Instructor(s): *J. Ipser*

PHYSICS DEPARTMENT

PHY 2004 2nd Exam March 22, 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 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.**

$g = 9.80$ m/s^2

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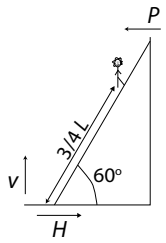
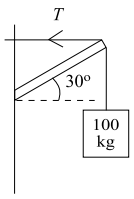
1. A uniform ladder of length $L = 3$ m and mass 50 kg leans against a wall. The ladder makes an angle of 60° with respect to the horizontal. The wall pushes on the ladder in the horizontal direction with a force of magnitude P. A child of mass 25 kg stands on the ladder midway between its middle and its top. Let V and H denote the vertical and horizontal forces, respectively, that the ground exerts on the bottom of the ladder. What is the value of the ratio H/V?



(1) 0.34 (2) 0.48 (3) 0.57 (4) 0.69 (5) 0.77

2. A uniform crane attached to a wall supports a 100 kg mass in equilibrium as shown. The crane's mass is 50 kg, its length is 3 m, and it makes an angle of 30° with respect to the horizontal. The end of the crane is supported by a horizontal cable. What is the tension T in the cable, in N?

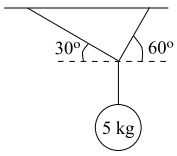


(1) 2123 N (2) 1520 N (3) 930 N (4) 455 N (5) 1835 N

3. A uniform seesaw rotates about its midpoint. The length of the seesaw is 4 m. Three objects of masses $M_1 = 100$ kg, $M_2 = 200$ kg, and $M_3 = 300$ kg, are placed on the seesaw in such a way that the seesaw remains in equilibrium. If M_3 is 1.5 m from the midpoint and M_2 is 2 m from the midpoint, how far is M_1 from the midpoint?

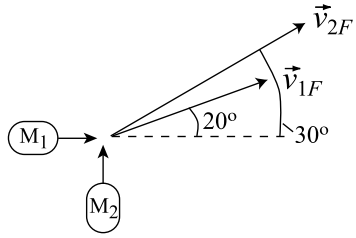
(1) 0.5 m (2) 0.2 m (3) 0.35 m (4) 0.75 m (5) 1 m

4. A ball of mass 5 kg hangs in equilibrium as shown. What is the tension in the rope that makes an angle of 30° with respect to the horizontal?



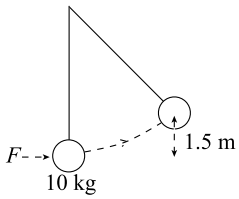
(1) 24.5 N (2) 20.3 N (3) 29.6 N (4) 16.2 N (5) 12.7 N

5. A pickup truck of mass $M_1 = 2 \times 10^3$ kg is initially moving along the x axis, and an auto of mass $M_2 = 10^3$ kg is initially moving in the perpendicular direction along the y axis. The vehicles collide. After the collision, the pickup is moving at 20 m/s at 20° with respect to the x axis, while the auto is moving at 30 m/s at 30° with respect to the x axis (see figure). What is the pickup's speed in m/s when the collision occurs?



(1) 31.8 m/s (2) 15.3 m/s (3) 23.4 m/s (4) 38.5 m/s (5) 63.6 m/s

6. A pendulum ball of mass $M = 10$ kg hanging in equilibrium is struck by a bat that exerts a horizontal force on the ball for 0.1 s. The ball subsequently rises through a height of 1.5 m before it turns around. What is the magnitude of the force of the bat on the ball?



(1) 542 N (2) 407 N (3) 666 N (4) 723 N (5) 908 N

7. An auto of mass M_1 and pickup truck of mass $M_2 = 2M_1$ undergo an elastic collision in one dimension. The magnitude of the change of velocity of the pickup is 20 m/s. What is the magnitude of the change of velocity of the auto?

