Support Worksheet – Option E, Worksheet 3

1 List the stages in the evolutionary path of:

a a $1\,M_e$ star. [1]

b a $10\,M_e$ star. [1]

2 Estimate the luminosity of a main sequence star whose mass is $3\,M_e$ in terms of the Sun's luminosity $L_\odot$, using a mass-luminosity relation of $L \propto M^{3.5}$. [1]

3 Define the **Chandrasekhar limit**. [1]

4 Define the **Oppenheimer–Volkoff limit**. [1]

5 State what is meant by a **pulsar**. [1]

6 State why pulsars cannot be seen with optical telescopes. [1]

7 State **Hubble's law**. [1]

8 State why in verifying Hubble's law data from nearby galaxies may not be used. [1]

9 A line in the spectrum of hydrogen in the lab is measured to have a wavelength of 656 nm. The same line in the spectrum of a distant galaxy is measured on Earth to be 680 nm. Calculate the speed of recession of this galaxy. [2]

10 A line in the spectrum of hydrogen in the lab is measured to have a wavelength of 656 nm. The same line in the spectrum of a distant galaxy is measured on Earth to be 670 nm. Calculate the distance to this galaxy using a Hubble constant of $73\,\text{km}\,\text{s}^{-1}\,\text{Mpc}^{-1}$. [3]

11 Calculate the value of the inverse of the Hubble constant $\frac{1}{H}$ using $H = 73\,\text{km}\,\text{s}^{-1}\,\text{Mpc}^{-1}$, expressing your answer in years. [1]

12 Outline how the inverse of the Hubble constant is an estimate of the age of the universe. [3]