King Fahd University of Petroleum and Minerals

Department of Physics

PHYS101-052
MAJOR 2 EXAM
Test Code: **100**

29 April 2006 in Building 54
Exam Duration: 2hrs (from 6:30pm to 8:30pm)

Name:	
Student Number:	
Section Number:	

Key at the end

1. A horizontal force (F) is applied on a 100-kg box. The box accelerates along the positive x direction with constant acceleration of 1.0 m/s^2 .If the coefficient of kinetic friction is 0.50 between the box and the surface then the work done by F as the box moves 100 m is:
   A) 5.9×10^4 J
   B) 2.5×10^4 J
   C) 3.8×10^4 J
   D) 1.0×10^4 J
   E) $- 3.8 \times 10^4$ J

2. An object of mass 1.0 kg is whirled in a horizontal circle of radius 0.50 m at a constant speed of 2.0 m/s. The work done on the object during one revolution is:
   A) 0 J
   B) 12 J
   C) -320 J
   D) 320 J
   E) 8.0 J

3. A boy holds a 40-N weight at arm's length for 10 s. His arm is 1.5 m above the ground. The work done by the force of the boy on the weight while he is holding it is:
   A) 120 J
   B) 40 J
   C) 20 J
   D) 0 J
   E) 10 J

4. A 40-N force is the only force applied on a 2.0-kg crate which is originally at rest. At the instant the object has traveled 2.5 m, the rate at which the force is doing work is:
   A) 500 W
   B) 300 W
   C) 400 W
   D) 25 W
   E) 75 W

5. A 4.0 kg block starts up a 30° incline with 128 J of kinetic energy. How far will it slide up the incline if the coefficient of kinetic friction between the block and the incline is 0.50?
   A) 5.5 m
   B) 1.5 m
   C) 2.5 m
   D) 4.5 m
   E) 3.5 m

6. A ball of mass 2.0-kg is kicked with an initial speed of $5(m/s)\hat{i} + 5(m/s)\hat{j}$. The ratio of the potential energy (relative to ground level) to the kinetic energy of the projectile at its highest point is:
   A) 0.50
   B) 2.0
   C) 1.5
   D) 1.0
   E) 0

7. A block is released from rest at a height h = 6.0 m along a frictionless loop-the-loop with a diameter of 3.0 m (see Fig 1). The speed at the top of the loop is:
   A) 3.6 m/s
   B) 4.3 m/s
   C) 7.7 m/s
   D) 5.4 m/s
   E) 2.9 m/s

8. A 2.0-kg block slides on a rough horizontal table top (see Fig 2). Just before it hits a horizontal ideal spring its speed is 5.0 m/s. It hits the spring and compresses it 10.0 cm before coming momentarily to rest. If the spring constant is 1200 N/m, the work done by friction is:
   A) 0
   B) -2.6 J
   C) -19 J
   D) -0.70 J
   E) -6.5 J

9. The location of two thin flat objects of masses m_1= 4.0 kg and m_2 = 2.0 kg are shown in Fig. 3, where the units are in m. The *x* and *y* coordinates of the center of mass of this system are:
   A) 0, 0
   B) 1.3 m, 1.7 m
   C) 1.0 m, -0.33 m
   D) 1.0 m, 0.33m
   E) 6.0 m, 2.0 m

10. The impulse which will change the velocity of a 2.0-kg object from $\vec{v}_1 = +30\hat{j}\,(m/s)$ to $\vec{v}_2 = -30\hat{i}\,(m/s)$ is:
   A) $\left(30\hat{i} - 30\hat{j}\right) N \cdot s$
   B) $\left(-60\hat{i} - 60\hat{j}\right) N \cdot s$
   C) $\left(-30\hat{i} + 30\hat{j}\right) N \cdot s$
   D) $\left(-15\hat{i} - 15\hat{j}\right) N \cdot s$
   E) $0\, N \cdot s$

11. A 2.00 kg pistol is loaded with a bullet of mass 3.00 g. The pistol fires the bullet at a speed of 400 m/s. The recoil speed of the pistol when the bullet was fired is:
   A) 0.500 m/s
   B) 0.400 m/s
   C) 1.75 m/s
   D) 1.60 m/s
   E) 0.600 m/s

12. Sphere A has mass $3m$ and is moving with velocity v in the positive the x direction. Sphere B has a mass m and is moving with velocity v in the negative x direction. The two spheres make a head-on elastic collision. After the collision the velocity of A (v_A) is:
    A) 0
    B) v
    C) $-2v/4$
    D) $-v/4$
    E) $-5v/3$

13. The angular position of a particle is given as $\theta = 2 + t - t^3$ where θ is in *rad* and t is in *s*. The angular acceleration when the particle is momentarily at rest is:
    A) 16 rad/s^2 clockwise
    B) 0 rad/s^2
    C) 3.5 rad/s^2 counterclockwise
    D) 3.5 rad/s^2 clockwise
    E) 16 rad/s^2 counterclockwise

14. A disk of rotational inertia 5.0 kg m^2 starts rotating from rest and accelerates with a constant angular acceleration of 1.0 rad/s^2. During the first 4.0 s, the work done on the disk is:
    A) 5.0 J
    B) 40 J
    C) 320 J
    D) 2.5 J
    E) 1800 J

