

Cosmology & Astrophysics problem sheet Question 2 solutions

Solar radius /m	6.96E+08
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Solar mass /kg	1.99E+30
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Solar luminosity /Wm^-1	3.85E+26
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Source data (Wikipedia)

Star	Luminosity /solar luminosity	Mass /solar masses	peak wavelength/nm	Parallax (milli-arc seconds)	Redshift	Distance /ly	Radius /solar radii	Recessional velocity /kms ⁻¹	Surface temperature /K	Average density /kgm ⁻³	Surface gravity /Nkg ⁻¹
Sun	1	1	502	-	-	1.582E-05	1.00	-	5,778	1407.02	273.74
Sirius A	25.4	2.06	292	379.21	-1.83E-05	8.6	1.71	-5.5	9,940	579.67	192.85
Canopus	10,700	8	394	10.55	6.77E-05	310	71.00	20.3	7,350	0.03	0.43
Arcturus	170	1.08	676	88.83	-1.73E-05	36.66	25.40	-5.19	4,286	0.09	0.46
Vega	40.12	2.14	302	130.23	-4.64E-05	25.04	2.36	-13.9	9,602	229.08	105.18
Capella Aa	78.7	2.57	583	75.02	9.99E-05	42.92	11.98	29.94	4,970	2.10	4.90

Calculations as per the problem sheet.

Star	Luminosity /solar luminosity	Mass /solar masses	peak wavelength/nm	Parallax (milli-arc seconds)	Redshift	Distance /ly	Radius /solar radii	Recessional velocity /kms ⁻¹	Surface temperature /K	Average density /kgm ⁻³	Surface gravity /Nkg ⁻¹
Sun	1	1	502	-	-	1.582E-05	1.00	-	5,778	1409.63	274.08
Sirius A	25.4	2.06	292	379.21	-1.83E-05	8.61	1.70	-5.50	9,940	588.00	194.69
Canopus	10,700	8	394	10.55	6.77E-05	309.36	63.75	20.30	7,358	0.04	0.54
Arcturus	170	1.08	676	88.83	-1.73E-05	36.74	23.68	-5.19	4,286	0.11	0.53
Vega	40.12	2.14	302	130.23	-4.64E-05	25.06	2.29	-13.90	9,602	250.02	111.50
Capella Aa	78.7	2.57	583	75.02	9.99E-05	43.51	11.98	29.94	4,970	2.10	4.90

Light year /m	9.454E+15
AU /m	1.496E+11

$$(\lambda_{\text{max}}/\text{nm}) = \frac{2.899 \times 10^6}{(T / \text{K})}$$

$$R = \sqrt{\frac{L}{4\pi\sigma}} \left(\frac{\lambda_{\text{max}}}{b} \right)^2$$

$$b = 2.899 \times 10^6 \text{ nmK}$$

$$\sigma = 5.67 \times 10^{-8} \text{ Wm}^{-2} \text{ K}^{-4}$$

$$z = \frac{\Delta\lambda}{\lambda} \approx \frac{v}{c}$$

$$x = \frac{1AU}{\Delta\theta}$$