(1) 40 m/s (2) 20 m/s (3) 30 m/s (4) 50 m/s (5) 60 m/s

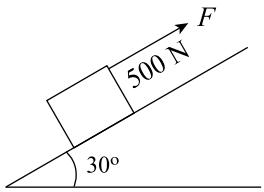
8. A ball of mass $M_1 = 0.1$ kg moving with speed 20 m/s hits a stationary ball of mass $M_2 = 0.4$ kg. M_1 rebounds in the backwards direction with speed 20 m/s. What is the speed of M_2 immediately after the collision?

(1) 10 m/s (2) 7 m/s (3) 0 (4) 13 m/s (5) 16 m/s

9. Two equal-mass autos undergo an elastic head-on collision in one dimension. One auto is initially moving at 20 m/s and the other auto is initially moving at 30 m/s in the opposite direction. What are the speeds of the autos immediately after the collision, in m/s?

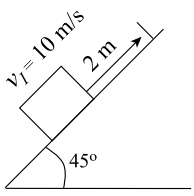
(1) 30, 20 (2) 15, 20 (3) 20, 20 (4) 30, 45 (5) 10, 15

10. A 15 kg block is pulled up a frictionless incline by a force $F = 500$ N that is parallel to the incline. The incline makes an angle of 30° with respect to the horizontal. If the block starts from rest, what is its speed after it has moved 2 m up along the incline?



(1) 10.7 m/s (2) 8.6 m/s (3) 6.3 m/s (4) 4.2 m/s (5) 2.1 m/s

11. A 10 kg block is moving up an incline with initial speed 10 m/s. The incline makes an angle of 45° with respect to the horizontal. The block moves 2 m along the incline before it is brought to rest by friction. How much work is done by friction in bringing the block to rest?



(1) −360 J (2) +72 J (3) −720 J (4) −540 J (5) −990 J

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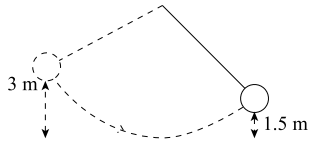
12. A pendulum ball of mass 5 kg is moving with speed 3 m/s when it is 3 m above its equilibrium point. What is its speed when it is 1.5 m above its equilibrium point?

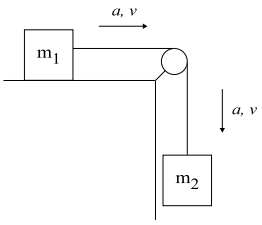


(1) 6.2 m/s (2) 4.3 m/s (3) 3.7 m/s (4) 5.5 m/s (5) 7.4 m/s

13. An elevator motor lifts a 10^3 kg elevator at a constant acceleration rate of 2 m/s^2. If the elevator starts from rest, what is the power output of the motor when it has lifted the elevator for 5 s?

(1) 1.2×10^5 W (2) 3.3×10^5 W (3) 5.2×10^5 W (4) 7.6×10^5 W (5) 9.4×10^5 W

14. Masses $M_1 = 2$ kg and $M_2 = 3$ kg are connected as shown. The table is horizontal and the pulley is frictionless. If the acceleration of the masses is 4 m/s^2, what is the value of the kinetic friction coefficient? M_2 is moving down.

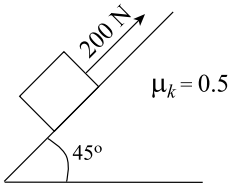


(1) 0.48 (2) 0.42 (3) 0.54 (4) 0.61 (5) 0.73

15. A 2 kg block slides a distance of 0.75 m across a horizontal surface before coming to rest. If the block's intiial speed is 0.75 m/s, what is the value of the kinetic friction coefficient?

(1) 0.038 (2) 0.022 (3) 0.011 (4) 0.4 (5) 0.7

16. A box is pulled up an incline at constant speed by a force F that is parallel to the incline. The incline makes an angle of 45° with respect to the horizontal, the value of F is 200 N, and the kinetic friction coefficient is 0.5. What is the mass of the box in kg?



(1) 19 kg (2) 24 kg (3) 31 kg (4) 39 kg (5) 47 kg