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

Mark Schemes

Q1.

Question Number	Answer	Mark
	B – 545 ÷ 838 000	1
	Incorrect Answers: Correct method: mass = energy transfer ÷ latent heat of vaporisation A – uses energy transfer ÷ latent heat of fusion C – uses latent heat of fusion ÷ energy transfer D – uses latent heat of vaporisation ÷ energy transfer	

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
	• Use of ½ $m \langle c^2 \rangle = 3/2\ kT$ (1) • $\sqrt{\langle c^2 \rangle} = 500\ \text{m s}^{-1}$ (1)	Example of calculation ½ $m \langle c^2 \rangle = 3/2\ kT$ ½ × 4.8×10^{-26} kg × $\langle c^2 \rangle = 3/2 \times 1.38 \times 10^{-23}\ \text{J K}^{-1} \times 292\ \text{K}$ $\langle c^2 \rangle = 2.52 \times 10^5\ \text{m}^2\ \text{s}^{-2}$ $\sqrt{\langle c^2 \rangle} = 502\ \text{m s}^{-1}$	2

Q3.

Question Number	Answer		Mark
	Use of $\lambda_{max} T = 2.898 \times 10^{-3}$ m K	(1)	
	$T = 3400$ (K)	(1)	
	Use of $L = 4\pi r^2 \sigma T^4$	(1)	
	$r_B = 6.8 \times 10^{11}$ (m) [8.82×10^{11} m if T = 3000 K, 6.87×10^{11} m if T = 3400 K]	(1)	
	$r_B / r_S = 980$ [1270 if $T = 3000$ K, 988 if $T = 3400$ K]	(1)	5
	Example of calculation $T = \frac{2.898 \times 10^{-3}\ \text{m K}}{850 \times 10^{-9}\ \text{m}} = 3410\ \text{K}$ $r_B = \sqrt{\frac{4.49 \times 10^{31}\ \text{W}}{4\pi \times 5.67 \times 10^{-8}\ \text{W m}^{-2}\text{K}^{-4} \times (3410\ \text{K})^4}} = 6.83 \times 10^{11}\ \text{m}$ $\frac{r_B}{r_S} = \frac{6.83 \times 10^{11}\ \text{m}}{6.95 \times 10^{8}\ \text{m}} = 983$		

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Q4.

Question Number	Acceptable answers	Additional guidance	Mark
	• Use of $\lambda_{max}T = 2.9\times10^{-3}$ **(1)** • $T = 5800$ K [accept 5780 K and 6000 K] **(1)** • Use of $L = 4\pi r^2\sigma T^4$ **(1)** • r = 6.9×10^8 m **(1)**	Example of calculation: $T = \frac{2.9\times10^{-3}\,\text{mK}}{5.02\times10^{-7}\,\text{m}} = 5780\,\text{K}$ $r = \sqrt{\frac{3.85\times10^{26}\,\text{W}}{4\pi\times5.67\times10^{-8}\,\text{Wm}^{-2}\text{K}^{-4}\times(5800\,\text{K})^4}} = 6.91\times10^8\,\text{m}$	**4**

Q5.

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)**

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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)**

Q6.

Question Number	Answer	Mark
	B	**1**

Q7.

Question Number	Answer	Mark
	B	**1**

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