25. Astronomy and Cosmology

25.2 Stellar radii

Paper 4

Marking Scheme

Q1.

(b)(i)	luminosity $= 4\pi\sigma r^2 T^4$ $= 4\pi \times 5.67 \times 10^{-8} \times (6.96 \times 10^8)^2 \times 5780^4$	**C1**
	$= 3.85 \times 10^{26}$ W	**A1**
(b)(ii)	$\lambda_{MAX} T$ = constant	**C1**
	temperature $= (5780 \times 501) / 624$ $= 4640$ K	**A1**

Q2.

(c)(iii)	$L = 4\pi\sigma r^2 T^4$ $3.8 \times 10^{26} = (4\pi \times 5.67 \times 10^{-8} \times 5780^4) \times r^2$	**C1**
	$r = 6.9 \times 10^8$ m	**A1**

Q3.

(c)(ii)	$L = 4\pi\sigma r^2 T^4$ $1.4 \times 10^{28} = 4\pi \times 5.67 \times 10^{-8} \times (2.3 \times 10^9)^2 \times T^4$	**C1**
	$T = 7800$ K	**A1**

Q4.

(c)(ii)	$L = 4\pi\sigma r^2 T^4$ $5.48 \times 10^{26} = 4\pi \times 5.67 \times 10^{-8} \times r^2 \times 6980^4$	**C1**
	$r = 5.69 \times 10^8$ m	**A1**

Q5.

(a)	temperature inversely proportional to wavelength	**M1**
	temperature is thermodynamic temperature of surface, and wavelength is the wavelength at which maximum emission rate occurs	**A1**
(b)(iii)	one tick placed in correct column in each row: wavelength: too high	**B1**
	surface temperature: too low	**B1**
	distance: unchanged	**B1**
	radius: too high	**B1**

Q6.

(a)	wavelength of maximum intensity is inversely proportional to (thermodynamic) temperature	**B1**
(b)(i)	λ_{MAX} = 0.50 μm for A **and** 0.65 μm for B	**C1**
	$T = 5800 \times (0.50 / 0.65)$ $= 4500$ K	**A1**
(b)(ii)	(star B has) greater peak / average wavelength	**B1**
	(star B looks) redder	**B1**

Q7.

(b)(ii)	$L = 4\pi\sigma r^2 T^4$ $9.86 \times 10^{27} = 4 \times \pi \times 5.67 \times 10^{-8} \times r^2 \times 9830^4$	**C1**
	radius = 1.22×10^9 m	**A1**
(c)	wavelength of peak intensity determined (from spectrum of star)	**B1**
	wavelength of peak intensity from object of known temperature determined	**B1**
	Wien's displacement law used **or** wavelength of peak intensity inversely proportional to temperature	**B1**