4(a)(i)	temperature = –273.15 °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)	$n = (3.4 \times 10^{22}) / (6.02 \times 10^{23})$ $= 0.056$ mol
4(c)	$\frac{1}{2} m\langle c^2\rangle = (3 / 2)\, kT$
	$\frac{1}{2} \times m \times 1900^2 = 1.5 \times 8.0 \times 10^{-21}$ $(m = 6.65 \times 10^{-27}$ kg)
	$m = (6.65 \times 10^{-27}) / (1.66 \times 10^{-27})$
	$= 4.0$ 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 *Any two points, 1 mark each*
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 °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)	mass $= 0.0424 / (1.27 \times 10^{25})$ $= 3.34 \times 10^{-27}$ kg
2(b)(iii)	$\frac{1}{2}m\langle c^2\rangle = (3 / 2)kT$
	$3.34 \times 10^{-27} \times v^2 = 3 \times 1.38 \times 10^{-23} \times 500$
	$v = 2490$ m s^{-1}
	or
	$pV = \frac{1}{3}(Nm)\langle c^2\rangle$ <u>and</u> Nm = mass of gas
	$0.0424 \times v^2 = 3 \times 1.37 \times 10^5 \times 0.640$
	$v = 2490$ m s^{-1}
2(c)	sketch: line from (0, 0) to (500, v)
	line with decreasing positive gradient throughout