Physics 2305 22 March, 2000
Practice for Exam 2

Exam 2 will consist of 8 multiple choice questions (each worth 8 points) and 3 free-form questions (each worth 12 points).

1. An object moving across a frictionless surface suddenly splits into two pieces of equal mass. If one piece is moving in the **y** direction with a velocity of 9.0 m/s and the other is moving at an angle of 20° above the horizontal (i.e. with positive components in both **x** and **y**) with a velocity of 5.0 m/s, how fast was the object moving before it exploded?

A) 5.1 m/s
B) 5.4 m/s
C) 5.8 m/s
D) 7.7 m/s
E) none of the above Answer: _____

2. Evil Emil has a travelling roadshow where he launches poor, innocent monkeys into the air and catches them with nets. If he launches a monkey straight up with an initial velocity of 8.5 m/s, how high will it go?

A) 0.4 m
B) 3.7 m
C) 7.4 m
D) You must know the mass of the monkey.
E) None of the above. Answer: _____

3. A 25.0 kg crate rests on the ice in a skating rink (i.e. the surface is frictionless). The local hockey team practices by hitting it with hockey pucks. If the players hit the crate with 2 pucks per second, each puck has a mass of 0.160 kg and a velocity of 22 m/s, and the collisions are one-dimensional and elastic (i.e. the pucks bounce), how fast does the crate accelerate?

A) 0.14 m/s^2
B) 0.28 m/s^2
C) 0.56 m/s^2
D) 0.88 m/s^2
E) none of the above Answer: _____

4. A force of 10 N holds an ideal spring with a 20-N/m spring constant in compression. The potential energy stored in the spring is:

A) 0.5 J
B) 2.5 J
C) 5 J
D) 10 J
E) none of the above Answer: _____

5. A flywheel, initially at rest, has a constant angular acceleration. After 9 seconds the flywheel has rotated 450 rad. Its angular acceleration in rad/s^2 is:

A) 1.77
B) 11.1
C) 15.9
D) 50
E) none of the above Answer: _____

6. A uniform plank is 12 ft long and weighs 20 lb. It is balanced on a sawhorse at its center. An additional 40 lb weight is now placed on the left end of the plank. To keep the plank balanced, its center must be moved what distance to the right?

A) 2 ft
B) 3 ft
C) 3.43 ft
D) 4 ft
E) none of the above Answer: _____

7. In a one-dimensional collision, the windshield of a tractor-trailer collides with a ping-pong ball at rest. If energy is conserved and the tractor-trailer is moving at 60 miles per hour, what is the velocity of the ping-pong ball after the collision?

A) 0
B) 30 mph
C) 60 mph
D) 120 mph
E) none of the above Answer: _____

8. A sign hanging outside of the door of a small store is held in place by a horizontal pole and a diagonal wire running from the outside end of the pole to a point on the wall 0.75 m above the inside end of the pole. The pole has a mass of 2.5 kg and a length of 1.0 m. The sign hangs from the center of the pole and has a mass of 3.0 kg. What is the tension in the diagonal wire?

A) 20 N
B) 27 N
C) 45 N
D) 54 N
E) none of the above Answer: _____

9. A 0.050 kg mass is tied to a point on the ceiling directly above with a string of length 2.0 m. It rests against a horizontal spring with spring constant k = 2500 N/m. The spring is compressed 1.0 cm and released, so that the mass swings to a maximum height h from its starting point and makes a maximum angle θ with respect to the vertical.

a) Find an expression for the maximum height h of the mass in terms of the initial compression distance of the spring, and evaluate it for an initial compression of 1.0 cm. (6 points)

b) Find an expression for the maximum angle θ (between the string connected to the mass and the vertical) in terms of the initial compression distance of the spring, and evaluate it for an initial compression distance of 1.0 cm. (6 points)

Remember to show your work clearly, express your answers as equations and numerical values, and circle both.

10. A child is rolling a marble on a frictionless track with a loop of radius 40 cm.

a) What is the minimum velocity of the marble at the top of the loop if it does not leave the track? (4 points)

b) What would the minimum kinetic energy of the marble be at the top of the loop if it were to remain in contact with the track? Express your answer as an equation in terms of v_{min}. A marble has a moment of inertia $I = (2/5)\ m\ r^2$. (4 points)

c) If the track leading to the loop forms a ramp, how high above the top of the loop would the marble have to be released to complete the loop without leaving the track? Express your answer in terms of the radius of the loop. (4 points)

Remember to show your work clearly, express your answers as equations and numerical values (except for part (b), where you'd have to know the mass of the marble to get a numerical answer), and circle both.

11. Derive the following equations starting with the differential definitions of α and ω.

a) $\omega = \alpha t + \omega_o$ (4 points)

b) $\theta = (\frac{1}{2})\ \alpha t^2 + \omega_o t + \theta_o$ (4 points)

c) $\omega^2 = \omega_o^{\ 2} + 2\alpha(\theta - \theta_o)$ (4 points)

Show your work clearly!

Answers: 1. C; 2. B; 3. C; 4. B; 5. B; 6. D; 7. D; 8. C;
9. (a) $h = kx^2/(2mg) = 0.26$ m; (b) $\theta = \cos^{-1}[1 - kx^2/(2mgL)] = 29°$;
10. (a) $v_m = (rg)^{1/2} = 2.0$ m/s; (b) $K = (7/10)\ mv_m^{\ 2}$; (c) $h = (7/10)\ r = 0.28$ m;
11. (a) Start with $\alpha = d\omega/dt$ and integrate. Don't forget to explain how the initial conditions allow you to evaluate the constant of integration. (b) Start with $\omega = d\theta/dt$, sub for ω from part (a), and continue as in (a). (c) Eliminate t from parts (a) and (b).