Question Number	Answer		Mark
19(a)	The natural frequency of the water molecule is about 10 GHz	(1)	
	The microwave radiation frequency (2.45 GHz) is not at/about the natural frequency of the water molecule and so this is not resonance **Or** The driving frequency is not is not at/about the natural frequency of the water molecule and so this is not resonance	(1)	**2**
19(b)(i)	The (rotating) water molecules collide with other molecules (in the food)	(1)	
	There is a transfer of kinetic energy to (adjacent) molecules (in the food)	(1)	
	This increases the internal energy and hence the temperature of the food **Or** this increases the (average) kinetic energy (of the molecules) and hence the temperature of the food	(1)	**3**
19(b)(ii)	Ice is a solid and so the molecules have fixed positions	(1)	
	This prevents the molecules in the solid ice from rotating **Or** only molecules in liquid water around the ice can rotate	(1)	**2**

Question Number	Answer		Mark
19(c)(i)	Use of $\Delta E = mc\Delta\theta$ and use of $P = \frac{\Delta W}{\Delta t}$	(1)	
	Use of efficiency $= \frac{\text{useful power output}}{\text{power input}}$ **Or** Use of efficiency $= \frac{\text{useful energy output}}{\text{energy input}}$	(1)	
	Efficiency = 56 %, so the manufacturer's claim is invalid	(1)	**3**
	<u>Example of calculation</u> $P = \frac{0.325\text{ kg} \times 4190\text{ J kg}^{-1}\text{ K}^{-1} \times (85.0 - 25.0)\text{ °C}}{225\text{ s}} = 363\text{ W}$ efficiency$= \frac{363\text{ W}}{650\text{ W}} \times 100\ \% = 55.8\ \%$		
19(c)(ii)	Energy transfer from water cooling = energy transfer to melt ice + energy transfer to heat ice	(1)	
	Use of $\Delta E = mc\Delta\theta$	(1)	
	Use of $\Delta E = mL$	(1)	
	θ = 59 °C	(1)	**4**
	<u>Example of calculation</u> Energy transfer from water cooling = energy transfer to melt ice + energy transfer to heat ice $m_{\text{water}}\, c\, \Delta\theta_{\text{water}} = m_{\text{ice}}\, L + m_{\text{ice}}\, c\, \Delta\theta_{\text{ice}}$ $0.325\text{ kg} \times 4190\text{ J kg}^{-1}\text{K}^{-1}\ (85.0 - \theta)$ $= 0.0625\text{ kg} \times 3.33 \times 10^5\text{ J K}^{-1} + 0.0625\text{ kg} \times 4190\text{ J kg}^{-1}\text{ K}^{-1}(\theta - 0.0)$ $1362\,\theta + 262\,\theta = +1.16 \times 10^5\text{ J} - 2.08 \times 10^4\text{ J}$ $\therefore \theta = \frac{9.52 \times 10^4}{1620} = 58.8\ \text{°C}$		
	Total for question 19		**14**