PEARSON EDEXCEL IGCSE PHYSICS · 4PH1

PHYSICS



MARK SCHEME

SECTION 5: SOLIDS, LIQUIDS AND GASES (PACK 1)

SCORE	PERCENTAGE
/270	%

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Mark Scheme

Q1.

Question number	Answer	Notes	Marks
(a)	molecules collide with walls; collisions provide force on walls; force per unit area gives a pressure;	allow particles or atoms formula alone is insufficient	3
(b)	any TWO from: MP1. number of molecules in container decreases; MP2. increase in temperature increases speed or KE of molecules; MP3. molecules have a high enough speed or KE to escape;	allow particles or atoms	2
(c)	any TWO from: MP1. idea fewer collisions per unit time gives lower force; MP2. idea that each collision is less hard; MP3. (lower force per unit area gives) lower pressure; MP4. pressure outside container is larger than pressure in can; MP5. pressure difference causes a force;	accept RA throughout accept "lower frequency of collisions" ignore collisions between molecules allow force (from air pressure) is lower inside than outside	2
		(Total for Question = 7 marks)	

Q2.

Question number	Answer	Notes	Marks
(a)	D (the Sun); A is incorrect because a comet is the smallest object B is incorrect because the Earth is smaller than the Sun C is incorrect because the Earth and the Sun are larger than the Moon		1
(b)	A (alpha); B is incorrect because beta is less ionising than alpha C is incorrect because gamma is less ionising than alpha D is incorrect because gamma has a higher frequency than UV so is more ionising		1
(c)	B (ohm); A is incorrect because ampere is the unit for electric current C is incorrect because volt is the unit for voltage D is incorrect because watt is the unit for power		1
(d)	D (x-ray); A is incorrect because infrared has a longer wavelength than ultraviolet and x-ray B is incorrect because microwave has the longest wavelength C is incorrect because ultraviolet has a longer wavelength than x-ray		1
(e)	C (273 K); A is incorrect because this is subtracting 273, rather than adding 273 B is incorrect because this is adding 3, rather than adding 273 D is incorrect because this is adding 373, rather than adding 273		1
		Total for question = 5 marks	

Q3.

Question number	Answer	Notes	Marks
(a) (i)	rearrangement OR substitution into given formula; evaluation; e.g. $V_2 = p_1 \times V_1 / p_2$ OR $120 \times 92 = 64 \times V_2$ (volume =) 170 (m^3)	 allow 172, 173, 172.5	2
(ii)	constant temperature / amount of air / mass of air;	however expressed e.g. number of particles constant	1
(b) (i)	any three from: MP1. (reduction in temperature) reduces speed/KE of particles; MP2. idea of fewer collisions with walls per unit time; MP3. idea of each collision with wall being less 'hard'; MP4. force (per unit area) on the container decreases;	 allow particles collide with walls less often	3
(ii)	substitution into given formula; rearrangement; evaluation; e.g. $120 / 290 = 64 / T_2$ $T_2 = (64 \times 290) / 120$ (temperature =) 150 (K)	 allow 155, 154.6... (K)	3

Q4.

Question number	Answer	Notes	Marks
(a) (i)	22 (K);	allow 22.15	1
(ii)	idea that this is absolute zero; speed / KE / pressure would be zero at this temperature;		2
(b)	conversion of cm to m; evaluation of area; substitution into pressure = force / area rearrangement; evaluation of force; e.g. side length = 0.054 (m) area = (0.054^2 =) 0.0029 (m^2) 7500 = force / 0.0029 force = 7500 × 0.0029 (force =) 22 (N)	 allow in cm^2 or m^2 allow ecf from incorrect area if clear from working allow 0.002916 (m^2) allow 21-22 (N) 405 (N) = 4 marks (not finding area) 218 700 (N) = 4 marks (not converting from cm) 40 500 (N) = 3 marks (not finding area or converting from cm)	5

Q5.

