

Physics Department

Physics 103
Final Exam

February 3, 2000
Time 1 ½ hours

NAME: _____

I.D. No. : _____

Information:

- No make up of this exam without legal reason
- Only one answer can be crossed in case of multiple choice question. Crossing more than one answer, cancels the question.



Part I : Multiple choice questions

- **(4 points)** A ball is thrown straight up. For which situation is both the instantaneous velocity and acceleration zero?
(a) on the way up (b) at the top (c) on the way back
(d) none of the above (e) just after start
- **(4 points)** A rock is released from rest from the top of 40 m tower. If the air resistance is neglected, what is the speed of the rock as it hits the ground?
(a) 30 m/s (b) 28 m/s (c) 56 m/s (d) 784 m/s
(d) none of these, my answer is: _____ m/s
- **(4 points)** A girl with her bicycle have a total mass of 40 kg. At the top of the hill her speed is 5 m/s and her speed doubles as she rides down the hill. The hill is 100 m long and 10 m high. How much energy is lost to friction?
(a) 1500 J (b) 2000 J (c) 2420 J
(d) none of these, my answer is: _____ J
- **(4 points)** A solid sphere of mass $M = 4.0$ kg, radius $R = 0.12$ m and moment of inertia $I = 0.023$ kg m² starts from rest at the top of a ramp inclined at 15° , and rolls to the bottom. The upper end of the ramp is 1.2 m higher than the lower end. The linear velocity of the sphere at the bottom of the ramp is about:
(a) 4.7 m/s (b) 3.4 m/s (c) 4.1 m/s (d) 2.4 m/s
(f) none of these, my answer is: _____
- **(5 points)** A figure skater on ice with arm extended spins at a rate of 2 rev/s. After she draws her arms in, she spins at 5 rev/s. By what factor does the skater's kinetic energy change after drawing in her arms?
(a) 3.0 (b) 0.4 (c) 0.20 (d) 2.5
(e) none of these, my answer is: _____

- X
- **(4 points)** A sled weighing 150 N is pulled up a 28° incline at constant speed by a force of 100 N. The coefficient of kinetic friction between the sled and the incline is:

(a) 0.53 (b) 0.22 (c) 0.13 (d) 0.33

(e) none of the above, my answer is: _____

- **(4 points)** An ice skater moving at 10 m/s can stop himself in a distance of 100 m. The coefficient of kinetic friction between the ice and the skater is:

(a) 0.02 (b) 0.10 (c) 0.05 (d) 0.20

(e) none of these, my answer is: _____

- **(4 points)** A bucket filled with water has a total mass $m = 23$ kg and is attached to a rope which is wound around a cylinder of 0.5 m radius at the top of a wall. The bucket is first raised to the top of the wall and then released. When the bucket hits the water it has a speed of 7.9 m/s. What is the angular velocity ω of the cylinder at this instant?

(a) 39 rad/s (b) 79 rad/s (c) 158 rad/s

(d) none of these, my answer is : _____ rad/s

- **(4 points)** A stone is thrown horizontally with a speed of 50 m/s from a top of a 50 m building. Neglect air resistance. The magnitude of the stone's velocity as it hits the ground is about:

(a) 56 m/s (b) 27.9 m/s (c) 112 m/s

(d) none of these my answer is: _____ m/s

- **(4 points)** An airliner flying at 500 km/h due east moves into a region where the wind blows at 120 km/h in a direction 30° north of east (N of E). What is the new speed and direction of the airliner?

(a) 620 km/h, 7.10° N of E

(b) 607 km/h, 5.68° N of E

(c) 550 km/h, 6.22° N of E

(d) none of these, my answer is: _____

- **(5 points)** A pendulum 2.0 m in length, is released when its supporting string is at an angle of 25° from the vertical. The initial speed at the release point is 1.20 m/s. To what maximum angle will the pendulum move as it swings to the other side?

(a) 37° (b) 30° (c) 27° (d) 21°

(e) none of these, my answer is: _____

- **(4 points)** A 0.01 kg bullet is fired into a 0.20 kg wooden block at rest on a horizontal table. After impact, the block slides a distance $d = 8.0$ m before coming to rest. If the coefficient of kinetic friction is $\mu = 0.4$, what is the speed of the bullet before impact?

