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British Physics Olympiad 2024-25

Round 2 Answer Booklet

Saturday 22 February 2025

Name	
School	
Account Number	

Instructions

Time: 3 hours (approximately 45 minutes per question).

Questions: All four questions should be attempted.

Marks: The four questions carry similar marks.

Solutions: Answers and calculations are to be written on loose paper or in examination booklets.
Students should ensure their name and school is clearly written on all answer sheets.
A new question should be started on a new page.
Pages must be numbered.

Instructions: Graph paper should be provided.
A standard formula booklet with standard physical constants should be supplied.

Calculators: Any standard calculator may be used, but calculators must not have symbolic algebra capability. If they are programmable, then they must be cleared or used in "exam mode".

Clarity: Solutions must be written legibly, in black pen (the papers are photocopied), and working down the page. Scribble will definitely not be marked and overall clarity is an important aspect of this competition paper.

BPhO Answer Booklet

Name: School: Account Number: Page:

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Formula Sheet

February 2025

Mechanics

Equations of motion	$s = ut + \frac{1}{2}at^2$
	$v^2 = u^2 + 2as$
	$s = 1/2(u+v)t$
Impulse	$F\Delta t = \Delta(mv)$
Work	$W = Fs\cos\theta$
Centripetal acceleration	$a = \frac{v^2}{r} = \omega^2 r$
Hydrostatic pressure	$p = \rho g h$

Electricity

Current	$I = \frac{\Delta Q}{\Delta t}$
Power	$P = VI$
Resistance	$V = IR$
Electric current	$I = nAvq$
Resistivity	$R = \frac{\rho \ell}{A}$
Resistors in series	$R = R_1 + R_2 + \ldots$
Resistors in parallel	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$
AC voltage	$V = V_0 \sin\omega t$

SHM

Acceleration	$a = -\omega^2 x$
Displacement	$x = A\sin(\omega t + \phi)$
Period of a spring	$T = 2\pi\sqrt{\frac{m}{k}}$

Radioactivity

Radioactive decay	$N = N_0 \exp(-\lambda t)$
Decay constant	$\lambda t_{\frac{1}{2}} = \ln 2 = 0.693$

Thermal

Heat transfer	$Q = mc\Delta T$ and $Q = mL$
Thermodynamics	$\Delta Q = \Delta U + \Delta W$

Waves

Refraction	$n_1 \sin\theta_1 = n_2 \sin\theta_2$
Double slit fringes	$w = \frac{\lambda d}{s}$
Doppler effect	$f_o = \frac{f_s c}{c \pm v_s}$
de Broglie wavelength	$\lambda = \frac{h}{p}$
Photon energy	$E = hf$

Gases

Gas law	$pV = nRT$
Work done by a gas	$\Delta W = p\Delta V$
Pressure of an ideal gas	$pV = \frac{1}{3}Nm\langle c^2 \rangle$
Energy of a molecule	$\frac{1}{2}mc^2_{\text{RMS}} = \frac{3}{2}kT$

Fields

Field and potential	$E = -\frac{\Delta V}{\Delta x}$
Gravitational potential	$V_g = -\frac{GM}{r}$
Gravitational field	$E_g = \frac{GM}{r^2}$
Electric potential	$V = \frac{Q}{4\pi\varepsilon_0 r}$
Electric field	$E = \frac{Q}{4\pi\varepsilon_0 r^2}$
Capacitance	$C = \frac{Q}{V}$
Capacitors in series	$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots$
Capacitors in parallel	$C = C_1 + C_2 + \ldots$
Energy of a capacitor	$E = \frac{1}{2}QV$
Magnetic force	$F = I\ell B$ and $F = qvB$
EM induction	$\varepsilon = -N\frac{\mathrm{d}\phi}{\mathrm{d}t}$