Answer on Question #40970, Physics, Mechanics

From point A to B on the rough surface, the cyclist lost 2000J of energy due to the frictional force of the rough surface of the 10 m road. She started with an initial speed vA at point A, arriving at point B with a speed of vB. The cyclist barely made it to the flat part (point C) of the frictionless surface without pedaling.

If the weight of the bike and the cyclist is 980N, and point C is located at h = 0.5 m above the ground, find:

a. The speed of cyclist at point B, vB

b. The speed of cyclist at point A, vA

c. The coefficient of kinetic friction, μk, between the bike tires and the road.

Solution

If the weight of the bike and the cyclist is 980N, then mass of the bike and the cyclist is

$$m = \frac{W}{g} = \frac{980}{9.8} = 100\ kg.$$

According to the law of conservation of energy the kinetic energy at point A is equal the sum of the wrk against the frictional force and potential energy at point C:

$$\frac{mv_A^2}{2} = A + mgh.$$

The speed of cyclist at point A:

$$v_A = \sqrt{\frac{2A}{m} + 2gh} = \sqrt{\frac{2 \cdot 2000\text{J}}{100\ kg} + 2 \cdot 9.8\frac{m}{s^2} \cdot 0.5\ \text{m}} = 7\frac{m}{s}.$$

The kinetic energy of cyclist at point B is

$$\frac{mv_B^2}{2} = \frac{mv_A^2}{2} - A.$$

The speed of cyclist at point B:

$$v_A = \sqrt{v_A^2 - \frac{2A}{m}} = \sqrt{7^2 - \frac{2 \cdot 2000}{100}} = 3\frac{m}{s}.$$

The coefficient of kinetic friction, μ_k, between the bike tires and the road is

$$\mu_k = \frac{A}{W \cdot l} = \frac{2000\text{J}}{980\text{N} \cdot 10\text{m}} = 0.2.$$