

Name: _____

$$W = Fd \cos \theta_{\vec{F}, \vec{d}}$$

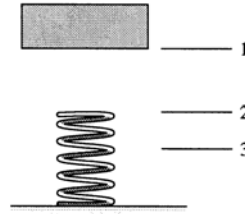
$$K = \frac{1}{2}mv^2$$

$$U_g = mgh$$

$$U_s = \frac{1}{2}kx^2$$

$$g = 9.8 \text{ m/s}^2 = 9.8 \text{ N/kg}$$

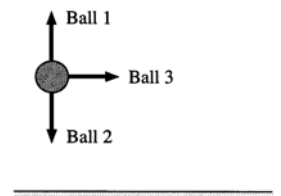
1) A heavy object is released from rest at position 1 above a spring. It falls and contacts the spring at position 2. The spring achieves maximum compression at point 3. See the figure. Fill in the table to indicate whether each of the quantities are **+**, **-**, or **0** during the intervals 1→2, 2→3, and 1→3.



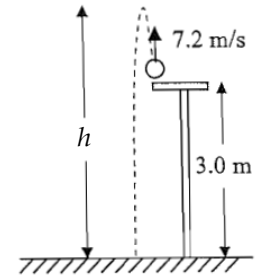
	1→2	2→3	1→3
ΔK			
ΔU_g			
ΔU_s			

2) Three balls of equal mass are fired simultaneously with *equal speed* from the *same height* above the ground. Ball 1 is fired straight up, Ball 2 is fired straight down, and Ball 3 is fired horizontally. See the figure. Rank in order, from smallest to largest, their *speeds* v_1 , v_2 , and v_3 , as they hit the ground. Indicate any ties with an equals sign.

smallest speed	largest speed
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3) A 0.120 kg ball is tossed straight upwards from a 3.0 m tower with an initial speed of 7.2 m/s. The ball reaches an unknown height h above the ground. It turns around and falls to the ground and reaches unknown speed v just before hitting the ground. Neglect air resistance. (The figure shows the path of the ball slightly off-set for clarity, but treat the ball as if it goes straight up and down.)



a) Determine the height h above ground that the ball reaches.

b) Determine the speed v of the ball just before it hits the ground.

c) If instead of tossing a 0.120 kg ball at 7.2 m/s, what if the ball were 0.240 kg but still with initial speed 7.2 m/s? How does the height it reaches compare with what you calculated in part a)? (circle one)

It reaches a larger height It reaches the same height It reaches a smaller height Not enough info

4) A horizontally oriented spring with spring constant 200 N/m is compressed 0.7 m from its uncompressed length. The compressed spring is used to launch an $M = 2.5 \text{ kg}$ block across a horizontal surface. The block continues up a ramp, reaching a maximum height h before turning around.



a) Neglecting friction, determine h .

b) If instead of using a 2.5 kg mass, what if the mass were 5.0 kg instead, but the same spring and compression distance as before? How does the height it reaches compare with what you calculated in part a)? (circle one)

It reaches a larger height

It reaches the same height

It reaches a smaller height

Not enough info

c) Return to the original scenario described above. When you carry out a test run, you discover that the 2.5 kg mass only reaches 80% of the height you calculated in part a), which you attribute to friction. Determine the work done by friction. If you were unable to calculate the height in part a), use $h = 1.0 \text{ m}$.