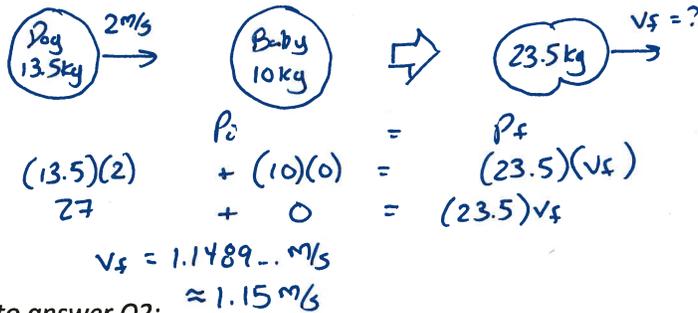First Name:_____   Last Name:_____

L07 – Formative Quiz – Collisions in 1-Dimension

Q1: An 13.5kg dog runs at 2m/s [E] and tackles a stationary 10.0kg baby. Their masses stick together as they fly through the air. Their velocity at the moment after impact is ____ m/s [E].

*(Record your **three digit** answer in the Numerical Response boxes below)*

1	.	1	5

Dog 13.5kg 2m/s →   Baby 10kg   ⇨   23.5kg → $v_f = ?$

$$P_i \quad = \quad P_f$$
$$(13.5)(2) \quad + (10)(0) \quad = \quad (23.5)(v_f)$$
$$27 \quad + \quad 0 \quad = \quad (23.5)v_f$$
$$v_f = 1.1489... \, m/s$$
$$\approx 1.15 \, m/s$$

Use the following information to answer Q2:

A 40g ball is travelling 2.0 m/s [R] when it collides with a stationary 80g ball. The 40g ball then rebounds at $0.\overline{3}$ m/s [L].

Stationary

A 40g — 2.0 m/s →   B 80g

$P_{i_A} = 0.08 \, kg\,m/s$ $P_{i_B} = 0 \, kg\,m/s$

???

← $0.\overline{3}$ m/s   A 40g   B 80g

$P_{f_A} = -0.01\overline{3} \, kg\,m/s$ $P_{f_B} = ?$

Q2: What is the final velocity of the 80g ball?

a. 0.83 m/s [R]
b. **1.17 m/s [R]** (circled)
c. 1.35 m/s [R]
d. 1.47 m/s [R]

$$P_i \quad = \quad P_f$$
$$P_{i_A} + P_{i_B} = P_{f_A} + P_{f_B}$$
$$0.08 \quad + 0 \quad = \quad -0.01\overline{3} \quad + P_{f_B}$$
$$0.09\overline{3} = P_{f_B}$$
$$\vec{P}_{f_B} = 0.09\overline{3} \, kg\,m/s \, [R]$$
$$\vec{v}_{f_B} = 1.1\overline{6} \, m/s \, [R]$$
$$\approx 1.17 \, m/s \, [R]$$

Use the following information to answer Q3:

The radioactive isotope Radium-226 decays via *Alpha Decay*, producing a Radon-222 daughter nucleus and an Alpha particle.

The mass of the parent nucleus, Radium-226, exceeds the sum of the daughter nucleus and the alpha particle. In radioactive decay, this missing "mass defect" is converted into the kinetic energy of the system.

$m_{Ra} \approx 3.75202 \times 10^{-25}$ kg

$^{226}_{88}Ra$

Before decay

$^{222}_{86}Rn$

α

$m_\alpha \approx 6.64250 \times 10^{-27}$ kg
$v_\alpha \approx 1.67189 \times 10^7$ m/s

