Physics II
Calculating Velocity with a Ballistic Pendulum

Name: Solutions / Answers

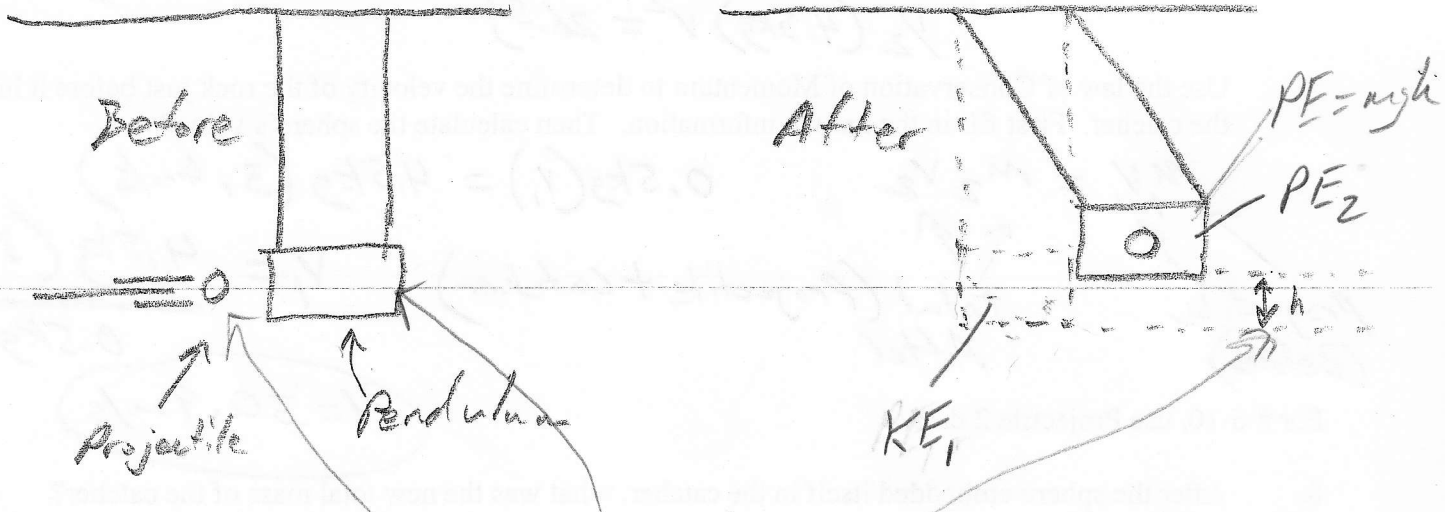
Formulas: PE = mgh KE = ½ mv² p = mv

$mv_{before} = mv_{after}$

$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$ (Any collision)

$PE_1 + KE_1 = PE_2 + KE_2$ (Elastic collisions only)

Ballistic Pendulum:



	Projectile 1	Projectile 2
Catcher Mass (kg)	4	0.5
Projectile Mass (kg)	0.5	0.02
Vertical distance gained by catcher during swing (m)	0.6	0.4

Use the data in the table above to answer the following questions for each projectile:

For # 1-5, use Projectile 1 data

1. After the sphere embedded itself in the catcher, what was the new total mass of the catcher?

4.5kg

2. After the sphere hit the catcher, the catcher swung ~~backward~~ and rose vertically. How much potential energy did the catcher (now including the embedded sphere) have at the highest part of its swing?

$PE = mgh = (4.5kg)(9.8 m/s^2)(0.6m)$

$PE = 26.5 j$

3. The catcher swung upward because it was moving. How much kinetic energy did catcher have very soon after it began moving?

zero at low point → $PE_1 + KE_1 = PE_2 + KE_2$ ← zero at high point

$KE_1 = 26.5j$

4. What was the catcher's (and the embedded sphere's) velocity at that point (just after it began moving)?

$KE = \frac{1}{2}mv^2 = 26.5j$ $\quad v = \sqrt{\frac{26.5j\,(2)}{4.5kg}} = 3.4 m/s$

$\frac{1}{2}(4.5kg)v^2 = 26.5j$

5. Use the law of Conservation of Momentum to determine the velocity of the rock just before it hit the catcher. First fill in the known information. Then calculate the sphere's velocity.

$m_1v_1 = m_2v_2$ $\quad 0.5kg(v_1) = 4.5kg(3.4m/s)$

Projectile (Before) — Total (Projectile + Catcher) After

$v_1 = \frac{4.5kg(3.4m/s)}{0.5kg}$

$v = 30.9 m/s$

For # 6-10, use Projectile 2 data

6. After the sphere embedded itself in the catcher, what was the new total mass of the catcher?

0.52kg

7. After the sphere hit the catcher, the catcher swung backward and rose vertically. How much potential energy did the catcher (now including the embedded sphere) have at the highest part of its swing?

2.0j

8. The catcher swung upward because it was moving. How much kinetic energy did catcher have very soon after it began moving?

2.0j

9. What was the catcher's (and the embedded sphere's) velocity at that point (just after it began moving)?

2.8m/s

10. Use the law of Conservation of Momentum to determine the velocity of the rock just before it hit the catcher. First fill in the known information. Then calculate the sphere's velocity.

72.6m/s