

Solutions

2.1 Answer: B. Differentiate H with respect to q and negate.

Compare the rejected options: kq ; p/m . Use the stated model and conditions.

2.2 Answer: C. Inverse-square scaling gives one quarter.

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

2.3 16. Stefan–Boltzmann scaling is T^4 .

2.4 False. Flux also depends on distance and attenuation.

3.1 $L \propto R^2 T^4$ gives $L_2/L_1 = 2^2(1/2)^4 = 1/4$. $F \propto L/d^2$ gives $F_2/F_1 = (1/4)/3^2 = 1/36$. Hamilton's equations give $\dot{q} = p/m$ and $\dot{p} = -4aq^3$. These describe an amplitude-dependent nonlinear oscillator; its restoring force is cubic, not a Hooke-law force with constant nonzero small-oscillation stiffness at zero. Award each ratio, each equation and the nonlinear interpretation.