

3(a)(i)	number of particles per unit amount of substance
3(a)(ii)	$N_A = R / k$
3(b)(i)	X pressure and Y pressure both $= NkT / V$
	X amount $= N / N_A$ and Y amount $= 2N / N_A$
	X mean-square speed $= 3kT / m$ and Y mean-square speed $= 3kT / 2m$
	X internal energy $= 3NkT / 2$ and Y internal energy $= 3NkT$
3(b)(ii)	line passing through the origin and not returning to either axis
	curve with positive decreasing gradient

3(a)(i)	(P and Q are at the) same temperature
	no <u>net</u> transfer of thermal energy (between P and Q)
3(a)(ii)	$Q = mc\Delta T$
	$24 \times 10^3 = (0.54 \times 390 \times \Delta T) + (0.37 \times 910 \times \Delta T)$
	$\Delta T = 44 \text{ K}$
3(b)(i)	work done $= p\Delta V$
	$= (1.6 \times 10^5) \times (0.18 - 0.32)$
	$= -2.2 \times 10^4 \text{ J}$
3(b)(ii)	$pV = NkT$
	$N = (1.6 \times 10^5 \times 0.18) / (1.38 \times 10^{-23} \times 273)$
	$= 7.6 \times 10^{24}$
3(b)(iii)	$\frac{1}{2}m\langle c^2 \rangle = (3 / 2)kT$
	r.m.s. speed $= \sqrt{[(3 \times 1.38 \times 10^{-23} \times (210 + 273)) / (4.7 \times 10^{-26})]}$
	$= 650 \text{ ms}^{-1}$

8(a)	234, 92 for the uranium nucleus
	4, 2 for the alpha particle
8(b)(i)	$N_0 = 0.874 / (238 \times 1.66 \times 10^{-27})$ $= 2.21 \times 10^{24}$
8(b)(ii)	$A = \lambda N$
	$= \frac{\ln 2}{87.7 \times 365 \times 24 \times 3600} \times 2.21 \times 10^{24}$
	$= 5.54 \times 10^{14} \text{ Bq}$
8(b)(iii)	power $= 5.54 \times 10^{14} \times 5.59 \times 10^{-6} \times 1.60 \times 10^{-19}$
	$= 496 \text{ W}$
8(b)(iv)	$65.3 = 100e^{\frac{\ln 2}{87.7} t}$
	$\ln 0.653 = -(\ln 2 / 87.7) t$
	$t = 53.9 \text{ years}$
8(c)	advantage: less mass so less energy needed to launch probe
	disadvantage: half-life shorter so will not provide power for as long