

GCSE / IGCSE Physics – Required Practicals

GCSE/IGCSE (Edexcel/AQA/Cambridge style) · Total marks: 44 · Answers on the last page

This worksheet covers the method, key variables, calculations and evaluation for the core required practicals. A calculator is allowed; show all working and give units.

Section A – Apparatus, method and variables (Skills questions)

1. A student finds the density of an irregularly shaped stone using a displacement can and a balance.
 - (a) State the two additional pieces of apparatus needed and how each measurement is taken.
 - (b) State the independent, dependent and one control variable in this experiment. [4]
2. In the resistance investigation, a student measures current through a resistance wire for a range of potential differences using a variable power supply, ammeter and voltmeter.
 - (a) Draw (describe in words) the correct circuit, stating how the ammeter and voltmeter are connected.
 - (b) State one control variable that must be kept constant for a valid comparison of different wires. [3]
3. In the specific heat capacity experiment, an immersion heater and joulemeter (or ammeter/voltmeter and timer) are used to heat a metal block.
 - (a) State one safety precaution needed for this experiment.
 - (b) Explain why the block should be insulated during heating. [3]
4. A student investigates how the extension of a spring depends on the applied force using a spring, clamp stand, ruler and slotted masses.
 - (a) State how the extension is calculated from the readings taken.
 - (b) State one way to improve the accuracy of the length measurement. [3]

Section B – Calculations from practical data (Calculator allowed; show working)

5. A student measures a cuboid block: mass 45.6 g, length 5.0 cm, width 3.0 cm, height 2.0 cm. Calculate the density of the block, giving the correct unit. [3]
6. In a Hooke's law investigation, the extensions for increasing force were: 0 N → 0 mm, 1 N → 15 mm, 2 N → 30 mm, 3 N → 45 mm, 4 N → 65 mm.
 - (a) Use the data up to 3 N to calculate the spring constant k in N m^{-1} .
 - (b) State, with a reason, between which two readings the limit of proportionality is exceeded. [4]
7. For a fixed length of resistance wire, a student records $V = 2.0 \text{ V}$ and $I = 0.40 \text{ A}$.
 - (a) Calculate the resistance of the wire.
 - (b) A filament lamp is then tested instead. Explain why its resistance increases as the current increases. [4]
8. In a specific heat capacity experiment, an electrical heater supplies 36 W to a 1.0 kg aluminium block for 500 s, and the temperature rises by 20°C . Calculate the specific heat capacity of aluminium from these results. [4]
9. A heater supplying 48 W melts ice in a funnel for 210 s. The mass of melted ice collected is 0.030 kg.
 - (a) Calculate the specific latent heat of fusion of ice from this data.
 - (b) The accepted value is $3.34 \times 10^5 \text{ J kg}^{-1}$. Comment on the result. [4]

Section C – Extended analysis

10. A trolley is released from rest at the top of a 0.60 m ramp and a light gate/timer records a time of 0.48 s to reach the bottom.
- (a) Calculate the acceleration of the trolley, assuming it starts from rest.
 - (b) State one way to reduce random error in the measured time. [4]
11. In a ripple tank, waves of wavelength 2.5 cm are generated at a frequency of 8 Hz.
- (a) Calculate the speed of the waves.
 - (b) Describe how the frequency could be measured directly using a stroboscope. [4]
12. A student shines light from air into a glass block. The angle of incidence is 40° and the angle of refraction is measured as 25° .
- (a) Calculate the refractive index of the glass.
 - (b) Identify one source of random error in measuring the angle of refraction, and one way to reduce it. [4]

Answers

Check your working against these. If an answer does not match, try the question again before looking for the method.

- (a) A eureka can (displacement can) and measuring cylinder to find volume of water displaced; a top-pan balance to find mass of the stone.
 - (b) Independent: which object is tested (or its volume); Dependent: mass (and calculated density); Control: same water temperature/eureka can, same balance, stone fully submerged with no air bubbles.
- (a) Ammeter connected in series with the wire; voltmeter connected in parallel across the wire only.
 - (b) Length of wire (and its cross-sectional area/thickness, and temperature) must be kept constant.
- (a) Do not touch the heater or block once heated (hot surfaces), or take care with mains electricity/water near sockets.
 - (b) Insulation reduces heat loss to the surroundings, so the energy transferred is (more nearly) all used to raise the temperature of the block, giving a more accurate value for the specific heat capacity.
- (a) Extension = stretched length - original (unstretched) length, measured with a ruler against a fixed reference (set square used to read ruler at eye level).
 - (b) Use a set square to avoid parallax error, or view the scale at eye level, or use a pointer/marker on the spring.
- Volume = $5.0 \times 3.0 \times 2.0 = 30 \text{ cm}^3$. Density = $45.6/30 = 1.52 \text{ g cm}^{-3}$.
- (a) $k = F/x = 3/0.045 = 66.7 \text{ N m}^{-1}$ (using any linear pair, e.g. $1 \text{ N}/0.015 \text{ m} = 66.7 \text{ N m}^{-1}$).
 - (b) Between 3 N and 4 N, because the extension per newton increases from 15 mm to 20 mm, so extension is no longer proportional to force.
- (a) $R = V/I = 2.0/0.40 = 5.0 \Omega$.
 - (b) As current increases the filament heats up; the ions in the metal lattice vibrate more, so electrons collide with them more often, increasing resistance.
- Energy supplied = $Pt = 36 \times 500 = 18000 \text{ J}$. $c = \frac{Q}{m\Delta T} = \frac{18000}{1.0 \times 20} = 900 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$.
- (a) Energy supplied = $48 \times 210 = 10080 \text{ J}$. $L = \frac{Q}{m} = \frac{10080}{0.030} = 3.36 \times 10^5 \text{ J kg}^{-1}$.
 - (b) The result is very close to the accepted value (about 0.6% higher), suggesting only a small systematic error (e.g. some heat loss to surroundings or ice already melting before timing started).
- (a) Using $s = \frac{1}{2}at^2$: $a = \frac{2s}{t^2} = \frac{2 \times 0.60}{0.48^2} = 5.2 \text{ m s}^{-2}$.
 - (b) Repeat the timing several times and take a mean, or use light gates/data-logging instead of a stopwatch to remove human reaction-time error.
- (a) $v = f\lambda = 8 \times 0.025 = 0.20 \text{ m s}^{-1}$.
 - (b) Adjust the stroboscope flashing rate until the waves appear stationary; the flashing frequency then equals the wave frequency (read directly from the stroboscope).
- (a) $n = \frac{\sin 40^\circ}{\sin 25^\circ} = \frac{0.643}{0.423} = 1.52$.
 - (b) Random error: difficulty judging the exact position of the ray/normal by eye (parallax when marking points). Reduction: mark at least two points on the emerging ray as far apart as possible before drawing the line, or repeat and average several readings.

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