Question number	Answer	Notes	Marks
1 (a)	Substitution into given equation; Rearrangement; Calculation; e.g. $101 \times 1700 = p_2 \times 12$ $p_2 = 101 \times 1700 \div 12$ = 14 000 (kPa)	NB Equation is given on page 2 of QP Substitution and rearrangement in either order Accept working in Pa or kPa, litres and/or m^3. POT error = -1 mark 14300 (kPa) 14 MPa correct answer without working scores 3 marks	3
(b) (i)	In words or $p = h \times \rho \times g$;	F r *g* Accept "acceleration due to gravity" Reject "gravity" For h Accept depth or height For p accept pressure or pressure difference or as Δp	1
(ii)	Substitution; Calculation; e.g. $p=11 \times 1028 \times 10$ = 110 (kPa)	 Allow $g=9.8 m/s^2$ 113 (kPa) 113080 Pa Allow 111 kPa or 110818 Pa(from $g=9.8 m/s^2$)	2
(iii)	Answer to (b)(ii) + 101 (kPa);	Allow 210 (kPa) 211 214 Reject answer if new PoT error	1

Question number	Answer	Notes	Marks
(c)	EITHER MP1 pressure decreases (with decreasing depth)/ $p = h \times \rho \times g$; MP2 pV is constant (for fixed mass of gas)/ $p_1 \times V_1 = p_2 \times V_2$; OR MP3 Sea may be warmer near the surface; MP4 (causing the pressure inside the bubble to increase)which causes the volume to increase	 v is inversely proportional to p MP4 is DOP on MP3	2

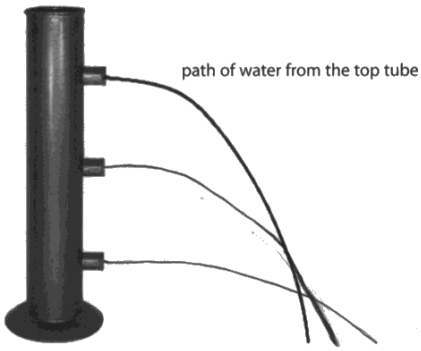
Total 9 marks

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>2 (a)</td><td>minimum of three straight arrows for different particles (with different lengths);

arrows in different directions;</td><td>judge by eye
arrows need not be attached to particles but it should be clear which particle they refer to</td><td>2</td></tr>
<tr><td>(b)</td><td>any three from:
MP1. particles collide/impact/eq;
MP2. with sides/walls of container;
MP3. idea that force is produced;

MP4. idea of pressure as force on an area;</td><td>allow
hit for collide

allow particle changes momentum
p = F/A</td><td>3</td></tr>
<tr><td>(c)</td><td>idea that pressure increases/eq;</td><td></td><td>1</td></tr>
<tr><td>(d)</td><td><table><tr><th>Statement</th><th>Tick ( )</th></tr><tr><td>the gas particles get bigger</td><td></td></tr><tr><td>the mass of gas particles stays the same</td><td>✓</td></tr><tr><td>the gas particles move faster</td><td>✓</td></tr><tr><td>the average distance between gas particles increases</td><td>✓</td></tr><tr><td>the temperature of the gas decreases</td><td></td></tr></table>
one mark for each correct;;;
if 4 ticks then max mark is 2
if 5 ticks then zero marks</td><td></td><td>3</td></tr>
<tr><td></td><td></td><td>total marks = 9</td><td></td></tr>
</table>

Question number	Answer	Notes	Marks
3 (a) (i)	pressure difference = ρ × g x h	accept in words or rearranged form allow 'd' for density do not accept 'gravity' must be 'g' or gravitational field strength	1
(ii)	both are curves; lowest curve travels further than top curve (if extrapolated);  		2
(iii)	MP1. water at bottom has greater pressure / pressure increases with depth; MP2. (therefore) force on water at the bottom is greatest;	allow idea that there is more weight above a point, the lower the point is allow water leaves lower holes with greater speed	2
(b) (i)	water level is constant in each vessel;	ignore lines drawn in gaps between vessels	1
(ii)	any two from: MP1. vessels are connected; MP2. same density / type of liquid in all; MP3. air pressure is the same for all; MP4. pressure only depends on the depth;	allow water flows to other vessels allow pressure does not depend on (surface) area total marks = 8	2

