Instructor(s): *J. Ipser*

PHYSICS DEPARTMENT

PHY 2004   Final Exam   December 16, 2004

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 76–80 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 <u>blue</u> or <u>black</u> 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.**

$$g = 9.80 \text{ m/s}^2 \qquad\qquad \rho_{\text{water}} = 10^3 \text{kg/m}^3$$

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1. A wood block of density $\rho = 0.3 \times 10^3 \text{kg/m}^3$ floats in water. The mass of the block is 2 kg. A blob of mass M is placed on the block, and the top of the block sinks to the level of the water. What is the value of M?
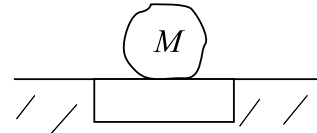
   (1) 4.67 kg   (2) 2.35 kg   (3) 1 kg   (4) 7.98 kg   (5) 12 kg

2. A mounted bicycle wheel of mass $M = 2$ kg and radius $R = 0.5$ m is spun up from rest by application of a force $F = 15$ N to its rim as shown. How many revolutions does the wheel make in 10 s?
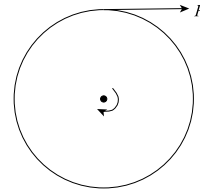
   (1) 120   (2) 10   (3) 20   (4) 50   (5) 75

3. A dumbbell consists of 2 5-kg masses separated from each other by 2 m. The dumbbell is rotating with angular velocity 5 rad/s about an axis through its center as shown. The distance between the masses is suddenly decreased to 0.5 m. What is the resulting kinetic energy of the dumbbell?
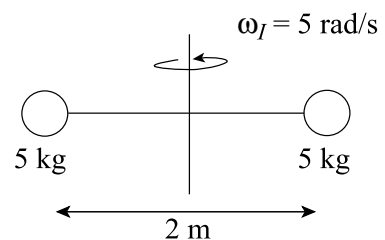
   (1) 2000 J   (2) 1000 J   (3) 6000 J   (4) 18,000 J   (5) 11,000 J

4. A bicycle tire of mass $M = 2$ kg and radius $R = 0.5$ m is rolling up an incline that makes an angle of 30° with respect to the horizontal. The initial speed of the tire is 4 m/s. How far up the incline (distance along incline) does the tire roll without slipping until its speed drops to 0?
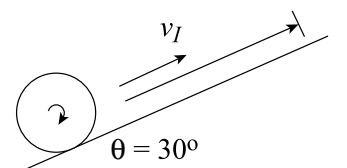
   (1) 3.25 m   (2) 4.5 m   (3) 1.75 m   (4) 7.5 m   (5) 9.25 m

5. A satellite is in orbit around the earth. The radius of the orbit is R_A and the period is 1 day. The satellite is then moved to a new orbit with a period of 2 days. What is the radius of the new orbit?

   (1) $1.6R_A$　　　　　(2) $3R_A$　　　　　(3) $0.5R_A$　　　　　(4) $0.1R_A$　　　　　(5) $0.75R_A$

6. Ball A of mass 0.2 kg has an elastic collision with ball B. Before the collision, A is moving in the positive x direction with speed 5 m/s. After the collision, A is moving in the negative x direction with speed 9 m/s, and B is moving in the positive x direction with speed 5 m/s. What is the speed of B before the collision?

