

Extraterrestrial Life: Final Formula Sheet

Please bring a calculator to the exam. Some of the following formulae and constants may be useful.

Constants

Astronomical unit: 1 AU = 150,000,000 km (1.5×10^8 km)

Light year: 1 light year = 9.5×10^{12} km

Solar luminosity: $L_{\text{sun}} = 3.9 \times 10^{26}$ watts

Gravitational constant: $G = 6.67 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$

$\pi = 3.14159$

Formulae

Surface area of a sphere of radius r: $A = 4\pi r^2$

Volume of a sphere of radius r: $V = \frac{4}{3}\pi r^3$

Area of a circle of radius r: $A = \pi r^2$

Flux at distance d from a star with a luminosity L: $F = \frac{L}{4\pi d^2}$

Power emitted in thermal radiation by a planet or star of radius R and temperature T: $P = 4\pi R^2 \sigma T^4$, where $\sigma = 5.67 \times 10^{-8} \text{ watts m}^{-2} \text{ K}^{-4}$ is a constant

Radioactive decay law: $N(t) = N_0 e^{-t/\tau}$, where N(t) is the number of atoms left at time t in a system that started (t = 0) with N_0 atoms. The decay time is τ .

Velocity of a planet orbiting at distance a from a star of mass M:

$$v_p = \sqrt{\frac{GM_*}{a}}$$

Stellar velocity caused by an orbiting planet of mass M_p :

$$v_* = \frac{M_p}{M_*} \sqrt{\frac{GM_*}{a}}$$