Physics 103 Final Exam   December 23, 2004

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 6–35.

1. A

2. D

3. C

4. B

5. E

6. The rate of change of acceleration is called a "jerk." What are the units of a jerk?

    a. m/s^3
    b. m/s^2
    c. m/s
    d. s^{-1}
    e. s

7. The information on a one-gallon paint can is that the coverage, when properly
    applied, is 450 ft^2. One gallon is 231 in^3. What is the average thickness of the
    paint in such an application?

    a. 0.0036 in
    b. 0.0090 in
    c. 0.014 in
    d. 0.043 in
    e. 0.051 in

8. An object goes from one point in space to another. After it arrives at its destination, the magnitude of its displacement is:

    a. always equal to the distance it traveled.
    b. either greater than or equal to the distance it traveled.
    c. always greater than the distance it traveled.
    d. either less than or equal to the distance it traveled.
    e. either less than or greater than the distance it traveled.

9. A drag racer starts from rest and accelerates at 10 m/s^2 for the entire distance of 400 m. What is the velocity of the race car at the end of the run?

    a. 45 m/s
    b. 130 m/s
    c. 180 m/s
    d. 63 m/s
    e. 89 m/s

10. A ball is thrown by one person (from shoulder height) and caught by a second person (at an equal shoulder height without the ball hitting the ground). At what point is the ball's speed at a minimum? (neglect air resistance)

    a. just after leaving the thrower's hand
    b. just before reaching the catcher's hand
    c. the speed is constant during the entire trajectory
    d. cannot be determined from the information given
    e. half way to the catcher

11. A rifle is aimed horizontally at the center of a target 100 m away. If the bullet strikes 10 cm below the center, what was the initial velocity of the bullet? (neglect air resistance)

    a. 300 m/s
    b. 333 m/s
    c. 500 m/s
    d. 980 m/s
    e. 700 m/s

12. A block is launched up an incline plane. After going up the plane, it slides back down to its starting position. The coefficient of friction between the block and the plane is 0.3. The time for the trip up the plane is:

    a. less than the time for the trip down.
    b. the same as the time for the trip down.
    c. more than the time for the trip down.
    d. either more or less than the time for the trip down depending on the angle of inclination.
    e. either more or less than the time for the trip down depending on the initial speed.

13. A girl and her bicycle have a total mass of 40.0 kg. At the top of a hill, her speed is 5.0 m/s and her speed doubles as she coasts down the hill. The hill is 10.0 m high and 100 m long. How much mechanical energy is converted into heat?

    a. 2420 J
    b. 1500 J
    c. 2000 J
    d. 3920 J
    e. 3420 J

14. Two cars, one twice as heavy as the other are at rest on a frictionless horizontal track. You push horizontally on each car for the same time and with the same force. The final kinetic energy of the lighter car is:

    a. 1/4 that of the heavy car
    b. half that of the heavy car
    c. equal to that of the heavy car
    d. four times that of the heavy car
    e. twice that of the heavy car

15. A 1200-kg automobile moving at 25 m/s has the brakes applied producing a deceleration of 8.0 m/s^2. How far does the car travel before it stops?

    a. 47 m
    b. 55 m
    c. 63 m
    d. 78 m
    e. 39 m

16. A 5-kg object moving to the right at 4 m/s collides with another object moving to the left at 5 m/s, and they stick together after colliding. After the collision, the combined object must:

    a. have less kinetic energy than the system had before the collision.
    b. have less momentum than the system had before the collision.
    c. be moving to the right.
    d. be moving to the left.
    e. be at rest.

17. Two identical billiard balls have velocities of 2.0 m/s and −1.0 m/s, respectively, when they meet in an elastic head-on collision. What is the final velocity of the first ball after the collision?

    a. −2.0 m/s
    b. −1.0 m/s
    c. −0.5 m/s
    d. +1.0 m/s
    e. 0 m/s

18. Consider a child who is swinging. As she reaches the lowest point in her swing:

    a. the tension in the rope is equal to her weight.
    b. the tension in the rope is greater than her weight.
    c. the tension in the rope is equal to her mass times her acceleration.
    d. her acceleration is downward at 9.8 m/s^2.
    e. her acceleration is zero

19. What angular speed (in revolutions/second) is needed for a centrifuge with a radius arm of 15.0 cm to produce an acceleration of 1000g?

    a. 75.4 rev/s
    b. 81.4 rev/s
    c. 151 rev/s
    d. 40.7 rev/s
    e. 256 rev/s

20. A solid disk and a ring with the same radius roll down an inclined plane. The ring is slower than the disk if:

    a. $m_{ring} < m_{disk}$
    b. $m_{ring} = m_{disk}$
    c. $m_{ring} > m_{disk}$
    d. It is never slower than the disk
    e. It is always slower than the disk

21. A uniform meter stick is hinged at its lower end and allowed to fall from a vertical position. If its moment of inertia is $ML^2/3$, with what angular speed does it hit the table?

    a. 2.71 rad/s
    b. 5.42 rad/s
    c. 1.22 rad/s
    d. 0.61 rad/s
    e. 29.4 rad/s

22. A large stone is resting on the bottom of a swimming pool. The normal force of the bottom of the pool on the stone is equal to the:

    a. weight of the stone.
    b. weight of the displaced water.
    c. weight of the stone plus the weight of the displaced water.
    d. weight of the displaced water minus the weight of the stone.
    e. weight of the stone minus the weight of the displaced water.

