Honors Physics **Quiz 3: Momentum and Mechanical Energy** **Mr. Kelley**

$\rho = mv$ $\quad \mathrm{KE} = \frac{1}{2}mv^2$ $\quad \mathrm{PE} = mgh$ $\quad \rho_\circ = \rho_f$ $\quad \mathrm{KE}_\circ + \mathrm{PE}_\circ = \mathrm{KE}_f + \mathrm{PE}_f$

1. A skateboarder with a mass of 60 kg is skating on perfectly frictionless bearings (and wheels) at a speed of 22 m/s. A 10 kg puppy falls out of the sky, directly into the skateboarder's arms. How fast is the puppy-skater now moving?

2. A tennis ball hits a duck head-on. The duck was flying with a speed of 5 m/s, and the tennis ball was traveling with a speed of 18 m/s. If the tennis ball bounces straight back (reverses direction) with a speed of 4 m/s, how fast is the duck now going? The duck has a mass of 1 kg and the tennis ball 57 g. (Hint: UNITS! SIGNS!)

3. Slightly dazed, the duck flies into the side of a building 20 m above the ground and comes to a stop, then falls towards the earth. How fast will the duck be going when it reaches ground level? (Neglect air resistance.)

4. It turns out that this was a *rubber* duck and it bounces straight up with an initial velocity of 16 m/s. How high will it go? (Neglect air resistance.)

5. A kumquat is flying through outer space at a constant speed of 10 m/s. It hits a stationary pomelo and bounces off at 6 m/s with an angle of 20°. What is the final velocity (magnitude and direction) of the pomelo? The pomelo's mass is 205 g, and the kumquat's is 3 g. Draw a picture.

6. What is the center of mass of this system? (Hint: Choose an origin)

$$x_{\text{CM}} = \frac{\sum_{i=1}^{n} m_i x_i}{\sum_{i=1}^{n} m_i}$$