4.2 Worksheet KEY

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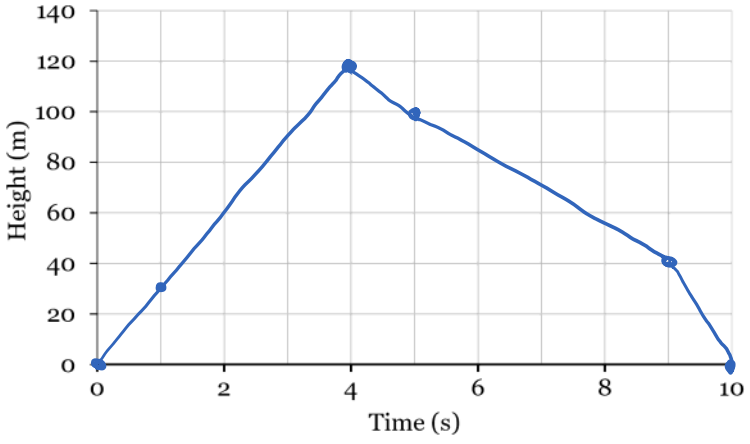
Science 10 – Physics Name: KEY
Date: _____

4.2 Worksheet

Part 1 – Use the data table below to create a graph of height vs. time for a model rocket with a mass of 2.45 kg. Use the graph to answer the questions below. Don't forget to show your work in the space provided.

Time (s)	Height (m)
0	0
1	30.00
4	120.0
7	100.0
9	40.00
10	0



1. What is the potential energy of the rocket at time 4 s?

$m = 2.45\ kg$ (3 SF)
$g = 9.81\ m/s^2$ (3 SF)
$h = 120.0\ m$ (4 SF)

$PE = mgh$
$= (2.45)(9.81)(120.0)$
$= 2884.14$

$PE = 2880\ J$ (or $2.88 \times 10^3\ J$)

2. What is the potential energy of the rocket at time 7 s?

$m = 2.45\ kg$ (3SF)
$g = 9.81\ m/s^2$ (3SF)
$h = 100.0\ m$ (4SF)

$PE = mgh$
$= (2.45)(9.81)(100.0)$
$= 2403.45$
$= 2.40 \times 10^3\ J$

Part 2 –Word problems

3. A box with a mass of 30 kg is sitting on a shelf 3 m above the ground. What is its potential energy?

$m = 30\ kg$ (1 SF)
$g = 9.81\ m/s^2$ (3SF)
$h = 3\ m$ (1 SF)

$PE = mgh$
$= (30)(9.81)(3)$
$= 882.9$

$PE = 900\ J$

4. A rubber ball has 150 J of potential energy and a mass of 0.254 kg. How high is the ball off the ground?

$PE = 150\ J$ (2 SF)
$m = 0.254\ kg$ (3SF)
$g = 9.81\ m/s^2$ (3SF)
$h = ?$

$h = \frac{PE}{mg}$
$= \frac{150}{(0.254)(9.81)}$

$h = 60.1988...$
$h = 6.0 \times 10^1\ m$

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5. A pole vaulter at the top of her jump is 5.90 m above the ground. If her potential energy is 4942 J, what is her mass?

$h = 5.90\ m$ (3 SF)
$PE = 4942\ J$ (4 SF)
$g = 9.81\ m/s^2$ (3 SF)
$m = ?$

$m = \frac{PE}{gh}$ | $m = 85.385...$
$= \frac{4942}{(9.81)(5.90)}$ | $m = 85.4\ kg$

6. In 1993, Cuban athlete Javier Sotomayor set the world record for high jump. If his potential energy at the top of the jump was 1970 J, and his mass was 82.0 kg, how high did he jump?

$PE = 1970\ J$ (3 SF)
$m = 82.0\ kg$ (3 SF)
$g = 9.81\ m/s^2$ (3 SF)
$h = ?$

$h = \frac{PE}{mg}$ | $h = 2.4489...$
$= \frac{1970}{(82.0)(9.81)}$ | $h = 2.45\ m$

7. A can of spinach with mass of 0.14 kg loses 28 J of potential energy falling off of a shelf. How high was the can before it fell?

$m = 0.14\ kg$ (2 SF)
$PE = 28\ J$ (2 SF)
$g = 9.81\ m/s^2$ (3 SF)
$h = ?$

$h = \frac{PE}{mg}$ | $h = 20.387...$
$= \frac{28}{(0.14)(9.8)}$ | $h = 2.0 \times 10^1\ m$

8. In a lab activity, a group of students measures the velocity of a model car at 2.5 m/s at the bottom of a ramp. The car's starting position at the top of the ramp is 1.00 m above the floor.

   a. If the model car had 2.35 J of potential energy at the top of the ramp, what is its mass?

$PE = 2.35\ J$ (3 SF)
$h = 1.00\ m$ (3 SF)
$g = 9.81\ m/s^2$ (3 SF)
$m = ?$

$m = \frac{PE}{gh}$ | $m = 0.2395...$
$m = \frac{2.35}{(9.81)(1.00)}$ | $m = 0.240\ kg$

   b. What is the kinetic energy of the car at the bottom of the ramp?

$KE = ?$
$m = 0.2397...$ (3 SF)
$v = 2.5\ m/s$ (2 SF)

$KE = \frac{1}{2}mv^2$ | $KE = 0.74936...$
$= \frac{1}{2}(0.2397...)(2.5)^2$ | $KE = 0.75\ J$

   c. The energy of the moving car can be converted to heat due to the friction of the wheels on the ramp. The difference between the potential energy of the car and its kinetic energy at the bottom of the hill equals the energy lost due to friction. How much energy is lost due as heat for the group's car?

$\text{Energy Lost} = 2.40 - 0.75$
$= 1.6\ J$