Question number	Answer	Notes	Marks
(a) (i)	as pressure increases, volume decreases; pattern statement relating to gradient; e.g. 'at a decreasing rate'	ORA 'inversely proportional' scores 2 marks.	2
(ii)	pressure = depth × gravitational field strength × density;	allow recognised symbols e.g. P or p for pressure d or h for depth ρ for density reject d for density, reject gravity for g	1
(iii)	substitution; evaluation; e.g. pressure = 0.22 × 10 × 1080 pressure = 2 400 (Pa)	 Accept use of g=9.8(1) (N/kg) 2376 (Pa) -1 for POT error provided *g* is used	2
(iv)	103 000 (Pa)	accept 103 400 (Pa) allow ECF	1
(v)	substitution into given formula; rearrangement; evaluation; e.g $p_1 \times V_1 = p_2 \times V_2$ 101 000 × 0.084 = 103 000 x V_2 V_2 = 0.082 (cm^3)	allow ECF from (iv) e.g. 98624 gives 0.086 (cm^3) 0.082368932 -1 for POT error	3
(b)	vertical arrow upwards labelled upthrust; vertical arrow downwards labelled weight; upthrust > weight;	 ignore drag reject this mark if there are more than two arrows	3
		(Total for Question = 12 marks)	

Q6.

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

Q7.

Question number		Answer	Notes	Marks
(a)	(i)	pressure = force / area;	allow standard symbols and rearrangements e.g. p = F / A	1
	(ii)	substitution; rearrangement; evaluation; e.g. 1.03×10^6 = force / 1.13 (force =) $1.03 \times 10^6 \times 1.13$ (force =) 1.16×10^6 (N)	 -1 for POT error allow 1.2×10^6, 1163900 etc.	3
	(iii)	any two from: MP1. idea that gas particles move randomly; MP2. idea that gas particles collide with **all** walls of container; MP3. idea that force per unit area is the same on all sides of cylinder;	 allow move in all directions	2
(b)	(i)	idea of extrapolating line backwards; absolute zero is the temperature when the pressure is zero;	allow if seen on graph allow temperature when line cuts x-axis/temperature axis (may be indicated on graph)	2
	(ii)	−273 (°C);	allow −273.15	1
	(iii)	straight line with positive gradient drawn; line passes through the origin;	judge by eye	2
			Total for Question = 11 marks	

Q8.

Question number	Answer	Notes	Marks
(a)	use of p = h × density × *g*; conversion of 57 cm into 0.57 m; evaluation; e.g. pressure difference = 57 × 820 × 10 pressure difference = 0.57 × 820 × 10 (pressure difference =) 4700 (Pa)	allow mark if formula on its own is seen in working allow use of *g* = 9.8, 9.81 470 000, 467 000, 467 400, 458 052, 458 519.4 etc. score 2 marks allow 4670, 4674, 4580.52, 4585.194 etc.	3
(b) (i)	substitution into W = m × g; evaluation; correct unit; e.g. W = 24 × 10 (W =) 240 newtons / N	no mark for formula on its own allow use of *g* = 9.8, 9.81 -1 for POT error e.g. incorrectly changing kg to g mark independently allow 235.2, 235.44	3
(ii)	substitution into p = F/A; evaluation; e.g. p = 240 / 1.2 (p =) 200 (Pa)	no mark for formula on its own allow ecf from (i)	2
(iii)	substitution into p = F/A; rearrangement; evaluation; e.g. 200 = F / 4.8 F = 200 × 4.8 (F =) 960 (N)	no mark for formula on its own allow ecf from (ii)	3

(c)	GPE of piston X = decrease; GPE of piston Y = increase; chemical energy of piston Y = no change; kinetic energy of piston Y = no change;	allow marks if the meaning is clear e.g. allow +, ↑ for increase etc.	4
		Total for Question = 15 marks	

Q9.

