

## Physics Questions

1. 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?  
(a) 34.689 m/s=124.88 km/h
2. The planetary model of the atom pictures electrons orbiting the atomic nucleus much as planets orbit the Sun. In this model you can view hydrogen, the simplest atom, as having a single electron in a circular orbit  $1.06 \times 10^{-10}$  m in diameter. (a) If the average speed of the electron in this orbit is known to be  $2.20 \times 10^6$  m/s, calculate the number of revolutions per second it makes about the nucleus. (b) What is the electron's average velocity per revolution?  
(a)  $6.61 \times 10^{15}$  rev/s  
(b) 0 m/s
3. A swan on a lake gets airborne by flapping its wings and running on top of the water. (a) If the swan must reach a velocity of 6.00 m/s to take off and it accelerates from rest at an average rate of  $0.350 \text{ m/s}^2$ , how far will it travel before becoming airborne? (b) How long does this take?  
(a) 51.4 m  
(b) 17.1 s
4. Calculate the height of a cliff if it takes 2.35 s for a rock to hit the ground when it is thrown straight up from the cliff with an initial velocity of 8.00 m/s. (b) How long would it take to reach the ground if it is thrown straight down with the same speed?  
(a) 8.26 m  
(b) 0.717 s
5. A shopper pushes a grocery cart 20.0 m at constant speed on level ground, against a 35.0 N frictional force. He pushes in a direction  $25.0^\circ$  below the horizontal. (a) What is the work done on the cart by friction? (b) What is the work done on the cart by the gravitational force? (c) What is the work done on the cart by the shopper? (d) Find the force the shopper exerts, using energy considerations. (e) What is the total work done on the cart?  
(a) -700 J  
(b) 0  
(c) 700 J  
(d) 38.6 N  
(e) 0

6. A hydroelectric power facility converts the gravitational potential energy of water behind a dam to electric energy. What is the gravitational potential energy relative to the generators of a lake of volume  $50.0 \text{ km}^3$  (mass= $5.00 \times 10^{13} \text{ kg}$ ), given that the lake has an average height of  $40.0 \text{ m}$  above the generators?  
(a)  $1.96 \times 10^{16} \text{ J}$
7. A  $5.00 \times 10^5 \text{ kg}$  subway train is brought to a stop from a speed of  $0.500 \text{ m/s}$  in  $0.400 \text{ m}$  by a large spring bumper at the end of its track. What is the force constant  $k$  of the spring?  
(a)  $7.81 \times 10^5 \text{ N/m}$
8. A person in good physical condition can put out  $100 \text{ W}$  of useful power for several hours at a stretch, perhaps by pedaling a mechanism that drives an electric generator. Neglecting any problems of generator efficiency and practical considerations such as resting time: (a) How many people would it take to run a  $4.00\text{-kW}$  electric clothes dryer? (b) How many people would it take to replace a large electric power plant that generates  $800 \text{ MW}$ ?  
(a) 40  
(b) 8 million
9. A  $63.0 \text{ kg}$  sprinter starts a race with an acceleration of  $4.20 \text{ m/s}^2$ . What is the net external force on him?  
(a)  $265 \text{ N}$
10. Two teams of nine members each engage in a tug of war. Each of the first team's members has an average mass of  $68 \text{ kg}$  and exerts an average force of  $1350 \text{ N}$  horizontally. Each of the second team's members has an average mass of  $73 \text{ kg}$  and exerts an average force of  $1365 \text{ N}$  horizontally. (a) What is magnitude of the acceleration of the two teams? (b) What is the tension in the section of rope between the teams?  
(a)  $0.11 \text{ m/s}^2$   
(b)  $1.2 \times 10^4 \text{ N}$
11. Which of the following statements is true regarding a rider in a roller coaster cart moving with a constant speed through a loop?  
(a) The rider is accelerating.  
(b) The sum of all the forces acting on the rider is zero.  
(c) Gravity is the only force doing work on the rider.  
(d) There are two forces acting on the rider, but neither does any work on the rider.
12. The stopping distance  $d$  is the distance a vehicle will travel from the point when the brakes are fully applied to when it comes to a complete stop. A racecar with a combined mass  $m$  of  $25 \text{ kg}$  with the driver, is traveling along a racetrack at a velocity  $v$  of  $100 \text{ m/s}$ . The coefficient of friction  $\mu$  between wet asphalt and rubber is  $0.20$ , while the coefficient between dry asphalt and rubber can reach  $0.90$ . Which of the following statements is true about the stopping distance assuming friction does all the work for stopping the car?

- (a) The stopping distance is directly proportional to the initial velocity of the car.
  - (b) The calculated stopping distance is 4.5 times greater for a racecar on wet asphalt than on dry asphalt.
  - (c) The greater the coefficient of friction, the greater the stopping distance.
  - (d) Both vehicles use static friction to come to a complete stop.
13. An insect is climbing up a 30 ft. vertical wall. Starting from the bottom it climbs up 3 ft. during the day and slips down 2 ft. at night. In how many days will it reach the top of the wall?
- (a) 31 days
  - (b) 30 days
  - (c) 29 days
  - (d) 28 days
  - (e) 27 days
  - (f) Never
14. A hiker started to climb up a hill at 6:00 a.m. and either kept climbing up or rested at some place(s). He reached the top at 6:00 p.m. He rested there for the next 12 hours. The next day at 6:00 a.m. he began to travel down the same path. He either moved downward or rested at some place(s). For the up and down trips, how many times was he at the same place at the same time?
- (a) Never
  - (b) At least once
  - (c) Once and only once
  - (d) At most once
  - (e) Only twice
  - (f) None of these
15. A person travels from city A to city B with a speed of 40 mph and returns with a speed of 60 mph. What is his average round-trip speed?
- (a) 100 mph
  - (b) 50 mph
  - (c) 48 mph
  - (d) 10 mph
  - (e) None of these