ASSESSMENT and QUALIFICATIONS ALLIANCE

# Mark scheme June 2003

# GCE

## Physics B

### Unit PHB6



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# PHB6

## Exercise 1

### Question 1

| | | | |
|---|---|---|---|
| (a)(i) | value ≈ 5 (mm) allow 1 or 2 s.f.. | B1 | |
| | repeated and averaged appropriate unit | B1 | **2** |
| (ii) | correct substitution into $\pi r^2$ | M1 | |
| | correct calculation in $cm^2$ only (*0.20/0.28 most likely*) | A1 | **2** |
| (b) | measurement of length in cm | B1 | |
| | multiplication by area and addition of 5.0 $cm^3$ (2/3 s.f.) (*5 $cm^3$ scores 1 and 5.0 $cm^3$ scores 2*) | B1 | **2** |
| (c)(i) | mention of bottom of *meniscus* allow clear diagram | B1 | **1** |
| (ii) | start at same level one up and one down, two up and two down etc. or other sensible clear statements | B1 | **1** |
| (d)(i) | minimum of 3 positive values of $h$ (not including 0) | B3 | |
| | minimum of 3 negative value of $h$ | B3 | |
| | minimum of six readings showing $h$ to be the sum of distances from neutral position on each side/ repeats and averages of $l$ or $h$ shown | B1 | |
| | minimum of six $l$ values consistent with h's recorded | B1 | |
| | neat table with consistent significant figures | B1 | **9** |
| (ii) | table containing corresponding values of $h$, $V$ and $1/V$ with correct units | B1 | |
| | $V$ correctly calculated/or simply read from syringe scale | B1 | |
| | all $V$ values to 1 d.p. in $cm^3$ | B1 | |
| | $1/V$ correctly calculated (*check first value*) | B1 | **4** |
| (e) | axes correct way round and quantities and units correctly labelled | B1 | |
| | scales non-awkward and at least half length of paper in each direction | M1 | |
| | min of five points correctly plotted (allow 1 error of 1mm) **check and tick two extreme (from table) points** | A1 | |
| | best straight line (0 if less than four points plotted) | B1 | |
| | overall quality of the graph | B1 | **5** |
| (f)(i) | candidate relates $k$ to gradient | M1 | |
| | use of large gradient triangle (at least half plotted line in each direction) with correct side lengths/coordinates | M1 | |
| | consistent value for $k$ 2/3 s.f.* | A1 | **3** |
| (ii) | $cm^4$ etc. | B1 | **1** |
| | use of point on line | B1 | |
| | substitute coordinates and $k$ value | B1 | |

| | | | |
|---|---|---|---|
| | consistent calculation of $P$ (in same units as $h$) 2/3 s.f.*<br>*compensation of 1 for correctly read intercept on poor scale* (in same units as $h$)<br>*only one penalty | B1 | **3** |
| | number of moles or mass of gas<br>relevant comparison of equation with ideal gas<br>temperature<br>relevant comparison of equation with ideal gas | M1<br>A1<br>M1<br>A1 | |
| | density of liquid in tube<br>clear link with $p = h\rho g$ | M1<br>A1 | **Max 4** |
| | the use of physics is accurate, the answer is fluent/well argued with few errors in spelling, punctuation and grammar<br>(**must gain at least 2 for Physics**) | | **2** |
| | the use of physics is accurate but the answer lacks coherence or the spelling, punctuation and grammar are poor<br>(**must gain at least 1 for Physics**) | | **1** |
| | the use of the physics is inaccurate, the answer is disjointed with significant errors in spelling punctuation and grammar. | | **0** |
| | | | **Max 2** |
| | | | **6** |
| | | | **Total 39** |

