A Level Physics

22nd Mar 2021 – Astrophysics

Suitable for **ALL** exam boards

This session will look at some questions about space.

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Question taken from:

OCR A Physics - Jan 2013 – G485 - Question 9

OCR A Physics - Jun 2013 – G485 - Question 10

9 (a) State Olbers' paradox and the two assumptions made about the Universe.

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.... **[3]**

(b) State Hubble's law and explain how it resolves Olbers' paradox.

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.... **[2]**

(c) A galaxy at a distance of 1.4×10^{25} m is observed to be receding from the Earth at a velocity of 3.4×10^7 m s^{-1}.

(i) Calculate the Hubble constant H_0 based on this data.

$H_0 =$ .... unit .... **[3]**

(ii) Estimate

   1   the age in years of the Universe

            1 year $= 3.2 \times 10^7$ s

age = ...years **[2]**

   2   the maximum distance in parsec (pc) we can observe from the Earth.

            1 pc $= 3.1 \times 10^{16}$ m

distance = ... pc **[2]**

[Total: 12]

10 (a) Calculate the distance of 1 light-year (ly) in metres.

distance = ... m **[1]**

(b) Fig. 10.1 shows an incomplete diagram drawn by a student to show what is meant by a distance of 1 parsec (pc).
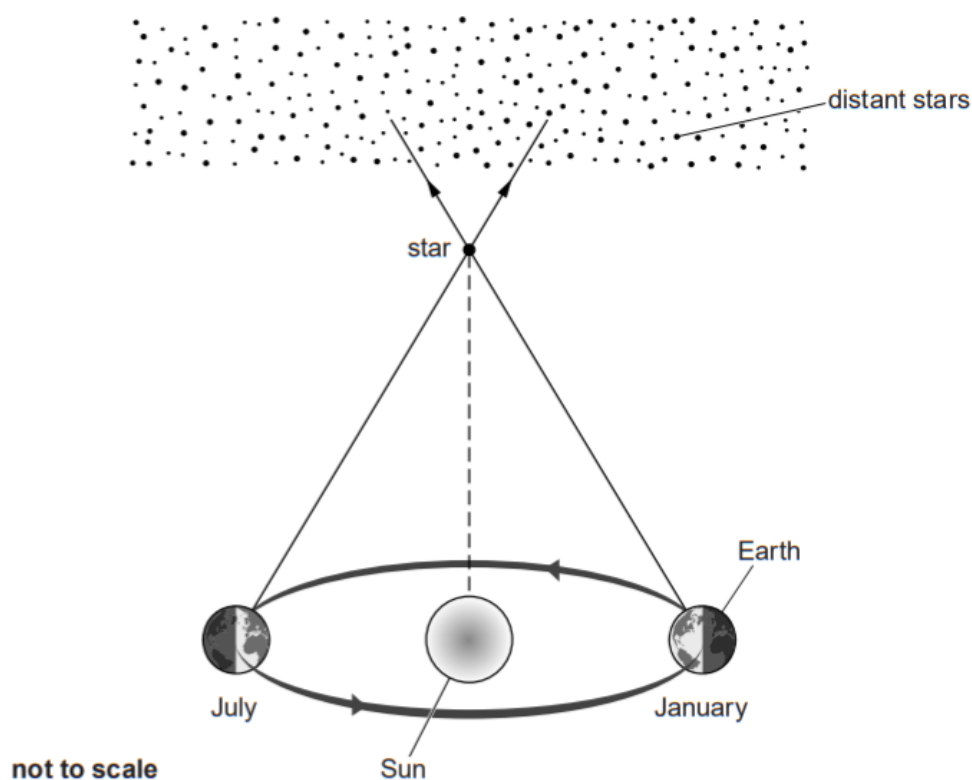

Fig. 10.1

Complete Fig. 10.1 by showing the distances of 1 pc and 1 AU, and the parallax angle of 1 second of arc (1″). **[1]**

(c) A recent supernova, SN2011fe, in the Pinwheel galaxy, M101, released 10^{44} J of energy. The supernova is 2.1×10^7 ly away.

(i) Calculate the distance of this supernova in pc.

1 pc = 3.1×10^{16} m

distance = ... pc **[2]**

(ii) Our Sun radiates energy at a rate of 4×10^{26} W. Estimate the time in years that it would take the Sun to release the same energy as the supernova SN2011fe.

time = ... y **[2]**

(d) One of the possible remnants of a supernova event is a black hole. State **two** properties of a black hole.

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....**[2]**

[Total: 8]