EXAM-2

PHYS 201 (Fall 2010), 10/14/10

Name:

Lab-Sect. no.:

Signature:

Duration: 75 minutes
Show all your work for full/partial credit!
Include the correct units in your final answers for full credit!
Unless otherwise stated, quote your results in SI units!

1.) *Multiple Choice* *(18 pts.)*

For each statement below, circle the correct answer (TRUE or FALSE, no reasoning required).

(a) In uniform circular motion, the centripetal force is directed parallel to the velocity of the object.
TRUE FALSE

(b) Work is a vector quantity.
TRUE FALSE

(c) The normal force is a conservative force.
TRUE FALSE

(d) The elastic spring force is a conservative force.
TRUE FALSE

(e) The momentum of an object points in the same direction as its velocity.
TRUE FALSE

(f) Gravitational mass and inertial mass, figuring into Newton's law of gravitation and into Newton's 2. law of motion, respectively, are two different concepts.
TRUE FALSE

No.	Points
1	
2	
3	
4	
5	
6	
Sum	

2.) *Satellite Motion* *(18 pts.)*

The secret service plans to put a surveillance satellite (mass $250\,tons$) into a circular orbit so that it revolves around Earth 3 times a day. (mass of Earth: $M_E = 6 \cdot 10^{24} kg$, radius of Earth: $R_E = 6400 km$, $1\,ton$=$1000\,kg$).

(a) At what height above the Earth surface does the satellite have to be released?

(b) What is the speed of the satellite in its orbit?

(c) What is the centripetal force on the satellite and where does it come from?

3.) *Energy Conservation in Projectile Motion* *(14 pts.)*

A kid throws a stone with initial speed of $28mph$ from the edge of a cliff toward the open sea. The cliff is $23m$ above sea level. During flight, the stone reaches a maximal height of $7m$ above the cliff. $(1m/s = 2.25mph)$

(a) Calculate the minimal speed of the stone during flight.

(b) Calculate the maximal speed of the stone during flight.

4.) *Power and Uphill Acceleration* *(18 pts.)*

A sports car ($m = 1.3tons$) accelerates from 0 to $60mph$ in $6.8s$ on a horizontal road. ($1m/s = 2.25mph$, $1\,ton$=$1000\,kg$)

(a) How much net work is done on the car in the process?

(b) What average power is being applied to the car?

(c) In a different run (with the same car), the acceleration process is repeated on an uphill road. The car covers a vertical height difference of $25m$. How much longer does it take to go from 0-60?

5.) *Ballistic Sliding Block* *(16 pts.)*

A cannon from the middle ages is shot at a giant wood block (mass $0.75\,tons$). The projectile, a spherical rock of mass $80\,kg$, hits the block in horizontal direction and gets stuck in it. The block recoils and slides on a horizontal gravel surface for $6.3m$ before coming to rest. The kinetic friction coefficient between block and gravel surface is 0.18.

(a) What was the speed of the block+rock right after the rock got stuck?

(b) What was the speed of the rock just before it hit the wood block?

6.) *Projectile Break-up in 2 Dimensions* *(16 pts.)*

A middle-aged stone shell ($m = 24\,kg$), filled with explosive powder (negligible mass), is traveling horizontally due East at a speed of $32\,m/s$ when it suddenly breaks up into two fragments of mass $m_1 = 10\,kg$ and $m_2 = 14\,kg$. Right after break-up both fragments are still traveling in the horizontal plane, with the lighter one heading 40° North of East with a speed of $28m/s$ (see the sketch below). Ignore gravity in this problem.

(a) What is the speed of the heavier fragment right after break-up?
(*Hint: you need to keep track of both x and y components*)

(b) Calculate the total kinetic energies before and after break-up and then decide whether the explosive powder ignited ($W_{nc} > 0$) or not ($W_{nc} < 0$).