Instructor(s): *J. Ipser*

PHYSICS DEPARTMENT

PHY 2004 Final Exam December 12, 2006

Name (print, last first): ______________________ Signature: ______________________

*On my honor, I have neither given nor received unauthorized aid on this examination.*

**YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.**

(1) **Code your test number on your answer sheet (use lines 76–80 on the answer sheet for the 5-digit number)**. Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY**. Code your UFID number on your answer sheet.
(2) Print your name on this sheet and sign it also.
(3) Do all scratch work anywhere on this exam that you like. **Circle your answers on the test form.** At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout.
(4) **Blacken the circle of your intended answer completely, using a #2 pencil or blue or black ink**. Do not make any stray marks or some answers may be counted as incorrect.
(5) The answers are rounded off. Choose the closest to exact. There is no penalty for guessing. If you believe that no listed answer is correct, **leave the form blank**.
(6) **Hand in the answer sheet separately.**

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Suggestion: Try * problems first.
$g = 9.80$ m/s$^2$

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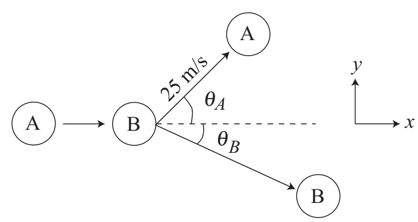
1. Auto A undergoes a 1-dimensional elastic collision with auto B along the $x$ axis. The mass of A is twice that of B. Before the collision, the $x$ component of the velocity of A is +20 m/s, and B is at rest. What is the velocity of A after the collision, in m/s?

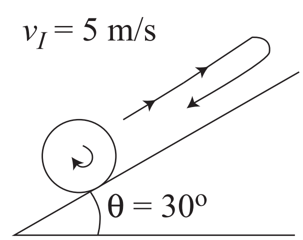
(1) 6.67 (2) 9.34 (3) 4.23 (4) 2.21 (5) 11.3

2. Autos A and B have the same mass and undergo a 2-dimensional collision in which B is initially at rest, while A has initial velocity 30 m/s in the positive $x$ direction. After the collision, A has speed 25 m/s, and the $x$ component of the velocity of B is 10 m/s. What is the $y$ component of the final velocity of B?




(1) −15 m/s (2) −25 m/s (3) 0 (4) 10 m/s (5) 35 m/s

3. At time $t = 0$ a thin bicycle tire of mass $M = 2$ kg and radius $R = 0.5$ m is rolling up an incline with initial speed 5 m/s. The tire rolls without slipping, and the incline makes an angle of 30° with respect to the horizontal. How much time transpires before the tire returns to its initial position? (Hint: use the work-energy theorem for a rolling object.)

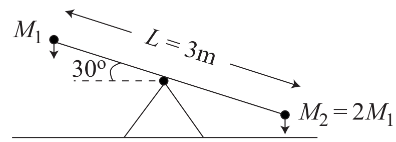



(1) 4 s (2) 6 s (3) 8 s (4) 10 s (5) 12 s

4. * Idealize the sun as a thin bicycle tire of mass $10^{33}$ kg and radius $10^9$ m. The sun is currently rotating with an angular velocity $w = 2 \times 10^{-6}$ rad/s (about 1 revolution every month). If the sun suddenly were to shrink to a radius of $10^4$ m, what would be the value of its angular velocity? Assume angular momentum is conserved.

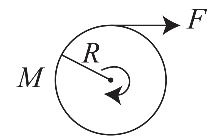
(1) $2 \times 10^4$ rad/s (2) $4 \times 10^6$ rad/s (3) $2 \times 10^{-1}$ rad/s (4) $2 \times 10^{-6}$ rad/s (5) $2 \times 10^{-12}$ rad/s

5. A uniform seesaw of length of 3 m rotates about a fulcrum at its midpoint and makes an angle of 30° with respect to the horizontal. Masses $M_1$ and $M_2 = 2M_1$ sit at opposite ends of the seesaw. How far along the seesaw from its midpoint (distance measured along seesaw) must a mass $M_3 = 3M_1$ be placed so that the seesaw is in equilibrium?




(1) 0.5 m (2) 0.25 m (3) 0 (4) 1 m (5) 1.5 m

6. A thin bicycle tire of mass $M = 2$ kg is spun up from rest by a constant force $F = 10$ N applied parallel to its rim. After 2 s the tire has made 3 revolutions. What is the radius of the tire? (Hint: use the analog of Newton's 2nd Law for rotational motion.)




