Alex wants to hold a weekly study session (optional). The possibilities

M	W	W	W	R	R	F	F
4-5	3-4	4-5	5-6	4-5	5-6	3-4	4-5
a	b	c	d	e	f	g	h

Heat Capacities of gases (at constant Volume)

We've seen K.E. of a particle is $\frac{1}{2} m v_{avg}^2 = \frac{3}{2} kT$

$\rightarrow$ K.E. of a gas of N particles is $N \frac{1}{2} m v_{avg}^2 = N \frac{3}{2} kT$

When temp changes by dT, K.E. of gas changes by $dK = N \frac{3}{2} k\, dT$ (or $n \frac{3}{2} R\, dT$)

We've also seen that adding heat to a gas changes the temp

$dQ = n C_v dT$ $\quad dk = dQ \Rightarrow$ $\boxed{C_v = \frac{3}{2} R \text{ for an ideal gas}}$

C_v : how much energy changes, per amount of stuff, if temperature changes

equipartition : for every "degree of freedom" a gas particle has energy $\frac{1}{2} kT$

e.g. For N particles, movement in x, y, z directions $\rightarrow$ $E = 3 \cdot N \cdot \frac{1}{2} kT$ $\quad C_v = \frac{3}{2} R$

rigid diatomic $\quad E = (3+2) N \frac{1}{2} kT = \frac{5}{2} NkT$ $\quad C_v = \frac{5}{2} R$
(3: translation, 2: rotation)

vibrating diatomic $\quad E = (3+2+2) N \frac{1}{2} kT = \frac{7}{2} NkT$ $\quad C_v = \frac{7}{2} R$

Triatomic molecule (that is hot!) $\quad 3 + 3 + 6$ (trans. rot. vibr.) $\quad C_v = \frac{12}{2} R$

56.html i) $\frac{3}{2} kT$ $\quad$ ii) $\frac{5}{2} kT$

Example How much heat does it take to increase the T of 1.80 mol of an ideal gas by 50.0 K near room T if the gas is held at constant volume?

a) diatomic $\quad C_v = 5/2\, R$ $\quad Q = nC_v \Delta T = n \frac{5}{2} R \Delta T = 1.8 \cdot \frac{5}{2} \cdot 8.3145 \cdot 50.0 = \boxed{1871 J}$

b) monatomic $\quad C_v = 3/2\, R$ $\quad Q = nC_v \Delta T = n \frac{3}{2} R \Delta T = 1.8 \cdot \frac{3}{2} \cdot 8.3145 \cdot 50.0 = \boxed{1122 J}$

57.html $\boxed{\text{Case A}}$ Since $Q = nC_v \Delta T$ and C_v is higher

Phases of matter $\quad$ Liquid $\quad$ Solid $\quad$ vapor

liquid $\xleftrightarrow{L_f}$ solid

liquid $\xleftrightarrow[L_v]{}$ vapor

solid $\longleftrightarrow$ vapor (possible?) $\quad$ yes! e.g., dry ice

[illegible]