Physics 111 PRACTICE COMMON Exam 3

Name (Print): _____ 4 Digit ID:_____ Section: _____

Honors Code Pledge: For ethical and fairness reasons all students are pledged to comply with the provisions of the NJIT Academic Honor Code. You must answer the exam questions entirely by yourself. **Turn off all cell phones, pagers, or other communication devices**. Use only your own calculator.

Instructions:

A

- First, write your name and section number on **both** the Scantron card and this exam sheet.
- Use the formula sheet (last exam booklet page) and no other materials.
- Budget your time. There are 10 multiple choice problems (2 pts each) and 2 long problems (10 pts each).
- **For the long workout problems, you must show how you got your answers on this set of exam sheets.** Use the backs of pages if necessary. For most, if not all, of the multiple choice problems, it will be difficult to arrive at the correct answer without showing your work. However, while partial credit will be awarded for the long workout problems, partial credit will not be awarded on the multiple choice problems.
- Answer each question on the Scantron card using #2 pencil. Also circle your answers on question papers.
- Do not hesitate to ask for clarification of any exam question, if needed, from your proctor or Professor.

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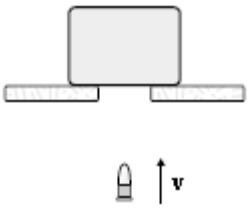
1. A 1.2-kg object moving with a speed of 8.0 m/s collides perpendicularly with a wall and emerges with a speed of 6.0 m/s in the opposite direction. If the object is in contact with the wall for 2.0 ms, what is the magnitude of the average force on the object by the wall?

a. 9.8 kN
b. 8.4 kN
c. 7.7 kN
d. 9.1 kN
e. 1.2 kN

2. A 3.0-kg ball with an initial velocity of $(4\hat{\mathbf{i}} + 3\hat{\mathbf{j}})$ m/s collides with a wall and rebounds with a velocity of $(-4\hat{\mathbf{i}} + 3\hat{\mathbf{j}})$ m/s. What is the impulse exerted on the ball by the wall?

a. $+24\hat{\mathbf{i}}$ N·s
b. $-24\hat{\mathbf{i}}$ N·s
c. $+18\hat{\mathbf{j}}$ N·s
d. $-18\hat{\mathbf{j}}$ N·s
e. $+8.0\hat{\mathbf{i}}$ N·s

3. A 10-g bullet moving 1 000 m/s strikes and passes through a 2.0-kg block initially at rest, as shown. The bullet emerges from the block with a speed of 400 m/s. To what maximum height will the block rise above its initial position?



a. 78 cm
b. 66 cm
c. 56 cm
d. 46 cm
e. 37 cm

4. A 2.0-kg object moving 5.0 m/s collides with and sticks to an 8.0-kg object initially at rest. Determine the kinetic energy lost by the system as a result of this collision.

a. 20 J
b. 15 J
c. 30 J
d. 25 J
e. 5.0 J

5. Three particles are placed in the *xy* plane. A 40-g particle is located at (3, 4) m, and a 50-g particle is positioned at (–2, –6) m. Where must a 20-g particle be placed so that the center of mass of this three-particle system is located at the origin?

a. (–1, –3) m
b. (–1, 2) m
c. (–1, 12) m
d. (–1, 7) m
e. (–1, 3) m

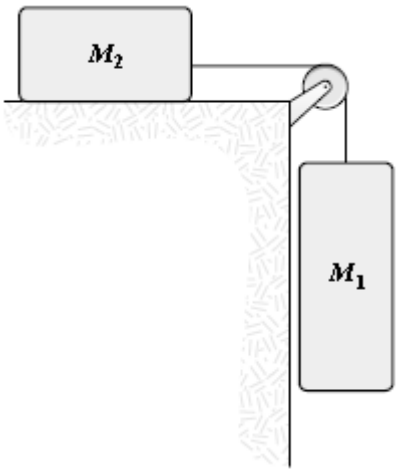
6. The turntable of a record player has an angular velocity of 8.0 rad/s when it is turned off. The turntable comes to rest 2.5 s after being turned off. Through how many radians does the turntable rotate after being turned off? Assume constant angular acceleration.

