AQA A-LEVEL PHYSICS · 7408

PHYSICS



EXAM QUESTION PACK

3.9.3 COSMOLOGY

SCORE	PERCENTAGE
/44	%

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Q1.

(a) Describe the links between galaxies, black holes and quasars.

_____

_____

_____

_____

_____

_____

(2)

(b) At a distance of 5.81×10^8 light year, Markarian-231 is the closest known quasar to the Earth. The red shift z of Markarian-231 is 0.0415

Use these data to estimate an age, in seconds, of the Universe.

age = _____ s

(4)

(c) A typical quasar is believed to be approximately the size of the solar system, with a power output similar to that of a thousand galaxies.

Estimate, with reference to the inverse-square law, how much further the most distant visible quasar is likely to be compared to the most distant visible galaxy.

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(3)
(Total 9 marks)

Q2.

Evidence to support the Big Bang theory comes from cosmological microwave background radiation and the relative abundance of hydrogen and helium in the Universe.

(a) Explain what is meant by cosmological microwave background radiation and how its existence supports the Big Bang theory.

(3)

(b) Explain how the relative abundance of hydrogen and helium supports the Big

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Bang theory.

(3)
(Total 6 marks)

Q3.

According to NASA nearly 2000 exoplanets had been discovered by 2016, and the search continues. One aim of this search is to find an Earth-like planet orbiting a Sun-like star.

Discuss the difficulties associated with the detection of an Earth-like planet orbiting a Sun-like star.

In your answer you should compare the methods that are used in the search and suggest which may be the most successful.

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(Total 6 marks)

Q4.

Two methods involved in the detection of exoplanets are the radial velocity method and the transit method.

(a) Explain what is meant by the transit method of detection.

(3)

(b) Explain why it is important that there is more than one method of detection.

(2)

(Total 5 marks)

Q7.

(a) State which property of the first identified quasar led to its discovery.

(1)

(b) 3C48 is a quasar in the constellation Triangulum. It is believed to have a power output 4×10^{11} times greater than that of the Sun. At the Earth, the Sun's intensity is 1.4×10^{17} times greater than that of the quasar.

(i) Calculate, using the inverse square law, the distance from Earth to this quasar in AU.

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distance = _____ AU

(3)

(ii) Measurements of the red shift of the quasar suggest the expansion of the Universe has accelerated since the detected light left the quasar.
State the cause of this acceleration.

_____

(1)

(Total 5 marks)

Q8.

NGC 3842 is a galaxy which contains one of the biggest black holes ever discovered.

(a) State what is meant by a black hole.

_____

_____

_____

(1)

(b) The mass of the black hole in NGC 3842 is believed to be 1.0×10^{10} times greater than that of the Sun.

Calculate the radius of its event horizon.

radius = _____ m

(2)

(c) NGC 3842 is 3.3×10^{8} light years from the Earth, and is receding at a velocity of 6.3×10^{6} m s^{-1}.

Estimate, using these data, an age in seconds for the Universe.

age of Universe = _____ s

(3)

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(Total 6 marks)

Q9.

(a) State what is meant by the Hubble constant.

_____

_____

(1)

(b) The recessional velocity of a galaxy 8.0×10^8 ly from Earth is measured to be 1.8×10^4 km s^{-1}.

Show that this suggests a value for the Hubble constant of 73 km s^{-1} Mpc^{-1}.

(2)

(c) (i) Using the value for the Hubble constant given in part (b), estimate the age of the Universe.
Give your answer in years.

age of the Universe _____ years

(3)

(ii) State **one** assumption that must be made to justify the estimate made in part (i).

_____

_____

(1)

(Total 7 marks)

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