Physics 1 Test Prep

Intro

On May 26, 1934, a streamlined, stainless steel diesel train called the Zephyr set the world's nonstop long-distance speed record for trains. Its run from Denver to Chicago took 13 hours, 4 minutes, 58 seconds, and was witnessed by more than a million people along the route. The total distance traveled was 1633.8 km. What was its average speed in km/h and m/s?

An unwary football player collides with a padded goalpost while running at a velocity of 7.50 m/s and comes to a full stop after compressing the padding and his body 0.350 m. (a) What is his deceleration? (b) How long does the collision last?

An object takes 13.2 minutes to move 18.0 miles what is the magnitude of the object's velocity in m/s?

Vectors

Suppose you walk 18.0 m straight west and then 25.0 m straight north. How far are you from your starting point, and what is the compass direction of a line connecting your starting point to your final position?

You fly 32.0 km in a straight line in still air in the direction 35.0º south of west. (a) Find the distances you would have to fly straight south and then straight west to arrive at the same point. (This determination is equivalent to finding the components of the displacement along the south and west directions.)

Kinenmatics

A bullet in a gun is accelerated from the firing chamber to the end of the barrel at an average rate of $6.20\times10^{5}\text{m/s}^{2}$ for $8.10\times10^{-4}\text{s}$. What is its muzzle velocity (that is, its final velocity)?

While entering a freeway, a car accelerates from rest at a rate of $2.40\ \text{m/s}^{2}$ for 12.0 s. (a) Draw a sketch of the situation. (b) List the knowns in this problem. (c) How far does the car travel in those 12.0 s? To solve this part, first identify the unknown, and then discuss how you chose the appropriate equation to solve for it. After choosing the equation, show your steps in solving for the unknown, check your units, and discuss whether the answer is reasonable. (d) What is the car's final velocity? Solve for this unknown in the same manner as in part (c), showing all steps explicitly.

Projectile motion

A projectile is launched at ground level with an initial speed of 50.0 m/s at an angle of 30.0º above the horizontal. It strikes a target above the ground 3.00 seconds later. What are the x and y distances from where the projectile was launched to where it lands?

An eagle is flying horizontally at a speed of 3.00 m/s when the fish in her talons wiggles loose and falls into the lake 5.00 m below. Calculate the velocity of the fish relative to the water when it hits the water.

Forces

A 63.0-kg sprinter starts a race with an acceleration of 4.20 m/s2 . What is the net external force on him?

In Figure 4.7, the net external force on the 24-kg mower is stated to be 51 N. If the force of friction opposing the motion is 24 N, what force F (in newtons) is the person exerting on the mower? Suppose the mower is moving at 1.5 m/s when the force F is removed. How far will the mower go before stopping?

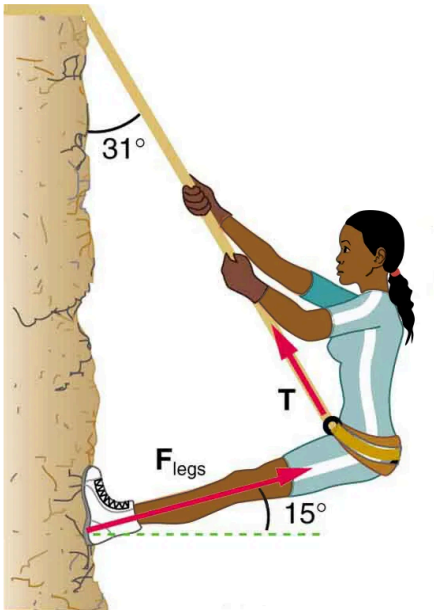
Suppose a 60.0-kg gymnast climbs a rope. (a) What is the tension in the rope if they climb at a constant speed? (b) What is the tension in the rope if they accelerate upward at a rate of 1.50 m/s2 ?

Calculate the force a 70.0-kg high jumper must exert on the ground to produce an upward acceleration 4.00 times the acceleration due to gravity. Explicitly show how you follow the steps in the Problem-Solving Strategy for Newton’s laws of motion.

Friction

A physics major is cooking breakfast when he notices that the frictional force between his steel spatula and his Teflon frying pan is only 0.200 N. Knowing the coefficient of kinetic friction between the two materials, he quickly calculates the normal force. What is it?

Consider the 52.0-kg mountain climber in Figure 5.20. (a) Find the tension in the rope and the force that the mountain climber must exert with her feet on the vertical rock face to remain stationary. Assume that the force is exerted parallel to her legs. Also, assume negligible force exerted by her arms. (b) What is the minimum coefficient of friction between her shoes and the cliff?



Circular motion

Semi-trailer trucks have an odometer on one hub of a trailer wheel. The hub is weighted so that it does not rotate, but it contains gears to count the number of wheel revolutions—it then calculates the distance traveled. If the wheel has a 1.15 m diameter and goes through 200,000 rotations, how many kilometers should the odometer read?

A truck with 0.420-m-radius tires travels at 32.0 m/s. What is the angular velocity of the rotating tires in radians per second? What is this in rev/min?

When kicking a football, the kicker rotates his leg about the hip joint.

(a) If the velocity of the tip of the kicker's shoe is 35.0 m/s and the hip joint is 1.05 m from the tip of the shoe, what is the shoe tip's angular velocity?

(b) The shoe is in contact with the initially stationary 0.500 kg football for 20.0 ms. What average force is exerted on the football to give it a velocity of 20.0 m/s?

(c) Find the maximum range of the football, neglecting air resistance.

At takeoff, a commercial jet has a 60.0 m/s speed. Its tires have a diameter of 0.850 m. (a) At how many rev/min are the tires rotating? (b) What is the centripetal acceleration at the edge of the tire? (c) With what force must a determined 1.00×10^{-15}kg bacterium cling to the rim? (d) Take the ratio of this force to the bacterium's weight.

Gravitation

Earth is not a perfect sphere. Its radius as well as the value of g vary with latitude. (a) Calculate Earth's mass given the acceleration due to gravity at the North Pole is 9.807 m/s2 and the radius of the Earth at the pole is 6356.8 km. (b) Compare this with the accepted value of 5.972×10^{24}kg