(1) 0.53 m (2) 0.24 m (3) 0.11 m (4) 0.38 m (5) 0.67 m

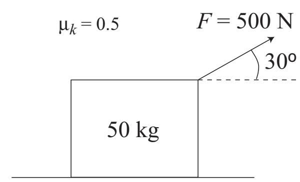
7. A $10^3$ kg auto's engine puts out an average power of 100 hp for 10 s (1 hp = 746 W). Neglect frictional energy losses. During this time, the auto climbs up a hill through a height of 30 m, starting from rest. What is the auto's final kinetic energy after it has climbed the 30 m during this interval of 10 s? (Hint: use the work-energy theorem.)

(1) $4.5 \times 10^5$ J (2) $3.1 \times 10^5$ J (3) $1.3 \times 10^5$ J (4) $8.5 \times 10^4$ J (5) $5.3 \times 10^4$ J

8. A $10^3$ kg elevator is initially moving downwards at 5 m/s. The cable of the elevator motor exerts a constant upward force of $10^4$ N on the elevator. Ten seconds later, what is the elevator's speed?

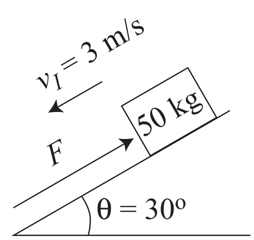
(1) 3 m/s (2) 0 (3) 5 m/s (4) 8 m/s (5) 1.5 m/s

9. A 50 kg trunk is pulled across a horizontal surface by a force $F =$ 500 N that makes an angle of 30° with respect to the horizontal as shown. The coefficient of kinetic friction is $\mu_k = 0.5$. The trunk starts from rest. How much time is required to pull it across the floor through a distance of 10 m?




(1) 1.8 s (2) 0.5 s (3) 2.9 s (4) 3.7 s (5) 0.2 s

10. A 50 kg trunk is initially sliding with speed 3 m/s down a frictionless incline that makes an angle $\theta = 30°$ with respect to the horizontal. A force $F$ directed up along the incline is applied to the trunk in order to bring it to rest. After the force is applied for 2 s, the trunk is brought to rest. What is the value of $F$?




(1) 320 N (2) 115 N (3) 55 N (4) 185 N (5) 235 N

11. * A 50 kg lady stands on a scale in an elevator that exhibits a steady reading of 75 kg for the lady's apparent mass. At time $t = 0$ the elevator is moving down with speed 5 m/s. What is the elevator's speed at $t = 2$ s?

(1) 4.8 m/s (2) 2.4 m/s (3) 1.2 m/s (4) 9.6 m/s (5) 13.4 m/s

12. * An auto accelerates at a constant rate from 0 to 30 m/s in 6 s. The auto's wheels roll without slipping, and their radius is 0.5 m. How many revolutions do the wheels make during the 6 s interval?

(1) 29 (2) 14 (3) 7 (4) 21 (5) 4

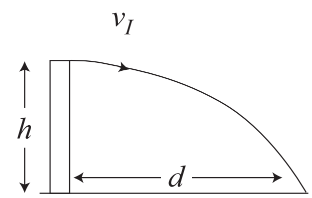
13. * A hiker walks at a constant speed of 2 m/s. All angles are measured counterclockwise with respect to the positive $x$-axis. The hiker first walks a distance of 300 m at an angle of 30°, and then 500 m at an angle of 120°. Finally, the hiker returns to her initial starting point. How much time is required to complete the trip?

(1) 690 s (2) 100 s (3) 50 s (4) 250 s (5) 400 s

14. * A ball is shot straight up from the ground and reaches its maximum height at time $t = 4$ s. What is its speed at time $t = 6$ s?

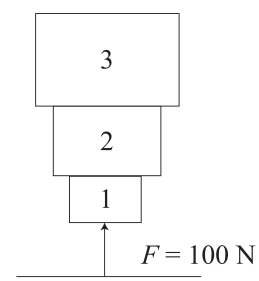
(1) 19.6 m/s (2) 39.2 m/s (3) 0 (4) 14.3 m/s (5) 4 m/s

15. A rock is thrown out horizontally with speed 20 m/s from a tower of height $h$. The rock hits the ground at a distance $d = 40$ m from the base of the tower. What is the height $h$ of the tower?




(1) 19.6 m (2) 24.9 m (3) 31.3 m (4) 43.4 m (5) 56.2 m

16. Three blocks, $M_1 = 2$ kg, $M_2 = 4$ kg, and $M_3 = 6$ kg are glued together and move above the earth. A force $F = 100$ N is applied vertically upwards to the bottom of $M_1$. What is the magnitude of the force of $M_2$ on $M_1$?




(1) 83 N (2) 98 N (3) 116 N (4) 129 N (5) 156 N