G.C.E. (A/L) Grade 12 – Unit Test

Answer Key – Final Answers

Physics I – Measurement · Working is not repeated; full marks need full working (see the marking scheme).

Section A – Physics and the scientific method

A1 **(4)** A2 **(1)** A3 **(3)**

A4. (a) Length of the string; (b) Time for one oscillation (period); (c) Any two: mass of the bob, amplitude (angle), place/value of g; (d) Advances in physics rest on repeated observations; repeating reduces random error and makes the inference reliable

Section B – Physical quantities and SI units

B1 **(3)** B2 **(5)** B3 **(3)** B4 **(5)** B5 **(2)** B6 **(2)** B7 **(5)** B8 **(4)** B9 **(2)** B11 **(1)** B12 **(4)** B13 **(4)**

B10. (a) $108 \times 1000/3600 = 30$ m s^{-1}; (b) $13.6 \times 10^3 = 1.36 \times 10^4$ kg m^{-3}; (c) $5 \times (10^{-3})^2 = 5 \times 10^{-6}$ m^2; (d) $2 \times (10^{-1})^3 = 2 \times 10^{-3}$ m^3

B14. (a) $G = F r^2 / (m_1 m_2)$; (b) = kg m s^{-2} m^2 kg^{-2} = kg^{-1} m^3 s^{-2}

Section C – Significant figures and scientific notation

C1 **(4)** C2 **(4)** C3 **(2)** C4 **(4)** C5 **(5)** C6 **(1)**

C7. (a) The final zero shows the reading is to 0.01 cm (least count of the vernier) – it is a significant figure; (b) = 9.26 cm^3 (3 s.f.)

Section D – Dimensions

D1 **(1)** D2 **(4)** D3 **(1)** D4 **(5)** D5 **(1)** D6 **(5)** D8 **(1)** D9 **(3)** D10 **(1)** D13 **(2)** D14 **(1)**

D7. (a) 2as: $(LT^{-2})(L) = L^2T^{-2}$ → all terms the same; (b) Dimensionless constants (e.g. ½, 2) cannot be checked

D11. (a) $T = M^x L^y (LT^{-2})^z$; (b) T: $-2z = 1$; (c) $z = -½$, $y = ½$, $x = 0$ → $T = k\sqrt{(l/g)}$

D12. $x = -1$ → $f = (k/l)\sqrt{(T/\mu)}$

Section E – Errors in measurement

E1 **(1)** E2 **(4)** E3 **(3)** E4 **(1)** E5 **(2)** E6 **(5)** E8 **(5)** E10 **(5)**

E7. (a) $T = 32.4/20 = 1.62$ s; (b) $0.2/32.4 \times 100 = 0.62$ %; (c) $0.2/1.6 \times 100 = 12.5$ %; (d) The same absolute error is spread over a larger reading → smaller percentage error

E9. (a) $(4.52 + 4.53 + 4.51 + 4.52)/4 = 4.52$ cm; (b) $4.52 - (-0.03) = 4.55$ cm; (c) (b) systematic (zero) error

Section F – Metre ruler and choosing the right instrument

F1 **(4)** F2 **(3)** F3 **(5)** F5 **(5)**

F4. (a) Micrometer screw gauge; (b) Vernier caliper (depth bar); (c) Spherometer; (d) Travelling microscope; (e) Scientific electronic balance; (f) Stopwatch (digital) – timing many oscillations

Section G – Vernier caliper

G1 **(1)** G2 **(1)** G3 **(2)** G4 **(3)** G5 **(2)** G6 **(2)** G7 **(3)** G8 **(3)** G9 **(4)** G10 **(2)** G11 **(2)** G12 **(4)** G13 **(1)** G15 **(5)** G16 **(2)** G17 **(3)** G19 **(3)** G20 **(2)**

G14. (a) D – outer jaws; d – inner jaws; h – depth bar (all three); (b) $(3.84 - 3.22)/2 = 0.31$ cm; (c) = 36.6 cm^3

G18. (a) covering 19 mm; (b) $54 + 13 \times 0.05 = 54.65$ mm; (c) $-(20 - 18) \times 0.05 = -0.10$ mm; (d) $54.65 - (-0.10) = 54.75$ mm

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Section H – Micrometer screw gauge

H1 **(5)** H2 **(3)** H3 **(3)** H4 **(4)** H5 **(3)** H6 **(2)** H7 **(4)** H8 **(4)** H9 **(4)** H11 **(3)** H13 **(1)**

H10. (a) Corrected = 0.52 − 0.02 = 0.50 mm; (b) = 1.96×10^{-7} m²; (c) The wire may not be perfectly circular in cross-section

H12. (a) 2.5/5 = 0.5 mm; (b) 0.5/50 = 0.01 mm; (c) +0.03 mm; (d) Corrected = 6.84 mm; (e) $(4/3)\pi(3.42)^3 = 167$ mm³

Section I – Spherometer

I1 **(1)** I2 **(3)** I3 **(2)** I4 **(2)** I5 **(3)** I7 **(1)** I8 **(3)**

I6. (a) h = 2.36 − 1.86 = 0.50 mm; (b) = 67.5 cm; (c) h is very small compared with $l^2/6h$; (d) Press the legs on paper, measure the three distances between marks and take the mean

Section J – Travelling microscope

J1 **(5)** J2 **(5)** J3 **(2)** J4 **(5)** J6 **(2)**

J5. (a) Radius = 0.027 cm; (b) Bore may not be circular; (c) To avoid backlash error

Section K – Balances, stopwatches and the digital multimeter

K1 **(3)** K2 **(2)** K3 **(2)** K4 **(3)** K5 **(1)** K6 **(4)** K7 **(1)**

Section L – Scalars and vectors

L1 **(5)** L2 **(5)** L3 **(3)** L4 **(1)** L5 **(5)** L6 **(4)** L7 **(1)** L8 **(4)** L9 **(4)** L11 **(4)** L12 **(5)**

L10. (a) = 76 → R = 8.7 N; (b) $\alpha \approx 37°$

L13. (a) $R = \sqrt{(15^2 + 8.66^2)} = 17.3$ N at 30° to the x-axis; (b) 17.3 N at 210° (opposite to R)

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