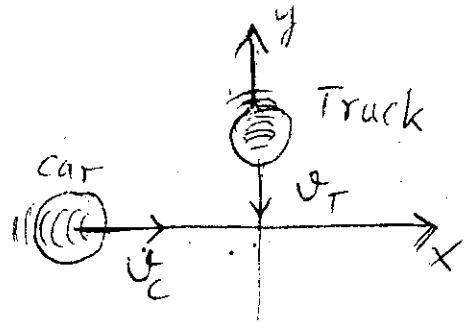
(a) 170 m/s (b) 166 m/s (c) 226 m/s

(d) none of these, my answer is: _____ m/s

Part 2: Problems

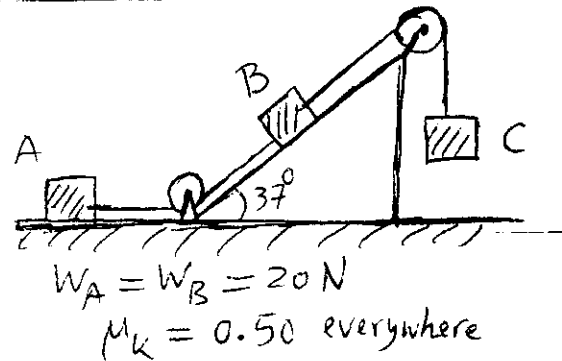
2.1) (10 points) A 1000 kg car moving eastward at 50 km/h collides with 8000 kg truck moving southward at 20 km/h. The two vehicles stick together.

- (a) How ~~far~~^{fast} can they move?
(b) In what direction will they move?



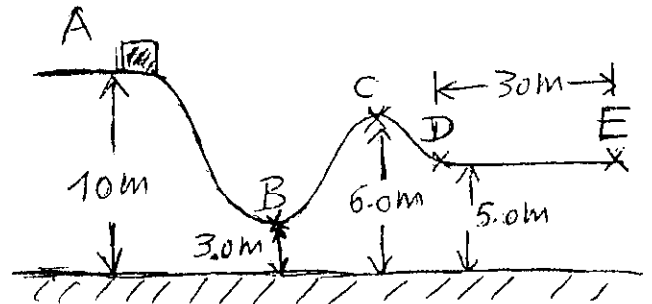
2.2) (10 points) Two blocks A and B of equal weight of 20 N are connected by a rope of neglected mass to block C over a frictionless pulley (see Figure). The coefficient of friction is $\mu_k = 0.50$ everywhere. Assume that the block C falls at constant velocity.

- (a) What is the tension in the rope connecting the blocks A and B?
(b) What is the weight of block C?



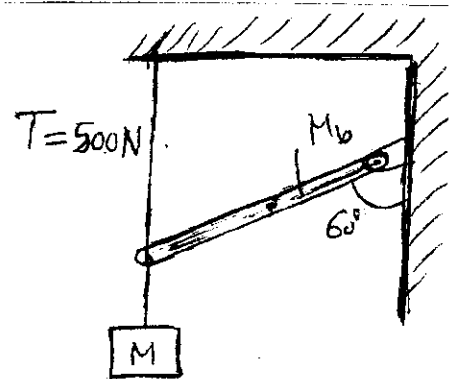
2.3) (10 points) A roller coaster car starts from rest at point A and moves without friction, along the track as shown in the Figure.

- (a) How fast is the car going at points B
- (b) How fast is it going at point C
- (c) What constant deceleration must be applied at point D to stop the car at point E?



2.4) (10 points) A uniform beam of mass 20 kg is hinged to a vertical wall and is supported at its other end by a wire (see Figure).

- (a) What is the mass M supported from the beam if the tension $T = 500 \text{ N}$?
(b) What is the reaction force R at the hinge that acts on the beam?



2.5) (10 points) A mass of 0.45 kg rotates in the vertical plane at the end of a string of length 0.65 m. When it is at the highest point, the tension in the string is 8.82 N.

- (a) What is the speed of the mass at this highest point (position 1)?
- (b) What is the speed of the mass at the lowest point (position 2)?
- (c) What is the tension at position 2?

