

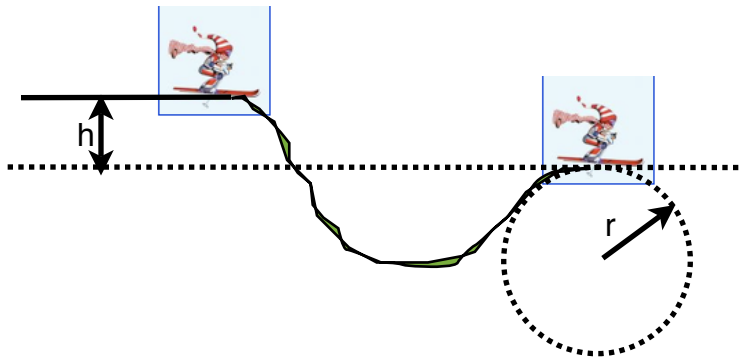
**3. Assignment**                      **due October 13th**                      (distributed October 3rd)

Please note your name clearly on your solutions, number the pages and write notes along the way, so that it is easy to follow your thought process.

The points for every single number are stated below.

- 1.) Two cars, A and B are traveling with the same speed of 50 m/s, each having started from rest. Car A has a mass of  $1.23 \times 10^3$  kg and car B has a mass of  $2.51 \times 10^3$  kg. Compared to the work required to bring car A up to speed, how much additional work is required to bring car B up to speed? (2 points)
  
- 2.) An elevator whose mass is 2.34 tones can carry passengers with up to 935 kg mass. A 3.775 kN constant friction force acts opposite to the upward movement.
  - a) What is the minimum power required by the engine of the elevator to make sure to lift the elevator at a constant speed of 2.5 m/s?
  - b) What is the required power when the elevator is designed to develop an upward acceleration of  $1.75 \text{ m/s}^2$  in addition to the speed of 2.5 m/s? (3 points)
  
- 3.) Two Stones are thrown horizontally with the same velocity from the tops of two different buildings. The first stone lands twice as far from the base of the building from which it was thrown compared to the landing place of the second stone. Find the ratio of the height of the taller building to the height of the shorter building. (3 points)
  
- 4.) The Space Shuttle travels at a speed of about  $7.6 \times 10^3$  m/s. The blink of an astronaut's eye lasts about 110 ms. How many football fields (length = 91.4 m) does the Shuttle cover in the blink of an eye? (2 points)
  
- 5.) As the earth rotates through one revolution, a person standing on the equator traces out a circular path whose radius is equal to the radius of the earth ( $6.38 \times 10^6$  m). What is the average speed of this person in a) meters per second? b) miles per hour? (2 points)
  
- 6.) A speedboat has a constant acceleration of  $+2.0 \text{ m/s}^2$ . If the initial velocity of the boat is  $+6.0 \text{ m/s}$ , find its displacement after 8.0 s. (2 points)
  
- 7.) A jet is taking off from the deck of an aircraft carrier. Starting from rest, the jet is catapulted with a constant acceleration of  $+31 \text{ m/s}^2$  along a straight line and reaches a velocity of  $+62 \text{ m/s}$ . Find the displacement of the jet. (2 points)
  
- 8.) Suppose the water at the top of Niagara Falls has a horizontal speed of 2.7 m/s just before it cascades over the edge of the falls. At what vertical distance below the edge does the velocity vector of the water point downward at a  $75^\circ$  angle below the horizontal? (3 points)

- 9.) A rescue helicopter is lifting a man (weight = 822 N) from a capsized boat by means of a cable and harness.
- What is the tension in the cable when the man is given an initial upward acceleration of  $1.10 \text{ m/s}^2$ ?
  - What is the tension during the remainder of the rescue when he is pulled upward at a constant velocity? (3 points)
- 10.) A satellite is placed in orbit  $6.00 \times 10^5 \text{ m}$  above the surface of Jupiter. Jupiter has a mass of  $1.90 \times 10^{27} \text{ kg}$  and a radius of  $7.14 \times 10^7 \text{ m}$ . Find the orbital speed of the satellite. (3 points)
- 11.) A skier starts from rest at the top of a hill. The skier coasts down the hill and up a second hill, as the drawing illustrates. The crest of the second hill is circular, with a radius of  $r = 36 \text{ m}$ . Neglect friction and air resistance. What must be the height  $h$  of the first hill so that the skier just loses contact with the snow at the crest of the second hill? (3 points)



- 12.) A baseball ( $m = 149 \text{ g}$ ) approaches a bat horizontally at a speed of  $40.2 \text{ m/s}$  and is hit straight back at a speed of  $45.6 \text{ m/s}$ . If the ball is in contact with the bat for a time of  $1.10 \text{ ms}$ , what is the average force exerted on the ball by the bat? (Neglect the weight of the ball since it is so much less than the force of the bat. Choose the direction of the incoming ball as the positive direction.) (2 points)