Physics 103 Exam 2 October 30, 2003

Name_____ ID #_____

Section #_____ TA Name_____

Fill in your name, student ID # (not your social security #), and section # (under ABC of special codes) on the Scantron sheet. Fill in the letters given for the first 5 questions on the Scantron sheet. These letters determine which version of the test you took, and it is very important to get this right. Make sure your exam has questions 6–25.

1. A

2. B

3. D

4. C

5. E

6. A 1000-kg car is rolling across a level surface at 1.5 m/s, heading toward a group of small children. The doors are locked, and so you cannot get inside to apply the brakes. Instead, you run in front of the car and push on the hood at an angle of 30° from the horizontal. How hard must you push to stop the car in a distance of 3 m?

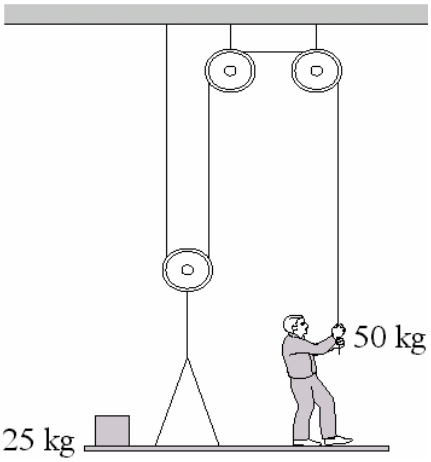
    a. 289 N
    b. 750 N
    c. 1730 N
    d. 375 N
    e. 433 N

7. A block sliding along a frictionless horizontal surface with speed v collides with a spring. The far end of the spring is fixed in place, and the block compresses the spring to a maximum compression of 1.4 cm. If the same block has a speed of $2v$, what is the maximum compression of the spring?

    a. 1.4 cm
    b. 2.8 cm
    c. 5.6 cm
    d. 1.0 cm
    e. 0.7 cm

8. A 50-kg person stands on a 25-kg platform and pulls down on a rope that is attached to the platform by the frictionless pulley system shown in the diagram. If he pulls the platform up at a steady rate, with how much force is he pulling on the rope?

    a. 735 N
    b. 613 N
    c. 490 N
    d. 74 N
    e. 245 N



9. Water flows over a section of Niagara Falls at a rate of 1.20×10^6 kg/s and falls 50.0 m. What is the power dissipated by the waterfall?

    a. 294 MW
    b. 147 MW
    c. 588 MW
    d. 60 MW
    e. 1180 MW

10. A sports car accelerates from zero to 30 MPH in 1.5 s. How long does it take for it to accelerate from zero to 60 MPH, assuming the power of the engine is independent of velocity and neglecting friction?

    a. 2 s
    b. 3 s
    c. 4.5 s
    d. 12 s
    e. 6 s

11. A golf ball is fired at a bowling ball initially at rest and bounces back elastically. Compared to the bowling ball, the golf ball after the collision has

    a. more momentum but less kinetic energy.
    b. less momentum and less kinetic energy.
    c. more momentum and more kinetic energy.
    d. less momentum but more kinetic energy.
    e. the same momentum and kinetic energy.

12. Two people facing each other on roller blades throw a ball back and forth. After a couple of throws, they are (ignoring friction)

    a. standing where they were initially
    b. standing farther away from each other
    c. standing closer together
    d. moving toward each other
    e. moving away from each other

13. A 120-kg football player running south with a speed of 4 m/s tackles a 90-kg opponent running north at 10 m/s, and holds on to him. What is their velocity just after the collision?

    a. 2.0 m/s north
    b. 2.0 m/s south
    c. 6.6 m/s north
    d. 6.6 m/s south
    e. 3.5 m/s north

14. A car wash nozzle directs a steady stream of water at 1.5 kg/s, with a speed of 30 m/s, against a car window. What force does the water exert on the glass? Ignore backsplash.

    a. 45 N
    b. 11 N
    c. 110 N
    d. 440 N
    e. 90 N

15. A model rocket sits on the launch pad until its fuel is ignited, blasting the rocket upward. During the short time of blast-off, as the ignited fuel goes down, the rocket goes up because

    a. the fuel pushes down on the ground.
    b. air friction pushes on the escaping fuel.
    c. the downward force on the fuel produces an upward force on the rocket.
    d. the force of gravity is less than the downward momentum of the fuel.
    e. the ground pushes up on the fuel

