

Name: _____ Student ID# _____ ID CODE A

Section # _____ TA Name _____

Fill in your name, student ID # (not your social security #), and section # (under ABC of special codes) on the Scantron sheet. Be sure to fill in the letter for the ID code on the upper right of this page for the first question. This determines which version of the test you took, and it is very important to get this correct. Make sure your exam has questions 2-33 and 9 total pages.

Physics 103 Final Exam

December 18, 2005

Multiple Choice, Closed Book

Circle the letter of the choice that best completes the statement or answers the question and also mark this answer on your Scantron sheet. You must do both.

Please be very careful with the first question:

1. ENTER THE ID CODE ABOVE IN THE UPPER RIGHT CORNER
 - A. ID Code A
 - B. ID Code B
 - C. ID Code C
 - D. ID Code D
 - E. ID Code E

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2. If a is acceleration, v is velocity, x is position, and t is time, then which equation is not dimensionally correct?
- A. $a = v^2/x$
 - B. $v = a/t$
 - C. $t^2 = 2x/a$
 - D. $t = x/v$
 - E. $x = vt/2$
3. A train slowly climbs a 500-m mountain track which is at an angle of 10.0° with respect to the horizontal. How much altitude does it gain?
- A. 492 m
 - B. 88.2 m
 - C. 341 m
 - D. 86.8 m
 - E. 272 m
4. A cheetah can maintain its maximum speed of 100 km/hr for 30 seconds and then has to stop. What minimum initial distance must a gazelle running 80 km/hr be ahead of the cheetah to escape?
- A. 70 m
 - B. 100 m
 - C. 167 m
 - D. 83 m
 - E. 87 m
5. The slope of the acceleration vs. time curve represents:
- A. The rate of change of velocity
 - B. The rate of change of acceleration
 - C. The velocity
 - D. The displacement
 - E. The area under the velocity vs. time curve

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6. John throws a rock down with initial speed 14 m/s from the top of a 30-m tower. Neglecting air resistance, what is the rock's speed just before it hits the ground?
- A. 12 m/s
 - B. 28 m/s
 - C. 350 m/s
 - D. 784 m/s
 - E. 21 m/s
7. A string attached to an airborne kite is maintained at an angle of 40° with the horizontal. If a total of 120 m of string is reeled in while bringing the kite back to the ground, how high was the kite? (Assume the kite string does not sag.)
- A. 84 m
 - B. 101 m
 - C. 92 m
 - D. 77 m
 - E. 89 m
8. A helicopter is traveling at 40 m/s at a constant altitude of 100 m over a level field. If a wheel falls off the helicopter, with what speed will it hit the ground, neglecting air resistance?
- A. 50 m/s
 - B. 60 m/s
 - C. 40 m/s
 - D. 70 m/s
 - E. 80 m/s
9. Two projectiles are launched simultaneously at 100 m/s, the angle of elevation for the first being 30° and for the second 60° . Which one of the following statements is false? (Neglect air resistance.)
- A. Both projectiles have the same acceleration while in flight.
 - B. The second projectile has the lower speed at maximum altitude.
 - C. Both projectiles have the same range.
 - D. Both projectiles hit the ground at the same time.
 - E. Both projectiles hit the ground at the same speed.

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10. An automobile of mass 2 000 kg moving at 30 m/s is braked suddenly with a constant braking force of 12 000 N. How far does the car travel before stopping?

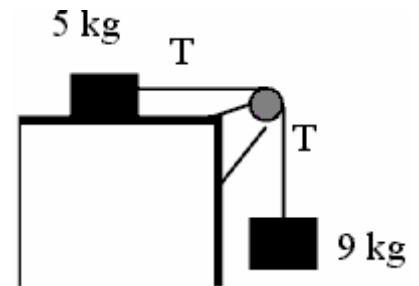
A. 90 m
B. 46 m
C. 150 m
D. 38 m
E. 75 m

11. There are six books in a stack, each with a weight of 5 N. The coefficient of static friction between all the books is 0.20 as is the coefficient between the table and the bottom book. If you push on the book next to the bottom book, what is the minimum magnitude of the force required to just start the top five books sliding off the bottom book?

A. 1 N
B. 5 N
C. 3 N
D. 6 N
E. 4 N

12. A 9-kg hanging weight is connected by a string over a pulley to a 5-kg block sliding on a flat table. If the coefficient of kinetic friction between the sliding block and the table is 0.20, what is the tension in the string?

A. 32 N
B. 19 N
C. 24 N
D. 38 N
E. 88 N



13. A golf ball strikes a wall perpendicular to its surface and bounces back at $\frac{3}{4}$ of the original speed. What fraction of the ball's original kinetic energy did it lose in the collision?

A. $\frac{9}{16}$
B. $\frac{7}{16}$
C. $\frac{1}{4}$
D. $\frac{3}{8}$
E. $\frac{1}{2}$

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14. A 1 000-kg sports car accelerates from zero to 25 m/s in 7.5 s. What is the average power delivered by the automobile engine?
- A. 52.4 kW
 - B. 20.8 kW
 - C. 30.3 kW
 - D. 41.7 kW
 - E. 32.7 kW
15. If a glass of water is on a table resting on a piece of cloth, it is relatively easy to pull the cloth out without disturbing the glass very much if you pull quickly. This is because, with a quick pull:
- A. The cloth is in contact with the glass for only a short time.
 - B. The force on the glass is less.
 - C. The momentum of the cloth is greater than the momentum of the glass.
 - D. The coefficient of friction is less.
 - E. The mass of the glass is greater than the mass of the cloth.
16. A 2 500-kg truck moving at 10 m/s strikes a car waiting at a traffic light and locks bumpers. The two continue to move together at 7 m/s. What was the mass of the struck car?
- A. 1 070 kg
 - B. 1 550 kg
 - C. 1 730 kg
 - D. 1 200 kg
 - E. 1 430 kg
17. At what angle (relative to the horizontal) should a curved road 52 m in radius be banked if no friction is required to prevent a car from slipping when traveling at 12 m/s?
- A. 28°
 - B. 16°
 - C. 32°
 - D. 10°
 - E. 13°