After decay

$m_{Rn} \approx 3.68549 \times 10^{-25}$ kg
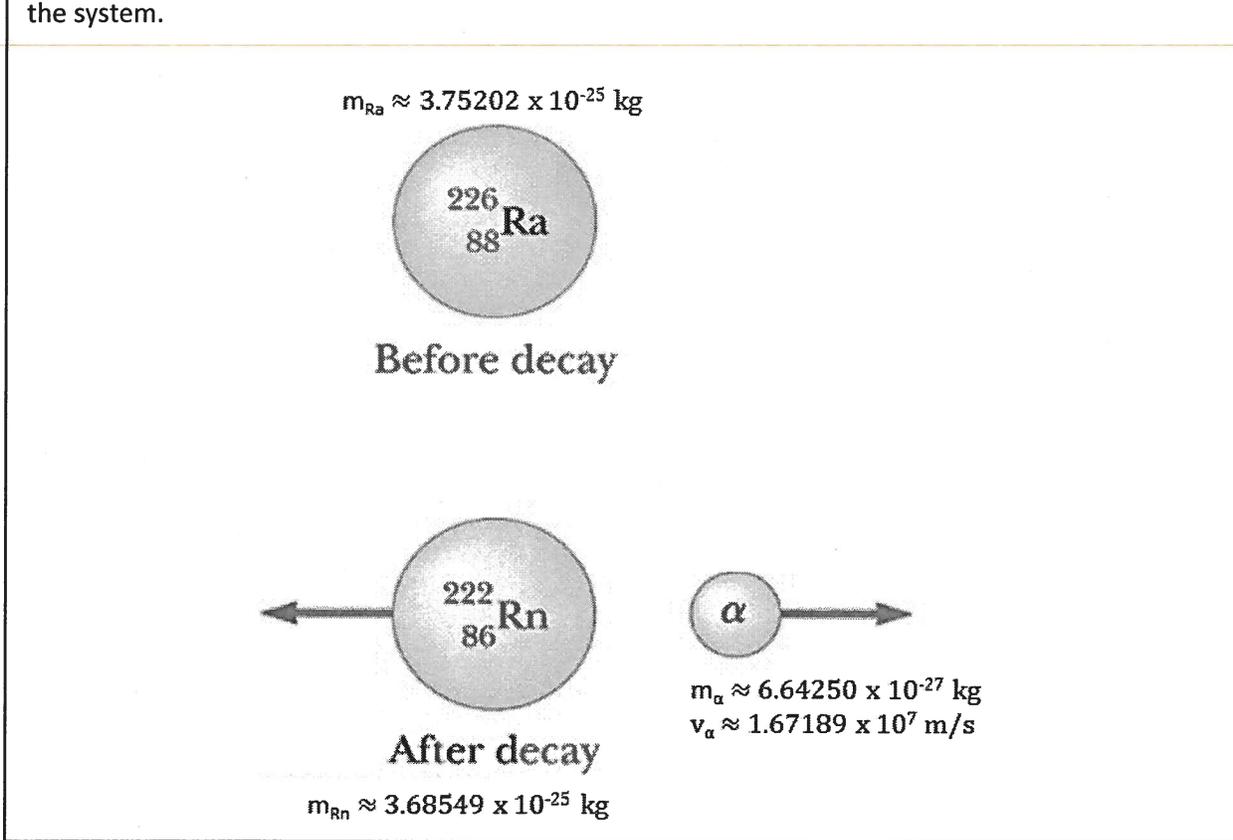
Q3: If the Radium-226 parent nucleus was originally stationary, and the Alpha particle ejects at a speed of 1.67189×10^7 m/s, then the recoil speed of the Radon-222 daughter nucleus is $a.bc \times 10^d$ m/s, where *a, b, c,* and *d* are ___, ___, ___, and ___.

*(Record your **four digit** answer in the Numerical Response boxes below)*

3	0	1	5

MARKING:

Beginning	0.
Progressing	1
Competent	2
Exemplary	3

$P_i \quad = \quad P_f$

$0 \quad = \quad m_{Rn} v_{Rn} \; + \; m_\alpha v_\alpha$

$0 = (3.68549 \times 10^{-25}) v_{Rn} + (6.64250 \times 10^{-27})(1.67189 \times 10^7)$

$0 = (3.68549 \times 10^{-25}) v_{Rn} + 1.1105529325 \times 10^{-19}$

$\vec{v}_{Rn} = -3.01331 \times 10^5$ m/s [forward]

$|\vec{v}_{Rn}| \approx 3.01 \times 10^5$ m/s