Ping Blaster!

Summary of Possibilities

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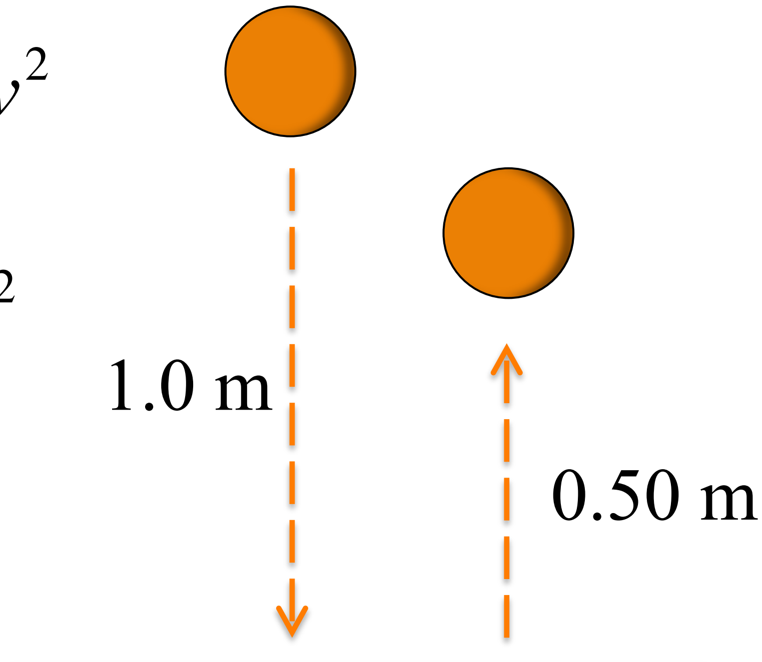
Part 1

$$mgh = \frac{1}{2}mv^2$$

$$9.8 \cdot 1 = \frac{1}{2}v^2$$

$$v = \sqrt{2 \cdot 9.8}$$

$$v = 4.43\,\tfrac{\text{m}}{\text{s}}$$



$$mgh = \frac{1}{2}mv^2$$

$$9.8 \cdot 0.50 = \frac{1}{2}v^2$$

$$v = \sqrt{2 \cdot 9.8 \cdot 0.50}$$

$$v = 3.13\,\tfrac{\text{m}}{\text{s}}$$

$$e = \frac{v'}{v} = \frac{3.13}{4.43}$$

$$e = 0.71$$

$$e = \sqrt{\frac{h'}{h}} = \sqrt{\frac{0.50}{1.0}}$$

$$e = 0.71$$

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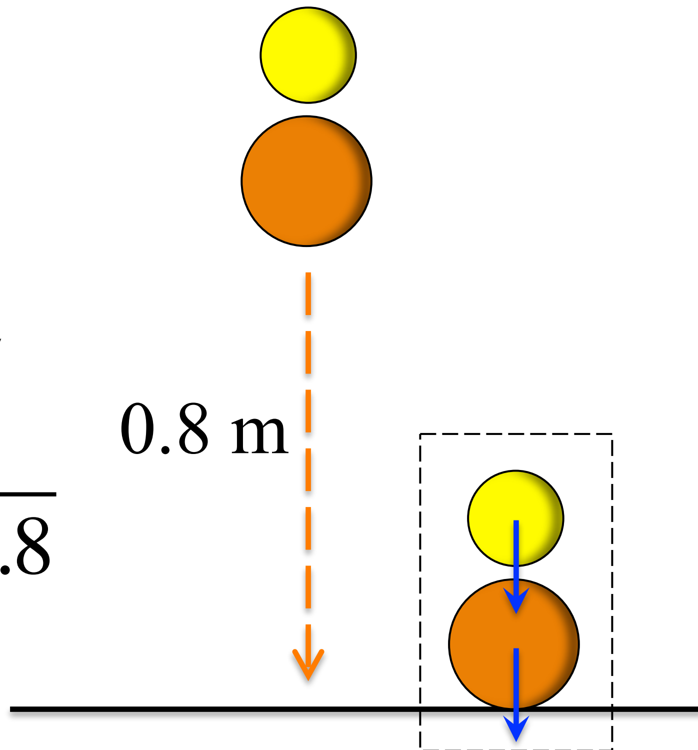
Part 2

