



QUESTION WORKBOOK

Quasars and exoplanets

Astrophysics · Year 13

AQA 3.9.3.3, 3.9.3.4

10 questions · 30 marks

NAVY SCREEN EDITION

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 $H = 65 \text{ km s}^{-1} \text{ Mpc}^{-1}$. [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]