Mechanics 2, practice, solutions

Problem 1:
(D) $p = \gamma mv = mc/2$. $\gamma^2 v^2 = c^2/4$. $v^2/(1 - v^2/c^2) = c^2/4$.

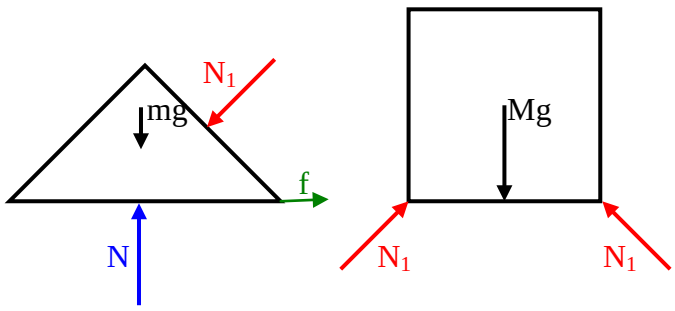
Problem 2:
(B) $p_x = \frac{1}{2}mc/2 = mc/4$. $p_y = p_x \tan 30^o = p_x/3^{1/2}$. $p = (p_x^2 + p_y^2)^{1/2}$.

Problem 3:
(B)

Problem 4:
(A) Momentum conservation

Problem 5:
(A) This is the mode for which the CM stays at rest. The two pendulums have the same amplitude and a phase difference of π.

Problem 6:
(D) Statics: $\sqrt{2}*N_1 = Mg$, $N - mg - N_1/\sqrt{2} = 0$, $f = \mu N = N_1/\sqrt{2}$. → $M = 2\mu m/(1 - \mu)$.



Problem 7:
(C) Centripetal acceleration.

Problem 8:
(A) We have only one independent coordinate. Let us choose y. Then $x = (y/a)^{1/2}$, $dx/dt = \frac{1}{2}(a/y)^{1/2}(1/a)dy/dt$. $(dx/dt)^2 = (1/(4ay))(dy/dt)^2$, $L(y, dy/dt) = T - U$.

Problem 9:
(D) The maximum height is proportional v^2.

Problem 10:
(C) $F(r) = -|k|/r^3$, $F = -dU(r)/dr$, $U(r) = -\frac{1}{2}k/r^2$.
Centripetal acceleration: $mv^2/r = |k|/r^3$, $T = \frac{1}{2}mv^2 = \frac{1}{2}k/r^2$, $T + U = 0$.