SACRED HEART COLLEGE SENIOR

YEAR 10 SCIENCE- ASTRONOMY WORKSHEET

1. Name some of the common units of distance used in astronomy and explain each one. Suggest a reason why they are used.

light year: distance light will travel in 1 year
parsec = 3.26 l.y.
Distances are too big for the kilometer to be convenient

2. Betelgeuse is 650l.y. away.
How many parcecs is this?

$\frac{650}{3.26} = 199$ pc

3. Bellatrix is 75pc away, how many light years is this?

75 x 3.6 = 244.5 l.y.

4. **Contrast** the terms absolute magnitude and apparent magnitude

Absolute magnitude is a measure of the amount of light produced by a star if it was 10pc from Earth
Apparent magnitude is a measure of how bright a star appears to an observer on Earth

Describing Stars

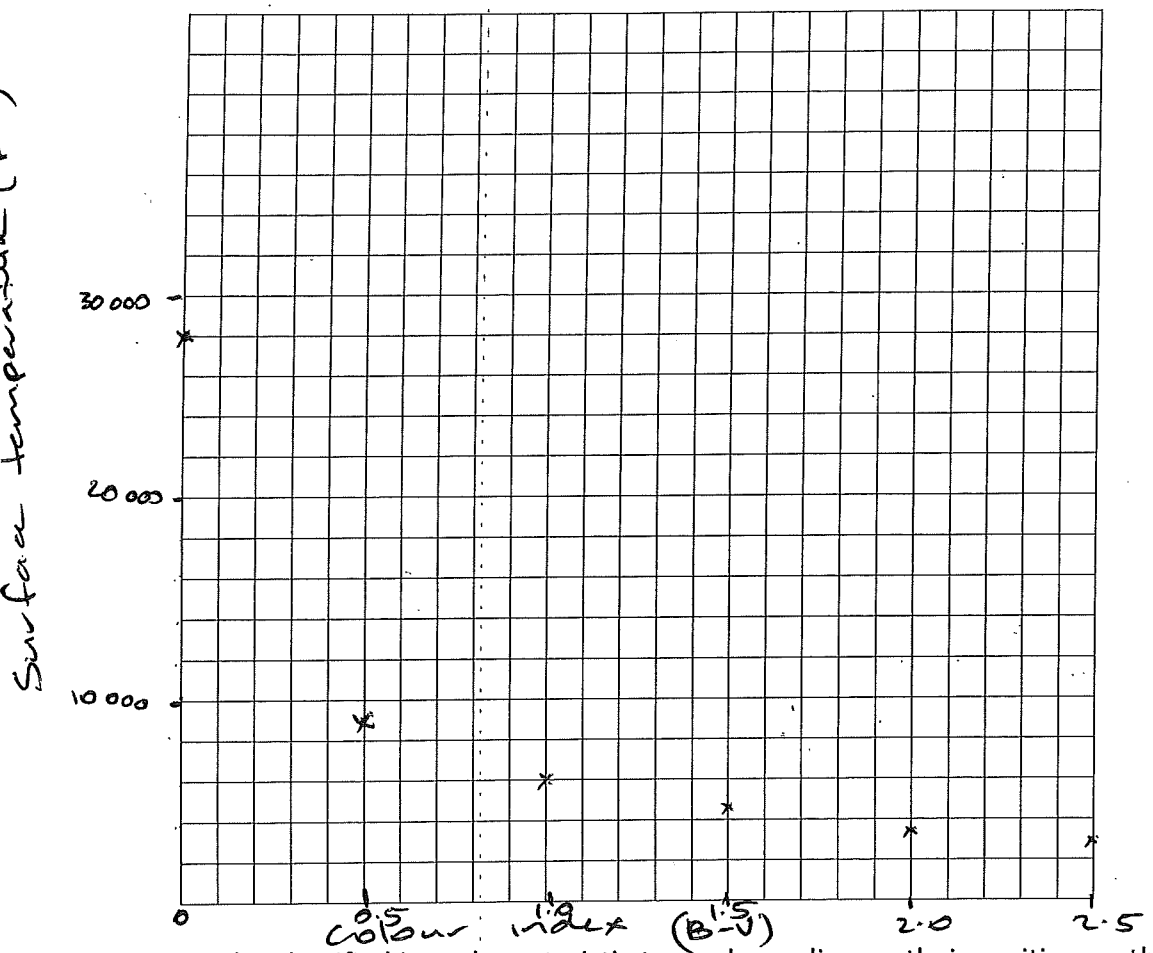
Astronomers can analyse the light from a star to determine its colour or **spectral type**. These colours range from blue through white and yellow to red. The colour of a star corresponds to its temperature. Blue stars are the hottest of the stars with temperatures of around 20 500°C, white stars are around 9500°C, and red stars are the coolest with temperatures less than 3000°C.

