Question	Answer	Marks	Guidance
1 a i	Idea that **electrons** are involved / collide with ions or atoms (in aluminium) [1] But idea that electrons pass on energy [2] idea that particles vibrate **more** / get fast**er** / gain KE [1] idea that (kinetic) energy / movement is passed from particle to particle [1]	3	**allow** electrons vibrate [1] **ignore** 'particles start to vibrate' **allow** vibrate faster [1] **allow** 'particles move more' [1]
ii	The water is heated and it **expands**. [1] This makes the water **less dense** so it rises. [1]	2	**one mark for each correct sentence** **allow** equivalent answers worded differently. e.g. occupies a larger volume / takes up more space / particles spread out [1] **ignore** particles expand **allow** equivalent answers worded differently. **eg.** denser water sinks [1] **ignore** particles become more dense
b i	idea that microwaves heat water (and fat) only / microwaves penetrate food [1] **but** microwaves increase **KE** / movement / vibration of water (or fat) particles [2]	2	**allow** IR heats all particles on surface / IR heats surface only [1] **ignore** microwaves cook from the centre **allow** IR increases KE of all food particles / particles on the surface [2]

ii	(Both are) electromagnetic waves / reflected by shiny surfaces or metal walls / conduction or convection (heat) to centre of food [1] both transfer KE to particles / [1]	2	**maximum two marks** **ignore** references to heat **eg** (both) conduct to the rest of the food [1] **allow** both cause particles to vibrate more / vibrate faster [1] eg 'KE passed on to other particles in the rest of the food scores' [2]
	Total	**9**	

Question	Answer	Marks	Guidance
2	**Level 3: (5 – 6 marks)** **Full quantitative** **AND** **a qualitative comparison.** Quality of written communication does not impede communication of the science at this level. **Level 2: (3 – 4 marks)** **Partial quantitative comparison** **OR** **qualitative comparison showing alloy has greater mass but smaller specific heat capacity.** Quality of written communication partly impedes communication of the science at this level. **Level 1: (1 – 2 marks)** **Idea of same mass of water** **OR** **water rises in temperature by the same amount** **OR** **same energy needed** Quality of written communication impedes communication of the science at this level. **Level 0: (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted up grade A*** **Indicative scientific points ay level 3 may include:** **relevant points for level 1 and level 2 and** • idea that heat capacity / energy is the same for each • correct calculation to show heat energy capacity is the same for each e.g. 400 x 1.5 x 80 = 500 x 1.2 x 80 400 x 1.5 = 500 x 1.2 **Indicative scientific points ay level 2 may include:** • alloy has a smaller specific heat capacity • alloy has greater mass • stainless steel has a larger specific heat capacity • stainless steel has smaller mass • heat capacity /(energy) correctly calculated e.g. 400 x 1.5 (x 80) 500 x 1.2 (x 80) **Indicative scientific points ay level 1 may include:** • mass of water is the same / mass of water in each kettle is 1.8 kg • temperature rise of water in each kettle is the same / water rises from 20^0C to 100^0C in each kettle / temperature rise of water in each kettle is 80^0C • power of kettle is the same • same amount of water (1.8 kg) and temp rise (80^0C) • water heating needs same energy for each kettle **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**
	Total	**6**	

Question	Answer	Marks	Guidance
3 a	1.9(333) (g/cm^3)	1	
b	2.7 (g) [2] **BUT** if answer is incorrect then 0.9 x 3 scores [1]	2	
c	Mark explanation only B is heaviest [0] Unknown liquid is denser than water [1] Unknown liquid is denser than oil [1] and is liquid X [1]	3	If answer is A then it is still possible to gain up to 2 marks If no clear reference to density of water or oil is made then **allow** unknown liquid is heavier than oil / water [1]
d i	Oil (linear) reduction in density with increasing temperature / ORA [1]	1	
ii	Water density rises up to 5˚ and then falls (non-linearly) as temperature increases AW [1]	1	**Eg.** water's maximum density is at 5^OC [1] **Allow** 3^OC - 6^OC tolerance
d iii	Any two from: Ice (at 0^oC) is less dense (than water at 0^oC) [1]	2	

Question	Answer	Marks	Guidance
	Density of water increases up to $5^{o}C$ [1] (Idea that) water warm**er** as depth **increases** [1]		 e.g. 'warmest water at the **bottom**' scores [1]
	Total	**10**	

