Astronomy and Cosmology

Modern physics · 4 questions · step-by-step answers at the end

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USEFUL EQUATIONS

$F = L / (4\pi d^2)$ $\lambda_{max} T = 2.9 \times 10^{-3}$ m K $L = 4\pi r^2 \sigma T^4$ $\Delta\lambda / \lambda \approx v / c$ $v = H_0 d$

Questions

Show your working in the space under each question.

1. Taking $H_0 = 2.3 \times 10^{-18}$ s^{-1}, estimate the age of the Universe.

2. The Sun's spectrum peaks at 500 nm. Find its surface temperature. A galaxy's 656.3 nm line is observed at 662.9 nm: find its recession speed.

3. A star has a parallax of 0.10 arcseconds. How far away is it?

4. A galaxy has a red-shift z = 0.050. Find its recession speed, and its distance if $H_0 = 70$ km s^{-1} Mpc^{-1}.

Step-by-step answers

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1. $1/H_0 = 4.3 \times 10^{17}$ s ≈ **14 billion years**.

2. 1. $T = 2.9 \times 10^{-3}/\lambda_{max} = 2.9 \times 10^{-3}/500 \times 10^{-9}$ = **5800 K**.
2. $\Delta\lambda/\lambda = (662.9 - 656.3)/656.3 = 0.0101$.
3. $v = 0.0101 \times 3.0 \times 10^{8}$ = **3.0×10^{6} m s^{-1}**, moving away.
Answer: 5800 K; 3.0×10^{6} m s^{-1}

3. 1/0.10 = **10 parsecs**.

4. $v = zc$ = **1.5×10^{7} m s^{-1}** = 15 000 km s^{-1}; $d = v/H_0$ = **210 Mpc**.