

4(a)(i)	temperature = $-273.15\text{ }^{\circ}\text{C}$
4(a)(ii)	temperature = 0 K
4(b)(i)	gas is ideal
4(b)(ii)	$pV = NkT$
	$N = 270 / (8.0 \times 10^{-21})$ $= 3.4 \times 10^{22}$
4(b)(iii)	$n = (3.4 \times 10^{22}) / (6.02 \times 10^{23})$ $= 0.056\text{ mol}$
4(c)	$\frac{1}{2} m \langle c^2 \rangle = (3 / 2) kT$
	$\frac{1}{2} \times m \times 1900^2 = 1.5 \times 8.0 \times 10^{-21}$
	$(m = 6.65 \times 10^{-27}\text{ kg})$
	$m = (6.65 \times 10^{-27}) / (1.66 \times 10^{-27})$ $= 4.0\text{ u}$

2(a)(i)	0 K
2(a)(ii)	(measurement) depends on properties of the liquid
2(b)(i)	- resistivity varies with temperature - variation with temperature is linear - unique value of resistivity for each (different value of) temperature <i>Any two points, 1 mark each</i>
2(b)(ii)	thermometer has high heat capacity/specific heat capacity or energy transfer needed for thermometer to reach correct temperature or thermometer takes time to reach the correct temperature
2(b)(iii)	thermocouple
2(c)	(variation is) inverse or (variation is) non-linear

2(a)(i)	(gas that obeys) $pV \propto T$ (for all values of p, V and T)
	where T is thermodynamic temperature
2(a)(ii)	temperature = $-273.15\text{ }^{\circ}\text{C}$
2(b)(i)	$pV = NkT$
	$N = (1.37 \times 10^5 \times 0.640) / (1.38 \times 10^{-23} \times (227 + 273))$
	$= 1.27 \times 10^{25}$
2(b)(ii)	$\text{mass} = 0.0424 / (1.27 \times 10^{25})$ $= 3.34 \times 10^{-27} \text{ kg}$
2(b)(iii)	$\frac{1}{2}m\langle c^2 \rangle = (3/2)kT$
	$3.34 \times 10^{-27} \times v^2 = 3 \times 1.38 \times 10^{-23} \times 500$
	$v = 2490 \text{ m s}^{-1}$
	or
	$pV = \frac{1}{3}(Nm) \langle c^2 \rangle$ and $Nm = \text{mass of gas}$
	$0.0424 \times v^2 = 3 \times 1.37 \times 10^5 \times 0.640$
	$v = 2490 \text{ m s}^{-1}$
2(c)	sketch: line from (0, 0) to (500, v)
	line with decreasing positive gradient throughout