Physics 161   NAME _____ANSWERS_____

Final Exam   Section # _____

Dr. Dennis Drew   **May 17, 2004**

Turn in both the exam and the scantron sheets at the end of the exam.

Part I : 3 Partial credit questions each worth 11 pts. Show your work directly on the exam.

1. A block of wood of mass 2 kg is being pushed up a vertical wall at constant velocity with a force F that is directed at an angle of 50° with respect to the horizontal. The coefficient of kinetic friction between the block and the wall is $\mu_k = 0.2$.
 a. Draw the free body of the block and identify all forces acting on it.
 b. Find the magnitude of the force F.

F=30.7 N

2. Calculate the Earth's angular momentum in the approximation that treats the Earth's orbit around the sun as a circle. ($M_{Sun} = 1.99 \times 10^{30}$ kg; $T = 3.156 \times 10^{7}$ s; $M_E = 5.98 \times 10^{24}$ kg.)

L = 2.68 x 10^{40} kg m^2/s
 perpendicular to the Earth orbit as given by the right hand rule.

3. A tennis player standing 12.6 m from the net hits the ball at 3.0° above the horizontal. To clear the net, the ball must rise at least 0.33 m. If the ball just clears the net at the apex of its trajectory, what was the velocity of the ball when it left the racket?

|v| = 48.6 m/s
direction 3 ° above horizontal

or, v_x = 48.5 m/s, v_y = 2.54 m/s

Part II : 6 conceptual questions each worth 10 pts. Mark the correct answer for each question directly on the exam.

1. The value of the momentum of a system is the same at a later time as at an earlier time if there are no

   a. collisions between particles within the system.
   b. inelastic collisions between particles within the system.
   c. changes of momentum of individual particles within the system.
   d. internal forces acting between particles within the system.
   e. **external forces acting on particles of the system.**

2. In order to jump off the floor, the floor must exert a force on you

   a. in the direction of and equal to your weight.
   b. opposite to and equal to your weight.
   c. in the direction of and less than your weight.
   d. opposite to and less than your weight.
   e. **opposite to and greater than your weight.**

3. Two eggs of equal mass are thrown at a blanket with equal velocity. Egg B hits the blanket but egg A hits the wall instead. Compare the work done on the eggs in reducing their velocities to zero.

   a. More work was done on A than on B.
   b. More work was done on B than on A.
   c. **The amount of work is the same for both.**
   d. It is meaningless to compare the amount of work because the forces were so different.
   e. Work was done on B, but no work was done on A because the wall did not move.

4. **Sta**rs originate as large bodies of slowly rotating gas. Because of gravity, these clumps of gas slowly decrease in size. The angular velocity of a star increases as it shrinks because of

   a. **conservation of angular momentum**
   b. conservation of linear momentum
   c. conservation of energy
   d. the law of universal gravitation
   e. conservation of mass

5.	A projectile starts at the coordinate origin, where the displacement vector also originates. The initial velocity, $\mathbf{v}_0$, makes an angle θ_0 with the horizontal where $0 < \theta_0 < 90°$. At the instant when the projectile is at the highest point of its trajectory, the displacement, velocity and acceleration vectors are $\mathbf{r}$, $\mathbf{v}$ and $\mathbf{a}$. Which statement is true?

a.	$\mathbf{r}$ is parallel to $\mathbf{v}$.
b.	$\mathbf{r}$ is perpendicular to $\mathbf{v}$.
c.	$\mathbf{v}$ is parallel to $\mathbf{a}$.
d.	**v is perpendicular to a.**
e.	$\mathbf{r}$ is perpendicular to $\mathbf{a}$.

6.	The figure below shows a planet traveling in a clockwise direction on an elliptical path around a star located at one focus of the ellipse. When the planet is at point A,
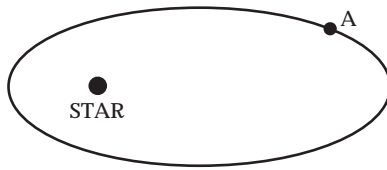
a.	its speed is constant.
b.	its speed is increasing.
c.	**its speed is decreasing.**
d.	its speed is a maximum.
e.	its speed is a minimum.

Part III: 10 multiple choice problems each worth 8 pts. Mark the correct answer for each question directly on the exam.

