

Instructor(s): *J. Ipser*

## PHYSICS DEPARTMENT

PHY 2004

Final Exam

December 14, 2005

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.**

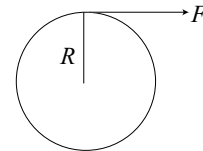
- (1) **Code your test number on your answer sheet (use lines 76–80 on the answer sheet for the 5-digit number).** Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY.** Code your UFID number on your answer sheet.
- (2) Print your name on this sheet and sign it also.
- (3) Do all scratch 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 with scratch work most questions demand.
- (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.
- (6) **Hand in the answer sheet separately.**

$$g = 9.80 \text{ m/s}^2$$

1. A bicycle wheel has mass  $M = 2 \text{ kg}$ . Its initial radius is 1 m, and its initial angular velocity is 4 rad/s. The bicycle wheel's radius is suddenly reduced to 0.5 m. How many revolutions per minutes does the bicycle wheel make in its final state? Angular momentum is conserved.

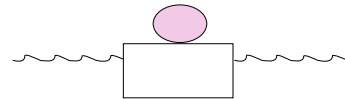
(1) 153                      (2) 186                      (3) 129                      (4) 65                      (5) 239

2. A mounted bicycle wheel of mass  $M = 2 \text{ kg}$  and radius  $R = 1 \text{ m}$  is spun from rest by a force  $F = 10 \text{ N}$  that is applied parallel to its rim. How much time is required for the wheel to turn through a total angle of 20 rad?



(1) 2.8 s                      (2) 1.6 s                      (3) 4.3 s                      (4) 6.2 s                      (5) 9.1 s

3. A 0.25 kg mass rests on top of a block of balsa wood of mass 1 kg. The block floats in water. What volume of water is displaced by the floating block?



(1)  $1.25 \times 10^{-3} \text{ m}^3$       (2)  $1.75 \times 10^{-3} \text{ m}^3$       (3)  $2.4 \times 10^{-3} \text{ m}^3$       (4)  $3.25 \times 10^{-3} \text{ m}^3$       (5)  $6.25 \times 10^{-3} \text{ m}^3$

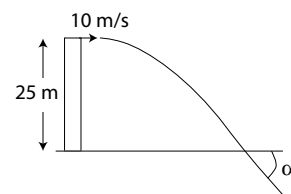
4. A hiker walks 100 m at angle  $\theta = 90^\circ$  measured counterclockwise with respect to the positive  $x$  direction. She then walks 100 m at angle  $\theta = 180^\circ$  measured counterclockwise with respect to the positive  $x$  direction. What is the magnitude of the net displacement for this trip?

(1) 141 m                      (2) 100 m                      (3) 200 m                      (4) 325 m                      (5) 625 m

5. An auto accelerates uniformly from rest for 10 s and then maintains constant velocity for 10 s (1 dimensional motion). The total distance traveled is 150 m. What is the auto's final velocity in m/s?

(1) 10                      (2) 5                      (3) 2.5                      (4) 15                      (5) 20

6. A rock is thrown out horizontally with speed 10 m/s from the top of a tower of height 25 m. When it reaches the ground, what angle  $\alpha$  does its velocity vector make with respect to the ground?

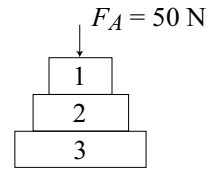


(1)  $66^\circ$                       (2)  $90^\circ$                       (3)  $47^\circ$                       (4)  $26^\circ$                       (5)  $11^\circ$

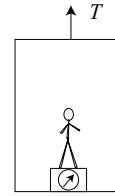
7. On earth a cannon shoots a cannonball a maximum distance of 400 m. The acceleration of gravity on the moon is  $1/6$  that of Earth. If the cannon is aimed at  $15^\circ$  above the horizontal on the moon, how far can it shoot a cannonball there?

(1) 1200 m                      (2) 1500 m                      (3) 1800 m                      (4) 2100 m                      (5) 2400 m

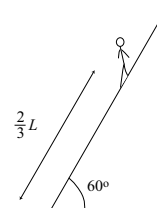
8. Three blocks are glued together and move above the Earth. The blocks have masses  $M_1 = 1$  kg,  $M_2 = 2$  kg, and  $M_3 = 3$  kg. A force  $F_A = 50$  N is applied vertically downward on the top of  $M_1$ . What is the magnitude of the force of block 2 on block 3?



- (1) 25 N                      (2) 20 N                      (3) 15 N                      (4) 10 N                      (5) 5 N
9. A lady stands on a scale in an elevator. The mass of the elevator system is  $4 \times 10^3$  kg. The lady's mass is 50 kg. At a given moment, the scale reads 650 N for the lady's weight. What is the tension  $T$  in the elevator motor's cable?



- (1)  $5.2 \times 10^4$  N              (2)  $4.3 \times 10^4$  N              (3)  $6.7 \times 10^4$  N              (4)  $9.2 \times 10^4$  N              (5)  $1.2 \times 10^5$  N
10. An elevator of mass  $2 \times 10^3$  kg is accelerated upward from rest for 10 s by a tension of  $4 \times 10^4$  N in its cable. The tension is then reduced so that after another 10 s the elevator is moving downward at 2 m/s. What is the total amount of work done on the elevator by all forces acting during the 20 s times interval?
- (1)  $4 \times 10^3$  J                      (2)  $4 \times 10^4$  J                      (3)  $2 \times 10^3$  J                      (4)  $4 \times 10^5$  J                      (5)  $2 \times 10^4$  J
11. A rifle shoots a 0.05 kg bullet at 500 m/s. The rifle's recoil is stopped by the rifleman's shoulder, which exerts a force  $F$  on the rifle for 0.1 s. What is the value of  $F$ ?
- (1) 250 N                      (2) 100 N                      (3) 420 N                      (4) 580 N                      (5) 750 N
12. Autos 1 and 2 undergo a 1-dimensional elastic collision. After the collision, auto 1 is moving in the positive  $x$  direction at 10 m/s, and auto 2 is moving in the positive  $x$  direction at 30 m/s. Before the collision, 1 is moving in the positive  $x$  directions at 20 m/s. What is the magnitude of the change of velocity experienced by 2 in the collision in m/s?
- (1) 30                      (2) 20                      (3) 10                      (4) 40                      (5) 50
13. A uniform ladder of weight  $10^3$  N and length  $L$  leans against a wall at an angle of  $60^\circ$  with respect to the horizontal. A climber whose weight is 750 N stands on the ladder at a point that is two thirds of the way up the ladder. Assume that the force  $W$  exerted by the wall on the ladder is horizontal. What is the value of  $W$ ?



- (1) 577 N                      (2) 223 N                      (3) 416 N                      (4) 116 N                      (5) 739 N
14. Satellites A and B are in circular orbits around the Earth. The radii of the orbits satisfy  $R_A = 2R_B$ . If the period of the orbit of A is  $\tau_A$ , what is the period of the orbit B?
- (1)  $0.35\tau_A$                       (2)  $\tau_A$                       (3)  $2\tau_A$                       (4)  $0.1\tau_A$                       (5)  $0.67\tau_A$