Pearson Edexcel

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

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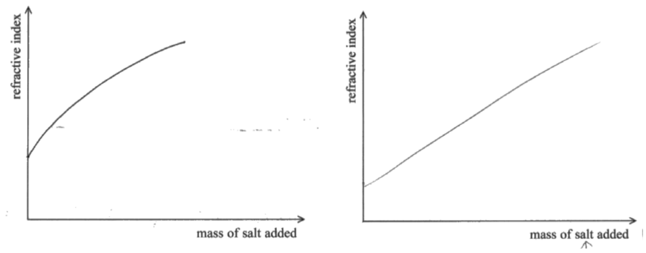
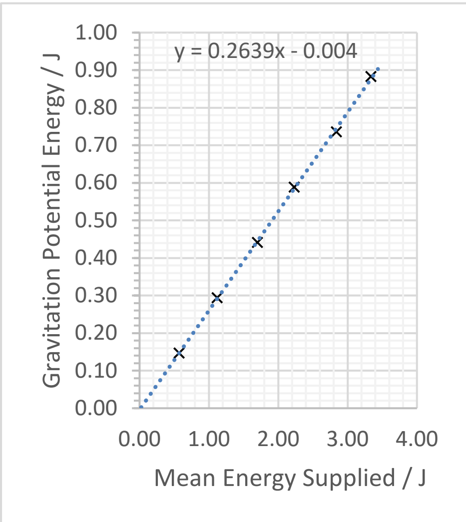
|---|---|---|
| **2(a)** | • Identifies upthrust = weight (of displaced fluid) (1)<br>• See $W = m \times g$ **and** $m = V \times \rho$ (1)<br>• See $V = A \times d$ **and** $A = \pi r^2$ (1)<br>• A conversion to SI units (e.g. g to kg) (1) | **4** |
| **2(b)** | • Calculates gradient using large triangle (1)<br>• Use of their gradient = $1/\pi r^2$ (1)<br>• Diameter = 6.9 to 7.1 cm (1)<br><br>Accept use of a correct pair of values from the graph and the equation stated for 1 mark only.<br><br><u>Example of calculation</u><br>gradient = (6.8 cm – 1.6 cm) / 200 g = 0.026 cm $g^{-1}$<br>$r = \sqrt{\dfrac{1}{0.026\,\pi}} = 3.5$ cm<br>diameter = 2 × $r$ = 7.0 cm | **3** |
| **2(c)** | • Mass/weight of the beaker (not included) (1)<br>• 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)<br>• Volume (of solution) measured with a measuring cylinder (1)<br>• Calculate density = mass / volume ($\rho = m / V$) (1) | **3** |
| **3(b)** | • Positive intercept on the refractive index axis (1)<br>• Refractive index increases as mass of salt added increases (1)<br> | **2** |
| **3(c)** | • Measure $\theta_2$ for different $\theta_1$ (1)<br>• Measure at least 5 pairs of angles (1)<br>• Plot graph of sin $\theta_1$ against sin $\theta_2$ (1)<br>• 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)<br>• Max value = 1.38 (1)<br>• Min value = 1.30 (1)<br><br><u>Example of calculation</u><br><br>$n_{max} = \frac{\sin 33.5°}{\sin 23.5°} = 1.384$<br><br>$n_{min} = \frac{\sin 32.5°}{\sin 24.5°} = 1.296$ | **3** |
| **3(d)(ii)** | • Use of half range of values (1)<br>• Percentage uncertainty = 3 (%) (1)<br><br>Allow ecf from (d)(i)<br><br><u>Example of calculation</u><br>Range of values = 1.38 – 1.30 = 0.08<br>Half range of values = 0.04<br>$\text{percentage uncertainty} = \frac{0.04}{1.34} \times 100\% = 3\%$ | **2** |
| | **Total for question 3** | **14** |

