

Solutions

2.1 Answer: B. $\omega = \sqrt{k/m}$.

Compare the rejected options: 2; $1/2$. Use the stated model and conditions.

2.2 Answer: B. Total momentum is conserved; kinetic energy is generally reduced.

Compare the rejected options: kinetic energy; each body's velocity. Use the stated model and conditions.

2.3 2. $\omega = \sqrt{16/4} = 2$.

2.4 True. dL/dt equals the net torque about the fixed point.

3.1 Force is $F = -V' = -4ax^3 + 2bx$. Equilibrium requires $x = 0$ or $x^2 = b/(2a)$. Curvature is $V'' = 12ax^2 - 2b$: it is $-2b$ at zero and $4b$ at either outer point. Zero is unstable; both outer points are stable. Write $x = x_0 + \xi$ and retain terms linear in ξ : $m\ddot{\xi} = -4b\xi$, so $\omega = \sqrt{4b/m}$. At zero the displacement grows rather than oscillates. The approximation requires $|\xi|$ small compared with $\sqrt{b/(2a)}$. Award equilibrium, curvature, classification, linearisation, frequency and condition: one mark each.