Exam Answers
Chapter 10·3 - Standard Model

Answer 1 2011:1:9

(4 marks)

Describe briefly how Edwin Hubble's observations of the redshifts of galaxies were used to formulate Hubble's Law and explain how Hubble's Law is used to support the Big Bang theory.

Description	Marks
All moving objects have a Doppler effect in their spectrum showing the relative speed to the observer, Redshift means the object is moving away.	1
The more the redshift the faster the object is moving	1
Hubble's Law states the more distant the object, the faster it is moving –	1
this means there is a common origin, e.g. all started from an original point in a "big bang"	1
	Total 4

Answer 2 2013:1:2

(3 marks)

A distant star is seen by an astronomer using a powerful telescope to be travelling toward the Earth with a velocity of 0.1c.

(a) At what velocity does the light reach the telescope? (1 mark)

Description	Marks
c or 3×10^8 m s^{-1}	1
Total	**1**

(b) What is it about the starlight's spectrum that tells the astronomer that the star is approaching? Explain your answer. (2 marks)

Description	Marks
The light will be blue shifted	1
Incoming light will appear to be the same, but spectrum will show signature lines to be shifted towards the blue side of the spectrum	1
Total	**2**

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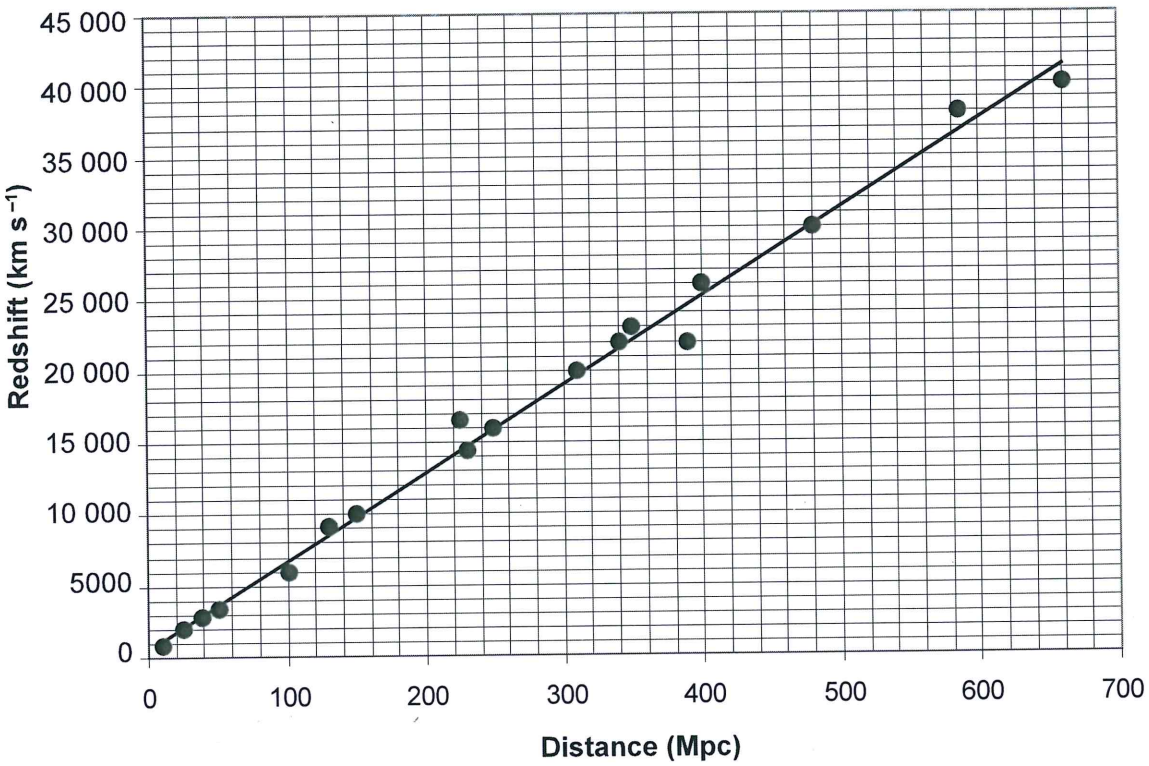
Answer 3 2014: 1:12

(5 marks)

Hubble's law can be used to estimate the maximum size of the observable Universe. The graph below indicates the relationship between recessional speed of a star (or galaxy) and the distance to that star (or galaxy).

Distances are given in megaparsecs (Mpc) where 1 Mpc = 3.26 light years.



(a) The vertical axis is labelled 'redshift' with units for velocity (km s^{-1}). Explain briefly the relationship between redshift and the speed of the object. (2 marks)

Description	Marks
How much the lines are shifted is related to the star's velocity	1
States or explains that redshift increases with velocity.	1
Total	**2**

(b) Use the gradient of the graph to extrapolate a value for the maximum distance, in Mpc, for a galaxy to be observed from in the Earth. Show **all** workings. (3 marks)

Description	Marks
Maximum speed $c=3\times10^{8}$ m s^{-1} or 3×10^{5} km s^{-1}	1
Determines gradient 31 000/500= 62 km s^{-1}/Mpc. Allow range 60-65 km s^{-1}/Mpc.	1
Maximum distance of the Universe => 3×10^{5}/(62 km s^{-1}/Mpc) = 4800 Mpc Allow 4600-5000 Mpc	1
Total	**3**