Higher Hubble's Law and the Big Bang Questions

1. **Hubble's Law** is shown using the equation below.

$$v = H_0 d$$

a) State the **quantities** and **units** in the equation.

b) **State any constant** in the equation with its associated units.

c) i) **Describe** the graph obtained for **v against d**?

ii) What does this tell us about the **relationship** between **v and d**?

iii) **Which quantity** is worked out from the **gradient** of the graph of **v against d**?

2. a) Show using Hubble's Law that the age of the universe can be worked out by using the formula

$$t = \frac{1}{H_o}$$

b) Hubble's Law can show that the **universe is expanding** and can also be used to find the **age of the universe**.

What assumption is being made in both of these cases?

3. A galaxy is moving away from Earth at **0.087c**.

a) Convert **0.087c** into **ms^{-1}**.

b) Calculate the approximate **distance** of this galaxy from Earth **in metres**.

4. A distant galaxy is **20 light years** away from Earth.

Use Hubble's Law to **determine the velocity** of the galaxy as it moves away from Earth.

5. A distant Quasar is moving away from Earth. One of the Hydrogen lines coming from the Quasar is observed to have a **wavelength of 506nm** from the same frame of reference. The same line is measured as having a wavelength of **486nm** from a source on Earth. Calculate:

a) The **speed** at which the **Quasar** is moving away from Earth.

b) The **distance** that Quasar is from Earth **in light years**.

6. a) State **four pieces of evidence** for the **'Big Bang Theory'**.

b) Give a **brief description of each** of these four pieces of evidence.

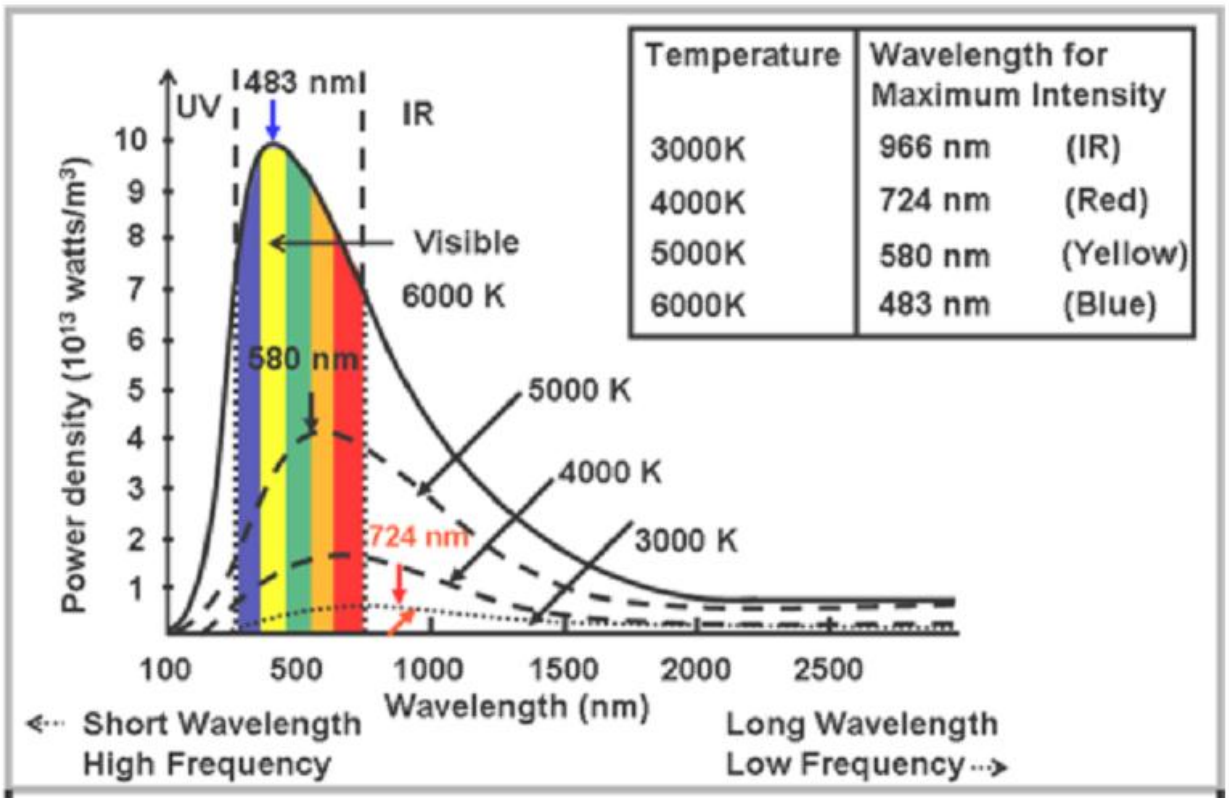
7. a) What is a **'blackbody radiator'**?

b) A star is not a perfect blackbody, but the blackbody radiation theory can still be applied to it.