1.	If M = 6.0 kg, what is the tension in string 1?
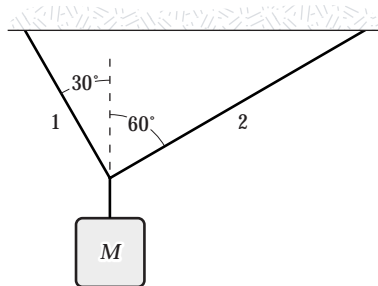
a.	39 N
b.	34 N
c.	29 N
d.	44 N
e.	**51 N**

2.   A 30-kg child rides on a circus Ferris wheel that takes her around a vertical circular path with a radius of 20 m every 22 s. What is the magnitude of the resultant force on the child at the highest point on this trajectory?

    a.   **49 N**
    b.   0.29 kN
    c.   0.34 kN
    d.   0.25 kN
    e.   0.76 kN

3.   A 2.5-kg object falls vertically downward in a viscous medium at a constant speed of 2.5 m/s. How much work is done by the force the viscous medium exerts on the object as it falls 80 cm?

    a.   +2.0 J
    b.   +20 J
    c.   −2.0 J
    d.   **−20 J**
    e.   +40 J

4.   A spring (k = 200 N/m) is suspended with its upper end supported from a ceiling. With the spring hanging in its equilibrium configuration, an object (mass = 2.0 kg) is attached to the lower end and released from rest. What is the speed of the object after it has fallen 4.0 cm?

    a.   90 cm/s
    b.   **79 cm/s**
    c.   96 cm/s
    d.   83 cm/s
    e.   57 cm/s

5. A 2.0-kg object moving with a velocity of 5.0 m/s in the positive x direction strikes and sticks to a 3.0-kg object moving with a speed of 2.0 m/s in the same direction. How much kinetic energy is lost in this collision?

    a.   2.4 J
    b.   9.6 J
    c.   **5.4 J**
    d.   0.6 J
    e.   6.0 J

6. A 5.0-g particle moving 60 m/s collides with a 2.0-g particle initially at rest. After the collision each of the particles has a velocity that is directed 30° from the original direction of motion of the 5.0-g particle. What is the speed of the 2.0-g particle after the collision?

    a.   72 m/s
    b.   **87 m/s**
    c.   79 m/s
    d.   94 m/s
    e.   67 m/s

7. Two particles (m_1 = 0.20 kg, m_2 = 0.30 kg) are positioned at the ends of a 2.0-m long rod of negligible mass. What is the moment of inertia of this rigid body about an axis perpendicular to the rod and through the center of mass?

    a.   **0.48 kg · m^2**
    b.   0.50 kg · m^2
    c.   1.2 kg · m^2
    d.   0.80 kg · m^2
    e.   0.70 kg · m^2

8. Two blocks, m_1 = 1.0 kg and m_2 = 2.0 kg, are connected by a light string as shown in the figure. If the radius of the pulley is 1.0 m and its moment of inertia is 5.0 kg · m², the acceleration of m₁ is
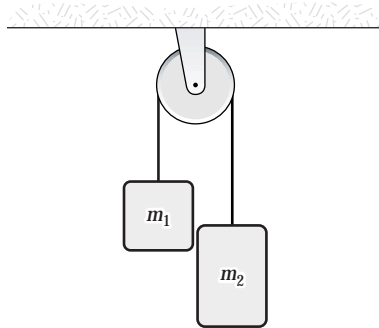
a. $(1/6)g$
b. $(3/8)g$
c. **$(1/8)g$**
d. $(1/2)g$
e. $(5/8)g$

9. Two vectors lying in the *xy* plane are given by the equations **A** = 5**i** + 2**j** and **B** = 2**i** – 3**j**. The value of **A** × **B** is

a. 19**k**
b. –11**k**
c. **–19k**
d. 11**k**
e. 10**i** – **j**

10. A satellite circles planet Roton every 2.8 h in an orbit having a radius of 1.2×10^7 m. If the radius of Roton is 5.0×10^6 m, what is the magnitude of the free-fall acceleration on the surface of Roton?

a. 31 m/s²
b. **27 m/s²**
c. 34 m/s²
d. 40 m/s²
e. 19 m/s²