$$mgh = \frac{1}{2}mv^2$$

$$9.8 \cdot 0.8 = \frac{1}{2}v^2$$

$$v = \sqrt{2 \cdot 9.8 \cdot 0.8}$$

$$v = 3.96\,\frac{\text{m}}{\text{s}}$$



ea. object:
v = 3.96 m/s, down

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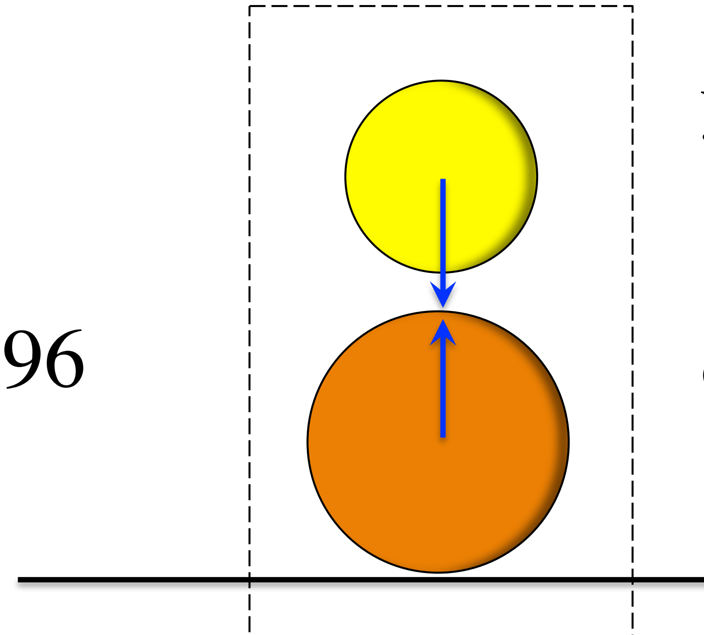
Part 3

$$e = \frac{v'}{v}$$

$$v' = ev$$

$$v' = 0.707 \cdot 3.96$$

$$v' = 2.80\ \tfrac{\text{m}}{\text{s}}$$



yellow still falling:
$v_1 = 3.96$ m/s, down

orange rebounds:
$v_2 = 2.80$ m/s, up

(or $v_2 = 3.96$ m/s, up if it is assumed perfectly elastic)

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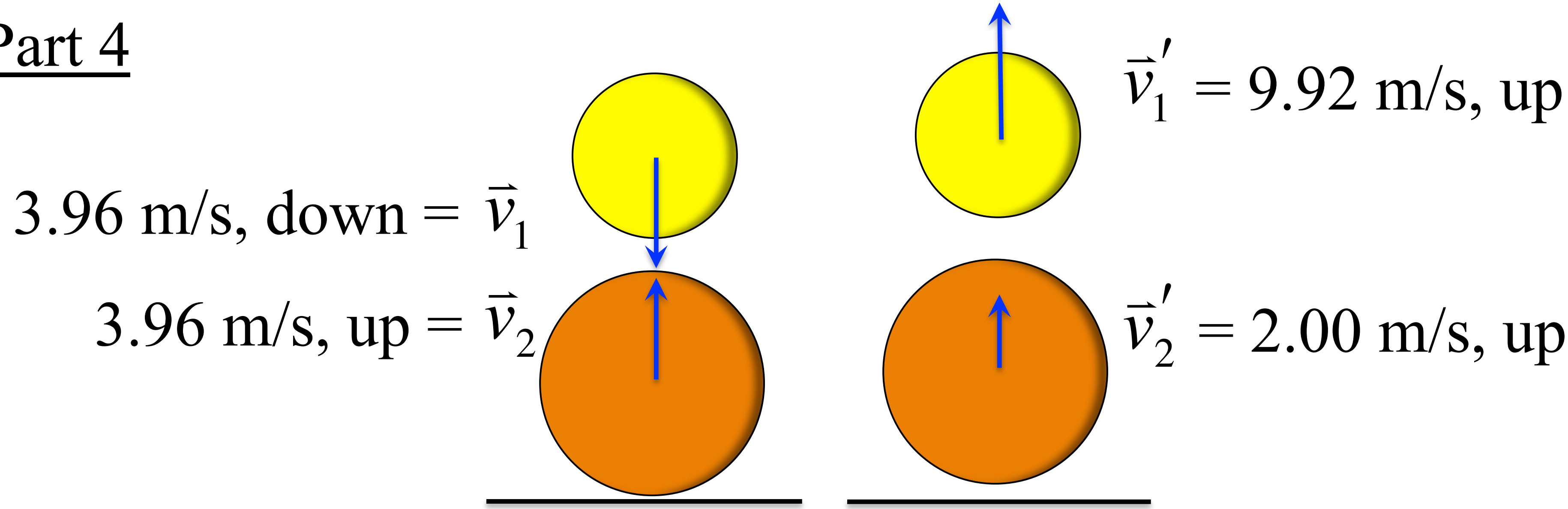
Part 4



