Name of the Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable answers	Additional guidance	Mark
(i)	An answer that makes reference to the following: • because the helium atoms are moving, there is a change in frequency/ wavelength of the emitted light (1) • for particles moving away from the observer there will be an decrease in frequency and for particles moving towards the observer there will be an increase in frequency (1) OR for particles moving away from the observer there will be an increase in wavelength and for particles moving towards the observer there will be an decrease in wavelength (1)		**(2)**

Question Number	Acceptable answers	Additional guidance	Mark
(ii)(1)	• use of $v/c = \Delta\lambda/\lambda$ • $v = 1530$ m s^{-1}	Example of calculation: $v / 3 \times 10^{8}$ m s^{-1} = 3×10^{-3} nm / 587 nm $v = 1530$ m s^{-1}	**(2)**

Question Number	Acceptable answers	Additional guidance	Mark
(ii)(2)	• mass of helium atom = 4u • use of ½ $m \langle c^2 \rangle = 3/2\ kT$ • $T = 375$ K	Example of calculation: Mass of He atom = $4 \times 1.66 \times 10^{-27}$ kg = 6.64×10^{-27} kg ½ 6.64×10^{-27} kg × (1530 m s^{-1})^2 = $3/2 \times 1.38 \times 10^{-23}$ J K^{-1} × T $T = 375$ K	**(3)**

Q2.

Question Number	Answer		Mark
	QWC – Work must be clear and organised in a logical manner using technical wording where appropriate		
	Standard candles are (stellar) objects of known luminosity	(1)	
	Standard candle's brightness on earth is measured/known/found [accept apparent magnitude or flux in place of brightness] [Do not accept 'used' in place of 'measured'] [Do not accept 'used' in place of 'measured']	(1)	
	Use inverse square law [$F=L/4\pi d^2$] **Or** use distance modulus method [$M - m = 5\log(d/10)$]	(1)	
	(Hence) distance to standard candle is calculated	(1)	
	Dust layer will reduce brightness /magnitude/flux of Cepheid	(1)	
	Cepheid will appear to be further away than it is [accept "star" for "standard candle" or for "Cepheid" for MP2 to MP6]	(1)	6

Q3.

Question Number	Acceptable answers	Additional guidance	Mark
	A description that makes reference to the following: • (main sequence) stars are (primarily) converting hydrogen to helium in their core (1) • stars on main sequence maintain a constant luminosity (for most of their lifetime) (1)		**(2)**