Question number	Answer	Notes	Marks
(a)	determination of mass of water; substitution into / rearrangement of density formula; evaluation; rounding to 3 s.f.; e.g. mass = 49.5 (g) 0.998 = 49.5/volume OR volume = mass/density volume = 49.599 49.6 (cm^3)	 allow ECF from incorrect mass mark independently	4
(b)	determination of mass of liquid; use of volume from (a); evaluation; e.g. 143.8 - 63.4 = 80.4 (g) density = 80.4 / 49.6 density = 1.62 (g/cm^3)	 allow ECF from (a) allow ECF from incorrect mass	3
(c)	any three from: MP1. with measuring cylinder can read volume to nearest cm^3; MP2. measuring cylinder is easier/quicker to use; MP3. measuring cylinder does not need to be dried; MP4. idea that measuring cylinder value could be incorrect due to parallax errors/meniscus etc; MP5. 'bottle' gives volume to nearest 1dp; MP6. 'bottle' allows density to be more precisely determined;	allow RA throughout	3

Q10.

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

Q11.

Question number	Answer	Notes	Marks
(a)	substitution into $v^2 = u^2 + 2as$; rearrangement; evaluation; e.g. $0^2 = u^2 + (2 \times -1.8 \times 92\,000)$ $u = \sqrt{3.6 \times 92000}$ (initial speed =) 580 (m/s)	allow answers in terms of conservation of energy for full marks ignore units condone poor handling of minus signs allow 575.(499...) (m/s) answer of 331 200 gains 2 marks POT error on distance will give 18.2 (m/s) for 2 marks	3

(b)	(i)	particles collide with walls; (collisions result in) force on walls; force over area gives pressure;	ignore collisions between particles allow momentum arguments allow p = F / A	3
	(ii)	substitution into $p_1/T_1 = p_2/T_2$; rearrangement; evaluation; e.g. $8.2/1200 = p_2/1600$ $p_2 = (1600 \times 8.2/1200)$ (p_2 =) 11 (kPa)	allow pressure in kPa or Pa allow 10.9... (kPa)	3
	(iii)	any three from: particles have more kinetic energy; particles collide with walls more **frequently**; idea that particles collide with walls with more force / 'harder'; (average) force increases;	allow particles move faster/eq.	3
	(iv)	any three from: MP1. idea that higher pressure means higher speed; MP2. Tvashtar particles have more (initial) KE; MP3. particles from both chambers experience the same deceleration; MP4. (higher speed with same deceleration) takes longer to reach 0 m/s; MP5. relevant quantitative argument based on motion formulae; MP6. Tvashtar particles have more GPE (at max. height);	allow Tvashtar particles have higher speed / RA allow Tvashtar particles take longer to reach max. height / RA	3
			Total for Question = 15 marks	

Q12.

Question number	Answer	Notes	Marks
(a) (i)	weight = mass × gravitational field strength;	allow rearrangements and standard symbols e.g. W = m × g ignore 'gravity' for g	1
(ii)	substitution or rearrangement; evaluation; e.g. 520 = mass × 10 OR mass = W / g (mass =) 52 (kg)	 allow g = 9.8, 9.81 allow 53.1, 53.0, 53	2
(b) (i)	evidence of counting squares to find area; number of squares in range 37-42; evaluation of area of one square; evaluation of total area; e.g. dots seen in each square in diagram number of squares = 39 area of one square = (2 × 2) = 4 cm² total area = (4 × 39) = 156 cm²	allow attempt to find area by splitting into rectangles / triangles allow if 2 × 2 seen in working allow ecf from incorrect number of squares allow 148-168	4
(ii)	pressure = force / area;	allow standard symbols and rearrangements e.g. p = F / A	1
(iii)	dimensionally correct substitution; evidence of doubling area or halving pressure to account for both feet; evaluation with matching unit; e.g. (pressure =) 520 / 156 area = 156 × 2 OR pressure = 3.2 ÷ 2 (pressure =) 1.7 N/cm²	allow ecf from (b)(i) allow N/cm², N/m² or Pa if no marks awarded for calculation allow 1 mark if valid unit for pressure given allow 1.5-1.8 N/cm² allow 15 000-18 000 N/m²	3

Q13.

