2}$ **(1)**
- ... rounded to 3 s.f. **(1)**

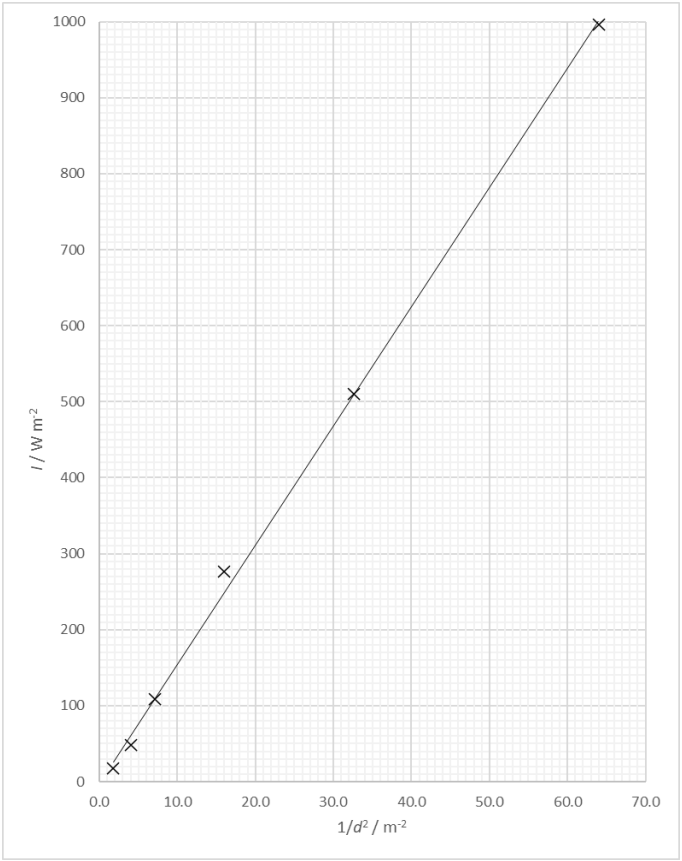
2

d / m	I / W m^{-2}	$\frac{1}{d^2}$ / m^{-2}
0.125	996	64.0
0.175	510	32.7
0.250	276	16.0
0.375	109	7.11
0.500	48	4.00
0.750	18	1.78

4(b)(iii)

- Labels axes with quantities and units **(1)**
- Sensible scales **(1)**
- Plotting **(2)**
- Line of best fit **(1)**

5



4(b)(iv)

- Calculates gradient using large triangle **(1)**
- k between 15.4 and 16.1 **(1)**
- k given to 2 or 3 s.f. **and** correct unit (W) **(1)**

3

Example of calculation

k = gradient = $\frac{940 - 200}{60 - 13}$ = 15.7 W

4(b)(v)

- Use of $I = \frac{k}{d^2}$ **(1)**
- d between 1.96 m and 2.01 m given to 2 or 3 s.f. (allow e.c.f. from 4(b)(iv)) **(1)**

2

Example of calculation

$d^2 = \frac{15.7}{(8 - 4)} = 3.93$

$d = \sqrt{3.93} = 1.98$ m

	Total for question 4	**18**

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