Stars can therefore be classified according to their colour. Their colour is often determined by the surface temperature of the star.

5. Draw the graph of the results of examining colour and the temperature of the star. (Place the Colour Index on the X axis and the surface temperature on the Y axis)

Colour Index (B-V)	0	0.5	1.0	1.5	2.0	2.5
Surface Temperature (°F)	28000	9000	6000	4500	3500	3000

Title: The effect of



6. Stars can be classified into characteristic types depending on their position on the H–R diagram see page 220). Stars outside the main sequence and near the top of the diagram are extremely large (supergiants); those at the bottom of the diagram are white dwarfs and are very small. Within the main sequence there is an increase in mass from the lower right moving up to the top left.

(a) State the surface temperatures of a blue star and a red star.

Blue star: 20500°C Red star = 3040°C

(b) State the surface temperature of our own Sun.

≃ 6000°C

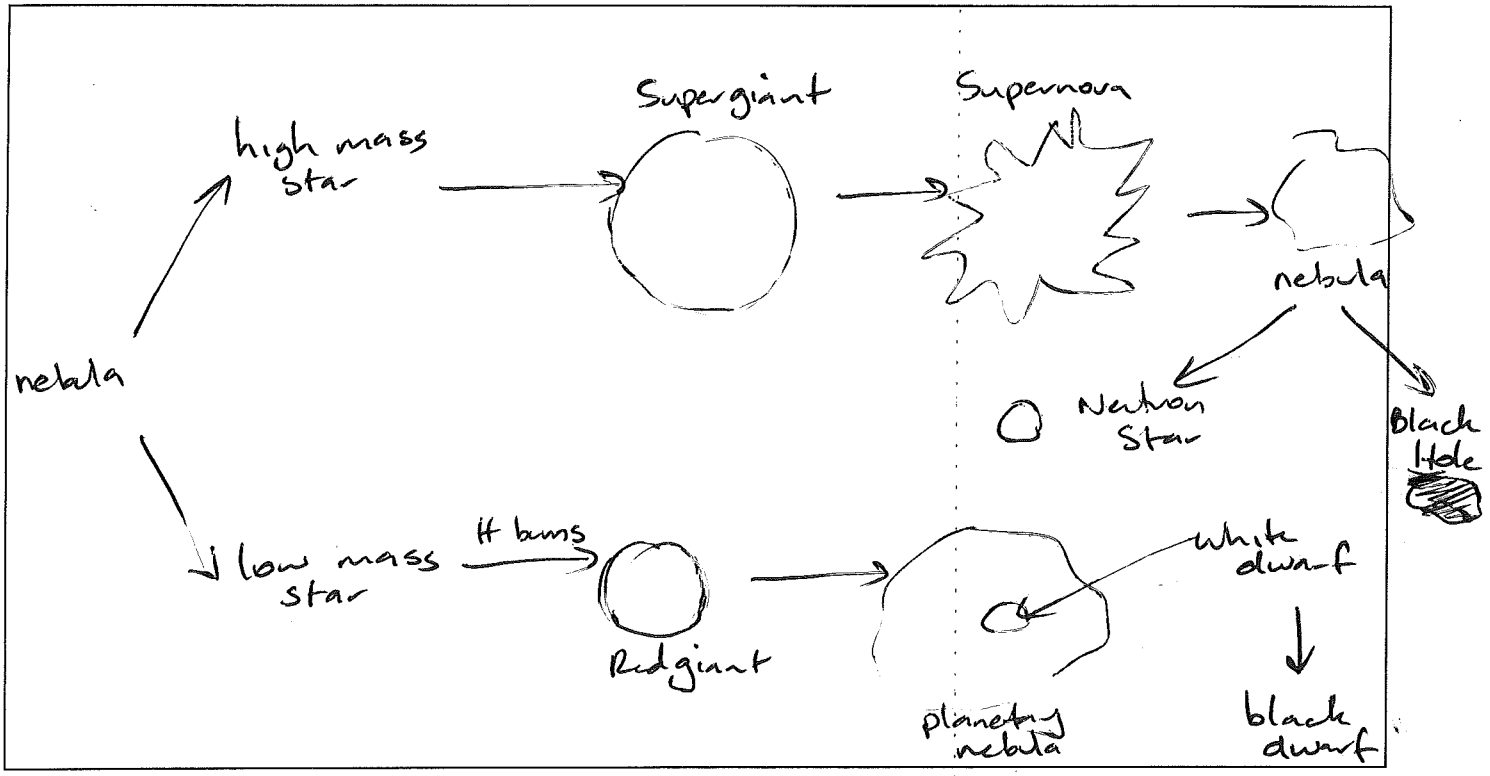
(c) State the temperature range of supergiants.