Question number	Answer	Notes	Marks
(a) (i)	any FOUR from: MP1. measure mass; MP2. use (mass) balance; MP3. measure diameter; MP4. use ruler/callipers/micrometer; MP5. further experimental detail e.g. use set square against ruler/use callipers in different orientations/fully submerged/avoid splashing; MP6. repeat readings and take average; MP7. use formula to find volume of a sphere e.g. $V = 4/3\ \pi r^3$; MP8. use density = mass ÷ volume;	condone reference to letting the ice melt allow scales reject scale allow use of displacement method and measuring cylinder for MP3, MP4, MP7	4
(ii)	substitution into equation density = mass ÷ volume; evaluation; unit i.e g/cm^3; correct answer = 0.85 g/cm^3 e.g. density = mass ÷ volume density = 0.94 ÷ 1.1 density = 0.8545... density = 0.85 g/cm^3	allow use of standard symbols e.g. D = M ÷ V accept ρ for density -1 for POT error independently marked accept unit matching calculation i.e. if mass converted into kg accept 0.854 or 0.855	3
(b)	any TWO from: MP1. warm air rises; MP2. warm air expands; MP3. warm air is less dense than cold air; MP4. a convection current is formed;	allow 'cloud' for 'air' allow air particles spread out reject 'particles expand'	2
		(Total for Question = 9 marks)	

Q14.

Question number	Answer	Notes	Marks
(a)	using a balance; suitable method to subtract mass of container;	ignore weighing scales / scales e.g. • measure mass of similar empty container and subtract • place another container on balance and press zero then pour liquid into this container	2
(b)	any two from: MP1. measuring cylinder placed on horizontal surface; MP2. reading taken from bottom of meniscus/eq; MP3. reading taken at eye level (to avoid parallax); MP4. wait for all liquid to run down the sides of the measuring cylinder; MP5. ensure measuring cylinder is empty before use;	ignore idea of 'repeat and average' condone 'flat surface'	2
(c)	use of density formula; evaluation of density of liquid; liquid is sunflower oil; e.g. density = 150 / 163 density = 0.92 (g/cm^3) closest to sunflower oil => liquid is sunflower oil	unsupported correct conclusion scores 1 mark only	3

Q15.

Question number	Answer	Notes	Marks
(a)	any one from: • idea that there is no data at the value of 0; • idea that {pressure of gas / speed of particles} cannot be zero; • idea that all data would be bunched together at the top of the axis / eq;		1
(b)	for either graph: MP1. as temperature increases, pressure/speed increases; for graph 1: MP2. relationship is linear; for graph 2: MP3. relationship is non-linear; MP4. idea of decreasing gradient of curve;	ignore positive correlation accept proportional only if there is a clear link to the temperature being measured in kelvin	3
(c)	any two from: MP1. this temperature is <u>absolute zero</u>; MP2. pressure/speed/kinetic energy of gas particles would be 0 at this temperature; MP3. idea that it is impossible to have a temperature lower than this;	allow idea that negative pressure/speed/KE is impossible	2

(d)	(i)	answer in range 520-525 (m/s);	ignore 515	1
	(ii)	recall of KE formula; substitution; evaluation; e.g. KE = ½ × mass × speed^2 (KE =) 0.5 × 5.3 × 10^{-26} × 520^2 (KE =) 7.2 × 10^{-21} (J)	can be implied from working ECF from (i) -1 for POT error allow 7.16×10^{-21} - 7.31×10^{-21}	3
	(iii)	373 (K);		1
	(iv)	straight line with positive gradient; line passes through origin;	judge straightness by eye	2

Q16.

Question number	Answer	Notes	Marks
(a)	any four from: MP1. neutron absorbed by nucleus; MP2. uranium-235 becomes uranium-236; MP3. nucleus splits; MP4. producing (two) daughter nuclei; MP5. producing neutrons; MP6. releasing/transferring energy;	condone atom for nucleus throughout allow collides for absorbs allow named daughter nuclei e.g. krypton and barium etc. ignore daughter cells condone producing energy, radiation	4
(b) (i)	idea that products of fission/radiation are harmful/dangerous; idea that shielding absorbs radiation / fission products;	allow specific danger e.g. daughter nuclei are radioactive etc. allow idea that radiation cannot penetrate concrete	2
(ii)	particles collide with walls (of pipes); force is exerted on walls; pressure is force on an area;	ignore collisions with other particles allow p=F/A	3
		Total for question = 9 marks	

Q17.

