Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
(a)	An explanation that makes reference to the following linked points: • particles collide with walls (of container) (1) and any two from: • more frequently/time between collisions is less (1) • (resulting in) larger force (1) • (over a) smaller surface area (1)	 allow 'more often'	3

Question number	Answer	Additional guidance	Mark
(b)	A description that makes reference to the following three points: • (average kinetic energy) increases (1) • in (direct) proportion to (1) • Kelvin temperature (1)	 dependent on point 1 dependent on point 1	3

Q2.

Question number	Answer	Notes	Marks
(a)	24 (kPa);		1
(b)	any three from: MP1. reading increases / pressure increases; MP2. reading doubles / pressure doubles/ reading is 48 kPa; MP3. (because) air particles collide with walls more **often**; MP4. (because) pressure × volume is constant;	 scores first 2 marks allow quoted formula allow (because) pressure is inversely proportional to volume	3
(c) (i)	{speed / velocity / KE} of particles decreases;	allow less frequent collisions ignore 'motion / movement decreases'	1
(ii)	pressure decreases; particles collide with walls less often; particles collide with less force;	 allow particles colliding less hard	3

Q3.

Question number	Answer	Notes	Marks
(a) (i)	(average) speed = distance (moved) / time (taken);	allow rearrangements and use of standard symbols e.g. v = s/t condone s = d/t	1
(ii)	use of one correct pair of readings from the graph; substitution of a correct distance and time into formula; evaluation; matching unit; e.g. total distance = 700 (km), total time = 60 (mins) (speed =) 400 / 30 (speed =) 13 km/minute	seen anywhere in working must be consistent with units used in substitution 400 000 / 1800 222 m/s 0.222 km/s gains 4 marks 800 km/hour gains 4 marks 12 km/minute gains 2 marks only 194 m/s gains 2 marks only	4
(b)	pressure increases; air molecules move faster / gain KE; molecules collide more often with aeroplane;	 allow temperature proportional to KE allow idea that air becomes more dense at lower height / RA ignore molecules colliding with each other allow molecules colliding with aeroplane with more force / harder	3
			Total for question 3 = 8 marks

Q4.

Question number	Answer	Notes	Marks
(a) (i)	Selection of P=F/A; Conversion of g to kg; Evaluation of weight; Evaluation of pressure; Correct answer: 140 (Pa) i.e. $W = 3.7 \times 10^{-3} \times 10 = 3.7 \times 10^{-2}$ N; $P = 3.7 \times 10^{-2} / (2.6 \times 10^{-4})$; P = 140 (Pa);	 0.0037 seen anywhere Accept any value that rounds to 140. i.e 142, 142.3, Accept use of 9.8(1) for 'g', giving 139(.46)	4
(ii)	Same weight (and larger cross-sectional area); P=F/A so smaller pressure;	Allow 'force' for weight	2
(b)	Increases continuously from -10 °C to 0 °C; Remains constant at 0 °C; Increases continuously from 0 °C to 20 °C;	Responses with no period of time at 0 °C score max 1 mark. Accept • Any gradient • Straight lines or curves for the increasing temperature parts • Any non-zero amount of time at 0 °C by eye Ignore any numbers on the time axis.	3
(c)	Any TWO from: Bonds between particles are weakened or broken; Particles go from regular to irregularly packed/EQ; Particles go from vibrating (about a fixed position) to sliding past each other/EQ;	 Allow particles get (slightly) further apart/EQ; ignore references to KE	2

Q5.

Question number	Answer	Notes	Marks
(a) (i)	downward arrow labelled weight; downward arrow is equal in length to upthrust arrow;	ignore starting point of arrow allow 'gravitational force', 'force due to gravity' reject 'gravity' judge by eye	2
(ii)	(a quantity with) magnitude; and direction;	allow size, amount ignore quantity, measurement	2
(iii)	any correct vector; e.g. velocity, displacement, acceleration, momentum etc.	ignore force, any named force e.g. weight, upthrust etc	1
(b) (i)	pressure (difference) = height × density × g;	allow standard symbols and rearrangements e.g. $p = h \times \rho \times g$ allow d for density ignore "gravity" for g	1
(ii)	substitution; evaluation of pressure difference in Pa OR kPa to at least 3s.f.; addition of surface pressure (100 kPa) to give answer; e.g. $p = 15.8 \times 1030 \times 10$ $p = 162740$ Pa OR 162.74 kPa $p = 162.74 + 100$ (= 260 kPa)	allow g = 9.8, 9.81 -1 for POT error unless due to physics error reject this mark if inconsistent units used allow final answer in Pa or kPa allow 262 740 (Pa)	3
(iii)	any two from: MP1. idea that {weight of ship / downwards force} is greater; MP2. larger pressure difference (when deeper in water); MP3. larger upthrust force (needed to keep forces balanced);	allow ship is heavier, ship has more mass allow larger pressure (on bottom of ship)	2

Q6.

