General Physics B1 - Midterm Exam 1 (10/25, 8:00AM~9:50AM)

There are 6 problme sets on two sides. Total:100 points

You may answer in English or Chinese. Please use SI units and take significant figure to the second decimal place for the answers. The graviational acceleration g=$9.8m/s^2$.

1.Safety distance on a highway

On a dry road, a car with good tires may be able to brake with a constant deceleration of $5.00m/s^2$. (a) How many seconds does such a car, initially traveling at $90.00km/hr$, take to stop? (5points) (b) How many meters does it travel in this time? (10points)

2. Relative motion

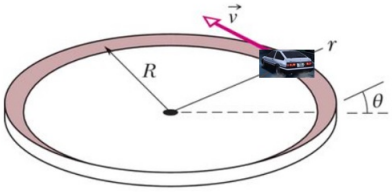
Ship A is located 40.00m north and 25.00m east of ship B. Ship A has a velocity of 3.00 m/sec toward the south, and ship B has a velocity of 2.00 m/s in a direction 45° north of east. (a) Write an expression (in terms of $\hat{i}$ and $\hat{j}$) for the position of A relative to B as a function of t, where t = 0 when the ships are in the positions described above. (5points) (b) At what time is the separation between the ships least? (10points)

maybe useful: sin45°=0.7071, cos45°=0.7071

3. Car on a tilted curve with friction

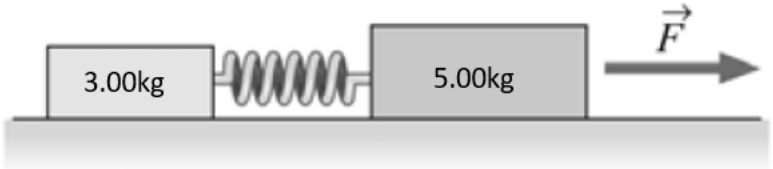
Assuming a car with mass $m = 1000kg$ turn on a tilted curve. The tilted angle is θ= 15°. The curve can be approximate as a part of a circle with radius $R = 60m$. If the static frictional coefficient $\mu_s = 0.8$. What is the maximum speed of this car can make the turn? (20points)

maybe useful: sin15°=0.2588, cos15°=0.9659



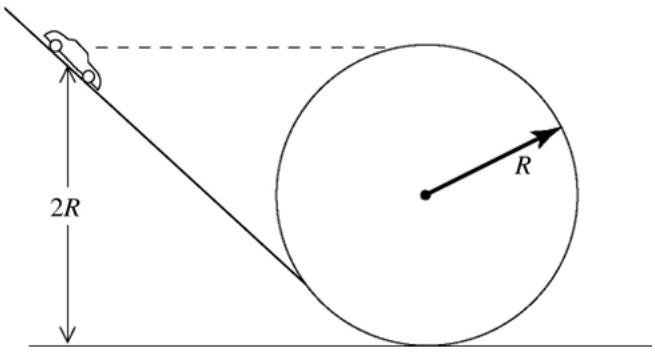
4.Spring Force Between Blocks

A 3.00kg mass and a 5.00kg mass are on a horizontal frictionless surface connected by a massless spring with spring constant $k = 90N/m$. A $24.00N$ force is applied to the larger mass, as shown in the following figure. How much does the spring stretch from its equilibrium length? (10point)



5. Conservation of energy in a Looping-Loop

In the figure, a toy race car of mass m=0.50kg is released from rest on the loop-the-loop track. If it is released at a height 2R=2.00m above the floor, (a)What is the velcoity of the toy car at the very bottom of the loop? (10points) (b)how high is it above the floor when it leaves the track, neglecting friction? (10point)



6.Circular Motion around the Moon

During the Apollo Moon landings, one astronaut remained with the command module in lunar orbit, about 130km above the moon survace. For half of each orbit, this astronaut was completely cut off from the rest of humanity as the spacecraft rounded the far side of the Moon. (a)How long did this period last? (10point) (b)What is the velocity of this spacecraft should have in order to completely escape from the bound of this lunar orbit (130km above the moon survace)? (10points)Given the radius of the Moon is $R_M = 1.74 \times 10^6 m$ and the mass of the Moon is $M = 7.35 \times 10^{22} kg$. The gravitational constant $G = 6.67 \times 10^{-11} N \cdot m^2/kg^2$.