Question			Answer	Marks	Guidance
4			300 (seconds) to 500 (seconds) (1) energy used to break intermolecular bonds / bonds between molecules (1)	2	**allow** 300 to 310 (1) **allow** overcome intermolecular forces **ignore** breaks intermolecular forces **not** intra-molecular forces **ignore** bonds between particles **allow** breaks bonds between liquid particles (1) both marking points are independent of each other
			Total	**2**	

Question			Answer	Marks	Guidance
5	(a)		30240 (from the calculation) **and** E / the 35000 heater (2) **but** if the answer incorrect or no heater selected 0.6 x 12 x 4200 **or** 30240 (1)	2	no mark for just choosing E with no working or answer no mark for choosing E with an incorrect calculation
	(b)	(i)	$\frac{48000}{20}$ or 2260 × 20 and liquid A indicated or named scores (2) **but** $\frac{48000}{(53 \text{ or } 20)}$ or s.l.h. × (20 or 53) without comment or incorrect comment scores (1)	2	Allow correct rearrangements: **Eg $\frac{48\,000}{2260}$ = 21,2 (38938) or 21 and liquid A [2]** A chosen with incorrect calculation scores (0)
		(ii)	melting or freezing / solidification	1	**allow** condensation / sublimation **allow** acceptable named change of state **ignore** evaporation **ignore** liquid to gas / boiling
			Total	**5**	

Question			answer	Marks	Guidance
6	(a)		**[Level 3]** A **detailed** explanation of the conduction in the glass together with a link to the energy transfer from air in the room to the glass **or** from the glass into the (cold) air outside. Quality of written communication does not impede communication of the science at this level. (5-6 marks) **[Level 2]** Limited explanation of one process by which energy is transferred between particles and leads to energy loss from the room or window. The description may not be specific to the window or glass. Quality of written communication partly impedes communication of the science at this level. (3-4 marks) **[Level 1]** An incomplete explanation, naming some processes by which energy is transferred or lost from the room. Quality of written communication impedes communication of the science at this level. (1-2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grades up to A/A*** **Indicative scientific points at Level 3 may include:** warm air particles: • move around quickly • hit glass particle making them vibrate (move) more **glass particles**: • vibrate more / gain **KE** • pass vibrations / **KE** through glass cold air particles: • hit (warm) glass particles • gain **KE** / bounce off with more speed **Indicative scientific points at Level 2 may include one of :** warm air particles: • move around quickly • hit glass particle making them vibrate or move more glass particles: • vibrate or move more / gain energy • pass vibrations or movement or energy through glass cold air particles: • hit (warm) glass particles • gain energy / bounce off with more speed • change of air density causes convection (outside) **Indicative scientific points at Level 1 may include:** • idea of particles passing on energy • idea of conduction through window / glass • idea of convection in air outside / in the room • idea of radiated heat from outer surfaces of window **ignore** heat escapes or draughts **ignore** heat particles / particles move through glass **ignore** references to double glazing **Use the L1, L2, L3 annotations in Scoris; do not use ticks**

Question			Answer	Marks	Guidance
	(b)	(i)	61.67 / 61.7 / 61.66 / 62 [3] **if answer incorrect then** 41.67 / 41.7 / 41.66 / 42 [2] **or** 2100 000 / (12 x 4200) scores [1]	3	**allow** 61.666666 etc [3] **allow** 61 / 61.6 [2] **allow** 41.666666 etc [2] **allow** 41 / 41.6 [1]
		(ii)	heat or energy heating steel / metal / case / radiator [1] idea of heater / steel / case / metal / radiator conducting [1] heat / energy being given out or lost to or from the room / surroundings / atmosphere / air / AW [1]	1	**ignore** lost / wasted unless qualified **ignore** references to electricity **but** **allow** steel or metal conducts electricity [1] **allow** explanation eg heat passes through the steel [1] **ignore** references to change of state or boiling point of water **ignore** efficiency
	(c)		water or 'it' heats (gets to 50°C or maximum) slower / AW / ORA for oil [1] water or 'it' contains more energy / has higher (specific) heat capacity / ORA for oil [1] **linked to** water or 'it' stays hotter for longer / gives out more heat or energy to the room / AW [1]	3	**does not have to appear in this order to gain full marks** **allow** idea that water reaches 50°C more gradually or heats up more gradually **but ignore** merely its gradual **allow** water (graph) has a lower gradient / AW / ORA **ignore** efficiency **ignore** cost **ignore** references to boiling points **allow** oil cools down quicker / gives out less heat to the room
			Total	**13**	