

HSC physics: NESA's data sheet and formulae sheet, annotated

Printed in every HSC Physics paper since 2019, unchanged: one page of constants, two pages of formulas in four module boxes, and the periodic table. Values as on the sheet.

The data sheet

Constant	Value	Constant	Value
Charge on the electron	$-1.602 \times 10^{-19} \text{ C}$	Universal gravitational constant G	$6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
Mass of the electron	$9.109 \times 10^{-31} \text{ kg}$	Mass of the Earth	$6.0 \times 10^{24} \text{ kg}$
Mass of the neutron	$1.675 \times 10^{-27} \text{ kg}$	Radius of the Earth	$6.371 \times 10^6 \text{ m}$
Mass of the proton	$1.673 \times 10^{-27} \text{ kg}$	Planck constant h	$6.626 \times 10^{-34} \text{ J s}$
Speed of sound in air	340 m s^{-1}	Rydberg constant (hydrogen)	$1.097 \times 10^7 \text{ m}^{-1}$
g	9.8 m s^{-2}	Atomic mass unit	$1.661 \times 10^{-27} \text{ kg}; 931.5 \text{ MeV}/c^2$
Speed of light c	$3.00 \times 10^8 \text{ m s}^{-1}$	1 eV	$1.602 \times 10^{-19} \text{ J}$
Electric permittivity constant	$8.854 \times 10^{-12} \text{ A}^2 \text{ s}^4 \text{ kg}^{-1} \text{ m}^{-3}$	Density of water	$1.00 \times 10^3 \text{ kg m}^{-3}$
Magnetic permeability constant	$4 \pi \times 10^{-7} \text{ N A}^{-2}$	Specific heat capacity of water	$4.18 \times 10^3 \text{ J kg}^{-1} \text{ K}^{-1}$
		Wien's displacement constant	$2.898 \times 10^{-3} \text{ m K}$

Formulae sheet, boxes 1 and 2

Box	Given	Not given: derive or know
Motion, forces and gravity	$s = ut + \frac{1}{2}at^2$; $v^2 = u^2 + 2as$; $v = u + at$; $\Delta U = mg \Delta h$; $P = \Delta E / \Delta t$; KE and momentum conservation sums; impulse $\Delta p = F \Delta t$; $\omega = \Delta \theta / t$; torque $= rF \sin \theta$; $v = 2\pi r / T$; $U = -GMm/r$; $F = ma$; $W = Fs \cos \theta$; $K = \frac{1}{2}mv^2$; $P = Fv \cos \theta$; $a_c = v^2/r$; $F_c = mv^2/r$; $F = GMm/r^2$; $r^3/T^2 = GM / 4\pi^2$	projectile components and results; orbital velocity $\sqrt{GM/r}$; escape velocity $\sqrt{2GM/r}$; total orbital energy $-GMm/2r$; friction and inclines; Newton's laws as statements
Waves and thermodynamics	$v = f\lambda$; $f = 1/T$; $d \sin \theta = m\lambda$; $n = c/v$; $I = I_{\max} \cos^2 \theta$; $Q = mc \Delta T$; beats; the Doppler equation; Snell's law; the critical angle; $I_1 r_1^2 = I_2 r_2^2$; $Q/t = kA \Delta T / d$	standing waves and harmonics (strings, open and closed pipes); resonance; $Q = mL$ (given when needed); the Doppler sign conventions

Boxes 3 and 4, and the exam habits

Box	Given	Not given: derive or know
Electricity and magnetism	$E = V/d$; $V = \Delta U / q$; $W = qV$; $W = qEd$; B of a wire $\mu_0 I / 2 \pi r$; B of a solenoid $\mu_0 N I / L$; flux = $BA \cos \theta$; $\text{emf} = -N \Delta \text{flux} / \Delta t$; $V_p/V_s = N_p/N_s$; $F = qE$; Coulomb's law; $I = q/t$; $V = IR$; $P = VI$; $F = qvB \sin \theta$; $F = IIB \sin \theta$; F/l between parallel wires; torque = $nIAB \sin \theta$; $V_p I_p = V_s I_s$	resistors in series and parallel; Kirchhoff's laws; $E = F/q$ and the field of a point charge; the right-hand rules; Lenz's law; back emf; transmission losses with $P = I^2 R$; motor torque variation with angle
Quantum, special relativity and nuclear	$\lambda = h/mv$; $K_{\max} = hf - \text{work function}$; $\lambda_{\max} = b/T$; $E = mc^2$; $E = hf$; the Rydberg equation; time dilation; length contraction; relativistic momentum; $N = N_0 e^{(-\lambda t)}$; $\lambda = \ln 2 / \text{half-life}$	mass defect and binding energy per nucleon procedure; $E = \gamma mc^2$ and relativistic KE; threshold frequency and stopping voltage; Bohr's postulates and the energy levels; the spectral series; the Standard Model; nuclear equations; the H-R diagram and stellar evolution; Hubble's law

Exam habits

[] Match the box to the module: satellites in box 1, Doppler in box 2, motors and transformers in box 3, anything with h , c or a half-life in box 4

[] Read the subscripts: Doppler is $(v_{\text{wave}} + v_{\text{observer}}) / (v_{\text{wave}} - v_{\text{source}})$; the force on a charge uses v perpendicular; the coil torque uses A perpendicular

[] Use the data sheet's precision ($g = 9.8$; $c = 3.00 \times 10^8$) and the question's significant figures

[] Formula first, rearrangement second, substitution with units third: the marking guidelines give method marks

[] Not on the sheet and asked every year: orbital velocity (equate GMm/r^2 and mv^2/r), escape velocity (total energy zero), resistors in series and parallel, binding energy from the mass defect

My module checklist

Formulas I keep looking up (practise these):

Derivations I must be able to do in two lines:

Constants I misread (units, powers):

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sciencewithshobha.com/blog/hsc-physics-formula-sheet-and-data-sheet-every-formula-and-constant-nesa-gives-you-by-module-and-what-you-must-memorise/