23. To what temperature must the air in a hot-air balloon with a volume of 1000 m^3 be raised if it is to lift a mass of 100 kg? Assume the outside air temperature is 27°C, the pressure of the air inside and outside the balloon is 1 atmosphere (1.013 × 10^5 Pa), and the average molecular weight of air is 29 g/mole.

    a. 327°C
    b. 75°C
    c. 100°C
    d. 55°C
    e. 127°C

24. In the liquid-nitrogen cannon demonstration that was done in the lecture, the main reason the cork was blown off was that:

    a. the temperature increased.
    b. some of the liquid nitrogen froze.
    c. the volume decreased as a result of pounding on the cork.
    d. shaking the cannon caused dissolved nitrogen gas to be released.
    e. the liquid boiled and produced nitrogen gas.

25. When water freezes, it expands about nine percent in volume. What would be the pressure increase inside your automobile engine block if the water in the block froze? (The bulk modulus of ice is 2.0×10^9 Pa, and 1 atm = 1.013×10^5 Pa.)

    a. 18 atm
    b. 270 atm
    c. 1800 atm
    d. 1080 atm
    e. 180 atm

26. Which of the following processes requires the most heat?

    a. Boiling 5 grams of liquid water originally at 20°C
    b. Boiling 6 grams of liquid water originally at 100°C
    c. Melting 30 grams of ice originally at 0°C
    d. Heating 40 grams of liquid water from 20°C to 90°C
    e. Heating 20 grams of ice from 0°C to 50°C

27. A slice of bread contains about 100 kcal. If the specific heat of a person is the same as that of water, by how many degrees Celsius would the temperature of a 70-kg person increase if all the energy in the bread was converted into heat and none of the heat was lost?

    a. 1.43°C
    b. 2.25°C
    c. 1.86°C
    d. 1.00°C
    e. 0.70°C

28. Heat is applied to an ice-water mixture in equilibrium to melt some of the ice. In this process:

    a. work is done by the ice-water mixture.
    b. the temperature increases.
    c. the entropy of the mixture decreases.
    d. the volume of the mixture increases.
    e. the internal energy of the mixture increases.

29. What is the change in entropy when one mole of silver (108 g) is completely melted at 961°C? (The heat of fusion of silver is 8.82×10^4 J/kg.)

    a. 5.53 J/K
    b. 7.72 J/K
    c. 9.91 J/K
    d. 12.10 J/K
    e. 13.85 J/K

30. Suppose there is an object for which $F = +kx$. What will happen if the object is moved away from equilibrium ($x = 0$) and released?

    a. It will return to the equilibrium position.
    b. It will move farther away with constant velocity.
    c. It will move farther away with constant acceleration.
    d. It will move farther away with increasing acceleration.
    e. It will oscillate about the equilibrium position.

31. Transverse waves with a wavelength of 20 cm and a frequency of 1000 Hz travel along a taut copper wire that has a diameter of 1.50 mm. What is the tension in the wire? (The density of copper is 8.93 g/cm³.)

    a. 1890 N
    b. 1260 N
    c. 631 N
    d. 315 N
    e. 357 N

32. Three observers A, B, and C located as shown in the figure are listening to a moving source of sound. Which one of the following is true?

    a. A observes the highest wave speed.
    b. C observes the highest frequency.
    c. C observes the highest wave speed.
    d. A observes the highest frequency.
    e. B observes the highest frequency.
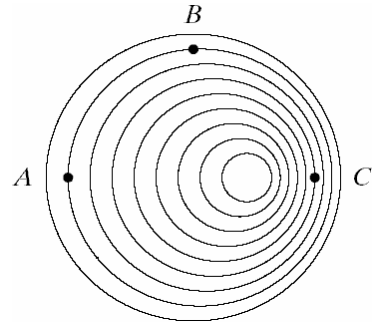
33. If one-third of the members of a symphony orchestra are absent because of head colds, thus reducing the overall intensity of sound by 33%, what will be the reduction in the decibel level?

    a. 1.8 dB
    b. 30 dB
    c. 3 dB
    d. 48 dB
    e. 4.8 dB

34. The phases of the Moon are caused by which of the following?

    a. the shadow of the Earth on the Moon
    b. clouds
    c. the varying distance of the Moon from the Earth
    d. the angle between the Moon and the Sun as seen from the Earth
    e. the rotation of the Moon

35. Astrologers (erroneously) believe that the position of the planets at the moment of one's birth influences life events, presumably through a gravitational tidal force. Given that the tidal force is like the usual gravitational force except that it decreases inversely with the cube rather than the square of the distance, what is the strength of the tidal force of Mars (mass $= 6.4 \times 10^{23}$ kg) at its closest approach to Earth (7×10^{10} m) compared to a 100-kg human 10 meters away?

    a. 2×10^{-8}
    b. 130
    c. 3×10^{-18}
    d. 2×10^{-6}
    e. 2×10^{-18}