a. 12 rad
b. 8.0 rad
c. 10 rad
d. 16 rad
e. 6.8 rad

7. A wheel rotates about a fixed axis with a constant angular acceleration of 4.0 rad/s^2. The diameter of the wheel is 40 cm. What is the linear speed of a point on the rim of this wheel at an instant when that point has a total linear acceleration with a magnitude of 1.2 m/s^2?

a. 39 cm/s
b. 42 cm/s
c. 45 cm/s
d. 35 cm/s
e. 53 cm/s

8. A mass (M_1 = 5.0 kg) is connected by a light cord to a mass (M_2 = 4.0 kg) which slides on a smooth surface, as shown in the figure. The pulley (radius = 0.20 m) rotates about a frictionless axle. The acceleration of M_2 is 3.5 m/s^2. What is the moment of inertia of the pulley?



a. 0.29 kg·m^2
b. 0.42 kg·m^2
c. 0.20 kg·m^2
d. 0.62 kg·m^2
e. 0.60 kg·m^2

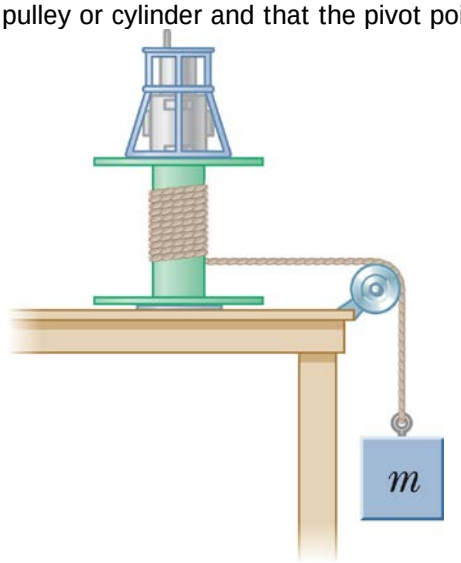
9. A horizontal disk with a radius of 10 cm rotates about a vertical axis through its center. The disk starts from rest at $t = 0$ and has a constant angular acceleration of 2.1 rad/s^2. At what value of t will the radial and tangential components of the linear acceleration of a point on the rim of the disk be equal in magnitude?

a. 0.55 s
b. 0.63 s
c. 0.69 s
d. 0.59 s
e. 0.47 s

10. If $M = 0.50$ kg, $L = 1.2$ m, and the mass of each connecting rod shown is negligible, what is the moment of inertia about an axis perpendicular to the paper through the center of mass? Treat the mass as particles.

a. 3.7 kg·m^2
b. 2.8 kg·m^2
c. 3.2 kg·m^2
d. 2.3 kg·m^2
e. 3.9 kg·m^2

11. A block of mass M turns a pulley with moment of inertial I_p and radius r_p as well as a rotating cylinder with radius R as shown in the picture. The mass M is falling with an acceleration of a_m. You can assume that the rope does not slip on the pulley or cylinder and that the pivot points of both the pulley and cylinder are frictionless



A) Draw free body diagrams of the block, the pulley and the rotating cylinder. (2.5 pts)

B

B) From the free body diagrams, apply Newton's second law of motion and derive three equations of motion for the block, pulley and rotating cylinder. (2.5 pts)

C) What is the moment of inertia of the cylinder? Express your answer in terms of R, r, I_p, M, g, and a_m (2.5 pts)

D) What is the torque experienced by the cylinder (2.5 pts)?

12. A solid cylinder of mass M and radius R rolls without slipping on an inclined plane. The angle of the incline is Θ. Answer all of the questions below in terms of *M*, *R*, D, and physical constants such as *g*.

A) Assuming that the cylinder is initially at rest, what is the velocity of its center of mass if the cylinder rolls a distance D down the incline? (5 pts)

B) What is the angular velocity of the cylinder about its center of mass a distance D down the incline? (2 pts)

C) If the cylinder were to slide without friction down the incline (no rolling), what would be its velocity after it slides a distance D down the incline? (2 pts)

D) For the case in which the incline has friction so that the cylinder rolls without slipping down the incline, what is the work done by friction on the contact point of the cylinder with the inclined surface. (1 pt)