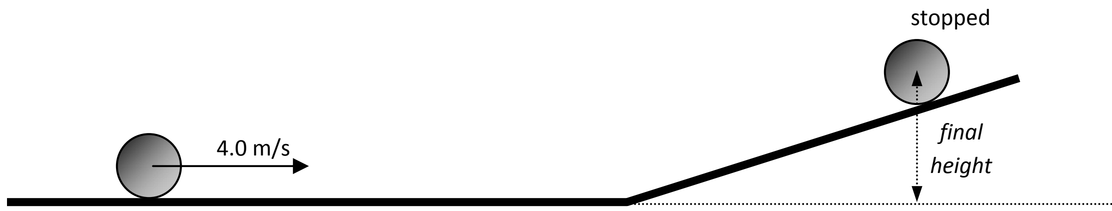
Physics Honors — Name: **KEY**

Quiz 1a – Chapters 1 & 2 – Math Review, Units & Energy Conservation — Period:

1. A small marble is sliding horizontally along the ground with a speed of 4.0 m/s. It approaches a ramp, slides up it, and eventually comes to a stop before sliding back down the ramp. The friction between the marble and the ground is too small to make a difference to this problem.




a. It helps to have a "feel" for how fast this marble is going. Convert the speed to miles per hour (MPH). [Curricular items 1a & 1b / 2 points]

(4.0m / 1s)(1km / 1000m)(1mi / 1.61km)(3600s / 1hr) = **8.94 mi/hr**

b. The marble is made from glass with a density of 2500 kg/m$^3$. As you know, objects with density greater than water density (1 g/cm$^3$) will sink in water. Would this marble sink in water? Answer by converting the marble's density to units appropriate for comparison with water. [Curricular items 1a & 1c / 2 points]

(2500kg / 1m$^3$)(1000g / 1kg)(1$^3$m$^3$ / 100$^3$cm$^3$) = **2.5 g/cm$^3$ *Yes, it would sink.***

c. What final height does the marble reach? (Show your work – remember that the highest grades are given to students who write a solution that can be understood by *everyone* in the class.) [Curricular item 5d / 6 points]

$E_{bottom} = E_{top}$

$U_{bottom} + K_{bottom} = U_{top} + K_{top}$

$m\, g\, h_{bottom} + ½\, m v_{bottom}^2 = m\, g\, h_{top} + ½\, m\, v_{top}^2$

$g\, h_{bottom} + ½\, v_{bottom}^2 = g\, h_{top} + ½\, v_{top}^2$

$(10 m/s^2)(0) + ½\,(4 m/s)^2 = (10 m/s^2)\, h_{top} + ½\,(0)^2$

$8\, m^2/s^2 = (10\, m/s^2)\, h_{top}$

**$h_{top} = 0.8$ m**

Physics Honors
Quiz 1a – Chapters 1 & 2 – Math Review, Units & Energy Conservation

Name: **KEY**
Period:

2. The Earth is moving through space due to its orbit around the Sun with an average speed of 29.7 km/s. Calculate the kinetic energy of the Earth. (You may need to refer to your equation sheet for this problem.) [Curricular items 1a, 1b & 5b / 2 points]

   $v = (29.7\text{km} / 1\text{s})(1000\text{m} / 1\text{km}) = 29{,}700 \text{ m/s}$
   $K = ½ \, m \, v^2$
   $K = ½ \, (6×1024 \text{ kg})(29700\text{m/s})^2$

   **$K = 2.646×10^{33}$ J**

3. The radius of Mars is only half the radius of the Earth. So you might think there'd be less "real estate" available on Mars. However, 70% of the Earth's surface is covered with water. So: which planet has more *land area*? Justify your answer with a calculation or carefully written argument. (Note: surface area is calculated using the formula $SA = 4\pi R^2$ – this formula is available on your equation sheet.) [Curricular item 1c / 3 points]

   Earth
   $SA = 4\pi(6.4×10^6 \text{ m})^2$
   $SA = 5.15×10^{14} \text{ m}^2$
   $\text{Land Area} = 0.3(SA) = 0.3(5.15×10^{14} \text{ m}^2)$
   $\text{Land Area} = 1.5×10^{14} \text{ m}^2$

   Mars
   $SA = 4\pi(3.2×10^6 \text{ m})^2$
   $SA = 1.3×10^{14} \text{ m}^2$
   $\text{Land Area} = SA = 1.3×10^{14} \text{ m}^2$

   *Earth still has more land area. In fact it has about 15% more:*

   $1.5×10^6 \text{ m}^2 / 1.3×10^{14} \text{ m}^2 = 1.15$

4. The Olympic gold medal in women's diving this year went to Chen Ruolin. The diving board was 10.0 m above the surface of the water. Assume Chen Ruolin began by launching off the board with a speed of 3.0 m/s. At what speed did she hit the water? *Please include an energy bar graph in your solution.* [Curricular items 5a & 5d / 5 points]

   $E_{bottom} = E_{top}$
   $U_{bottom} + K_{bottom} = U_{top} + K_{top}$
   $m \, g \, h_{bottom} + ½ \, m v_{bottom}^{\,2} = m \, g \, h_{top} + ½ \, m \, v_{top}^{\,2}$
   $g \, h_{bottom} + ½ \, v_{bottom}^{\,2} = g \, h_{top} + ½ \, v_{top}^{\,2}$
   $(10\text{m/s}^2)(0) + ½ \, v_{bottom}^{\,2} = (10\text{m/s}^2)(10\text{m}) + ½(3\text{m/s})^{\,2}$
   $½ \, v_{top}^{\,2} = 100 \text{ m}^2/\text{s}^2 + 4.5 \text{ m}^2/\text{s}^2$
   $½ \, v_{top}^{\,2} = 104.5 \text{ m}^2/\text{s}^2$
   $v_{top}^{\,2} = 209 \text{ m}^2/\text{s}^2$

   **$v_{bottom} = 14.46$ m/s**