Question number	Answer	Notes	Marks
(a)	idea that not doing so means impossible to tell what change caused the change in the dependent;	allow idea of a 'fair test' ignore references to accuracy, reliability	1
(b) (i)	straight line; (line) does not go through origin;	condone linear	2
(ii)	given line extrapolated to x-axis; -300 °C;	accept in range -320 to -280 degrees C	2
(iii)	any THREE from: MP1 (increase in temperature) increases speed/KE; MP2 collisions between walls and particles more frequent/eq; MP3 idea collisions between walls and particles are harder; MP4 idea that force (between wall and particle) is increased; MP5 P=F/A so increased force means increased pressure for same area.		3
(c) (i)	conversion of both temperatures to kelvin scale; substitution; rearrangement; evaluation; e.g. 35 °C and 340 °C → 308 and 613 K 112 (kPa)/308 = P / 613 P = 613 × 112 / 308 P = 220 (kPa)	-1 for POT error accept 222.909... accept 1088 (kPa) for 2 marks (no conversion of temperature)	4
(ii)	number of {particles/moles/mass/molecules} of gas	accept type of gas	1
		(Total for Question = 13 marks)	

Q18.

Question number		Answer	Notes	Marks
(a)	(i)	pressure (difference) = height × density × g;	allow standard symbols and rearrangements e.g. $h = p / (\rho \times g)$ condone d for density	1
	(ii)	substitution; rearrangement; evaluation in cm; e.g. 2300 = h × 1000 × 10 h = 2300 / (1000 × 10) (h =) 23 (cm)	allow g = 9.81, 9.8 -1 for POT error but check carefully due to value of g 0.23 (cm) gains 2 marks allow 23.46..., 23.44... (cm)	3

(b)	(i)	line drawn of similar curved path and aiming towards ground to the left of path from hole B;	reject if curve drawn upwards at any point	1
	(ii)	any two from: MP1. pressure is lower at A; MP2. force acting on water at A is less; MP3. water leaves the bottle at a lower speed/KE at A; OR any two from: MP1. initial velocity of water is horizontal; MP2. (force of) gravity acts on the water; MP3. water accelerates downwards;	allow "near top of bottle"/eq for A allow RA allow RA allow RA allow water leaves bottle horizontally	2
	(iii)	any three from: MP1. idea that path from C is identical / symmetrical to path from B; MP2. (because) pressure is the same; MP3. (initial) speed of water is the same; MP4. idea that pressure acts (equally) in all directions;	ignore holes at same height above ground allow path is the same (as B) allow force acting on water is the same allow (initial) KE of water is the same	3
	(iv)	any one from: MP1. idea that it allows **air** to enter the bottle (as water level falls); MP2. idea that it maintains equal pressure between air inside and air outside the bottle; MP3. idea that no water would come out of the holes otherwise;		1
			Total for Question = 11 marks	

Q19.

Question number	Answer	Notes	Marks
(a) (i)	358 (K);		1
(ii)	idea that speed / KE increases; **mean** speed / **mean** KE increases;	 allow average for mean	2
(iii)	number of molecules decreases;	however expressed	1
(b)	any four from: MP1. air in flask cools; MP2. molecules in flask slow down/kinetic energy of molecules reduces; MP3. pressure inside flask decreases (as temperature decreases); MP4. pressure outside flask greater than inside/eq; MP5. resultant force (from air) pushes egg down the neck of the flask; MP6. volume of air in flask decreases as the egg moves down; MP7. (so) pressure inside flask increases (as volume decreases); MP8. (eventually) pressure inside and outside balance; MP9. (so) resultant force is now zero (so egg stops moving down);	 allow 'stretches egg' allow higher level arguments including weight of egg, friction with neck, etc	4

Q20.

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

Q21.

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)

Q22.

