Instructor(s): *J. Ipser*

PHYSICS DEPARTMENT

PHY 2004						Exam 3						April 28, 2008

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 <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.**

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

1. In this problem all angles are measured counterclockwise with respect to the positive x-axis. A hiker travels at angle 30° for 10 s at a speed of 2 m/s. In the second leg of her trip, the hiker travels at angle 225° for 20 s at 1.5 m/s. At the end of the third leg of her trip, the hiker finds that for the whole trip of three legs her net displacement has magnitude 25 m and is directed at angle 180°. What is the angle of the third leg?

   (1) 152°			(2) 36°			(3) 238°			(4) 302°			(5) 180°

2. An auto travels along the x-axis. At time $t = 0$ the auto is moving in the positive x direction with speed 20 m/s. At this moment, the auto begins to accelerate at a constant rate. Twenty seconds later, the auto's net displacement is $\Delta x = -20$ m. What is the auto's constant acceleration, in m/s^2?

   (1) −2.1			(2) +2.4			(3) −1.2			(4) −3.8			(5) +1.1

3. At time $t = 0$ ball A is thrown out with speed 30 m/s from a tower of height 40 m, and at an angle of 30° below the horizontal. At the same moment ball B is thrown straight up from the ground with speed 40 m/s. At a later time, the balls are at the same height h. What is the value of h, in m?

   (1) 26.5			(2) 18.5			(3) 9.5			(4) 38.5			(5) 5.5

4. On Earth a cannon shoots a cannonball a distance of 500 m when it is aimed at 60° above the horizontal. On the moon, the same cannon shoots a cannonball a distance of 1000 m when it is aimed at angle θ_m above the horizontal. What is the value of θ_m? The acceleration of gravity on the moon is 1/6 that on Earth.

   (1) 8°			(2) 23°			(3) 31°			(4) 44°			(5) 62°

5. A student pushes a 50 kg trunk across a horizontal floor at constant acceleration. Starting from rest, the trunk travels 3 m in 5 s. The student pushes on the trunk at an angle of 30° below the horizontal. If the floor is frictionless, how much work does the student do during the process?

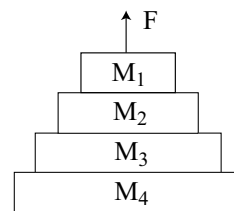 (1) 36 J			(2) 12 J			(3) 21 J			(4) 48 J			(5) 62 J

6. Four blocks of masses $M_1 = 2$ kg, $M_2 = 4$ kg, $M_3 = 6$ kg, $M_4 = 8$ kg are glued together and move above the Earth. An upward vertical force F acts on the top of M_1 as shown. Starting from rest, the system rises through a vertical distance of 20 m in 5 s under the action of the upward force F. During the process, what is the magnitude of the force that M_4 exerts on M_3?

(1) 91 N   (2) 34 N   (3) 16 N   (4) 48 N   (5) 69 N

7. A 2000 kg elevator is moving down with constant acceleration vector. As it passes the 5th floor the elevator's downward speed is 30 m/s. When it reaches the 2nd floor, which is 20 m below the 5th floor, its downward speed is 5 m/s. What is the magnitude of the acceleration, in m/s^2?

(1) 22   (2) 5   (3) 12   (4) 2   (5) 0

8. Two blocks, with masses $M_1 = 10$ kg and $M_2 = 5$ kg, are connected together by a horizontal rope, and are pulled across a horizontal floor by a force F that makes an angle of 30° with the horizontal as shown. The force $F = 50$ N. Starting from rest, the speed of the blocks is 5 m/s after 4 s. The work done by friction on M_2 during this time is -200 J. What is the coefficient of kinetic friction for M_1?
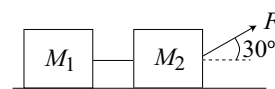
(1) 0.05   (2) 0.25   (3) 0.4   (4) 0.65   (5) 0.9

9. A uniform horizontal crane sticks out from a wall in equilibrium as shown. The crane's length is 5 m and the supporting cable makes an angle of 45° with respect to the horizontal as shown. The crane's mass is 100 kg and a 50 kg mass hangs from its end. What is the vertical component of the force of the wall on the crane?
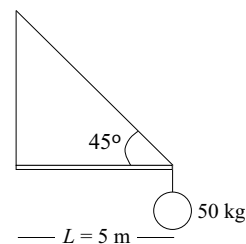
(1) 490 N   (2) 220 N   (3) 725 N   (4) 1030 N   (5) 1655 N

10. A 2000 kg auto is traveling in the positive x direction at 10 m/s and a 1000 kg auto is traveling in the positive y direction. The autos collide and stick together. The final velocity vector makes an angle of 60° with respect to the x direction. What is the initial speed of the 1000 kg auto in m/s?
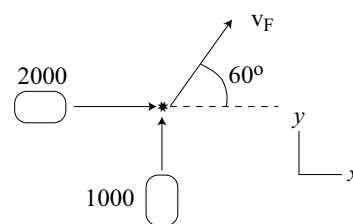
(1) 35   (2) 10   (3) 65   (4) 20   (5) 5

11. A block of mass 5 kg sits on a horizontal table. A 0.05 kg bullet moving horizontally with initial speed 1000 m/s strikes the block and bounces off of it with speed 500 m/s in the direction opposite to the incoming direction. As a result, the block slides along the table. How far along the table does the block slide if the coefficient of kinetic friction is 0.8?
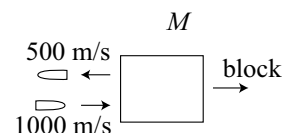
(1) 14.3 m   (2) 5.6 m   (3) 2.1 m   (4) 9.2 m   (5) 0.5 m

12. An auto's crankshaft is initially spinning at 4000 rpm (revolutions per minute). The crankshaft spins down uniformly and comes to rest after 10 s. How many revolutions does the crankshaft make during this process?

   (1) 330   (2) 490   (3) 680   (4) 920   (5) 1050

13. An automobile decelerates uniformly from 40 m/s to rest in 10 s. The radius of the auto's tires is 0.5 m. Through what angle do the tires rotate during this process?

   (1) 400 rad   (2) 200 rad   (3) 500 rad   (4) 600 rad   (5) 300 rad

14. The space shuttle, in its orbit approximately 200 km above the Earth's surface, makes 1 revolution around the Earth in approximately 1.5 hours. The radius of the Earth is $R_E = 6.5 \times 10^6$m. If the shuttle is placed in a new orbit such that it makes 1 revolution per day (24 hours) what is the radius of the new orbit?

   (1) $6.5R_E$ (2) $11R_E$ (3) $24.5R_E$ (4) $16R_E$ (5) $38R_E$

15. An automobile travels around a circular horizontal track. The radius of the track is 300 m and the coefficient of static friction between the track and the auto's tires is 0.75. What is the maximum speed at which the auto can travel around the track without beginning to slide out?

   (1) 47 m/s   (2) 31 m/s   (3) 14 m/s   (4) 38 m/s   (5) 65 m/s