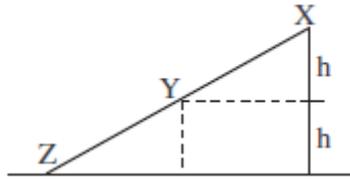


## Conservation of Energy Worksheet

1. A trolley makes two separate runs down an inclined plane. It is released first from Y, halfway up the slope and then from X at the top of the slope.

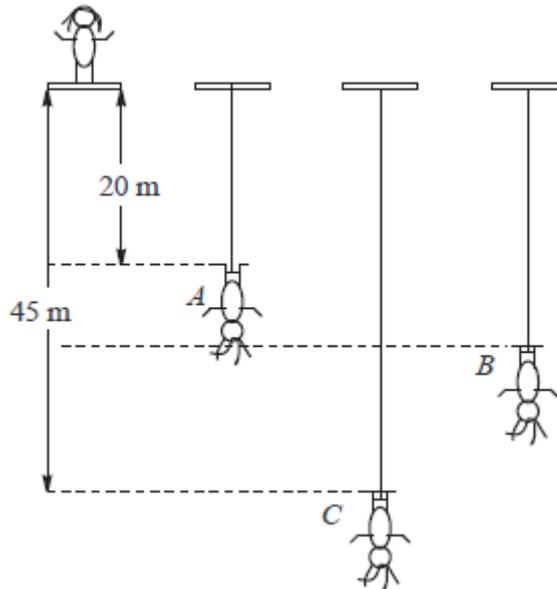


Which of the following statements is/are true?

- I. The trolley takes twice as long to run from X to Z as it take to run from Y to Z.
  - II. At Z the trolley is going twice as fast when released at X as it is when it is released at Y.
  - III. At Z the trolley has twice as much kinetic energy when released at X as it has when released at Y
- (A) (III) only  
(B) and (III) only  
(C) and (II) only  
(D) (I), (II) and (III)
2. A spring-loaded toy dart gun is used to shoot a dart straight up in the air, and the dart reaches a maximum height of 24 m. The same dart is shot straight up a second time from the same gun, but this time the spring is compressed only half as far as before firing. How far up does the dart go this time, neglecting friction and assuming an ideal spring?
- (A) 24 m  
(B) 17 m  
(C) 12 m  
(D) 6 m
3. A marble is dropped from the top of a skyscraper. The work done by the earth's gravitational force on the marble is
- (A) equal to the work done by the marble's gravitational force on the earth  
(B) smaller than the work done by the marble's gravitational force on the earth  
(C) larger than work done by the marbles gravitational force on earth  
(D) more information is needed.

4. Compared to the amount of energy required to accelerate a car from rest to 10 miles per hour, the amount of energy required to accelerate the same car from 10 mph to 20 mph is
- (A) the same.
  - (B) twice as much.
  - (C) three times as much.
  - (D) four times as much.
5. When a 50 kg person is hangs from a 20 m bungee cord it stretches to a length of 32m.
- (a) Calculate the spring constant of the bungee cord (assuming it obeys Hooke's law).
  - (b) How much work is required to stretch the cord by this much?
  - (c) How heavy a person is required to make the cord stretch twice as much?
  - (d) How much additional work is required to make the cord stretch twice as much?

6. In the sport of Bungee Jumping people stand on a high platform and allow themselves to fall while tied to the platform by an elastic cord attached to their ankles. Johanna does a bungee jump. The unstretched length of the bungee cord is 20.0 m. Johanna's center of mass is 1.0 m above her feet when she is standing and her mass is 54.0 kg. In her initial drop the lowest point she reaches is when her feet are 45.0 m below the platform (Since she is upside down while she is falling her center of mass is 47.0 m below its initial position).



- (a) As Johanna drops, describe the energy changes taking place. Do this by writing increasing, decreasing or constant under the headings gravitational potential energy, kinetic energy and elastic potential energy in the table below. The top row refers to energy changes between her initial position on the platform and position A - the point where the bungee cord just starts to stretch; the middle row as she falls from point A to point B - the final equilibrium position; and the bottom row as she falls from point B to position C the lowest point of her initial drop.

|                    | Gravitational Potential Energy | Kinetic Energy | Elastic Potential Energy |
|--------------------|--------------------------------|----------------|--------------------------|
| From platform to A |                                |                |                          |
| From A to B        |                                |                |                          |
| From B to C        |                                |                |                          |

- (b) Using conservation of energy calculate Johanna's speed at point A just before the bungee starts to stretch.

- (c) Using conservation of energy calculate how much energy is stored in the bungee cord at point  $C$  when Johanna is momentarily at rest at her lowest position?
- (d) Using your answer to (c) calculate the magnitude of the spring constant of the bungee (assuming it obeys Hooke's Law).
- \_\_\_\_\_
- (e) Calculate the net force acting on Johanna at  $C$  and hence calculate her acceleration as she bounces back up again.
- (f) After bouncing up and down a number of times she loses energy and comes to rest at  $B$  hanging by her angles. By how much is the cord stretched at  $B$ .
- (g) What problems could arise if the spring constant of the bungee were too small or too large?