Question number	Answer	Notes	Marks
(a)	conversion of cm to m; substitution into given formula; evaluation; e.g. 3.8cm = 0.038 pressure difference = $0.038 \times 1.3 \times 10^4 \times 10$ (pressure difference =) 4900 (Pa)	seen anywhere in working -1 for POT error 494 000 gains 2 marks allow 4940 (Pa) allow 4800, 4840, 4846, 4841 (Pa) for use of g=9.8/9.81	3
(b) (i)	any three from: MP1. particles have more energy in their kinetic store / particles speed up; MP2. {more **frequent** collisions / more collisions per second} with the walls of the tube; MP3. each collision with the wall is harder; MP4. increasing the force (on the walls of the container);	 allow particles have more KE allow particles collide more often with walls ignore collisions with each other allow 'greater momentum change' 	3
(ii)	conversion of temperatures to kelvin; substitution; rearrangement; evaluation; e.g. $T_1 = 289K$, $T_2 = 305K$ $9.95 \times 10^4 / 289 = p_2 = 305$ $p_2 = 9.95 \times 10^4 \times 305 / 289$ $(p_2 =) 1.1 \times 10^5$ (Pa)	not converting to kelvin giving 199 000 (Pa) gains 2 marks max. allow 1.05×10^5 (Pa), 105008.65... (Pa)	4

Q7.

Question number	Answer	Mark
(a)(i)	Process should include: • substitution • rearrangement • evaluation e.g. $100 \times 7.5 = p_2 \times 5.0$ (1) $p_2 = (100 \times 7.5)/5.0$ (1) $(p_2 =)$ 150 (kPa) (1)	3

Question number	Answer	Additional guidance	Mark
(a)(ii)	An explanation that makes reference to the following points: • particles collide with walls (of container) (1) And any two from: • more frequently/time between collisions is less (1) • (resulting in) larger force (1) • (over a) smaller surface area (1)	 allow 'more often'	 3

Question number	Answer	Additional guidance	Mark
(b)(i)	A description that makes reference to the following points: • (average kinetic energy) increases (1) • in (direct) proportion to (1) • Kelvin temperature (1)	 dependent on point 1 dependent on point 1	 3

Question number	Answer	Additional guidance	Mark
(b)(ii)	Process should include: • conversion of temperatures to Kelvin scale (1) • rearrangement (1) • substitution (1) • evaluation (1) e.g. 20 °C = 293 K OR 65 °C = 338 K (1) $(p_1/T_1)/T_2 = p_2$ (1) p_2 = (100 x 338)/293 (1) $(p_2 =)$ 115 (kPa) (1)	not converting to Kelvin gains 2 marks max. 100/293 = p_2/338 allow 115.358...	 4

(Total for question = 13 marks)

Q8.

Question number	Answer	Mark
(a)	A description that makes reference to three of the following points. For a liquid: • molecules closely spaced (1) • molecules slide over one another (1) For a gas: • molecules spread out (1) • molecules move with random motion (1)	3

Question number	Answer	Additional guidance	Mark
(b)(i)	Process includes: • Conversion of time into seconds substitution into or rearrangement of • $P = W/t$ • Evaluation e.g. time = 120 seconds (1) 2200 = W/120 (1) W = 260 000 (joules) (1)	seen anywhere in working allow 264 000 answer of 4400 (joules) gains 2 marks max	3

Question number	Answer	Additional guidance	Mark
(b)(ii)	Energy transferred = mass × specific heat capacity × change in temperature	equation can be given in words or symbols e.g. $\Delta Q = m \times c \times \Delta\theta$ allow E for Q, T for θ	1

Question number	Answer	Additional guidance	Mark
(b)(iii)	Process includes: • rearrangement of equation (1) • substitution into correct equation (1) • evaluation of temperature difference (1) • calculation of final temperature (1) e.g. 264 000 = 1.1 × 4200 × $\Delta\theta$ (1) $\Delta\theta = \frac{264\,000}{1.1 \times 4200}$ (1) ($\Delta\theta$ =) 57 (°C) (1) final temperature = 77 (°C) (1)	allow ecf from (b)(i)	4

Question number	Answer	Additional guidance	Mark
(c)(i)	Thermometer	allow temperature sensor AND data logger	1

Question number	Answer	Mark
(c)(ii)	An explanation that makes reference to the following points: • actual temperature lower than calculated (1) • energy is lost to the surroundings not all the energy is transferred to the water (1)	2

(Total for question = 14 marks)