* Some steps were omitted due to limited space.

Physics 112

SA – U3 – S2 & S3: Types of Energy and Work-Energy Theorems (Key)

(June 2018)

Name - Key Date - Wed. June 6/18

Solve the following problems on loose leaf. Show your work.

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1. A stuntman is attached to a bungee cord with an un-stretched length of 15 m. He jumps off a bridge and comes to a stop just above the river, giving the bungee cord a stretched length of 44 m. If the bungee cord has 9.97×10^3 J of elastic potential energy when stretched as described, what is the mass of the stuntman? (8)

$x = 29\text{m}$
$E_e = 9.97 \times 10^3 \text{J}$
$m = ?$

$E_e = \frac{1}{2}kx^2$
$k = \frac{2E_e}{x^2}$
$k = 23.7 \frac{\text{kN}}{\text{m}}$

$F = kx$
$mg = kx$
$m = \frac{kx}{g}$
$m = 70\text{kg}$

The man's mass is 70 kg.

2. Missy Dewater was a platform diver for the Ringling Brother's Circus. If she had 1.20×10^4 J of kinetic energy just prior to hitting the water on a particular dive, what was her speed at that instant? Missy's mass was 40.8 kg at the time of the dive. (3)

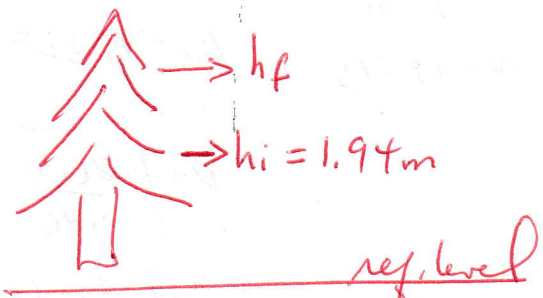
$E_K = 1.20 \times 10^4 \text{J}$
$m = 40.8 \text{kg}$
$v = ?$

$E_K = \frac{1}{2}mv^2$
$v = \sqrt{\frac{2E_K}{m}}$
$v = 24.3 \text{m/s}$

Her speed was 24.3 m/s.

3. You place a 3.70 g ornament on a branch of your Christmas tree that is 1.94 m from the floor. You change your mind and move the ornament to a higher branch by doing 0.0826 J of work on it. What is the final potential energy of the ornament relative to the floor? (7)

* There are several ways to solve this problem. } One is shown below.



$m = 3.70\text{g} = 0.00370\text{kg}$

$W = E_{gf} - E_{gi}$
$W = E_{gf} - mgh_i$
$E_{gf} = W + mgh_i$
$E_{gf} = 0.0826 + (0.00370)(9.8)(1.94)$
$E_{gf} = 0.153 \text{J}$.

The final potential of the ornament relative to the floor is 0.153 J.

4. A 9.345×10^3 kg UFO experiences a force of 8.34×10^2 N over a distance of 7.45×10^3 m. What was the initial speed of the UFO is its final speed was 195 km/h? (6)

$m = 9.345 \times 10^3 kg$

$F = 8.34 \times 10^2 N$

$d = 7.45 \times 10^3 m$

$v_i = ?$

$v_f = 195 \frac{km}{h} = 54.2 m/s$

$W = Fd = \Delta E_k$

$Fd = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$

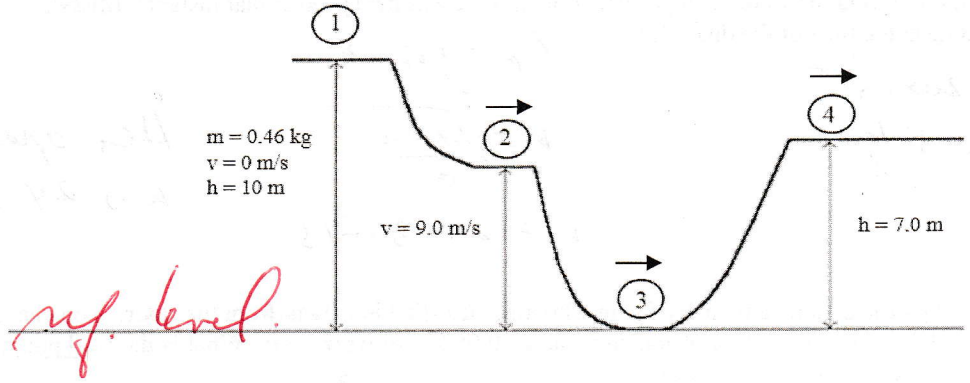
$v_i = \sqrt{\frac{m v_f^2 - 2Fd}{m}}$

$v_i = 40.1 m/s$

The initial speed was 40.1 m/s.

5. Calculate the potential energy, kinetic energy, mechanical energy, speed, and height of the ball at the positions indicated. Write and report answers to 2 SDs on the lines provided. (14)

①	②	③	④
$E_g =$ 45 J	$E_g =$ 26 J	$E_g =$ 0 J	$E_g =$ 32 J
$E_k =$ 0	$E_k =$ 19 J	$E_k =$ 45 J	$E_k =$ 13 J
ME = 45 J	ME = 45 J	ME = 45 J	ME = 45 J
	h = 5.8 m	v = 14 m/s	v = 7.5 m/s
		h = 0 m	



$E_g = (0.46)(9.80)(10)$

$E_g = 45 J$

$E_k = \frac{1}{2}(0.46)(9.0)^2$

$E_k = 19 J$

$E_g = 45 - 19 = 26 J$

$E_g = mgh$

$h = \frac{E_g}{mg}$

$h = 5.8 m$

$E_k = \frac{1}{2} m v^2$

$v = \sqrt{\frac{2E_k}{m}}$

$v = 14 m/s$

$E_g = (0.46)(9.80)(7.0)$

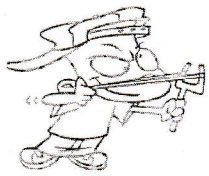
$E_g = 32 J$

$E_k = 45 - 32 = 13 J$

$v = \sqrt{\frac{2(13)}{0.46}}$

$v = 7.5 m/s$

6. A 0.012 g pebble is placed in a sling shot and is stretched back 0.485 m. What is the spring constant of the sling shot if the speed of the pebble is 70.7 m/s when it leaves the slingshot? (6)



$m = 0.012\,g = 0.012 \times 10^{-3}\,kg$

$x = 0.485\,m$

$k = ?$

$v_f = 70.7\,m/s$

$$E_{ki} + E_{gi} + E_{ei} = E_{kf} + E_{gf} + E_{ef}$$

$$E_{ei} = E_{kf}$$

$$\frac{1}{2}kx_i^2 = \frac{1}{2}mv_f^2$$

$$k = \frac{mv_f^2}{x_i^2}$$

$$k = \frac{(0.012 \times 10^{-3})(70.7)^2}{0.485}$$

$$k = 0.12\ N/m.$$

The spring constant was 0.12 N/m.