

Please hand this in by 20th January if possible.

1. What do we mean when we talk about a *black body*? What does the spectrum of a black body look like? Do the spectra of stars resemble those of black bodies? Do the spectra of nebulae resemble those of black bodies? (4)
2. When Ernest Rutherford fired alpha particles at very thin gold foil, what happened? What did this tell us about gold atoms? A cloud of hot hydrogen gas emits radiation at certain particular fixed wavelengths. What does this tell us about the nature of hydrogen atoms? (6)
3. What observations of a star do we need to measure its motion along the line of sight? What observations do we need to measure its motion in the plane of the sky? (3)
4. The William Herschel Telescope in the Canary Islands has a mirror 4.2m in diameter. What is the smallest angular separation that the WHT could measure, theoretically? Why might it not reach this limit in practice? (2)
5. The WHT is a reflecting telescope. Give three reasons why it would be impractical to build a refracting telescope this large. (4)
6. The WHT is designed to observe visible light, with a typical wavelength of 550nm. If you wanted to observe radio waves with a wavelength of 50cm, at the same resolution as the WHT has in the optical, how large a radio telescope would you need? (2)
7. When stars are plotted on a graph of luminosity against temperature, most stars lie on the *main sequence*. What determines where on the main sequence a star will lie? (1)
8. The Crab Nebula formed in a supernova explosion. Photographs show that in 1973 it had a size of 276 arcseconds, while in 2008 it has a size of 287 arcseconds. Roughly when did the explosion occur? (2)
- 9 a) The star Betelgeuse in Orion has a parallax of 5.07 milli-arcseconds. What is its distance in parsecs? (1)
b) If we carefully measure the amount of energy we receive at Earth from Betelgeuse, we find that it is $1.3 \times 10^{-7} \text{ W/m}^2$. What amount of energy is being emitted by Betelgeuse? The solar luminosity is $3.89 \times 10^{26} \text{ W}$ – how much more luminous than the Sun is Betelgeuse? (4)
c) If we look at the spectrum of Betelgeuse and find that the wavelength of the peak of the emission is 850nm, what is the temperature of Betelgeuse? (1)
d) What is the radius of Betelgeuse in metres? The Sun's radius is 700,000 kilometres – how much larger than the Sun is Betelgeuse? (4)