5700°C – 6930°C

Life and Death of stars

Stars were formed as a cloud of gas collapsed under its own gravity, releasing energy in the form of radiation. In its early life a star is bright but relatively cool (about 3000ºC); as it collapses it becomes hotter, igniting the **nuclear fusion** process. The nuclear reactions between the hydrogen atoms cause the release of energy and the production of heavier elements such as helium. When the hydrogen in the core of the star starts to run out, the core begins to collapse and is surrounded by a burning shell. The star has become a red giant. When our Sun reaches this stage, about 5 billion years from now, it will likely engulf Mercury, Venus and Earth. A star with little mass will then throw off its outer layer creating a **planetary nebula** out of its atmosphere and the core will form a **white dwarf**.

7. In the space below, draw the possible life cycles of a star.



8. What is the formula for calculating density and what are the units?

density = $\frac{\text{mass (kg)}}{\text{volume (m)}^3}$ units of density = kg/m^3, kgm^{-3}

9. Calculate the density of the following, *showing all working out.*

a) The moon, mass = 7.3×10^{22}kgs, volume = $2.2 \times 10^{19}m^3$

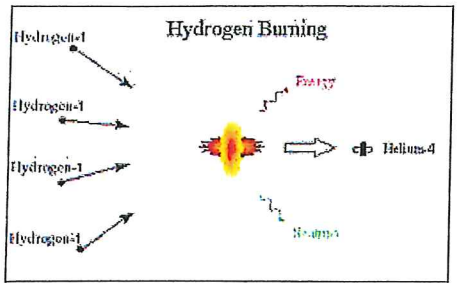
density = $\frac{7.3 \times 10^{22}}{2.2 \times 10^{19}} = \frac{7.3}{2.2} \times 10^{22-19} = 3.32 \times 10^{3}$ kg/m^3

b) A red giant, mass= 3.6×10^{31}kg, volume = $1.2 \times 10^{36}m^3$

density = $\frac{3.6 \times 10^{31}}{1.2 \times 10^{36}} = \frac{3.6}{1.2} \times 10^{31-36} = 3 \times 10^{-5}$ kg/m^3

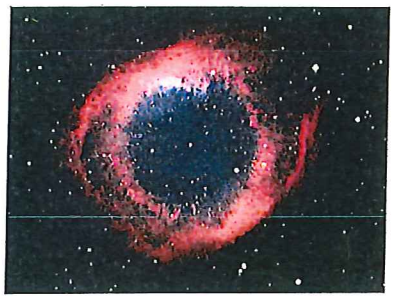
$(0.000030\ kg/m^3)$

10. State the meaning of:



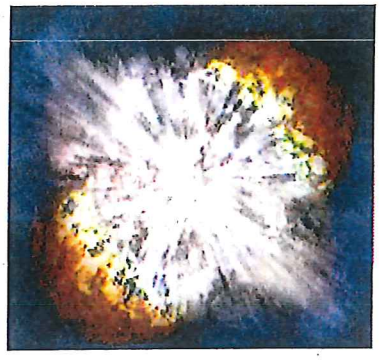
Nuclear fusion

Source of energy that keeps stars at such high temperatures
Protons collide to convert hydrogen to helium and energy



Nebula

A large cloud of dust + gas (helium + hydrogen) which forms into a star



Supernova

Hydrogen fuel runs out in super-giant, rapid collapse of supergiant at high speed that material rebounds in massive explosion called Supernova

Neutron Star

Formed if amount of material left by supernova is 1.4-3x our sun. Enormous density, very small (10-15kms)

Black Hole

If material left after supernova >3x mass of our sun, neutron star keeps shrinking even further.
Black holes have massive gravitational pull not even light can escape

Our expanding Universe

Scientific evidence that the Universe is expanding away from the site of the Big bang comes from the light emitted from stars.

