All The Equations You Need For The Exam

- The Doppler formula describes how the wavelength of lines is shifted at a given velocity: $\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$. Use the same units for v as for c.
- Kepler's 3rd law: $P^2 = a^3/M$
- Conversion between mass and energy: $E = mc^2$ where E is in Joules, m is in kg and c is in m/s. The mass defect of H converted to He is 0.007, so converting 1 kg of H into He releases $1 \times c^2 \times 0.007 = 6.3 \times 10^{14}$ Joules.
- For black holes, the Schwarzschild radius is calculated from: $R_s = \frac{2GM}{c^2}$ where R_s is in m, G is the gravitational constant, m is in kg and c is in m/s. Remember, a 1 solar mass star has a Schwarzschild radius $R_s = 3$ km.
- Black body radiation, e.g. from a star, has a peak wavelength: $\lambda = 3 \times 10^6/T$.
- The small angle formula $\frac{angular size}{206265} = \frac{diameter}{distance}$. Diameter and distance will be in the same units, angular size is in seconds of arc.
- Hubble's law: $v = Hd$ where v is the recessional velocity (km/s), d is the distance (in Mpc) and H is Hubble's constant in km/s/Mpc.
- The age of the universe is $1/H \times 10^{12}$ years if there is no matter (gravity).
- Distance modulus is defined as $m - M$, the difference between apparent and absolute magnitude.
- The distance to a star in parsecs is the inverse of its angle of parallax: d = 1/p.