25. Astronomy and Cosmology

25.1 Standard candles

Paper 4

Marking Scheme

Q1.

(a)(i)	total power	**B1**
	power radiated (by the star)	**B1**
(a)(ii)	standard candle has known luminosity	**B1**
	radiant flux intensity measured by observer	**B1**
	(distance calculated using) $F = L / 4\pi d^2$	**B1**

Q2.

(b)(i)	$F = L / 4\pi d^2$	**C1**
	$d = \sqrt{(1.90 \times 10^{36} / [4\pi \times 8.42 \times 10^{-16}])}$ $= 1.34 \times 10^{25}$ m	**A1**

Q3.

(c)(i)	$F = L / 4\pi x^2$	**C1**
	($g = GM / x^2$ and so) $x^2 = GM / g$ **and** $x^2 = L / 4\pi F$	**M1**
	elimination of x and subsequent algebra shown leading to $g = 4\pi GMF / L$	**A1**
(c)(ii)	correct read-off of pair of values of g and F and full substitution of values of g, G, M and F into equation e.g. $L = (4\pi \times 6.67 \times 10^{-11} \times 1.99 \times 10^{30} \times 1.83 \times 10^{3}) / (8.0 \times 10^{-3})$	**C1**
	$L = 3.8 \times 10^{26}$ W	**A1**

Q4.

(b)	$F = L / (4\pi d^2)$	**C1**
	$= (3.8 \times 10^{31}) / [4\pi \times (1.8 \times 10^{24})^2]$ $= 9.3 \times 10^{-19}$ W m^{-2}	**A1**

Q5.

(c)(i)	$L = F \times 4\pi d^2$	**C1**
	$L = 2.52 \times 10^{-8} \times 4\pi \times (4.16 \times 10^{16})^2$ $= 5.48 \times 10^{26}$ W	**A1**

Q6.

(b)(i)	(astronomical) object of known luminosity	**B1**

Q7.

(a)	total power of radiation emitted (by the star)	**B1**
(b)(i)	$F = L / (4\pi d^2)$	**C1**
	$= 9.86 \times 10^{27} / [4\pi \times (8.14 \times 10^{16})^2]$ $= 1.18 \times 10^{-7}$ W m^{-2}	**A1**