YELLOW EXAM

PHY 121/3 Midterm 2: 11 November 1999

Closed book exam; no calculators with text stored for this course
Name, exam color, lab+rec section numbers on the front of each book
Each problem begun on a new page; all work shown for full credit
If answer does not seem to make sense, some credit if you show why
Units required for all numerical answers
Incorrect work affects grade unless crossed out
Return signed honesty statement with exam
Each problem worth twenty points

1. A spherical ball of mass $m = 300$ g rolls without slipping down a ramp inclined at an angle $\theta_1 = 27^o$ to the horizontal, starting from rest at height $h = 1.7$ m.

(a) What is the speed at the bottom?

(b) The ball then rolls on and up without slipping along a second ramp with an angle $\theta_2 = 19^o$ to the horizontal. What is the maximum height reached on this ramp?

2. On the practice exam, you found that a satellite in orbit just above the earth would go around once every 1.41 hours. The moon's orbit has an average radius of $r = 385,000$ km $= 3.85 \times 10^8$ m.

(a) What is r in units of the earth's radius: If $r = xR_E$, what is x?

(b) Assuming a perfectly circular orbit, what should be the period of the moon's revolution about the earth in hours?

(c) How much is this in days? Comment on whether this agrees or disagrees with your knowledge of the moon's changing appearance in the sky.

3. Out in space a tennis ball ($m = 140$ g) collides with a basketball ($M = 740$ g). The initial velocity of the tennis ball is in the $+x$ direction, $v_{txi} = 7.4$ m/s, $v_{tyi} = 0$. The initial velocity of the basketball is in the $-x$ direction, $v_{bxi} = -1.4$ m/s, $v_{byi} = 0$.

(a) What is the total initial momentum (magnitude and direction)?

(b) If the tennis ball collides elastically with the basketball and comes out at an angle $\theta = 21^o$ from the $+x$ direction, what is the x-component of the final velocity of the basketball v_{bxf}?

4. A 2.3 kg box starting from rest at height $h = 1.7$ m slides down an incline at 27^o to the horizontal.

(a) What is the energy converted by friction to heat during the slide, assuming a coefficient of friction $\mu = 0.49$?

(b) What is the speed v of the box at the bottom?

5. A 0.3 kg pendulum bob held by a light string is pulled in from length 0.9 m to 0.7 m as it passes throught the straight-down position with velocity 2.3 m/s.

(a) What is the resulting change in kinetic energy? [Hint: The pull does not produce any torque about the suspension point of the pendulum.]

(b) What is the change in gravitational potential energy?

(c) How much higher above the floor (in m) will the pendulum swing than if it had not been pulled in?

[Note: This is a model for 'pumping' a swing to go higher and higher.]