Chapter **29** (Benson)

E03 (**a**) $P = q\,rB = 1.6{\times}10^{-20}\,\mathrm{kg{\cdot}m/s}$; (**b**) $K = P^2/2m = 4.8{\times}10^5\,\mathrm{eV}$.

E04 $\vec{v}_1 = 10^6\,\hat{\mathrm{i}}$ & $\vec{F}_1 = 0.05\,\hat{\mathrm{k}}\,\mathrm{N}$; $\vec{v}_2 = (-\hat{\mathrm{i}}+\hat{\mathrm{j}})\,10^6/\sqrt{2}$ & $\vec{F}_2 = -0.035\,\hat{\mathrm{k}}\,\mathrm{N}$;
$\vec{v}_3 = (\hat{\mathrm{i}}-\hat{\mathrm{k}})\,10^6/\sqrt{2}$ & $\vec{F}_3 = 0.035\,(\hat{\mathrm{i}}+\hat{\mathrm{k}})\,\mathrm{N}$.

E16 With I along $-\hat{z}$, the magnetic force is along $\hat{x}$. Equate force components along incline: $mg\sin\theta = ILB\cos\theta$. Thus $I = mg\tan\theta/LB = 5.9\,\mathrm{A}$.

E21 (**a**) With $\vec{B} = 0.5\,\hat{\mathrm{i}}\,\mathrm{T}$, $\vec{F}_1 = -\vec{F}_3 = 8\,\hat{\mathrm{k}}\,\mathrm{N}$; $\vec{F}_2 = -\vec{F}_4 = -40\,\hat{\mathrm{j}}\,\mathrm{N}$; (**b**) $\vec{\mu} = (8\,\hat{\mathrm{i}} - 13.8\,\hat{\mathrm{j}})\,\mathrm{A{\cdot}m^2}$; (**c**) $\vec{\tau} = 6.93\,\hat{\mathrm{k}}\,\mathrm{N{\cdot}m}$.

E30 $q_d{=}q_p$: (**a**) $P_d = P_p$, $r_d/r_p = P_d/P_p = 1$; (**b**) $v_d = v_p$, $r_d/r_p = m_d/m_p = 2$; (**c**) K_d/K_p, $r_d/r_p = (m_d/m_p)^{1/2} = 1.41$.

E41 $r = 50\,\mathrm{cm}$, $K = 10\,\mathrm{MeV}$. (**a**) $B = mv/er = (2mK)^{1/2}/er = 0.914\,\mathrm{T}$; (**b**) 200 crossings, so $10^7/200 = 50\,\mathrm{kV}$; (**c**) $f = eB/2m = 13.9\,\mathrm{MHz}$.

E46 (**a**) $v_d = V_H/Bw = 1.88\,\mathrm{mm/s}$; (**b**) $n = BI/Vqt = 3.13{\times}10^{27}\,\mathrm{m^{-3}}$.

E54 $\vec{F}_1 = -1.2\,\hat{\mathrm{i}}\,\mathrm{N}$; $\vec{F}_2 = 1.2\,\hat{\mathrm{j}}\,\mathrm{N}$; $\vec{F}_3 = 1.2\,\hat{\mathrm{k}}\,\mathrm{N}$; $\vec{F}_4 = 0$.

E58 $\vec{\mu} = NI(\pi r^2)(-\hat{\mathrm{k}})$; $\vec{\tau} = \vec{\mu}{\times}\vec{b} = -1.18\,\hat{\mathrm{j}}\,\mathrm{N{\cdot}m}$.

P03 $\vec{F} = \int I d\vec{l}{\times}\vec{B} = I(\int d\vec{l}){\times}\vec{B} = I(\Delta\vec{l}){\times}\vec{B}$. (Teacher: Jyh-Shinn Yang, 90.05.28)

P04 $\mu = NIA$, where $A = \pi r^2 = \pi(L/2\pi N)^2$, thus $\mu \propto 1/N$. μ is a maximum for $N = 1$.

P05 (**a**) For an elemental ring $dI = dq/T = (\sigma 2\pi r dr)\omega/2\pi$. $d\mu = dI(\pi r^2) = \sigma\omega\pi r^3 dr$; then $\mu = \int d\mu = \sigma\omega\pi R^4/4$; (**b**) $\tau = \mu B = \sigma\omega\pi B R^4/4$.