$$\vec{p}_1 + \vec{p}_2 = \vec{p}_1' + \vec{p}_2'$$

$$57.5(-3.96) + 407(3.96) = 57.5x + 407y$$

$$KE_1 + KE_2 = KE_1' + KE_2'$$

$$\tfrac{1}{2}57.5 \cdot 3.96^2 + \tfrac{1}{2}407 \cdot 3.96^2 = \tfrac{1}{2}57.5x^2 + \tfrac{1}{2}407y^2$$

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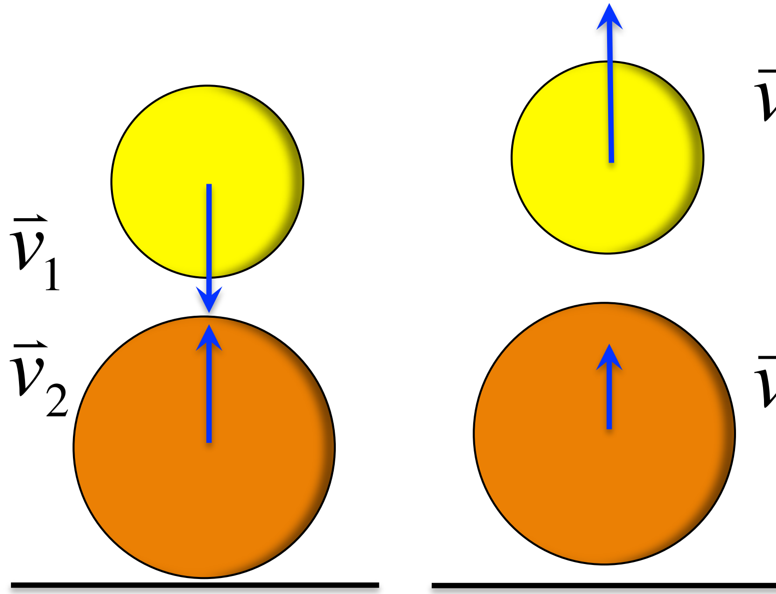
Part 4



$3.96\text{ m/s, down} = \vec{v}_1$

$2.80\text{ m/s, up} = \vec{v}_2$

$\vec{v}_1' = 7.89\text{ m/s, up}$

$\vec{v}_2' = 1.13\text{ m/s, up}$

$$\vec{p}_1 + \vec{p}_2 = \vec{p}_1' + \vec{p}_2'$$

$$57.5(-3.96) + 407(2.80) = 57.5x + 407y$$

$$KE_1 + KE_2 = KE_1' + KE_2'$$

$$\tfrac{1}{2}57.5 \cdot 3.96^2 + \tfrac{1}{2}407 \cdot 2.80^2 = \tfrac{1}{2}57.5x^2 + \tfrac{1}{2}407y^2$$

