教材习题1.1, 1.3/1.4(二选一), 1.5, 1.8, 1.9(可选做), 1.12, 1.14, 1.17, 1.19(可选做), 1.22

1.1

(a) 皮秒光学时间量级为 10^{-12} s, 飞秒光学时间量级为 10^{-15} s.

(b) 纳米尺度为 10^{-9} m.

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

1.3

地球质量 $M = 10 \times 6.02 \times 10^{23}\mathrm{kg} = 6.02 \times 10^{24}\mathrm{kg}$

精度为 $\dfrac{6.02 \times 10^{24} - 5.98 \times 10^{24}}{5.98 \times 10^{24}} = 0.67\%$

1.4

百分误差为 $\dfrac{365 \times 24 \times 60 \times 60 - \pi \times 10^7}{365 \times 24 \times 60 \times 60} \times 100\% = 0.38\%$

1.5

对数居间 $\dfrac{\lg 10^{-15} + \lg 10^{26}}{2} = 5.5$

即 $10^{5.5}\mathrm{m} = \sqrt{10} \times 10^5\mathrm{m} = 3.16 \times 10^5\mathrm{m}$

石家庄和天津的距离约为 $3.08 \times 10^5\mathrm{m}$.

1.8

$\because G = 6.673 \times 10^{-11}\mathrm{N \cdot m^2/kg^2} = 6.673 \times 10^{-11}\mathrm{m^3/(kg \cdot s^2)}$

$\therefore \dim G^\alpha m^\beta R^\gamma = v$

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

$\therefore \alpha = \frac{1}{2}, \beta = \frac{1}{2}, \gamma = -\frac{3}{2}$

$\therefore v = (\frac{Gm}{R^3})^{\frac{1}{2}}$

1.12

极低温下 $C_V = \alpha T^3 + \gamma T$ 和 $C_V = \gamma T$ 有相同的数量级.

1.14

$B \times C$ 为轴矢量, $A \times (B \times C)$ 为极矢量叉乘轴矢量, 最终结果应为极矢量.

1.17

$$\vec{b}_1 \cdot \vec{a}_1 = 2\pi \frac{\vec{a}_2 \times \vec{a}_3}{\vec{a}_1 \cdot (\vec{a}_2 \times \vec{a}_3)} \cdot \vec{a}_1 = 2\pi \frac{\vec{a}_1 \cdot (\vec{a}_2 \times \vec{a}_3)}{\vec{a}_1 \cdot (\vec{a}_2 \times \vec{a}_3)} = 2\pi$$

$$\vec{b}_1 \cdot \vec{a}_2 = 2\pi \frac{\vec{a}_2 \times \vec{a}_3}{\vec{a}_1 \cdot (\vec{a}_2 \times \vec{a}_3)} \cdot \vec{a}_2 = 0$$

$$\vec{b}_1 \cdot \vec{a}_3 = 0$$

$$\vec{b}_2 \cdot \vec{a}_1 = 0$$

$$\vec{b}_2 \cdot \vec{a}_2 = 2\pi \frac{\vec{a}_2 \cdot (\vec{a}_3 \times \vec{a}_1)}{\vec{a}_1 \cdot (\vec{a}_2 \times \vec{a}_3)} = 2\pi \frac{\vec{a}_1 \cdot (\vec{a}_2 \times \vec{a}_3)}{\vec{a}_1 \cdot (\vec{a}_2 \times \vec{a}_3)} = 2\pi$$

$$\vec{b}_2 \cdot \vec{a}_3 = 0$$

$$\vec{b}_3 \cdot \vec{a}_1 = 0$$

$$\vec{b}_3 \cdot \vec{a}_2 = 0$$

$$\vec{b}_3 \cdot \vec{a}_3 = 2\pi \frac{\vec{a}_3 \cdot (\vec{a}_1 \times \vec{a}_2)}{\vec{a}_1 \cdot (\vec{a}_2 \times \vec{a}_3)} = 2\pi$$

$$\therefore \vec{b}_i \cdot \vec{a}_i = \begin{cases} 2\pi, & i = j \\ 0, & i \neq j \end{cases}$$

1.19

$\because m\vec{a} = q\vec{v} \times \vec{B}, \vec{a} = \vec{w} \times \vec{v}$

$\therefore m\vec{w} \times \vec{v} = q\vec{v} \times \vec{B}$

$\therefore \vec{w} \times \vec{v} = -\frac{q}{m}\vec{B} \times \vec{v}$

$\therefore \vec{w} = -\frac{q}{m}\vec{B} + \lambda\vec{v}$, 其中 λ 是一个标量

1.22

(a) $\vec{A} \cdot \vec{B} = 12$

(b) $\vec{A} \times \vec{B} = (-2, 5, -1)$

(c) $\vec{A} \cdot (\vec{B} \times \vec{C}) = 12$

(d) $\vec{A} \times (\vec{B} \times \vec{C}) = (-2, 4, 8)$

(e) $\vec{A} \times (\vec{A} + \vec{B} \times \vec{C}) = (-2, 4, 8)$

(f) $\vec{A} \cdot (\vec{B} \times \vec{C} - \vec{A} \times \vec{B}) = 12$