Question number	Answer	Notes	Marks
(a)	zero/0 (N);		1
(b) (i)	pressure = depth × density × gravitational field strength;	allow use of standard symbols e.g. p = h × ρ × g allow 'd' for 'h' reject 'gravity' for 'g' in formula	1
(ii)	substitution; evaluation; e.g. pressure = depth × density × gravitational field strength pressure = 0.041 × 1000 × 10 pressure = 410 (Pa)	 -1 POT error allow use of 9.8(1) for 'g' giving 401.8...	2
(iii)	pressure = force ÷ area;	allow use of standard symbols e.g.P = F ÷ A	1
(iv)	substitution or re-arrangement; evaluation; e.g. pressure = force ÷ area 400 = force ÷ 0.0017 force = 400 × 0.0017 = 0.68 (N)	substitution and rearrangement in either order allow correctly rounded values e.g. 0.697 allow use of candidate's unrounded value even if not approx 400	2
(v)	upwards force greater than weight of cube; **resultant** force upwards;	 allow idea of ice being less dense than water for 1 mark.	2
		(Total for Question = 9 marks)	

Q23.

Question number	Answer	Notes	Marks
(a) (i)	323 (K);		1
(ii)	check data point at (323,112);	ALLOW ECF from (i) plotted point should be within +/- half small square	1
(iii)	line of best fit draw;	1st and 3rd points above line, 2nd and 4th points below line;	1
(b)	2/two;	IGNORE any unit included in response	1

Q24.

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

Q25.

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

Q26.

Question number	Answer	Notes	Marks
(a)	substitution into $p_1 \times V_1 = p_2 \times V_2$ OR rearrangement; evaluation of volume; correctly expressed in standard form; e.g. $100 \times 0.0043 = 270 \times V_2$ OR $V_2 = p_1 \times V_1 / p_2$ (V_2 =) 0.0016 (m^3) (V_2 =) 1.6×10^{-3} (m^3)	 allow 0.00159... (m^3) allow $1.59... \times 10^{-3}$ (m^3)	3
(b) (i)	idea that particles move more slowly at lower temp; particles collide with walls less often; particles collide with walls less force;	allow RA if clear allow lower kinetic energy (KE) reject no KE allow particles colliding less hard note: with walls/eq must be mentioned once	3
(ii)	dimensionally correct substitution into $p_1 / T_1 = p_2 / T_2$; conversion of either temperature into kelvin; rearrangement; correct subsequent evaluation of p_2 with consistent conclusion; e.g. $270 / 293 = p_2 / 275$ 293 or 275 used anywhere in calculation $p_2 = 270 \times 275 / 293$ (p_2 =) 253 (kPa) so light will not show	ignore units can be implied 27 (kPa) so light will show scores 3 marks 243 (kPa) so light will show scores 2 marks	4

Q27.

Question number	Answer	Notes	Marks
(a) (i)	work (done) = force × distance (moved);	allow rearrangements and standard symbols e.g. W = F × d allow E or W for work and d or s for distance	1
(ii)	substitution; evaluation; unit; e.g. (W =) 8750 × 2.3 (W =) 20000 joules / J	-1 if cm not converted to m 2012500 Ncm scores full marks allow 20125 condone Nm	3
(iii)	substitution into power formula; evaluation; e.g. (P =) 20125 / 7.0 (P =) 2900 (W)	allow ecf from (ii) allow 2880, 2875, 2860, 2857.14...	2
(b) (i)	idea of reducing pressure on ground;	allow idea of preventing damage to the ground / stopping leg sinking into the ground	1
(ii)	pressure = force / area;	allow rearrangements and standard symbols e.g. F = p × A	1
(iii)	evaluation of area; substitution into pressure formula; rearrangement; evaluation; e.g. area = 0.50 × 0.50 OR area = 0.25 (m^2) 148000 = F / 0.25 (F =) 148000 × 0.25 (F =) 37000 (N)	 allow ecf from incorrect area / use of 0.50 as area -1 for POT error 74000, 37 gets 3 marks 74 gets 2 marks	4
		Total for question = 12 marks	