

## 1-Dimensional Motion Challenge Problems

1. A Honda® and a Porsche® race, starting from the same point. The Honda accelerates at a constant  $4.00 \text{ m/s}^2$ ; the Porsche at a constant  $8.00 \text{ m/s}^2$ . The Porsche gives the Honda an advantage by letting it start first. The Honda accelerates, and when it is traveling at  $23.0 \text{ m/s}$ , the Porsche starts. How far do the cars travel from the starting point before the Porsche catches up with the Honda?
2. Superguy has attached a nitro booster to his motorcycle to assist him in his quest to rid Science City of his archenemy, Mad Maxwell. The motorcycle doubles its acceleration when the nitro is activated. Superguy is idling by the side of the highway when Maxwell tears by. At this instant Superguy steps on the gas and accelerates at a constant rate until he is moving at the same speed as Maxwell, then uses his booster to close the distance and catch Maxwell. Maxwell moves at a constant  $30.0 \text{ m/s}$  the entire time, and is caught  $60.0$  seconds after passing Superguy.
  - a. How far does Maxwell travel after passing Superguy before being caught?
  - b. What is the acceleration of the motorcycle with the nitro booster engaged?
  - c. How long is Superguy in motion before engaging the booster?
3. Two rocks are thrown off the edge of a cliff that is  $15.0 \text{ m}$  above the ground. The first rock is thrown upward, at a velocity of  $+12.0 \text{ m/s}$ . The second is thrown downward, at a velocity of  $-12.0 \text{ m/s}$ . (*From college text.*)
  - a. How long does it take for the first rock to hit the ground?
  - b. Determine at what velocity it hits.
  - c. Determine how long it takes the second rock to hit the ground.
  - d. Determine at what velocity the second rock hits.
4. A man is reported to have fallen  $144$  feet from the  $17^{\text{th}}$  floor of a building, landing on a metal ventilator box, which he crushed to a depth of  $18.0$  inches. He suffered only minor injuries. (*From college text.*)
  - a. The velocity of the man just before he collided with the ventilator box.
  - b. His average acceleration while in contact with the box.
  - c. The time it took to crush the box.
5. A show-off cowboy sitting on a tree limb wishes to drop vertically onto a horse galloping under the tree. The speed of the horse is  $10.0 \text{ m/s}$  and the distance from the limb to the saddle is  $3.00 \text{ m}$ . (*From college text.*)
  - a. What must be the horizontal distance between the saddle and the limb when the cowboy makes his move?
  - b. How long is he in the air?
6. A teenager has a car that speeds up at  $3.00 \text{ m/s}^2$  and slows down at  $-4.50 \text{ m/s}^2$ . On a trip to the store, he accelerates from rest to  $12.0 \text{ m/s}$ , drives at a constant speed for  $5.00 \text{ s}$ , and then comes to a momentary stop at an intersection. He then accelerates to  $18.0 \text{ m/s}$ , drives at a constant speed for  $20.0 \text{ s}$ , slows down for  $2.67 \text{ s}$ , continues for  $4.00 \text{ s}$  at this speed, and then comes to a stop. (*From college text.*)
  - a. How long does the trip take?

- b. How far has he traveled?
  - c. What is his average velocity for the trip?
  - d. How long would it take to walk to the store and back if he walks at  $1.50 \text{ m/s}$ ?
- 7. An inquisitive physics student and climber climbs a  $50.0 \text{ m}$  cliff that overhangs a pond. She throws two stones vertically downward,  $1.00 \text{ s}$  apart, and observes that they cause a single splash. The first stone has an initial speed of  $2.00 \text{ m/s}$ . (*From college text.*)
  - a. How long after the release of the first stone do the two stones hit the water?
  - b. What was the initial velocity of the second stone?
  - c. What is the velocity of each stone at the instant the two hit the water?