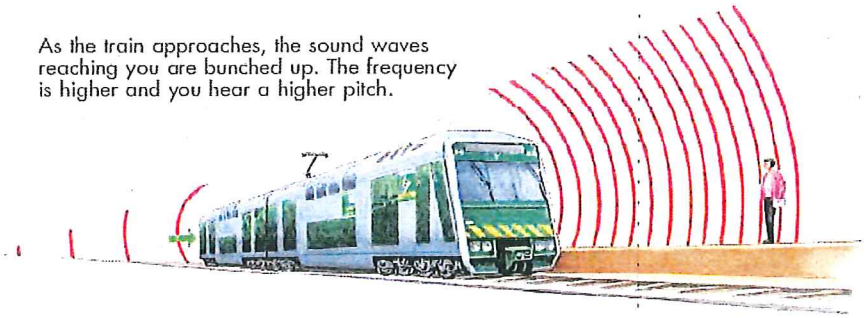
The normal light spectrum from stars shows the colours of the rainbow (ie Red, orange, yellow, green, blue, indigo and violet).

Normal Light Spectrum

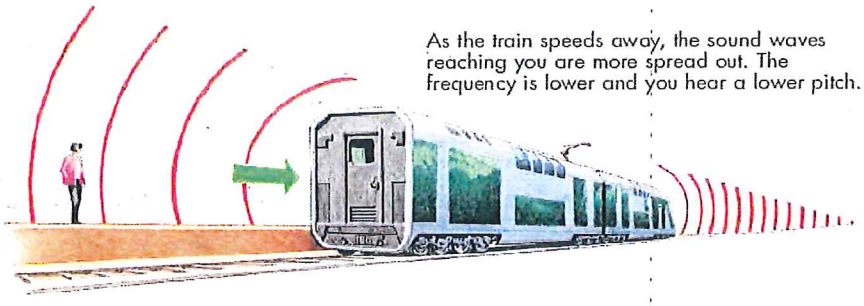
Violet Indigo Blue Green Yellow Orange Red

The spectrum also shows black lines formed when certain colours are absorbed in the atmosphere of the stars. Hence the light that reaches us on earth does not have those light colours and consequently we see black lines.

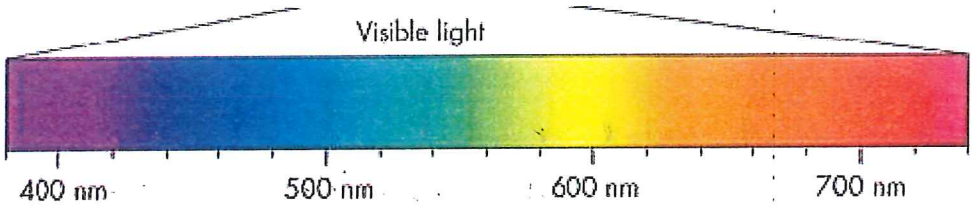
In the same way that sound waves are compressed (or squashed) by an object coming towards you, light waves from stars coming towards us are also compressed. In other words a star coming towards us has its light wavelengths squashed or shortened



On the other hand, a star moving away from us has its light wavelengths get longer.



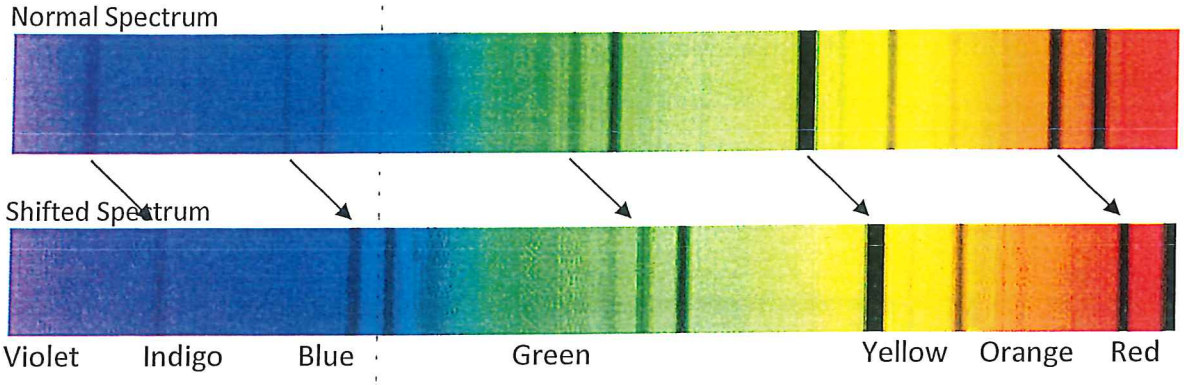
When light wavelengths get longer, they shift towards the red end of the spectrum.



