Name of the Student:_____
Max. Marks : 21 Marks **Time : 21 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable answers		Additional guidance	Mark
(a)	• Use of $L = 4\pi r^2 \sigma T^4$ • With 270 000 or 1420 • $T = 3494$ K which is smaller than the temperature of the Sun, so it is not correct • **Or** $T = 0.605\ T_{Sun}$ which is smaller than the temperature of the Sun, so it is not correct	(1) (1) (1)	Example of calculation 3.85×10^{26} W $\times$ 270 000 $= 4 \times \pi \times 5.67 \times 10^{-8} \times (1420 \times 6.96 \times 10^{8}$ m$)^2 \times T^4$ $T = 3494$ K	3

Question Number	Acceptable answers		Additional guidance	Mark
(b)	• Use of $\lambda_{max}\ T = 2.898 \times 10^{-3}$ m K • $\lambda_{max} = 8.29 \times 10^{-7}$ m (ecf for T from (a))	(1) (1)	Example of calculation $\lambda_{max} \times 3494$ K $= 2.898 \times 10^{-3}$ m K $\lambda_{max} = 8.29 \times 10^{-7}$ m	2

Question Number	Acceptable answers		Additional guidance	Mark
(c)	• Add to top right • Red giant/supergiant	(1) (1)	Consistent with the answer from (a) for both marking points Accept hypergiant	2

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
(i)	• Use of $z = \frac{\Delta\lambda}{\lambda}$ (1) • Uses $\Delta\lambda = 4.0 \times 10^{-6}\ \text{m} - \lambda$ and λ as the denominator (1) • Wavelength emitted = 2.7×10^{-7} m (1)	Example of calculation: $z = 14 = \frac{4.0 \times 10^{-6}\ \text{m} - \lambda}{\lambda}$ Wavelength emitted = 2.67×10^{-7} m	3
(ii)	An explanation that makes reference to the following points: • Wavelength of light has increased (1) One from: • Visible / UV light which was initially emitted might arrive as IR / radio (1) • Due to expanding universe/space (1)		2

Q3.

Question Number	Acceptable answers	Additional guidance	Mark
	An explanation that makes reference to the following points: (1) • Hubble is for cosmological distances (1) • is not suitable since S2 is in our galaxy (1) • trigonometrical parallax is suitable for local stars because the parallax angles produced are large enough to measure accurately	e.g. to distant galaxies	3

Q4.

Question Number	Acceptable answers	Additional guidance	
(a)	• Object of known luminosity (1)		1

Question Number	Acceptable answers	Additional guidance	
(b)	• The (parallax) angle becomes very small **(1)** **Or** the diameter of the Earth's orbit is very small • Giving a (very) large percentage uncertainty **(1)**		**2**

Question Number	Acceptable answers	Additional guidance	
(c)	• Measure change in wavelength / frequency **(1)** • Determine relative velocity using redshift formula **(1)** • Then apply $v = H_0 d$ **(1)**		**3**