Department of Physics University of Maryland College Park, Maryland

PHYSICS 121 Fall 2002

<u>Practice</u> Exam II

Prof. S. J. Gates Nov. 8, 2002

This is a closed book examination. Read the entire examination before you begin to work. Be sure to read each problem carefully. Any questions should be directed to the proctors. *ALL* work should be written within the examination booklet provided. There is a fifty minute time limit. Show all of your work. Use the backs of pages if necessary or request an extra booklet. Be sure to complete the front page of the examination booklet including your name and recitation section. Show all calculations needed to support your answers, where necessary.

Section I. Multiple Choice Questions

Each question in this section is worth eight (8) points. You should <u>NOT</u> take more than two minutes per question. If you do, it is advisable to continue on to the next question!

- (1.) Two teenagers decide to go sledding down a snow covered hillside. One starts at a height that is four times that of the other. The speed that one reaches at the bottom of the hill is: (a.) the same as the speed of the other at the bottom of the hill. (b.) twice the speed of the other at the bottom of the hill. (c.) four times the speed of the other at the bottom of the hill. (d.) none of the above.
- (2.) The power delivered by the force of gravity to an object moving five meters along the x-axis is; (a.) smaller than that for an object moving five meters along the y-axis. (b.) the same as that for an object moving five meters along the y-axis. (c.) larger than that for an object moving five meters along the y-axis. (d.) none of the above.
- (3.) Two forces F_1 and F_2 cause the same impulse when acting on a mass of 20 kg. The force F_1 acts for 3s and F_2 acts for 9s. It must be the case that; (a.) $F_1 = F_2$. (b.) $3F_1 = F_2$. (c.) $F_1 = 3F_2$. (d.) none of the above.
- (4.) A wheel starts from rest, accelerates uniformly until it completes nine revolutions after 3 s. It reaches an angular speed of 4 π rad/s² after; (a.) 9 s. (b.) 6 s. (c.) 3 s. (d.) none of the above.

(5.) Two cars are headed directly toward each other. One has a mass of 2000 kg with a speed of 6 $\frac{m}{s}$ and the other has a mass of 4000 kg with a speed of 3 $\frac{m}{s}$. After the collision they are stuck together and move with a speed of; (a.) 0 $\frac{m}{s}$. (b.) 3 $\frac{m}{s}$. (c.) 6 $\frac{m}{s}$ (d.) none of the above.

Section II. Analytical Questions

Problem (1.)

Before a collision, one ball of mass 10 kg is rolling in the positive x-direction with a speed of 7 $\frac{m}{s}$. A second ball of identical mass is rolling in the positive y-direction with an unknown speed. After the collision, the two stick together and are observed to move along a line that makes a 45° angle with respect to the x-axis.

(a.) What is the unknown speed of the second ball before the collision? (10 points).

Problem (2.)

The space shuttle is in orbit around the earth at a altitude of $5100 \ km$. It fires its rocket motors to reach a higher orbit. When it does, the astronauts on-board discover that it takes the twice as long to complete one orbit around the earth.

(a.) What is altitude of the new orbit of the space shuttle? (10 points)

Problem (3.)

The power at time t delivered to a ball is given by $P = \frac{J}{s^{14}} t^{13}$. The acceleration of the ball at time t is given by $a = \frac{m}{s^9} t^7$ and the velocity of the ball at time t is $v = 7 \frac{m}{s^7} t^6$.

(a.) What is the mass of the ball? (10 points).

If a 5 kg mass at the end of a pendulum 5 m long is released from rest 4 m above its lowest point, what is its centripetal acceleration when it reaches 3 m above its above its lowest point? (10 points).

Problem (5.)

Two football linemen on opposite teams are waiting for the quarterback to get the snap from the center. The first lineman has a weight of 250 N and when he collides with his opponent travels at a speed of 1.5 $\frac{m}{s}$. The second lineman has a weight of only 225 N but he is quicker.

(a.) How fast must the second lineman be travelling so that after the impact neither one "wins?" (10 points)

Problem (6.)

A 6 kg mass is sliding on a surface with friction. After travelling 10 m, it losses 2 J of energy. If its initial velocity was 15 $\frac{m}{s}$;

- (a.) How far does it travel before coming to rest? (5 points).
- (b.) How long does it take for the mass to stop? (5 points).