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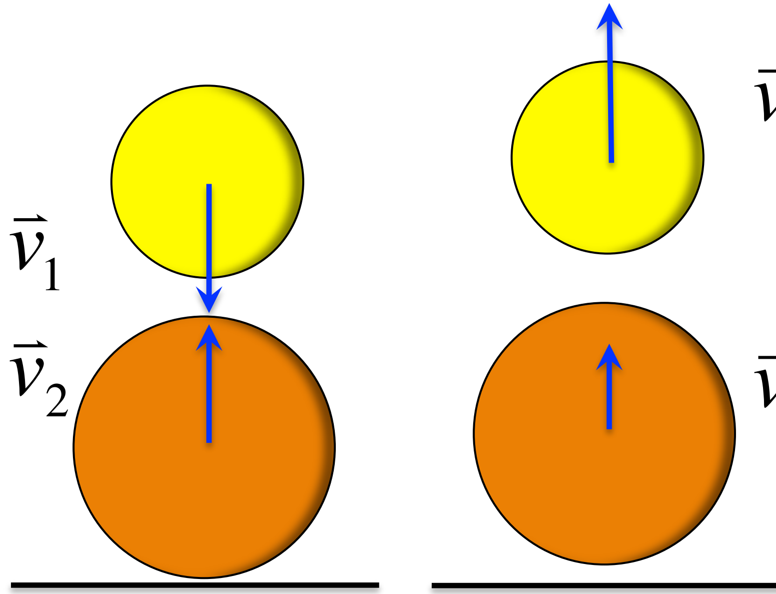
Part 4

$$3.96 \text{ m/s, down} = \vec{v}_1$$

$$2.80 \text{ m/s, up} = \vec{v}_2$$



$$\vec{v}_1' = 6.15 \text{ m/s, up}$$

$$\vec{v}_2' = 1.37 \text{ m/s, up}$$

$$\vec{p}_1 + \vec{p}_2 = \vec{p}_1' + \vec{p}_2'$$

$$57.5(-3.96) + 407(2.80) = 57.5x + 407y$$

$$\vec{v}_2 - \vec{v}_1 = e\left(\vec{v}_1' - \vec{v}_2'\right)$$

$$KE_1 + KE_2 \neq KE_1' + KE_2'$$

$$2.8 - (-3.96) = 0.707(x - y)$$

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Speed with which ping pong ball is launched:
(assuming all collisions are elastic)

$$v' = v\frac{3n-1}{n+1}$$

where: v = speed of each ball impacting floor

v' = speed of ping pong ball immediately after collision

n = ratio of masses (superball to ping pong ball)

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Speed with which ping pong ball is launched:
(assuming only first collision is inelastic)

$$v' = v\frac{n(1+2e)-1}{n+1}$$

where: v = speed of each ball impacting floor

v' = speed of ping pong ball immediately after collision

n = ratio of masses (superball to ping pong ball)

e = elasticity of first collision

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Speed with which ping pong ball is launched:
(assuming both collisions are inelastic)

$$v' = v \frac{n\left(2e + e^2\right) - 1}{n + 1}$$

where: v = speed of each ball impacting floor

v' = speed of ping pong ball immediately after collision

n = ratio of masses (superball to ping pong ball)

