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

Mark Schemes

Q1.

Question Number	Acceptable answers	Additional guidance	Mark
	• Energy lost by block = energy gained by water and/ or glass **(1)** • Use of $\Delta E = mc\Delta\theta$… **(1)** • …using temperature change of block **(1)** • $c = 310$ (J kg^{-1} K^{-1}) **Or** Required temperature change for tin = 103 K **Or** required starting temperature for tin = 126 °C **(1)** • Block is copper with justification e.g. some energy transferred to surroundings (so causes an underestimate in c) **or** block not fully at 100°C (so causes an underestimate in c) **or** tin cannot produce the required temperature change **(1)**	Example of calculation: $0.22\ \text{kg} \times c \times (100 - 23)\text{K}$ $= 0.05\ \text{kg} \times 840\ \text{J kg}^{-1}\ \text{K}^{-1} \times 4\ \text{K} +$ $0.3\ \text{kg} \times 4200\ \text{J kg}^{-1}\ \text{K}^{-1} \times 4\ \text{K}$ $16.94\ c = 168 + 5040 = 5208\ \text{J}$ $c = 307\ \text{J kg}^{-1}\ \text{K}^{-1}$ MP1 may be awarded for approach comparing energy gained by water and/or glass with maximum energy lost by block without equating them	5

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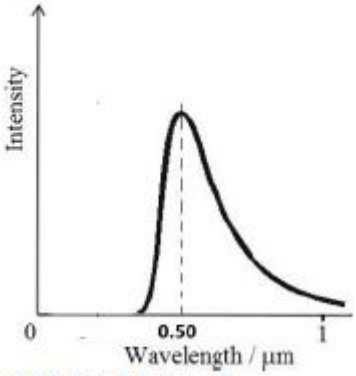
Q2.

Question Number	Acceptable answers		Additional guidance	Mark
	• Use of $pV = NkT$	(1)	Example of calculation $p_1 V_1 = NkT_1$	
	• Conversion of T in K	(1)	$p_1 V_1 / T_1 = NkT_1 = p_2 V_2 / T_2$ V_1 / 293 K = 2800 m^3 / 393 K	
	• Use of $\rho = m/V$ to determine mass of air in the balloon	(1)	Volume of gas before heating, V_1 = 2087 m^3 mass of air in balloon	
	• Calculation of total mass = mass of air at 120 °C + passengers + balloon	(1)	= 1.2 kg m^{-3} × 2087 m^3 = 2505 kg Total mass with 5 passengers = (2505 + 340 + 380) kg = 3225 kg	
	• Use of $W = mg$	(1)	W = 3225 kg × 9.81 N kg^{-1} = 31 637 N 31 600 N < 33 000 N	
	• W = 31 600 N, which is less than 33 000 N, so the balloon can take off			6

Q3.

Question Number	Acceptable answers		Additional guidance	Mark
(i)	An explanation that makes reference to the following points:			
	• Electrons / atoms exist in discrete/fixed/certain energy levels **Or** there are only a certain number of specific differences in energy levels of electrons / atoms	(1)		
	• (Absorbing) a photon causes an electron / atom to move to a higher energy level **Or** (Absorbing) a photon causes an electron / atom become excited	(1)		
	• Photons are (only) absorbed when the photon energy is equal to the difference between energy levels	(1)	May refer to photon energy $E = hf$	4
	• Photon energy depends on frequency/wavelength, so photons of specific frequencies/wavelengths are absorbed, (producing dark lines)			

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(ii)	• Use of $\lambda_{max}T = 2.898 \times 10^{-3}$ m K • $\lambda_{max} = 5.0 \times 10^{-7}$ (m) • Curve with a peak at candidate's value of λ_{max} • Black body asymmetric curve with intensity = 0 when wavelength = 0	(1) (1) (1) (1)	Example of calculation: $\lambda_{max} = \frac{2.898 \times 10^{-3}\ \text{m K}}{5800\ \text{K}}$ $= 5.0 \times 10^{-7}$ m  2.898×10^{-3} m K Meets x axis on left but not on right, steeper on the left than on the right and narrower on the left at every point than on the right	4
(iii)	An explanation that makes reference to the following points: • Fusion takes place (from hydrogen to helium) • This releases energy and leads to an (outward) pressure/force which balances gravitational forces	(1) (1)	Accept high temperature for energy	2

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