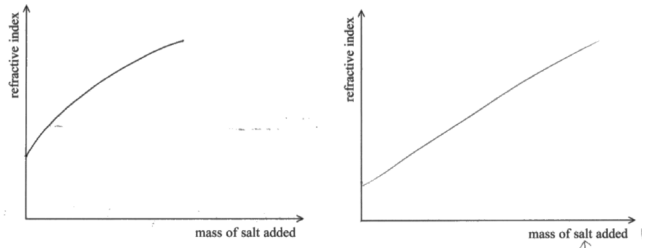
Mark Scheme (Results)

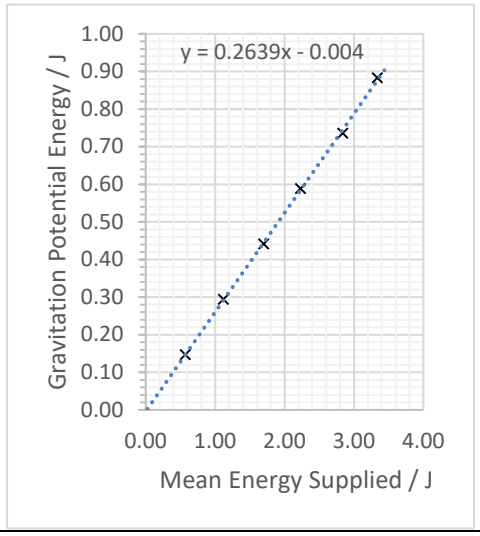
January 2020

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

Question Number	Answer	Mark
1(a)	A diagram which includes apparatus to; • change **and** measure diode temperature (e.g. water bath, Bunsen burner and beaker of water, thermometer) (1) • measure potential difference – connected in parallel with diode (e.g. voltmeter, multimeter on Volts setting) (1) • measure current – connected in series with diode (e.g. ammeter, multimeter on Amps setting) (1) • power source **and** means of changing p.d. (e.g. cell/battery and potential divider or variable resistor) (1) Accept incorrect symbols if correctly labelled	**4**
1(b)	• Comment identifying an appropriate safety issue (1) • Associated control measure (1) <u>Examples</u> • Risk of scalding from hot water • Clamp beaker • Risk of burns from hot apparatus • Wear gloves • Risk of electric shock from power supply • Keep separate from water bath **Or** Use a low voltage power supply	**2**
	Total for question 1	**6**

Question Number	Answer	Mark
2(a)	• Identifies upthrust = weight (of displaced fluid) (1) • See $W = m \times g$ **and** $m = V \times \rho$ (1) • See $V = A \times d$ **and** $A = \pi r^2$ (1) • A conversion to SI units (1) (e.g. g to kg)	**4**
2(b)	• Calculates gradient using large triangle (1) • Use of their gradient = $1/\pi r^2$ (1) • Diameter = 6.9 to 7.1 cm (1) Accept use of a correct pair of values from the graph and the equation stated for 1 mark only. <u>Example of calculation</u> gradient = (6.8 cm – 1.6 cm) / 200 g = 0.026 cm g^{-1} $r = \sqrt{\frac{1}{0.026\,\pi}} = 3.5$ cm diameter = $2 \times r$ = 7.0 cm	**3**
2(c)	• Mass/weight of the beaker (not included) (1) • Add the mass of the beaker to the mass of the load (and plot total) **Or** subtracting the depth when mass added is 0 (1)	**2**
	Total for question 2	**9**

