

4(a)(i)	sum of potential energy and kinetic energy									
	(total) energy of random motion of particles									
4(a)(ii)	potential energy (of molecules) (in an ideal gas) is zero, so the internal energy of the gas is equal to the total kinetic energy (of molecules)									
	kinetic energy of molecules is proportional to (thermodynamic) temperature (so internal energy is proportional to (thermodynamic) temperature))									
4(b)	cooling work done = 0									
	compression increase in internal energy = $+2U$									
	cooling change in internal energy = $-U$									
	both rows: thermal energy adds to work to give increase in internal energy in terms of U and/or W									
	(if fully correct, thermal energy for compression = $2U - W$ and thermal energy for cooling = $-U$:									
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3(a)(i)	gas for which $pV \propto T$		
	where T is thermodynamic temperature		
3(a)(ii)	no intermolecular forces		
	(so) potential energy is zero		
3(b)(i)	$pV = NkT$		
	$N = (2.0 \times 10^5 \times 0.26) / (1.38 \times 10^{-23} \times 290)$ $= 1.3 \times 10^{25}$		
3(b)(ii)	$E_K = (3/2) kT$		
	$E_K = (3/2) \times 1.38 \times 10^{-23} \times 290$ $= 6.0 \times 10^{-21} \text{ J}$		
3(b)(iii)	internal energy = total KE + PE of molecules or PE = 0 so internal energy = total KE of molecules		
	$\text{internal energy} = 1.3 \times 10^{25} \times 6.0 \times 10^{-21}$ $= 7.8 \times 10^4 \text{ J}$		
3(c)	straight line with positive gradient		
	line passing through the origin		