Higher Hubble's Law and the Big Bang Answers

1. a) v - speed of galaxy receding from us in ms^{-1}.

d – distance of galaxy from us in metres.

Ho – Hubble's constant.

b) Ho – Hubble's constant = $2.3 \times 10^{-18} s^{-1}$.

c) i) v against d shows a SLTO. (Straight Line Through the Origin)

ii) v is directly proportional to d.

iii) The gradient of the line is Hubble's constant.

2. a)

$$t = \frac{d}{v} \qquad (v = H_o d)$$

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

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

b) The assumption is that the universe is expanding at a constant rate.

3. a) $v = 2.61 \times 10^{7} ms^{-1}$.

b) $d = 1.16 \times 10^{25} m$.

4. $v = 0.44 ms^{-1}$.

5. a) $v = 1.2 \times 10^{7} ms^{-1}$.

b) $d = 5.22 \times 10^{24} m$.

6. a)

- We are certain the universe had a beginning.
- Presence of cosmic microwave background radiation.
- Doppler Effect
- The abundance of light elements such as Hydrogen and Helium.

b)

- It is assumed that there was a beginning as time started with the Big Bang.
- When the universe cooled sufficiently to form atoms, photons of radiation were able to travel distances which propagated the entire universe.
- Red shift which shows stars and galaxies are moving away from us in the continual expansion of the universe..
- In the early expansion quarks began to combine to form the nuclei of Hydrogen and Helium.

7. a) A blackbody radiator is an object which absorbs all of the radiation incident on it and then radiates energy which is dependent on the object itself.

b) Although a star is not a perfect blackbody radiator, it approximates close enough so that the blackbody radiator theory can be applied.

c) The greater the temperature of the star the smaller the peak wavelength of the light emitted from the star.

d)

- The greater the temperature the lower the peak wavelength of the light emitted.
- The greater the temperature the greater the area under the graph and so the greater the power emitted.

8. a) $\boldsymbol{\lambda_{peak}}$ - > Peak wavelength of light emitted from a blackbody radiator.

T -> Temperature of the blackbody radiator.

2.898×10^{-3} -> Constant linking the temperature and peak wavelength emitted by a blackbody.

b) The peak wavelengths emitted from blackbody radiators can be used to work out there surface temperatures and so the term blackbody radiators.

c) Temperature of the sun $T = \dfrac{2.898 \times 10^{-3}}{\lambda_{peak}}$

i.e the constant divided by the peak wavelength of light emitted from the sun.

d) Peak wavelength is indirectly proportional to temperature of the sun.

9.

λ_{peak} (m)	Temperature (K)
500×10^{-9}	**5796**
1.45×10^{-7}	20,000
1.5×10^{-3}	**1.93**
9.35×10^{-6}	310

10. $\lambda_{peak} = 5 \times 10^{-7}$m.

11. a) **Dark Energy** is related to the rate at which the universe is expanding.

This suggests that form of energy source is driving the expansion of the universe.

b) **Dark Matter** is the matter that exists in our universe but cannot be seen by astronomers.

c) **Dark Energy** contains a **far greater percentage** of the universe than Dark Matter.

12. a) **Stellar evolution** involves the way in which stars undergo sequences of dynamic and radical changes over a period of time.

b)

- Type of star.
- Radius of the star.
- Age of the star.
-

c) Lowest Temperature -> Red.

d) i) Highest Temperature -> Blue.

ii) Stars of higher temperature glow more brightly in the sky as the peak wavelength of light emitted is lower in the visible spectrum.

From the blackbody radiator graph it shower that these smaller wavelengths of light emitted have a greater of intensity of light or luminosity and therefore energy emitted.