1. An object initially at rest breaks up into two pieces of unequal masses when a spring-loaded device is released. Let K_1 be the kinetic energy of the larger mass and K_2 that of the smaller mass right after they separate. Which of the following statements is correct?

(A) $K_1 > K_2$ (B) $K_1 < K_2$ (C) $K_1 = K_2$

$P_1=m_1v_1$ $P_2=m_2v_2$ but $P_1=P_2$ → $v_1= (m_2/m_1)v_2$

$K_1= ½m_1v_1^2= ½\ m_1\ (m_2/m_1)^2\ v_2^2 = (m_2/m_1)\ (½m_2v_2^2) = (m_2/m_1)\ K_2$

Since $(m_2/m_1)<1$ we have $K_1 < K_2$ → **Correct answer is (B)**

2. A railroad car of mass *m* and speed *v* collides and sticks to an identical railroad car that is initially at rest. After the collision, the kinetic energy of the system is

(A) $½mv^2$ (B) $⅓mv^2$ (C) $¼\ mv^2$ (D) $⅛\ mv^2$ (E) mv^2

$P_{initial} = mv$ $P_{final} = 2mv_{final}$ → $v_{final} = ½\ v$

$K_{final} = ½\ (2m)\ v_{final}^2 = ¼\ mv^2$ → **Correct answer is (C)**

3. A red ball with a velocity of +3.0 m/s collides head-on with a yellow ball of equal mass moving with a velocity of -2.0 m/s. What is the velocity of the yellow ball after the collision

(A) +3.0 m/s (B) 0 (C) -2.0 m/s (D) +2.5 m/s (E) +5.0 m/s

$P_{initial} = mv_{1init} + mv_{2initial}$ and $P_{final} = mv_{1final} + mv_{2final}$ (red is 1, yellow is 2)

→ $v_{1final} = v_{1init} + v_{2initial} - v_{2final}$

$\frac{1}{2}mv^2_{1init} + \frac{1}{2}mv^2_{2init} = \frac{1}{2}mv^2_{1final} + \frac{1}{2}mv^2_{2final}$

→ $v^2_{1init} + v^2_{2init} = v^2_{1final} + v^2_{2final}$

→ $v^2_{1init} + v^2_{2init} = (v_{1init} + v_{2initial} - v_{2final})^2 + v^2_{2final}$

→ $0 = 2\,v^2_{2final} - 2\,v_{2final}(v_{1init} + v_{2initial}) + 2\,v_{1init}\,v_{2initial}$

→ This has two solutions

1. $v_{2final} = -2$ m/sec (which is the trivial solutions where nothing happens)
2. $v_{2final} = +3$ m/sec → **<u>Correct answer is (A)</u>**

Of course we could have saved us all this work by noting that the two masses are the same and obviously a solution where we exchanged the velocities of the read and yellow ball would satisfy conservation of both energy and momentum

4. An elastic collision of two objects is characterized by the following

(A) Momentum is conserved (B)Kinetic Energy is conserved

(C) Both (A) and (B) (D) Neither (A) nor B

Correct answer is (C) This is the definition of elastic collision

5. A 75 Kg swimmer dives horizontally with speed 4 m/sec off an initially stationary 500 Kg raft. What is the speed of the raft immediately after the dive?

(a) 0 m/sec (b) 0.2 m/sec (c) 0.5 m/sec (d) 0.6 m/sec (e) 4.0 m/sec

$P_{raft} = P_{swimmer} = m_{swimmer}\, v_{swimmer}$ and $P_{raft} = m_{raft}\, v_{raft}$

$\rightarrow V_{raft} = m_{swimmer}\, v_{swimmer} / m_{raft} = 75 * 4 / 500$ m/sec = 0.6 m/sec

Correct answer is (D)