<table>
<tr><th>Question Number</th><th>Answer</th><th></th><th>Mark</th></tr>
<tr><td>4(a)</td><td>Max 2 from<br>• Mass is not measured to the nearest gram<br>Or mass is not measured (in kg) to 3 d.p.<br>• Inconsistent/incorrect number of significant figures for GPE<br>• Mean energy supplied values should be 3 s.f. (to match measured values) (Accept 2 d.p.)</td><td>(1)<br>(1)<br>(1)</td><td>2</td></tr>
<tr><td>4(b)</td><td>• Use of $E_g = mgh$<br>• Change in gravitational potential energy = 0.88 (J)<br>• Mean energy supplied = 3.34 (J)<br><br><u>Examples of calculation</u><br>$E_g = 0.12 \text{ kg} \times 0.75 \text{ m} \times 9.81 \text{N kg}^{-1} = 0.883 \text{ J}$<br>Mean = (3.32 J + 3.36 J + 3.33 J) ÷ 3 = 3.34 J</td><td>(1)<br>(1)<br>(1)</td><td>3</td></tr>
<tr><td>4(c)</td><td>• Labels axes with quantities and units<br>• Sensible scales<br>• Plotting<br>• Line of best fit<br><br><br><br><table><tr><th>Change GPE / J</th><th>Mean E Supplied / J</th></tr><tr><td>0.147</td><td>0.573</td></tr><tr><td>0.29</td><td>1.12</td></tr><tr><td>0.441</td><td>1.7</td></tr><tr><td>0.59</td><td>2.23</td></tr><tr><td>0.74</td><td>2.84</td></tr><tr><td>0.88</td><td>3.34</td></tr></table></td><td>(1)<br>(1)<br>(2)<br>(1)</td><td>5</td></tr>
<tr><td>4(d)</td><td>• Calculates gradient using large triangle<br>• Efficiency = 0.25 to 0.27 (accept value converted to %)<br><br><u>Example of calculation</u><br>Gradient = (0.79 J – 0.26 J) ÷ (3.00 J – 1.00 J) = 0.265</td><td>(1)<br>(1)</td><td>2</td></tr>
<tr><td>4(e)</td><td>• Continue increasing the mass and extend the graph<br>• Identify the mass/point at which the line starts to curve<br>• Take smaller increments in mass around this point<br>OR<br>• Using larger masses, calculate the efficiency (using efficiency = mgh ÷ mean energy supplied) and plot a graph of efficiency against mass<br>• Identify the mass/point where the graph peaks<br>Or identify the mass where efficiency starts to decrease<br>• Take smaller increments in mass around this point</td><td>(1)<br>(1)<br>(1)<br><br>(1)<br>(1)<br>(1)</td><td>3</td></tr>
<tr><td></td><td>Total for question 4</td><td></td><td>15</td></tr>
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|---|---|---|
| **5(a)** | • (Diameter is 1/20 the original) so area is 1/400 original (1)<br>• (For the same breaking stress) maximum force needed to break the sample is only 20N (so it is safe) (1)<br><br>Accept correct calculations of both areas (with no comparison) for MP1<br><br>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)<br>• Use of $\sigma = F / A$ (1)<br>• Breaking stress of sample = $2.62 \times 10^7$ (Pa)<br>**Or** Force for manufacturers breaking stress = 18.1 (N) (1)<br>• Comparative statement consistent with their value (1)<br><br>For MP1 accept use of $A = \pi r^2$<br><br><u>Example of Calculation</u><br><br>$W = mg = 1.9 \text{ kg} \times 9.81 \text{ N kg}^{-1} = 18.6 \text{ N}$<br>$A = \pi d^2/4 = \pi \times (0.00095 \text{ m})^2 / 4 = 7.1 \times 10^{-7} \text{ m}^2$<br>$\sigma = F / A = 18.6 \text{ N} / 7.1 \times 10^{-7} \text{ m}^2 = 2.62 \times 10^7 \text{ Pa}$ | **4** |
| | **Total for question 5** | **6** |