Question number	Answer	Notes	Marks
4 (a) (i)	94;		1
(ii)	any two sensible suggestions: e.g. • to make results (more) reliable; • to produce an average reading; • to identify anomalous results; • because there may have been a temperature change; • because there may have been friction in the syringe;	ignore references to keeping it a fair test	2
(b) (i)	any sensible suggestion: e.g. • reduced scale gives fuller use of the grid; • because the lowest value of p or V is 50/eq; • because p or V cannot be zero;	allow RA ignore there are no values below 40	1
(ii)	idea of straight line having an even distribution of points about the line; all points seem to be on the curve;	no mark for a bald 'it's the curve' or 'it's the line' allow points are very close to the curve	2
(iii)	any sensible suggestion; e.g. • keep the temperature constant • ensure no air gets into/out of the syringe/eq • keep apparatus exactly the same • wait for same time after adding/removing loads to take the volume reading		1
(iv)	any two from: MP1. increase sensitivity/resolution of instruments; MP2. take reading(s) to fill in the middle of the graph/eq; MP3. take reading(s) to extend the range of the graph;	ignore references to parallax error / accuracy allow take readings with greater precision/eq	2

Question number	Answer	Notes	Marks
5 (a)	(Average speed) increases;		1
(b)	Any three of the following ideas-	allow	3
	MP1. Idea of (continuous) random motion; MP2. collide /impacts / eq; MP3. With walls (of balloon); MP4. idea that force is produced (by bombarding molecules); MP5. idea as pressure as force on an area;	 bombard, hit, impact upon momentum argument / N3 p = F/A	
(c)	Any one of the following ideas- MP1. convection (current moves hot air upwards); MP2. hot air/it is less dense;	allow RA ignore hot air rises condone lighter reject for MP2 less dense particles	1
(d) (i)	D = $\frac{\text{mass}}{\text{volume}}$;	Accept symbols or rearrangement e.g. $\rho = m/V$	1
(ii)	Substitution into correct equation; Rearrangement; Evaluation; e.g. $0.95 = \frac{m}{2800}$ $m = 0.95 \times 2800$ $= 2700$ (kg)	allow sub and rearrangement in either order 2660	3
(e) (i)	Any one of the following ideas - MP1. atmospheric density decreases as height increases; MP2. depth (from top of atmosphere) decreases; MP3. temperature of air is colder / (cold)molecules move slower;	Allow • number of molecules decreases (from ρ.g.h idea)	1
(ii)	Any one of the following ideas - MP1. air inside/balloon expands; MP2. (hot) air escapes (from the balloon); MP3. hot air (now) cools down / need to use burner;	Allow idea that outside air is cooler at altitude	1

Total 11 marks

Question number	Answer	Notes	Marks
6 (a) (i)	-273 (°C)		1
(ii)	any 3 of: MP1. idea of (continuous) **random** motion; MP2. collide/impacts/eq; MP3. with walls (of container); MP4. idea that force is produced (by bombarding molecules); MP5. idea of pressure as force on an area;	 bombard, hit, impact upon allow Newton's 2nd Law momentum argument p=F/A	3
(b) (i)	pressure = density x g x height;	in words or accepted symbols e.g. $p = \rho gh$ not 'gravity' for g	1
(ii)	use of correct pressure; substitution; rearrangement; evaluation; e. 104-100 = 4 kPa 4000 =1000 x 10 x h h = 4000/(1000x10) 0.4 (m)	sub and rearrange in either order deduct 1 mark for each of the following: • conversion error from kPa to Pa • use of wrong pressure e.g. use of 104 or 100 kPa and not changing to Pa gets 2 marks max	4

Total 9 marks