Question number	Answer	Notes	Marks
1 (a)	Ice – Regular arrangement; Water – Irregular arrangement; No gaps big enough to add another particle; Steam – Random and spaced (compared to water);	Ignore • variation in particle size Allow ice sample that does not fill the box Gaps to be smaller than printed particle (bottom left) Allow water with "surface" shown and space above Ignore arrows / lines indicating movement	4

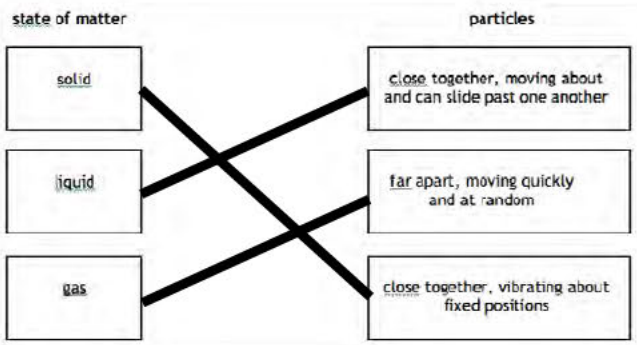
(b)	Ice – Vibrate (about fixed positions); Water – Change position/ move over each other; Steam – EITHER Random movement; OR Range of speeds;	Ignore ideas of • collisions • filling container • bonds • freedom • flowing Accept • oscillate • shake • jiggle Accept for change of position • move slowly • move around Allow slide past each other Accept quickly for range of speeds	3

(Total for Question 1 = 7 marks)

Question number		Answer	Notes	Marks
2 (a) (i)		90 (K)		1
(ii)		Any three of MP1 Idea that particles/molecules move apart; MP2 Idea that particles/molecules gain (kinetic) energy; MP3 Idea that particles/molecules move more freely; MP4 Idea that particles/molecules leave the liquid;	Ignore: molecules vibrate Allow: molecules spread out, take up more space May be shown on labelled diagram Allow: idea of moving **faster** Ignore : 'move **more**' Allow bonds break Ignore unqualified 'move **more**' Allow escape Ignore evaporate	3
(b) (i)		Any two of MP1 radiation / infrared; MP2 Idea of reflection; MP3 Idea of little/no absorption; MP4 Idea of poor emission;	 Allow IR Allow bad radiator	2
(ii)		Any two of (in a vacuum there are) no atoms/molecules/particles; so no/poor conduction; so no/little convection (currents);	 Allow: no 'medium' no 'material' There are no molecules to conduct = 2 marks There are no molecules to convect = 2 marks	2

(c)		Any two of MP1 Idea that there is cold gas/air/oxygen just above the liquid (surface); MP2 Idea that the gas/air/oxygen in the room is warmer; MP3 Idea that convection currents in air (above liquid surface) unlikely; MP4 Idea that (evaporated) oxygen /air / gas would insulate the surface; MP5 Idea that oxygen/gas would build up pressure in a sealed vessel;	Ignore "heat rises" Allow: warm air won't fall, cool air won't rise Ignore density arguments Allow: gas is a poor conductor Allow: flask would burst if it had a lid	2

Total for question 2 = 10 marks

Question number	Answer	Notes	Marks
3 (a)	any one line correct for one mark; all three lines correct for two marks;;  	more than one line to a box does not score	2
(b) (i)	18; 192; Temperature in °C / Temperature in kelvin room temperature: **18** / 291 triple point of ethyne: -81 / **192**		2
(ii)	decreases / OWTTE;	ignore "molecules slow down"	1
(iii)	remains constant / no change / nothing;		1

Total 6 marks

Question number	Answer	Notes	Marks
4 (a) (i)	smoke particles in air (in smoke cell) OR pollen on water OR dust particles in air;	Accept correct description of Brownian motion applied to unspecified particles in a suitable medium	1
(ii)	Any two of - MP1 Idea that tiny/smaller particles are hitting; MP2 Larger (observed) particles are moved; MP3 Idea of random motion of larger particles;	 Allow zig-zag movement	2
(b)	Any six ideas about arrangement and motion of particles Max 2 for each state	Accept same ideas shown in labelled diagrams	max 6
	Solid – Regular pattern OR close packed; Vibration in position; Little space between particles;	 Condone fixed position	
	Liquid – Irregular pattern; Able to move over/past other particles; Little space between particles;	 Condone no fixed position Ignore vibration relating to liquid	
	Gas – No pattern; Able to move freely/fast; Larger space between particles;	 Condone no fixed position Ignore vibration relating to gas	

Total 9 marks

Question number	Answer	Notes	Marks
5 (a)	Any three of evaporation as liquid→ gas/vapour; higher (kinetic) energy/faster particles/molecules leave/ evaporate; reducing (average) energy of particles left /heat remaining; reducing temperature;	 Accept: water/sweat → gas/vapour Accept: particles leaving take heat with them Accept: lower energy particles remain	3
(b) (i)	(still covered in) sweat /evaporation mentioned; not generating as much 'new' heat;	Ignore: conduction, convection and radiation losses Ignore: reference to shiny sheet	2
(ii)	Either barrier to reduce particle movement; reducing convection / evaporation; OR (shiny) surface reflects/poor absorber; reducing radiation /IR losses;	Ignore: conduction losses Accept: barrier to air currents / air is trapped	2

Question number	Answer	Notes	Marks
6 (a)	any four from – (at lower temp) particles move at lower speed / lower kinetic energy; on average; so hit sides less often / with less energy; reducing force / pressure; tension in rubber; pulls balloon material into smaller size;	Accept: momentum arguments	4

Question number	Answer	Notes	Marks
6 (b)	Any **three** explanations of faulty method, with a workable improvement. Note that the fault needs to be properly identified, not just "the method is faulty / inadequate", or the method numbered with a comment that "Step 2 is wrong" <u>Fault #1</u> 'different time in freezer' does not give range of temps / always cools to same temp; <u>Improvement #1</u> Way to get range of temp ; e.g use water bath(s), use freezer(s) set to different temps <u>Fault #2</u> Difficult /hard to 'measure temp of balloon with thermometer' OR this doesn't measure temp of gas inside; <u>Improvement #2</u> Measure temperature of surroundings ; e.g. inside of freezer, water bath or air <u>Fault #3</u> Measuring / plotting 'size' is imprecise /too vague; <u>Improvement #3</u> measure / plot a more precise quantity; e.g. volume / length / diameter / circumference	CREDIT any explanation OR improvement, up to three of each, wherever seen i.e. the "Fault" and "Improvement" marks do not have to form a matching pair. Allow answers that mention high and/or low temperatures Needs to be more than: can't + statement from stimulus Ignore reference to room temperature Not temperature	max 6

	Fault #4 'measure size next to ruler' is an inaccurate method / difficult to measure (with a ruler) / comment on shape ; Improvement #4 Sensible method to measure (a relevant quantity); e.g. measure volume by displacing water, measure circumference using tape/string, use set squares with ruler Fault #5 repeating does not make it a fair test; Improvement #5 control a named variable that does; e.g. starting volume of balloon Fault #6 balloon may warm up between leaving the freezer and being measured; Improvement #5 method of minimising this; e.g. idea of measuring quickly, having whole experiment at the measured temperature	Allow mention of parallax NOT "time in freezer"	