e = elasticity of each collision

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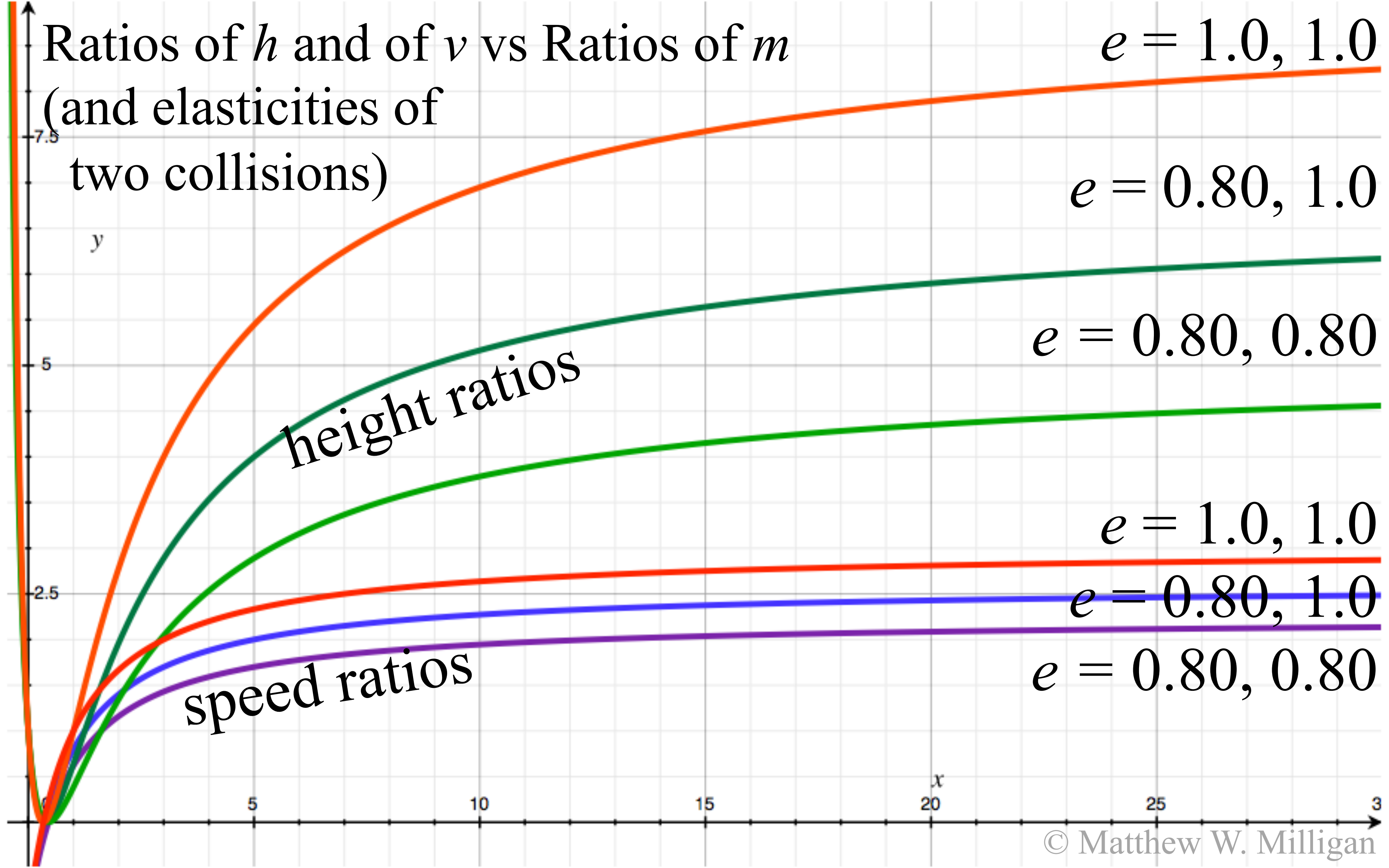