16. A 0.30-m-radius automobile tire accelerates from rest at a constant 2.0 rad/s^2. What is the centripetal acceleration of a point on the outer edge of the tire after 5.0 s?

    a. 300 m/s^2
    b. 30 m/s^2
    c. 3 m/s^2
    d. 33 m/s^2
    e. 3.3 m/s^2

17. An object with mass 0.4 kg is swung in a circular path and in a vertical plane on a string 50 cm long. If the angular speed at the bottom of the circle is 8.0 rad/s, what is the tension in the string when the object is at the bottom of the circle?

    a. 5.6 N
    b. 16.7 N
    c. 10.5 N
    d. 19.6 N
    e. 12.8 N

18. An asteroid is in orbit at 4 times the earth's distance from the Sun. What is its period of revolution?

    a. 4 years
    b. 8 years
    c. 2 years
    d. 16 years
    e. one fourth year

19. If the mass of Mars is 0.107 times that of Earth and its radius is 0.530 that of Earth, estimate the gravitational acceleration g at the surface of Mars:

    a. 2.20 m/s^2
    b. 3.73 m/s^2
    c. 4.20 m/s^2
    d. 5.50 m/s^2
    e. 4.95 m/s^2

20. Two satellites *A* and *B* of the same mass are orbiting around the Earth in concentric circular orbits. The distance of *B* for the Earth's center is twice that of *A*. What is the ratio of the speed of *B* to that of *A*?

    a. 0.707
    b. 0.5
    c. 1.0
    d. 0.25
    e. 2

21. A ventilation fan with a moment of inertia of 0.034 $kg \cdot m^2$ has a net torque of 0.11 N·m applied to it. If it starts from rest, what kinetic energy will it have 8.0 s later?

    a. 31 J
    b. 11 J
    c. 17 J
    d. 6.6 J
    e. 26 J

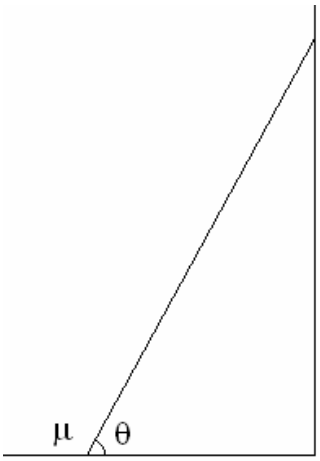
22. A 40-kg boy is standing on the edge of a stationary 30-kg platform that is free to rotate. The boy tries to walk around the platform in a counterclockwise direction. As he does:

    a. the platform doesn't rotate.
    b. the platform rotates in a clockwise direction just fast enough so that the boy remains stationary relative to the ground.
    c. both go around with equal angular velocities but in opposite directions.
    d. the platform rotates in a clockwise direction while the boy goes around in a counterclockwise direction relative to the ground.
    e. The boy remains fixed relative to the ground while the platform rotates clockwise.

23. A solid sphere of mass 4.0 kg and radius 0.12 m starts from rest at the top of a ramp inclined 15°, and rolls to the bottom. The upper end of the ramp is 1.2 m higher than the lower end. What is the linear speed of the sphere when it reaches the bottom of the ramp? (Note: $I = 0.4MR^2$ for a solid sphere and $g = 9.8$ m/s^2)

    a. 4.7 m/s
    b. 3.4 m/s
    c. 2.4 m/s
    d. 4.1 m/s
    e. 8.2 m/s

24. In the lecture, you saw a demonstration of a ladder leaning against a wall with an angle θ from the horizontal. What is the minimum angle θ for which the ladder will not slip if the coefficient of static friction on the horizontal surface is μ = 0.3 and the vertical surface is frictionless?



a. 17°
b. 59°
c. 73°
d. 31°
e. 53°

25. A spinning ice skater doubles her angular velocity by raising her arms above her head. Which one of the following statements is false?

a. Her angular momentum is conserved.
b. Her moment of inertia decreases.
c. She does net work.
d. Her kinetic energy is conserved.
e. No net torque is applied to her.