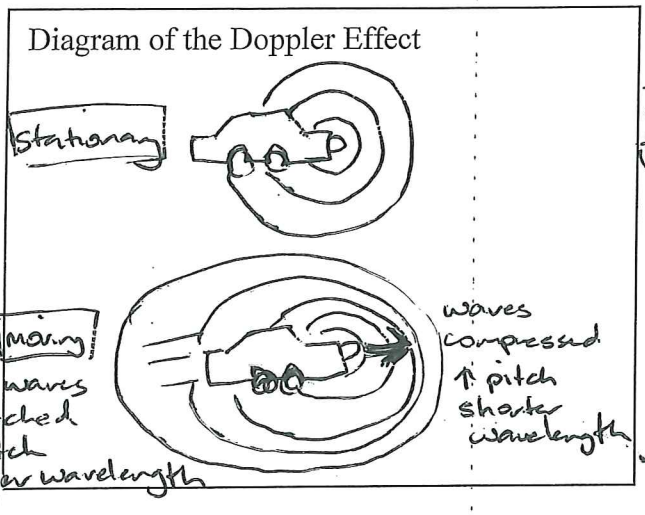
Wavelengths of different colours

This shows itself in an effect called the red shift discovered by Christian Doppler.

Example of a Red Shift



11. Explain, in your own words and diagrams, the Doppler effect



Shorter wavelength: Sound waves bunch together (compressed) as object moves toward observer = pitch higher

Longer wavelength: Sound waves spread out / stretched out as object moves away from observer = pitch lower

12. A small number of galaxies, including the Andromeda galaxy, are moving towards the Earth. If you were able to analyse the spectrum of light emitted by a star in this galaxy would you expect it to be red shifted or blue shifted? Explain your answer.

Moving towards : light wavelengths are compressed making the light appear bluer than it should = blue shift

(shorter wavelengths = bluer light on EM spectrum)

13. Name 3 shapes of galaxies.

Spiral, barred spiral, elliptical

14. Name the galaxy we live in, describe its shape, suggest how many stars it contains and how wide it is.

Milky Way : barred spiral

Topic: Theories of the origin of the Universe

15. Complete the following table to summarise the two main theories of the origin Universe. (page 316 of your text book)

Theory	Who suggested the theory and when?	Briefly explain the theory	State the evidence supporting the theory	Explain the evidence supporting the theory
The Steady State Theory	Fred Hoyle 1948	Universe is infinite and has always existed in roughly the same form as today - new material being formed	Galaxies appear relatively evenly distributed throughout space	New matter is being made to fill spaces between galaxies
The Big Bang Theory	Georges Lemaitre 1970s - 1980s theory accepted.	Universe is expanding Reasonable to assume at some point everything condensed into single point → explosion of energy known as Big bang	1. Galaxies display red shift 2. Cosmic Microwave Background Radiation	1. Red shift light from stars is shifted toward red side of spectrum so they are moving away from Earth • Background signal radiation from all directions - afterglow of big bang • Red shifted, consistent with universe expanding

16. Identify any similarities between the steady state theory and the Big Bang theory.

Both suggest galaxies moving away / universe getting bigger

17. Identify the main differences between the steady state theory and the Big Bang theory.

Big Bang: NO new material being made

Steady state: new material being made (so galaxies evenly distributed)

18. How old is the universe estimated to be?

≈ 14 billion years old

19. Scientists define the *observable universe* as anything within 13.7 billion light-years of Earth. Analyse why it is impossible for us to observe anything further away than this.

The Big Bang occured ≈ 13.7 billion years ago
Light from objects further than this have not had time to reach Earth