**Exercise 2**

**Question 1**

| | | | |
|---|---|---|---|
| (a) | **swing**: reference **to total** of 10 or more oscillations<br>calculated $T/s$<br>≈ 1s*<br>**bounce:** reference **to total** 5 or more oscillations<br>calculated $T/s$<br>≈ 0.5 s*<br>**twist:** reference **to total** 2 or more oscillations<br>calculated T/s<br>≈ 10 s*<br>*penalise any oscillations that are clearly ½ oscillations either by descriptions or inconsistent times<br>*penalise unit once only | B1<br>B1<br>B1<br>B1<br>B1<br>B1 | **6** |
| (b)(i) | greatest damping of bouncing oscillations + least damping twisting | B1 | **1** |
| (ii) | top gpe; bottom epe (+ gpe); middle ke ( + gpe)<br>temp rise of rubber/w.d. on rubber/ rubber "heats up" | B1<br>B1 | **2** |

| | | | |
|---|---|---|---|
| (iii) | air resistance<br>internal energy of rubber ***not*** *heating*<br><br>**further detail relating to either air resistance or increased internal energy of rubber**: large surface area at right angles to motion means high air resistance – energy transferred to surroundings /increased kinetic energy of air molecules/ on falling work is done by gravity in separating molecules /energy is not recovered when rubber contracts so loss of possible energy / hysteresis etc. | M1<br>M1<br><br><br><br><br><br>A1 | **3** |
| (c) | minimum of 5 steps of 100g<br>constant twist applied<br>time 10 oscillations<br>repeat and average times<br>graph of lg$T$ vs $l$g m (or reversed)<br>gradient $n$ (or 1/$n$)<br>lg$T$ intercept lg$c$ (or consistent with graph)<br>*max 3 for method | B1<br>B1<br>B1<br>B1<br>B1<br>B1<br>B1 | **Max 6** |
| | the use of physics is accurate, the answer is fluent/well argued with few errors in spelling, punctuation and grammar<br>(**must gain at least 3 for Physics**) | | **2** |
| | the use of physics is accurate but the answer lacks coherence or the spelling, punctuation and grammar are poor<br>(**must gain at least 1 for Physics**) | | **1** |
| | the use of the physics is inaccurate, the answer is disjointed with significant errors in spelling punctuation and grammar. | | **0** |
| | | | **Max 2** |
| | | | **8** |
| | | | **Total 20** |

**Question 2**

| | | | |
|---|---|---|---|
| (a)(i) | R = 120.0 Ω (4 s.f.) | B1 | **1** |
| (b) | value of $R_{max}$ approximately 2 Ω larger<br>any second reading<br>to ¾ s.f.<br>value of $R_{min}$ taken with gauge clearly on underside | B1<br>B1<br>B1<br>B1 | **4** |
| (c)(i) | larger value on the top – extension or wire thinner<br>smaller value on the bottom – compression or wire fatter | B1<br>B1 | **2** |
| (i) | min of 1 value of $\Delta R$ divided by $R$ (allow fraction) | B1 | **1** |

| | | | |
|---|---|---|---|
| (d)(i) | 8 – 10 mm | M1 | |
| | multiplied by number of strips (10 or 12) (u.p.) | A1 | **2** |
| (ii) | calculation of extension [2.1 x ©(ii) x (d)(i)] | B1 | |
| | estimate of $\delta l$ (either 1 or 2 mm) OR $\delta l / l$ | B1 | |
| | clear idea that % extension = $\%l + \%\Delta R + \%R$ | M1 | |
| | % x extension | A1 | **4** |
| (e)(i) | resistor in series with strain gauge and power supply | B1 | |
| | resistor ≈ 60 – 120 Ω **and** power supply (1 – 12 V) | B1 | **2** |
| (ii) | correct use of potential divider formula OR calculation of relevant current | M1 | |
| | calculation of unstretched and stretched voltages to give change in voltage OR of change in resistance ($\Delta R$) multiplied by current to give change in voltage | M1 | |
| | sensible comment regarding likelihood of being resolved base on precision of typical voltmeter | A1 | **3** |
| | | | **Total 19** |