Module 08

Introduction to Energy

QUESTIONS

Question 1 (LV1): A 14,000 kg airplane is flying at an altitude of 500 m. Determine the airplane's kinetic energy when flying at a speed of 300 km/h.

Question 2 (LV2): The total height of Niagara Falls is 51 m. Find the potential energy of one kilogram of water at the top, when measured with respect to the base of the waterfall.

Question 3 (LV3): A cone is falling from a pine tree from a height of 15 m. How fast is the cone moving as it reaches the ground?

Question 4 (LV4): A spring has a force constant of 12.0 N/m has an unstretched length of 3.00 m. When a mass is hung to the end of the spring and allowed to come to rest, the vertical length of the spring is 4.20 m. What is the elastic potential energy stored in the spring?

Question 5 (LV5): A croquet ball strikes a stationary ball of equal mass. The collision is elastic, and the incident ball goes off at and angle of 30° to its original direction. In what direction does the other ball move?

Question 6 (LV6): The potential energy of a 2.0-kg object constrained to the x-axis is given by $U = 3x^2 - x^3$, for $x \leqslant 3.0$ m and $U = 0$ for $x \geqslant 3.0$ m, where U is in joules and x is in meters. (a) Sketch a plot of U versus x. (b) Determine the point where the speed is maximum.

PROBLEMS

Problem 1 (LV1, LV2, LV3, LV4): A student does a bungee jump from Kawarau Bridge in New Zealand. The unstretched length of the cord is 25.0 m, the mass of the student is 70 kg, and there is a 43.0 m drop above the surface of the river below. Calculate the required force constant of the cord if the student is to stop safely 4.00 m above the river.

Problem 2 (LV1, LV2, LV3): Tarzan swings on a 20.0-m long vine initially inclined at an angle of 40.0° with the vertical. What is his speed at the bottom of the swing if he starts with an initial velocity of 3.00 m/s?

Problem 3 (LV1, LV5): Two identical billiard balls are initially at rest when they are struck symmetrically by a third identical ball moving with velocity $v_0 = 2$ m/s, as shown in Fig. 1. Find the velocities of all three balls after this elastic collision.

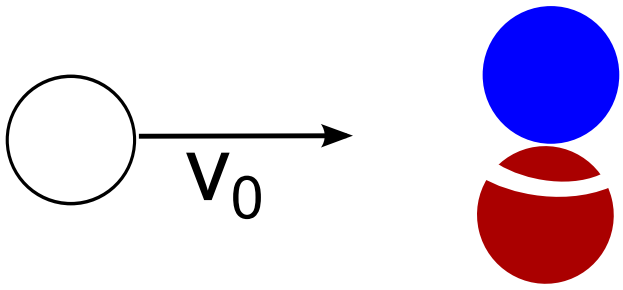

FIG. 1: Collision between three billiard balls.