

Solutions

2.1 B Divide the vector momentum (6,3) by total mass 3, component by component.

Compare the rejected options: (3,3) m/s; (1,2) m/s; (2,2) m/s; (0,0) m/s. Use the stated model and conditions.

2.2 D At fixed force $U = F^2/(2k)$, hence the inverse stiffness ratio.

Compare the rejected options: 3; 9; 1; 1/9. Use the stated model and conditions.

2.3 3. T scales as $\sqrt{L}$.

2.4 True. Displacement is zero, so spring energy is zero; speed is maximal.

3.1 The sum of equal velocity vectors has magnitude $2u|\cos(\theta/2)|$. Dividing momentum by total mass gives $v_f = u|\cos(\theta/2)|$. $K_i = mu^2$ and $K_f = mv_f^2$, so lost fraction is $\sin^2(\theta/2)$. The three limits are 0, 1/2 and 1. Award vector sum, speed, energy relation, lost fraction and limits. The formula uses $0 \leq \theta \leq \pi$ between directions.