   (1) 9 m/s　　　　　(2) 12 m/s　　　　　(3) 15 m/s　　　　　(4) 18 m/s　　　　　(5) 21 m/s

7. Mass $M_A = 5$ kg has a collision with mass $M_B = 5$ kg. Before the collision, B is at rest and A is moving in the positive x direction at 20 m/s. After the collision, B is moving down at an angle of 30°with respect to the x axis with speed 5 m/s. What is the final speed of A?
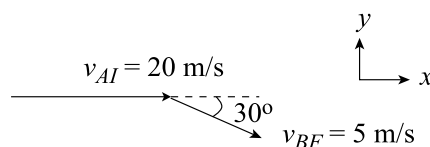
   (1) 16 m/s　　　　　(2) 12 m/s　　　　　(3) 8 m/s　　　　　(4) 4 m/s　　　　　(5) 0

8. A uniform ladder of length $L = 5$ m and mass 50 kg leans against a wall at an angle of 60° with respect to the horizontal. A climber of mass 75 kg is standing on the ladder at its mid-point. The force W of the wall on the ladder is horizontal. What is the value of W?
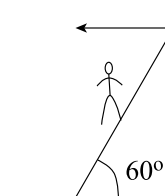
   (1) 355 N　　　　　(2) 620 N　　　　　(3) 565 N　　　　　(4) 720 N　　　　　(5) 980 N

9. An auto accelerates from rest up to a final speed of 30 m/s in 8 s. The radius of its wheels is $\frac{1}{3}$ m and they roll without slipping. What is the angular velocity of the wheels in rad/s once the auto reaches its final speed?

   (1) 90　　　　　(2) 80　　　　　(3) 60　　　　　(4) 40　　　　　(5) 20

10. A lady of mass $M = 50$ kg stands on a scale in an elevator. The elevator is moving up at a speed of 8 m/s and its speed is decreasing at the rate of 4 m/s². What is the reading on the scale for the lady's weight?

   (1) 290 N　　　　　(2) 140 N　　　　　(3) 350 N　　　　　(4) 420 N　　　　　(5) 760 N

11. A 20-kg block starts from rest and is pulled across a horizontal surface by a force of 150 N that is directed 30° above the horizontal. The force of friction is 50 N. What is the block's speed, in m/s, after it has been pulled through a distance 15 m?
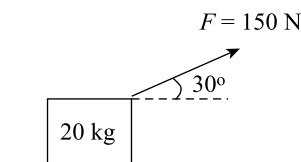
   (1) 11 m/s　　　　　(2) 12 m/s　　　　　(3) 8 m/s　　　　　(4) 4 m/s　　　　　(5) 0

12. An elevator of mass 10^3 kg is lowered from rest through a vertical distance of 20 m and is then raised through a vertical distance of 10 m, at which point its speed is 4 m/s. How much work is done by the elevator motor during this process?

   (1) -9×10^4J　　　　　(2) -5×10^4J　　　　　(3) 0　　　　　(4) $+5 \times 10^4$J　　　　　(5) $+15 \times 10^4$J
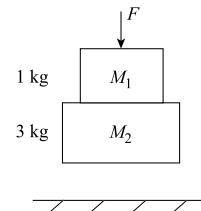
13. A ball is thrown up from height 30 m at an angle of 30° above the horizontal, with initial speed 20 m/s. How long is the ball in the air before it returns to its original height?
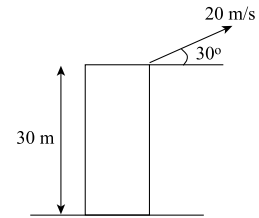
(1) 2 s (2) 1 s (3) 3 s (4) 4 s (5) 5 s

14. An auto slows at a constant rate from 40 m/s to rest in 10 s. How far does the auto travel during this slowing process?

(1) 200 m (2) 250 m (3) 300 m (4) 350 m (5) 400 m

15. A rifle bullet is fired from ground level at 750 m/s and travels a horizontal distance of 2000 m before returning to the ground. At what angle above the horizontal is the bullet shot? Neglect air friction.

(1) 1° (2) 4° (3) 8° (4) 20° (5) 30°

16. Two masses of mass $M_1 = 1$ kg and $M_2 = 3$ kg are glued together and move above Earth. A vertically downward force of $F = 100$ N is applied to M_1. What is the force of M_1 on M_2.

(1) 75 N (2) 25 N (3) 50 N (4) 100 N (5) 125 N