15. The rotational inertia of a solid sphere (mass M and radius R_1) about an axis parallel to its central axis but at a distance of $2R_1$ from it is equal to I_1. The rotational inertia of a cylinder (same mass M but radius R_2) about its central axis is equal to I_2. If $I_1=I_2$, the radius of the cylinder R_2 must then be:
    A) 4.9 R_1
    B) 9.0 R_1
    C) 8.8 R_1
    D) R_1
    E) 3.0 R_1

16. A rope pulls a 1.0-kg box on a frictionless surface through a pulley as shown in Fig 4. The pulley has a rotational inertia of 0.040 kg.m^2 and radius of 20 cm. If the force F is 10 N, then the acceleration of the box is:
    A) 10.0 m/s^2
    B) 0 m/s^2
    C) 1.0 m/s^2
    D) 0.50 m/s^2
    E) 5.0 m/s^2

17. A ring is given an initial speed of 7.0 m/s at its center of mass (see Fig 5). It then rolls smoothly up the incline. At the height 5.0 m the speed of the center of mass of the ring is:
    A) 7.0 m/s
    B) 0 m/s
    C) 2.0 m/s
    D) 3.5 m/s
    E) 4.1 m/s

18. The angular momentum of an object about the origin is given as functions of time as follows: $\vec{L} = (2t - 1)\hat{i}\ kg \cdot m^2 \cdot s$ where *t* is in *s*. The torque about the origin at *t* = 2.0 *s* is:
    A) (2.0 i) N.m
    B) (8.0 k) N.m
    C) (4.0 i – 2.0 j) N.m
    D) (2.0i + 4.0 j) N.m
    E) (4.0 k) N.m

19. Two identical thin rods of mass *M* and length *d* are attached together in the form of a plus sign "+" (see Fig 6). The whole structure is rotating counterclockwise with angular velocity of ω about the *z* axis (which is at the point of attachment). The angular momentum about the *z* axis is:
    A) (1/12) $M\ \omega\, d^2$ clockwise
    B) (1/24) $M\ \omega\, d^2$ counterclockwise
    C) (1/2) $M\ \omega\, d^2$ counterclockwise
    D) (1/6) $M\ \omega\, d^2$ counterclockwise
    E) $M\ \omega\, d^2$ clockwise

20. A solid sphere of mass *M*=1.0 kg and radius *R*=10 cm rotates about a frictionless axis at 4.0 rad/s (see Fig 7). A hoop of mass *m*=0.10 kg and radius *R* =10 cm falls onto the ball and sticks to it in the middle exactly. The angular speed of the whole system about the axis just after the hoop sticks to the sphere is:
    A) 0.80 rad/s
    B) 4.3 rad/s
    C) 3.2 rad/s
    D) 5.4 rad/s
    E) 0.66 rad/s

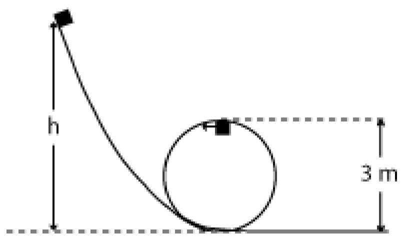

Figure 1

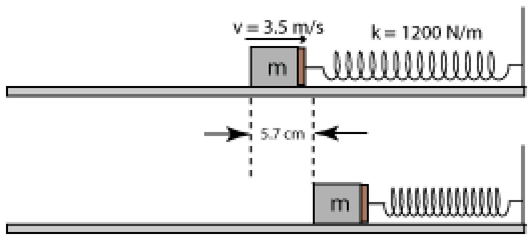

Figure 2

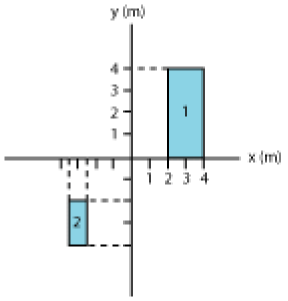

Figure 3

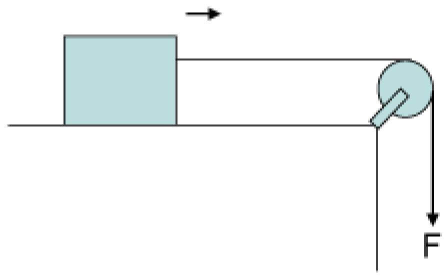

Figure 4

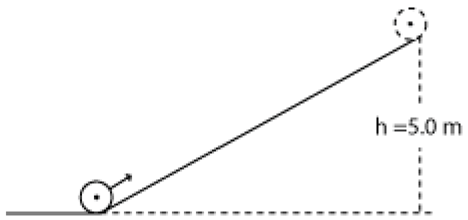

Figure 5

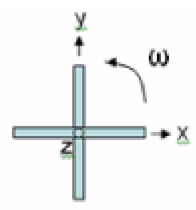

Figure 6

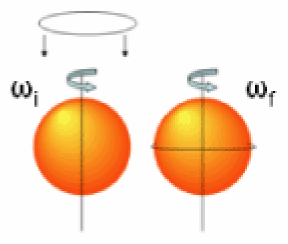

Figure 7

Answer Key

1. A
2. A
3. D
4. C
5. E
6. D
7. C
8. C
9. D
10. B
11. E
12. A
13. D
14. B
15. E
16. E
17. B
18. A
19. D
20. C