InkPhysics

QUESTION WORKBOOK

Quasars and exoplanets

Astrophysics · Year 13

AQA 3.9.3.3, 3.9.3.4

10 questions · 30 marks

PRINT EDITION

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SECTION A · Warm-up

A1 Explain the origin of the name “quasar”, and how the first quasars were discovered. [2]

A2 Give two reasons why an exoplanet is extremely difficult to photograph directly. [2]

A3 In the transit method, state what the depth of the dip in the light curve measures, and what its repeat interval gives. [2]

SECTION B · Standard

B1 A quasar shows a red shift of $z = 0.40$. Estimate its recession speed and its distance, taking $H = 65$ km s^{-1} Mpc^{-1}. [4]

B2 A quasar's brightness varies noticeably over about three days. Estimate the maximum size of the emitting region, and comment on the scale. [3]

B3 During each transit of an exoplanet, its star (radius 6.96×10^{8} m) dims by a fraction 2.5×10^{-3}. Calculate the planet's radius. [3]

B4 An orbiting planet makes its star move along our line of sight at up to 55 m s^{-1}. Calculate the maximum shift this produces in the star's 656.3 nm line. [3]

SECTION C · Stretch

C1 A quasar has apparent magnitude 16.1 at a distance of 1846 Mpc. Calculate its absolute magnitude, and compare its output with a bright galaxy of absolute magnitude -21. [4]

C2 Explain how an active supermassive black hole accounts for both defining properties of a quasar: enormous power output and small size. [4]

C3 A star's light curve shows periodic dips, and its spectrum shows a periodic Doppler wobble with the same period. Explain what each measurement contributes to the picture of the orbiting planet. [3]