Question Number	Answer	Mark
3(a)	• Mass (of solution) obtained using a (top pan) balance (1) • Volume (of solution) measured with a measuring cylinder (1) • Calculate density = mass / volume ($\rho = m / V$) (1)	**3**
3(b)	• Positive intercept on the refractive index axis (1) • Refractive index increases as mass of salt added increases (1) 	**2**
3(c)	• Measure θ_2 for different θ_1 (1) • Measure at least 5 pairs of angles (1) • Plot graph of sin θ_1 against sin θ_2 (1) • Refractive index is the gradient of the line (1)	**4**
3(d)(i)	• Use of $n_1 \sin \theta_1 = n_2 \sin \theta_2$ (with $n_1 = 1$) (1) • Max value = 1.38 (1) • Min value = 1.30 (1) <u>Example of calculation</u> $n_{max} = \frac{\sin 33.5^\circ}{\sin 23.5^\circ} = 1.384$ $n_{min} = \frac{\sin 32.5^\circ}{\sin 24.5^\circ} = 1.296$	**3**
3(d)(ii)	• Use of half range of values (1) • Percentage uncertainty = 3 (%) (1) Allow ecf from (d)(i) <u>Example of calculation</u> Range of values = 1.38 – 1.30 = 0.08 Half range of values = 0.04 percentage uncertainty = $\frac{0.04}{1.34} \times 100\% = 3\%$	**2**
	Total for question 3	**14**

Question Number	Answer	Mark
4(a)	Max 2 from • Mass is not measured to the nearest gram **Or** mass is not measured (in kg) to 3 d.p. (1) • Inconsistent/incorrect number of significant figures for GPE (1) • Mean energy supplied values should be 3 s.f. (to match measured values) (Accept 2 d.p.) (1)	**2**
4(b)	• Use of $E_g = mgh$ (1) • Change in gravitational potential energy = 0.88 (J) (1) • Mean energy supplied = 3.34 (J) (1) <u>Examples of calculation</u> $E_g = 0.12 \text{ kg} \times 0.75 \text{ m} \times 9.81 \text{N kg}^{-1} = 0.883 \text{ J}$ Mean = (3.32 J + 3.36 J + 3.33 J) ÷ 3 = 3.34 J	**3**
4(c)	• Labels axes with quantities and units (1) • Sensible scales (1) • Plotting (2) • Line of best fit (1)  | Change GPE / J	Mean E Supplied / J
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0.147	0.573
0.29	1.12
0.441	1.7
0.59	2.23
0.74	2.84
0.88	*3.34*		**5**
4(d)	• Calculates gradient using large triangle (1) • Efficiency = 0.25 to 0.27 (accept value converted to %) (1) <u>Example of calculation</u> Gradient = (0.79 J – 0.26 J) ÷ (3.00 J – 1.00 J) = 0.265	**2**
4(e)	• Continue increasing the mass and extend the graph (1) • Identify the mass/point at which the line starts to curve (1) • Take smaller increments in mass around this point (1) **OR** • Using larger masses, calculate the efficiency (using efficiency = mgh ÷ mean energy supplied) **and** plot a graph of efficiency against mass (1) • Identify the mass/point where the graph peaks **Or** identify the mass where efficiency starts to decrease (1) • Take smaller increments in mass around this point (1)	**3**
	Total for question 4	**15**

Question Number	Answer	Mark
5(a)	• (Diameter is 1/20 the original) so area is 1/400 original (1) • (For the same breaking stress) maximum force needed to break the sample is only 20N (so it is safe) (1) Accept correct calculations of both areas (with no comparison) for MP1 Accept repeated/combined calculations using $\sigma = F / A$ leading to a force of 20N to score both marks.	**2**
5(b)	• Use of $W = mg$ **and** $A = \pi d^2/4$ (1) • Use of $\sigma = F / A$ (1) • Breaking stress of sample = 2.62×10^7 (Pa) **Or** Force for manufacturers breaking stress = 18.1 (N) (1) • Comparative statement consistent with their value (1) For MP1 accept use of $A = \pi r^2$ <u>Example of Calculation</u> $W = mg = 1.9 \text{ kg} \times 9.81 \text{ N kg}^{-1} = 18.6 \text{ N}$ $A = \pi d^2/4 = \pi \times (0.00095 \text{ m})^2 / 4 = 7.1 \times 10^{-7} \text{ m}^2$ $\sigma = F / A = 18.6 \text{ N} / 7.1 \times 10^{-7} \text{ m}^2 = 2.62 \times 10^7 \text{ Pa}$	**4**
	Total for question 5	**6**