Chapter 1

1.(a) $1ps = 10^{-12}s$ $1fs = 10^{-15}s$

(b) ~~1m~~ $1nm = 10^{-9}m$

(c) $1MeV = 10^6 eV$, $1GeV = 10^9 eV$

~~2~~

3. $m = \cancel{n}$ $10mol \times 1kg \times 6.022\times10^{23}/mol$

$= 6.022\times10^{24}kg$

accuracy: $\frac{6.022\times10^{24}kg - 5.98\times10^{24}kg}{5.98\times10^{24}kg} \times 100\% = 0.702\%$

8.

8. $\cancel{F = \frac{Gm^2}{R^2}}$ $\cancel{G = \frac{FR^2}{m^2}}$

$\dim G = T^{-2} \cdot L^3 \cdot M^{-1}$

$\dim m = M$ $\dim R = L$ $\dim V = L \cdot T^{-1}$

$\dim G^\alpha m^\beta R^\gamma = \dim V$

$T^{-2\alpha} L^{3\alpha+\gamma} M^{-\alpha+\beta} = L \cdot T^{-1}$

$\therefore$ ~~...~~ $\alpha = \frac{1}{2}$ $\beta = \frac{1}{2}$ $\gamma = -\frac{1}{2}$

$\therefore$ It is $\cancel{\sqrt{\frac{G}{mR}}}$ $\sqrt{\frac{Gm}{R}}$

12. When $T \to 0$, ~~$C_v \to$~~ $C_v = \gamma T + \cancel{o(\alpha T^3)}\ \cancel{o(\alpha T)}\ o(T)$

so C_v has the same order of magnitude as γT.

14. $\because$ B and C are ~~axi~~ polar vectors

$\therefore$ $B\times C$ is an axial vector

又 $\because$ A is a polar vector

$\therefore$ $A\times(B\times C)$ is a polar vector.

17. if $i = j$ $b_1 \cdot a_1 = 2\pi \frac{a_1 \cdot (a_2 \times a_3)}{a_1 \cdot (a_2 \times a_3)} = 2\pi$

$b_2 \cdot a_2 = 2\pi \frac{(a_3 \times a_1) \cdot a_2}{a_1 \cdot (a_2 \times a_3)} = 2\pi \frac{a_3 \cdot (a_1 \times a_2)}{a_1 \cdot (a_2 \times a_3)} = 2\pi \frac{a_1 \cdot (a_2 \times a_3)}{a_1 \cdot (a_2 \times a_3)} = 2\pi$

$b_3 \cdot a_3 = 2\pi \frac{a_1 \times a_2 \cdot a_3}{a_1 \cdot (a_2 \times a_3)} = 2\pi \frac{a_1 \cdot (a_2 \times a_3)}{a_1 \cdot (a_2 \times a_3)} = 2\pi$

if $i \neq j$ $b_1 \cdot a_2 = 2\pi \frac{a_2 \cdot (a_2 \times a_3)}{a_1 \cdot (a_2 \times a_3)} = 2\pi \frac{a_2 \times a_2 \cdot a_3}{a_1 \cdot (a_2 \times a_3)} = 0$

$b_1 \cdot a_3 = 2\pi \frac{a_2 \times a_3 \times a_3}{a_1 \cdot (a_2 \times a_3)} = 2\pi \frac{a_2 \times a_3 \cdot a_3}{a_1 \cdot (a_2 \times a_3)} = 2\pi \frac{a_3 \times a_3 \cdot a_2}{a_1 \cdot (a_2 \times a_3)} = 0$

in the same way, we can conclude that

$$b_i \cdot a_j = \begin{cases} 2\pi, & i = j \\ 0, & i \neq j \end{cases}$$

22. (a) $A \cdot B = 10 + 2 = 12$

(b) $A \times B = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 2 & 1 & 1 \\ 5 & 2 & 0 \end{vmatrix} = (-2, 5, -1)$

(c) $A \cdot (B \times C) = \begin{vmatrix} 2 & 1 & 1 \\ 5 & 2 & 0 \\ 1 & 1 & 1 \end{vmatrix} = 3 - 1 = 2$

(d) $A \times (B \times C) = A \times \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 5 & 2 & 0 \\ 1 & 1 & 1 \end{vmatrix} = A \times (2, -5, 3) = 4 - 5 + 3 = 2$

(e) $A + B \times C = (4, -4, 4)$

$A \times (A + B \times C) = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 2 & 1 & 1 \\ 4 & -4 & 4 \end{vmatrix} = (8, -4, -12)$

(f) $B \times C - A \times B = (4, -10, 4)$

$A \cdot (B \times C - A \times B) = 8 - 10 + 4 = 2$

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