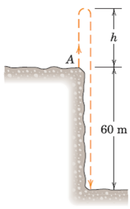
Engineering Mechanics | (8th Edition)

Problem

A ball is thrown vertically up with a velocity of 30 m /s at the edge of a 60-m cliff. Calculate the height *h* to which the ball rises and the total time *t* after release for the ball to reach the bottom of the cliff. Neglect air resistance and take the downward acceleration to be 9.81 m /s^2.



Problem 2/14

Walkthrough for problem | Related videos | Related examples

Step-by-step solution

Step 1 of 2

Write equation for displacement.

$$y = v_0 t + \frac{1}{2}at^2$$

Here, v_0 is the initial velocity, *a* is the acceleration and *t* is time in seconds.

Substitute $30\,\text{m/s}$ for v_0, $-9.81\,\text{m/s}^2$ for *a* and $-60\,\text{m}$ for *y*.

$$-60 = 30t + \frac{1}{2}(-9.81)t^2$$
$$-60 = 30t - 4.905t^2$$
$$4.905t^2 - 30t - 60 = 0$$

Solve the quadratic equation.

$$t = \frac{30 \pm \sqrt{30^2 - 4(-60)(4.905)}}{2(4.905)}$$
$$= 7.70\ \text{s and } -15.87\ \text{s}$$

Therefore, the required time is $\boxed{7.70\ \text{s}}$.

Comment

Step 2 of 2

Write equation for final velocity.

$$v^2 = v_0^2 + 2ay$$

Here, *v* is final velocity and *y* is vertical distance.

Substitute *h* for *y*, zero for *v*, $-9.81\,\text{m/s}^2$ for *a* and $30\,\text{m/s}$ for v_0.

$$v^2 = v_0^2 + 2ay$$
$$0^2 = 30^2 + 2 \times -9.81 \times h$$
$$h = \frac{900}{(2 \times 9.81)}$$
$$= 45.9\ \text{m}$$

Therefore, the required height to which the ball rises is $\boxed{45.9\ \text{m}}$.

Comment

Was this solution helpful? 11 0

WALKTHROUGH VIDEO

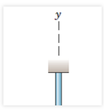
For this problem: Chapter 2, Problem 14P

4:58 1 0

Recommended solutions for you in Chapter 2

Chapter 2, Problem 217P

Collars A and B slide along the fixed right-angle rods and are connected by a cord of length L. Determine the acceleration ax...



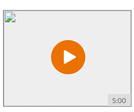
See solution

Chapter 2, Problem 216P

Determine the relationship which governs the velocities of the four cylinders. Express all velocities as positive down. How...

See solution

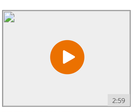
Videos related to **Chapter 2**



TEXTBOOK SOLUTION

Chain Rule

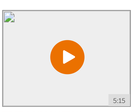
0 0



TEXTBOOK SOLUTION

Basic Differentiation (for Rectilinear Kinematics)

0 0



TEXTBOOK SOLUTION

Basic Integration (for Rectilinear Kinematics)

0 0

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Examples related to **Chapter 2**

Example 1

The position coordinate of a particle which is confined to move along a straight line is given by s = 2 t 3 – 24 t + 6 , where s is measured in meters from a convenient origin and t is in seconds. Determine (a) the time required for the particle to reach a velocity of 72 m / s from its initial condition at t = 0 , (b) the acceleration of the particle when v = 30 m / s , and (c) the net displacement of the particle during the interval from t = 1 s to t = 4 s .

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Example 2

Example 3

Example 4

Example 5

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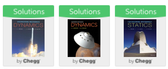

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