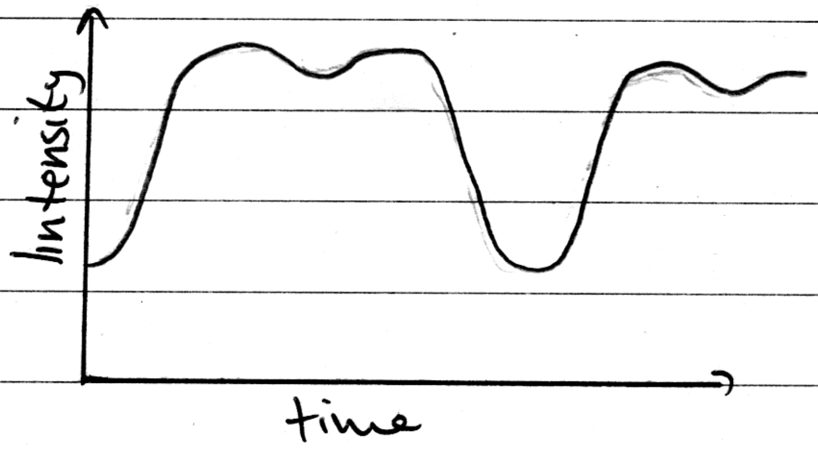
Q30

a) i) The stars light intensity periodically fluctuates in a regular pattern. For Algol the light intensity v's time graph appears like this:



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iii) The total mass of a binary system can be calculated by using Kepplers third law: $\frac{r^3}{T^2} = \frac{GM}{4\pi^2}$

To find the total mass of the system $M = (m_1 + m_2)$, and by rearranging we get:

$$m_1 + m_2 = \frac{4\pi^2 r^3}{GT^2}$$

The radius from the centre of mass must be worked out to find r. And the period for one cycle must also be worked out to find T. T is found thro-ugh inspecting a light intensity v's time graph. ~~tangent~~

b i) Lalande 21185.

ii) $\frac{I_A}{I_B} = 100^{\frac{m_B - m_A}{5}}$

$\frac{I_{Ross}}{I_{Prox}} = 100^{\frac{m_{Prox} - m_{Ross}}{5}}$

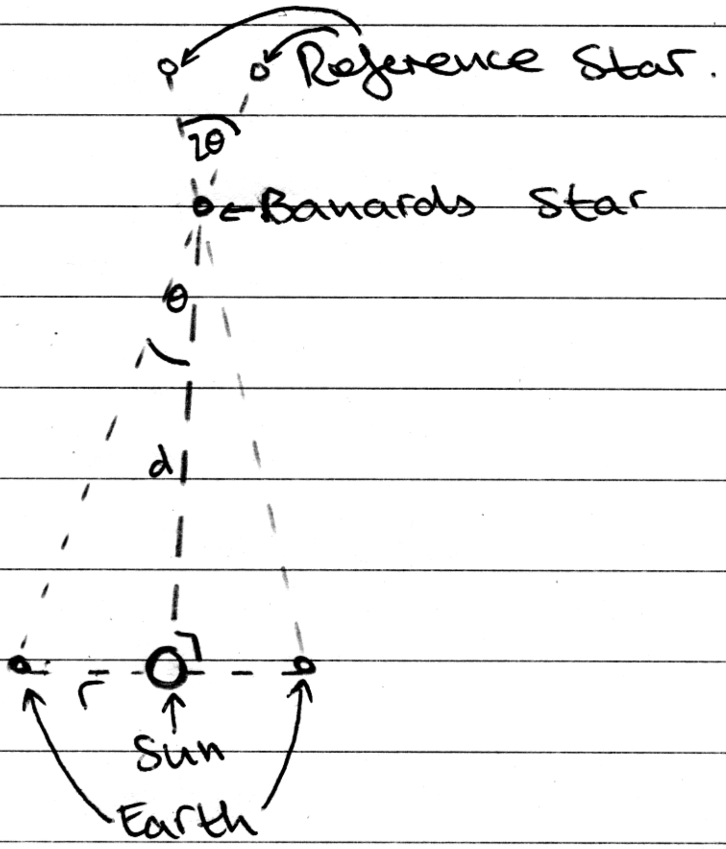
$= 100^{\frac{11.01 - 10.37}{5}}$

$= 100^{0.128}$

$= 1.803$

∴ Ross 154 is 1.803 times brighter than Proxima Centauri when viewed from Earth.

ORA 1117



Information required:

r - distance of Earth from the Sun.

2θ - Movement of reference star compared to Banards star, ~~to~~ during six-months, to find angle of paralax.

$\tan\theta = \frac{r}{d}$

$\therefore d = \frac{r}{\tan\theta}$

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c) i) White dwarfs would be found at S. This is because they have low luminosities, yet because they are quite dense, are ~~so~~ relatively hot.

ii) Because White Dwarfs are not hugely massive, ~~they~~ the ~~proton~~ repulsion between atoms is stronger than the force of gravity trying to make the star collapse. The star shrinks to a stage where the gravitational attraction equals atomic, or electrostatic, repulsion. Fusion is not taking place, therefore the star is stable.

(iii) Main sequence stars are characterised by the fusion of Hydrogen to Helium. This occurs in star below 16million °K predominantly as the proton-proton chain reaction.

Two hydrogens fuse together to form deutrium (heavy hydrogen). Also produced is a positron and neutrino. The deutrium and another hydrogen fuse to form light helium. Two of these light helium's fuse to create one stable helium atom, and two hydrogens:

$${}^{1}_{1}H + {}^{1}_{1}H \rightarrow {}^{2}_{1}H + e^{+} + \gamma$$

$${}^{2}_{1}H + {}^{1}_{1}H \rightarrow {}^{3}_{2}He$$

$${}^{3}_{2}He + {}^{3}_{2}He \rightarrow {}^{4}_{2}He + 2\,{}^{1}_{1}H$$

d) A major problem with ground-based astronomy is the effects of atmospheric blurring, known as seeing. This causes light from stars to appear blurred and, in terms of their exact position, inaccurate. Adaptive optics is a system that has been developed to ~~ov~~ partially overcome the problems of seeing, improving the telescope ability to define between two objects (resolution). A wavefront sensor uses a reference star to work out the movement of the atmosphere, and through a computer the adaptive optics system makes tiny adjustments to the telescopes primary mirror. These adjustments are made about 1000 times a second and reverse the effects of atmospheric blurring.

Another system that improves sensitivity and resolution is interferometry, and it works on interference patterns created when light (or other electromagnetic radiation ie: radio waves) is super imposed. Resolution is proportional to the diameter of the collecting mirror, not surface area, therefore if two telescope are placed a distance appart they can have a theoretically high resolution. Many radio telescopes are arranged in an array to create better resolution potentials. The largest of which is in Mexico, which consist of an array of 27 radio telescopes. By collecting information of the light hitting the dishes, and synchronising this information, an

interference pattern is created that
that elliminates atmospheric blurring
and improves resolution.