18. An Earth satellite is orbiting at an altitude above the Earth's surface equal to one Earth radius. At this location, what is the acceleration due to gravity?
- A. 4.9 m/s^2
 - B. 9.8 m/s^2
 - C. 2.45 m/s^2
 - D. 19.6 m/s^2
 - E. 0 m/s^2
19. A woman who weighs 500 N stands on an 8-m-long uniform board that weighs 100 N. The board is supported at each end. The support force at the right end is 3 times the support force at the left end. How far from the right end is the woman standing?
- A. 2.0 m
 - B. 4.0 m
 - C. 1.6 m
 - D. 2.7 m
 - E. 6.4 m
20. A rod of mass M and length L is hinged at one end and has a moment of inertia as the rod rotates around that hinge of $ML^2/3$. Suppose a 2-m rod with a mass of 3 kg is hinged at one end and is held in a horizontal position. The rod is released and the free end is allowed to fall. What is the initial angular acceleration of the rod?
- A. 3.27 rad/s^2
 - B. 3.70 rad/s^2
 - C. 7.35 rad/s^2
 - D. 4.90 rad/s^2
 - E. 2.45 rad/s^2
21. Two spherical balls, one solid and the other hollow, start rolling up a hill with the same initial velocity. Which ball rolls farther up the hill?
- A. Neither (they both roll the same distance)
 - B. The solid ball
 - C. It depends on their sizes
 - D. It depends on their masses
 - E. The hollow ball

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22. A hole is poked through the metal side of a drum holding water. The hole is 36 cm below the water surface. With what initial speed does water flow through the hole?
- A. 7.06 m/s
 - B. 1.88 m/s
 - C. 2.66 m/s
 - D. 3.53 m/s
 - E. 1.33 m/s
23. As a copper wire is heated, its length increases by 0.1%. What is the change in the temperature of the wire? (The coefficient of thermal expansion for copper is $\alpha = 16.6 \times 10^{-6}/\text{C}^\circ$.)
- A. 30.1°C
 - B. 120.4°C
 - C. 60.2°C
 - D. 6.0°C
 - E. 0°C
24. The absolute temperature of an ideal gas is directly proportional to which of the following properties of the molecules that make up the gas?
- A. average mass
 - B. average potential energy
 - C. average speed
 - D. average momentum
 - E. average kinetic energy
25. There is a proposal to use compressed air as a fuel for an automobile and a design that claims that a tank of air with a volume of 0.3 m^3 at a pressure of 300 atmospheres can yield a range of 200 km at urban driving speeds (assume 40 km/hr). What is the average power output of the engine ignoring all losses of energy (1 hp = 746 watts)?
- A. 0.7 hp
 - B. 17 hp
 - C. 70 hp
 - D. 40 hp
 - E. 500 hp

26. Suppose that 100 g of liquid nitrogen at its boiling point of 77 K is stirred into a beaker containing 200 g of water at 15°C. If the nitrogen leaves the solution as soon as it turns to gas, how much water freezes? (The heat of vaporization of nitrogen is 48 cal/g, and the heat of fusion of water is 80 cal/g.)
- A. 22.5 g
 - B. 60 g
 - C. 97.5 g
 - D. 200 g
 - E. 0 g
27. The use of fiberglass insulation in the outer walls of a building is intended to minimize heat transfer through the wall by what process?
- A. radiation
 - B. convection
 - C. conduction
 - D. vaporization
 - E. condensation
28. A heat engine operating between a pair of hot and cold reservoirs with respective temperatures of 200°C and 20°C will have what maximum efficiency?
- A. 50%
 - B. 62%
 - C. 90%
 - D. 10%
 - E. 38%
29. A mass of 0.40 kg, attached to a vertical spring with a spring constant of 80 N/m, is set into simple harmonic motion. What is the magnitude of the acceleration of the mass when at its maximum displacement of 0.10 m from the equilibrium position?
- A. 5 m/s²
 - B. 15 m/s²
 - C. 10 m/s²
 - D. 20 m/s²
 - E. 0 m/s²

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30. A 2-m-long horizontal piano string of mass 10 g is under a tension of 338 N. What is the speed with which a wave travels on this string?
- A. 1040 m/s
 - B. 130 m/s
 - C. 520 m/s
 - D. 260 m/s
 - E. 65 m/s
31. In the afternoon, the average sound level of a busy freeway is 80 dB with 100 cars passing a given point every minute. Late at night, the traffic flow is only 5 cars per minute. What is the late-night average sound level?
- A. 74 dB
 - B. 77 dB
 - C. 67 dB
 - D. 70 dB
 - E. 60 dB
32. A bat, flying at 5 m/s toward a wall, emits a sound at 50 kHz. If the wall reflects this sound wave, what is the frequency of the echo received by the bat? ($v_{\text{sound}} = 340 \text{ m/s}$)
- A. 50.5 kHz
 - B. 51.2 kHz
 - C. 40.8 kHz
 - D. 51.5 kHz
 - E. 48.5 kHz
33. A 1.5-m-long horizontal string is held fixed at both ends. When driven by a 180-Hz source, the string vibrates in four distinct segments. What is the natural fundamental frequency of the string?
- A. 600 Hz
 - B. 90 Hz
 - C. 240 Hz
 - D. 45 Hz
 - E. 180 Hz