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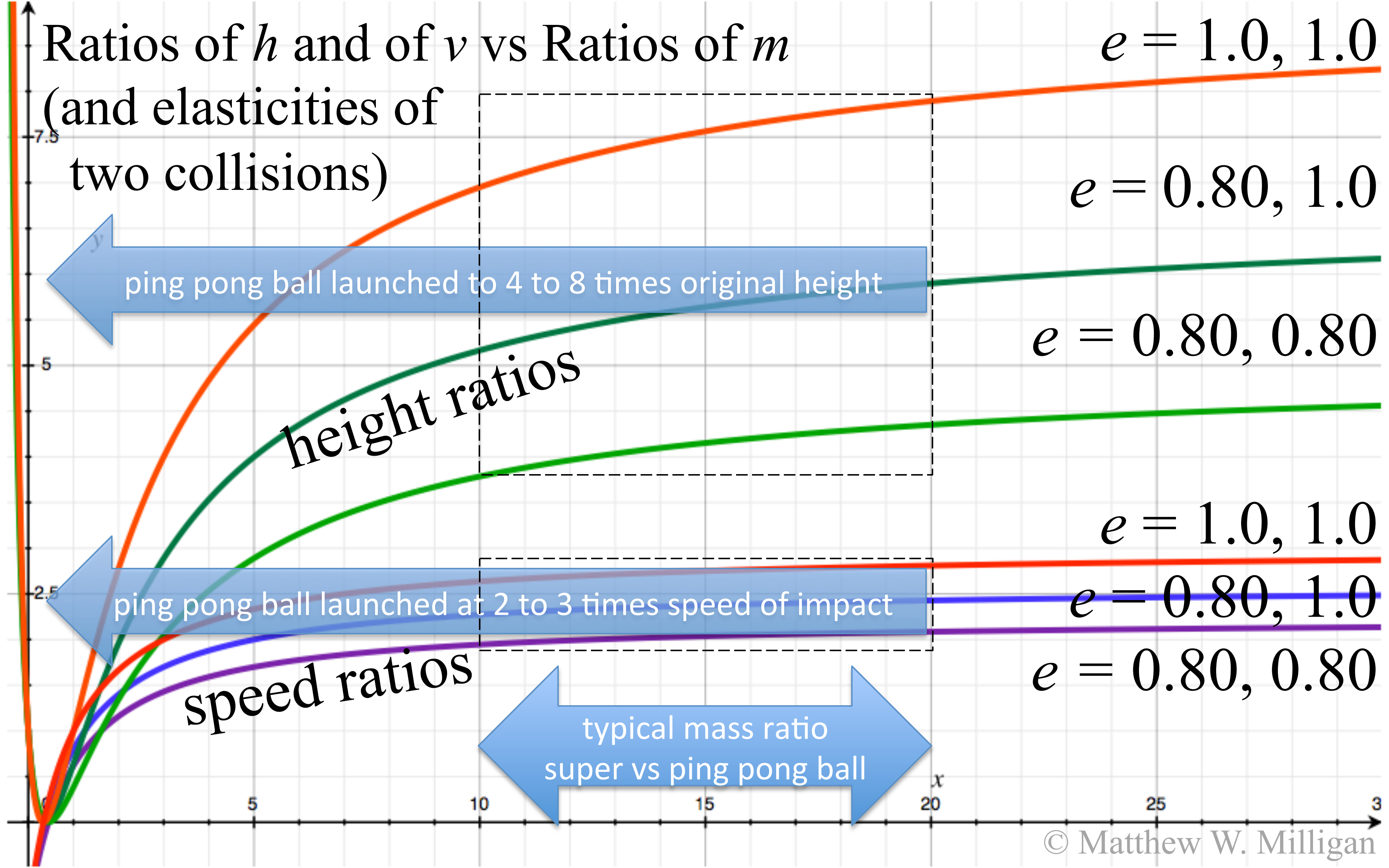

Ratios of h and of v vs Ratios of m
(and elasticities of two collisions)
e = 1.0, 1.0
e = 0.80, 1.0
e = 0.80, 0.80
ping pong ball launched to 4 to 8 times original height
height ratios
e = 1.0, 1.0
e = 0.80, 1.0
e = 0.80, 0.80
ping pong ball launched at 2 to 3 times speed of impact
speed ratios
typical mass ratio
super vs ping pong ball
7.5
5
2.5
y
x
5
10
15
20
25
3
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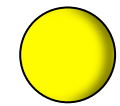
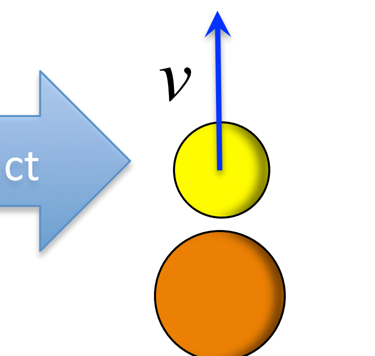
ping pong ball launched to 4 to 8 times original height



ping pong ball launched at 2 to 3 times speed of impact



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