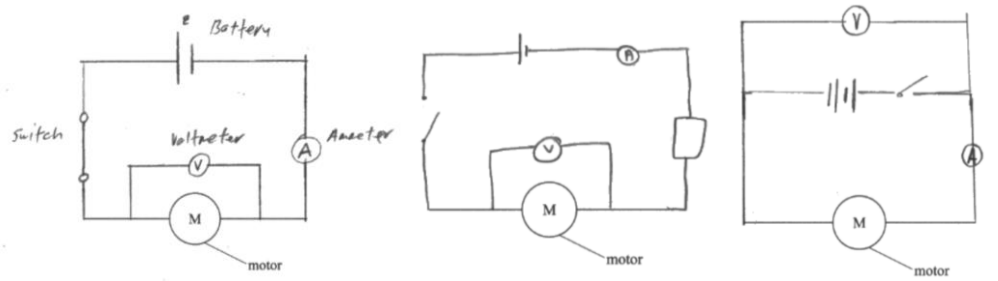
Pearson Edexcel

Mark Scheme (Results)

January 2024

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

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)**

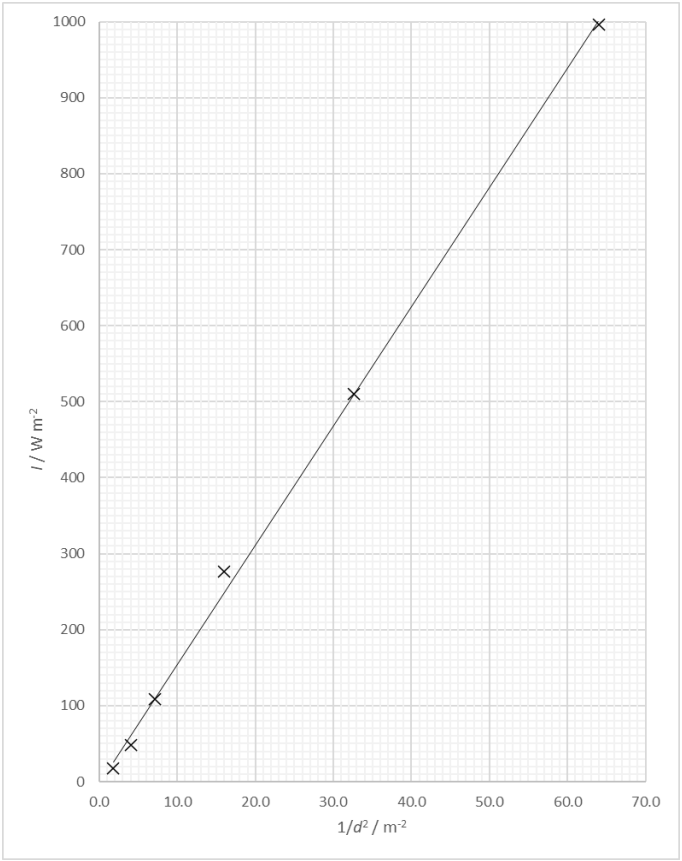
2

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**