Question Number	Answer		Mark
15(a)	Use of $z = \frac{\Delta\lambda}{\lambda}$	**(1)**	**2**
	$\lambda_o = 1.60 \times 10^{-6}$ m	**(1)**	
	Example of calculation $z = \frac{\Delta\lambda}{\lambda} = \frac{(\lambda_o - 134 \times 10^{-9}\text{ m})}{134 \times 10^{-9}\text{ m}} = 10.96$ $\therefore \lambda_o = (10.96 \times 134 \times 10^{-9}\text{ m}) + 134 \times 10^{-9}\text{ m} = 1.60 \times 10^{-6}\text{ m}$		
15(b)	d between 13 and 14 ($\times 10^9$ ly)	**(1)**	**3**
	Use of $s = ut$	**(1)**	
	$s = 1.3 \times 10^{26}$ (m) [Accept answers in range $1.2 \times 10^{26} \rightarrow 1.3 \times 10^{26}$]	**(1)**	
	Example of calculation $d = 13.4 \times 10^9$ ly 1 ly = 3.0×10^8 m s^{-1} $\times$ 3.15×10^7 s = 9.45×10^{15} m $s = 9.45 \times 10^{15}$ m $\times$ $13.4 \times 10^9 = 1.26 \times 10^{26}$ m		
15(c)	Very distant galaxies have (very) large red shifts	**(1)**	**2**
	So their light has become infrared when it arrives (at the telescope) [MP2: Do not credit statements that light is emitted in IR region of spectrum]	**(1)**	
	Total for question 15		**7**