Problem 1:
(B) Kepler's third law: $(T_1/T_2)^2 = (R_1/R_2)^3$. $(1440/80)^2 = (aR_E/R_E)^3$. $a = 6.87$.

Problem 2:
(A) Rolling: $\omega = v/R$. Energy conservation: $\frac{1}{2} mv^2 + \frac{1}{2} I\omega^2 = mgh$. $\omega^2 = gh/R^2$.
$L = mR^2\omega = mR(gh)^{1/2}$.

Problem 3:
(B) Harmonic oscillator: $T + U = \text{constant}$, $\omega^2 = k/m$.
$\frac{1}{2} kA^2 = \frac{1}{2} mv^2 + (1/8)kA^2$. $v = (3k/(4m))^{1/2} A = (3^{1/2}/2)\omega A = 3^{1/2}\pi fA$

Problem 4:
(A) The total angular momentum is conserved in a collision between two interacting objects.
Total angular momentum about the point P before the collision:
$L = I\omega - MvR = \frac{1}{2} MR^2*2v/R - MvR = 0$.

Problem 5:
(C) Harmonic oscillator potential: $U(x) = \frac{1}{2}kx^2 + \text{constant}$, $\omega^2 = k/m$.

Problem 6:
(E) $F = dp/dt$, $dp = p(t+dt) - p(t) = (m-|dm|)(v+dv) + |dm|(v-u) - mv = mdv - |dm|u$.

Problem 7:
(E) Solving a differential equation
Answers A - D are wrong. $(1/u)dv = -dm/m$.
Integrate: $v/u = -\ln(m/m_0)$ until the fuel is used up.

Problem 8:
(D) The simple pendulum: $T = 2\pi(L/g)^{1/2}$.

Problem 9:
(C) Motion in any central potential: Energy and angular momentum are conserved.

Problem 12:
(E) The parallel axis theorem: $I = MR^2 + MR^2 = 2\,MR^2$.