



QUESTION WORKBOOK

The HR diagram and stellar evolution

Astrophysics · Year 13

AQA 3.9.2.5, 3.9.2.6

10 questions · 31 marks

NAVY SCREEN EDITION

SECTION A · Warm-up

A1 State the quantities plotted on the two axes of a Hertzsprung–Russell diagram, including the direction each axis runs and its typical range. [3]

A2 Name the three populated regions of the HR diagram and state where each sits. [2]

A3 State what a star on the main sequence is doing, and where the Sun sits on the diagram. [2]

SECTION B · Standard

B1 Describe the future evolution of the Sun as a path on the HR diagram, naming each stage and the physical change that drives it. [4]

- B2** A red giant is cooler than the Sun yet far more luminous. Explain, using Stefan's law, how both can be true. [3]

- B3** A type Ia supernova peaks at apparent magnitude 18.2. Taking the peak absolute magnitude of every type Ia to be -19.3, calculate the distance to its host galaxy. [4]

- B4** A neutron star has mass 3.0×10^{30} kg and radius 12 km. Calculate its density. [3]

SECTION C · Stretch

- C1** Calculate the Schwarzschild radius of a black hole of six solar masses (solar mass 1.99×10^{30} kg), and state what the radius represents. [4]

- C2** Explain why type Ia supernovae can be used as standard candles, and what surprising conclusion their use led to in the late 1990s. [3]

- C3** Sketch in words the light curve of a type Ia supernova, and name one other transient event associated with the deaths of massive stars. [3]