Experimental Data:

Mass of steel sphere: 28.21 g or 0.02821 kg

Height of launcher: 0.964 m

Incident ball with no collision

Length (m): 1.14 m	Angle (°) 0°

	Incident ball after collision		Target ball after collision	
	Length (m)	θ_1 (°)	Length (m)	θ_2 (°)
Equal mass collision	0.34 m	70°	1.01 m	-17°
Unequal mass collision	0.8 m	10°	1.69 m	-18°

Analysis:

Time it takes for the spheres to reach the ground:

$y_f = y_i + v_{i,y} \cdot t - \frac{1}{2} g t^2 \rightarrow 0 = 0.964 - \frac{1}{2}(9.8)t^2$

$.1967 = t^2 \quad t = 0.4435$ seconds

	Velocity = x/t	$V_x = v\cos(0°)$	$P_x = mv_x$	$V_i = v\sin(0)$	$P_y = mv_y$
Incident Sphere before collision	$\frac{1.14}{.4435} = 2.57$ m/s	2.57 m/s	2.57 · .02821	0 m/s	0
Total Momentum before			0.0725 Ns		0 Ns

Equal Mass Collision

	Velocity = x/t	$V_x = v\cos\theta$	$P_x = mv_x$	$V_y = v\sin\theta$	$P_y = mv_y$
Incident Sphere After Collision	$\frac{0.34}{.4435} = 0.767$ m/s	$\theta = 70°$, 0.2622 m/s	0.0073967	0.7204 m/s, $\theta = 70°$	0.02032 Ns
Target Sphere After Collision	$\frac{1.01}{.4435} = 2.277$ m/s	$\theta = 17°$, 2.178 m/s	0.0614414	-0.6658 m/s, $\theta = -17°$	-0.01878 Ns
Total momentum after			0.068838 Ns		0.00154 Ns
Error (before vs after)			0.003662 Ns		-0.00154
Percent Error (before vs after)	$\left\|\frac{0.068838 - 0.0725}{0.0725}\right\| \times 100 = 5.051\%$				

Unequal Mass Collision (with mystery target sphere mass)

	Velocity x/t	$V_x = v\cos\theta$	$P_x = mv_x$	$V_y = v\sin\theta$	$P_y = mv_y$
Incident Sphere After Collision	$\frac{0.8}{.4435} = 1.8$ m/s	1.7726 m/s, $\theta = 10°$	0.05 Ns	0.3126 m/s, $\theta = 10°$	0.008818 Ns
Target Sphere After Collision	$\frac{1.69}{.4435} = 3.81$ m/s	3.6235 m/s, $\theta = -18°$	?	-1.177 m/s, $\theta = -18$	?
Initial Momentum of Incident			0.725 Ns		0 Ns
Expected Momentum of Target Sphere after collision			0.725 - 0.05		0 - 0.008818
			0.0225 Ns		-0.008818 Ns

Total (Pythagorized) momentum of Target Sphere after Collision: $P_f = \sqrt{(0.0225)^2 + (-0.008818)^2}$

$P_{Tf} = 0.024166$ Ns $= m_T \cdot v_f \quad m_T = \frac{0.024166}{3.81} = 0.00634$ kg

Actual Mass of Target Sphere: 0.00606 kg

Percent Error: $\left|\frac{0.00634 - 0.00606}{0.00606}\right| \times 100 = 4.62\%$