What assumptions are made here?

c) **What information** can we work out about **stars** from the blackbody radiation theory?

d) Which **two pieces** of information does this graph highlight?



8. Wien's Displacement law equation applied to blackbody radiation is written as:

$\lambda_{peak}\ T = 2.898 \times 10^{-3}\ mK.$

a) State what each of these **quantities** mean.

b) How can **blackbody radiators** be described as **stellar thermometers**?

c) How could **Wien's Displacement Law** be used to measure the **temperature of the Sun**?

d) **State the relationship** between the **peak wavelength** emitted from a blackbody radiator and its **temperature**.

9. **Calculate** the unknown quantities in the table below for a blackbody radiator using Wien's Displacement law.

λ_{peak} (m)	Temperature (K)
500×10^{-9}	**(a)**
(b)	20,000
1.5×10^{-3}	**(c)**
(d)	310

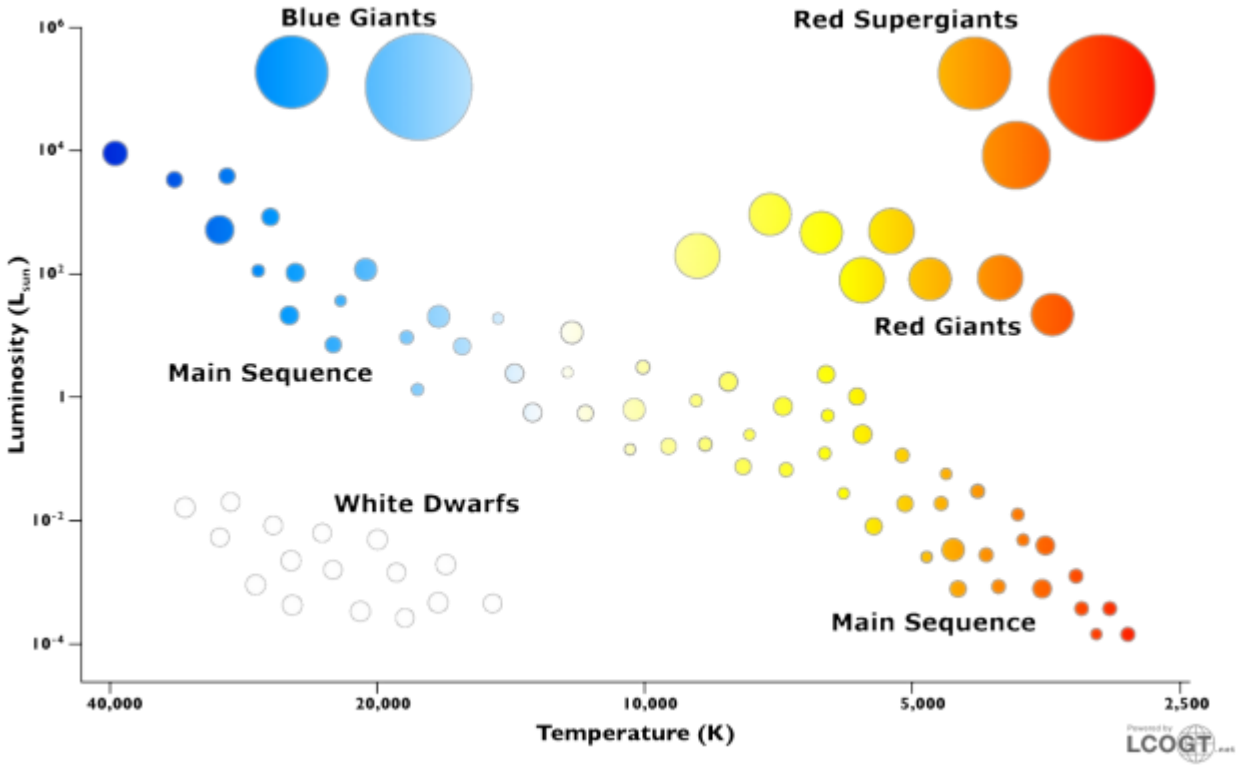
10. **Calculate** the peak wavelength of radiation emitted by the Sun if it has a temperature of **5800K**.

11. a) What is meant by the term **'Dark Energy'**?

b) What is meant by the term **'Dark Matter'**?

c) Does 'Dark Energy' or 'Dark Matter' make up a **bigger percentage** of the **universe**?

12. The Hertzsprung – Russell diagram is shown below.



a) The Hertzsprung-Russell diagram was seen as a major step forward in our understanding of **'stellar evolution'**.

What does this mean?

b) In the H-R diagram luminosity is plotted against temperature.

Which three factors does this tell us **about a star**?

c) **Which colour** of light represents **stars** of the **lowest temperatures**?

d) i) **Which colour** of light represents **stars** of the **highest temperatures**?

ii) Explain why **stars** of **higher temperature glow more brightly** in the sky?