

Astronomy and cosmology

Cambridge International AS & A Level Physics

Unlike IGCSE, 9702 gives you a data sheet: it is page 2 of Papers 1, 2 and 4, with more formulae on page 3 of Paper 4. Everything marked GIVEN is printed for you; everything else you must recall. Compiled by GioPhysics from the published syllabus. This is an independent study aid, not a Cambridge document; the official syllabus is the authority.

25.1 Standard candles

A LEVEL Radiant flux intensity (inverse square law)

$$F = L / (4\pi d^2)$$

F — radiant flux intensity (W m^{-2})

L — luminosity of the source (W)

d — distance (m)

25.2 Stellar radii

A LEVEL Wien's displacement law

$$\lambda_{\text{max}} \propto 1 / T$$

λ_{max} — peak wavelength (m)

T — surface temperature (K)

A LEVEL Stefan-Boltzmann law

$$L = 4\pi\sigma r^2 T^4$$

L — luminosity (W)

σ — Stefan-Boltzmann constant ($\text{W m}^{-2} \text{K}^{-4}$)

r — stellar radius (m)

T — surface temperature (K)

25.3 Hubble's law and the Big Bang theory

A LEVEL Doppler redshift

$$\Delta\lambda/\lambda \approx \Delta f/f \approx v/c$$

$\Delta\lambda$ — change in wavelength (m)

v — speed of recession (m s^{-1})

c — speed of light (m s^{-1})

For v much less than c.

A LEVEL Hubble's law

$$v \approx H_0 d$$

v — speed of recession (m s^{-1})

H_0 — Hubble constant (s^{-1})

d — distance to the galaxy (m)

— Values to know

AS	Acceleration of free fall, g	9.81 m s⁻²
AS	Speed of light in free space, c	3.00 × 10⁸ m s⁻¹
AS	Elementary charge, e	1.60 × 10⁻¹⁹ C
AS	Unified atomic mass unit, 1 u	1.66 × 10⁻²⁷ kg
AS	Rest mass of proton, mp	1.67 × 10⁻²⁷ kg

AS	Rest mass of electron, m_e	$9.11 \times 10^{-31} \text{ kg}$
AS	Avogadro constant, N_A	$6.02 \times 10^{23} \text{ mol}^{-1}$
AS	Molar gas constant, R	$8.31 \text{ J K}^{-1} \text{ mol}^{-1}$
AS	Boltzmann constant, k	$1.38 \times 10^{-23} \text{ J K}^{-1}$
AS	Gravitational constant, G	$6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
AS	Permittivity of free space, ϵ_0	$8.85 \times 10^{-12} \text{ F m}^{-1}$
AS	Planck constant, h	$6.63 \times 10^{-34} \text{ J s}$
A LEVEL	Stefan-Boltzmann constant, σ	$5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$