Mark scheme for Support Worksheet – Topic E, Worksheet 1

1 A constellation is a collection of stars usually in a recognisable pattern that are not necessarily physically close to each other; whereas a stellar cluster consists of stars that are close to each other and attract each other gravitationally. [2]

2 A star is a spherical mass of hot gases that undergoes nuclear fusion producing the energy needed for the star to be in equilibrium. [2]

3 Nuclear fusion in the star's core. [1]

4 The energy produced through fusion in the star's interior creates a pressure outward; that counterbalances the force of gravity. [2]

5 Luminosity is the power radiated by the star; luminosity depends on surface area; and surface temperature. [3]

6 $\frac{L_X}{L_Y} = \frac{\sigma 4\pi R_X^2 T^4}{\sigma 4\pi R_Y^2 T^4}$; and so $\frac{L_X}{L_Y} = \frac{2^2 R^2}{R^2} = 4$ [2]

7 $\frac{L_X}{L_Y} = \frac{\sigma 4\pi R^2 T_X^4}{\sigma 4\pi R^2 T_Y^4}$; and so $\frac{L_X}{L_Y} = \frac{2^4 T^4}{T^4} = 16$ [2]

8 The power received per unit area. [1]

9 $\frac{b_X}{b_Y} = \frac{\frac{L}{4\pi d_X^2}}{\frac{L}{4\pi d_Y^2}} = \frac{d_Y^2}{d_X^2}$; $\frac{b_X}{b_Y} = \frac{d^2}{2^2 d^2} = \frac{1}{4}$ [2]

10 $\frac{L_X}{L_Y} = \frac{b 4\pi d_X^2}{b 4\pi d_Y^2} = \frac{d_X^2}{d_Y^2}$; and so $\frac{L_X}{L_Y} = \frac{2d^2}{d^2} = 4$ [2]

11 From $b = \frac{L}{4\pi d^2} \Rightarrow d = \sqrt{\frac{L}{4\pi b}}$; and so $d = \sqrt{\frac{4.5\times 10^{28}}{4\pi \times 6.2\times 10^{-12}}} = 2.4\times 10^{19}$ m [2]

12 $\lambda_0 T = 2.9\times 10^{-3}$ m K and so $T = \frac{2.9\times 10^{-3}}{520\times 10^{-9}}$ K; i.e. $T = 5577 \approx 5.6\times 10^3$ K [2]

13 Its colour/temperature. [1]

14 Class G. [1]

15 See *Physics for the IB Diploma*, Figure E2.6 page 500; [1] for each region. [4]

16 A and B have the same luminosity and A has a higher temperature;
from $L = \sigma A T^4$ B must then have the larger surface area and hence larger radius. [2]

17 A and B have the same temperature and A has the larger luminosity; from $L = \sigma A T^4$ A must have the larger area and hence the greater radius. [2]

18 The position of a star is measured against the background of the distant stars twice at times six months apart; the shift in the star's position is twice the parallax angle *p*; the distance is found from $d = \frac{1}{p}$ [3]

19 At distances of about 300 pc the parallax angle becomes so small that the uncertainty becomes comparable to the angle itself; for space-based telescopes the lack of atmospheric turbulence and other atmospheric effects reduces the uncertainty in the measurement so that even smaller angles can be measured accurately. [2]

