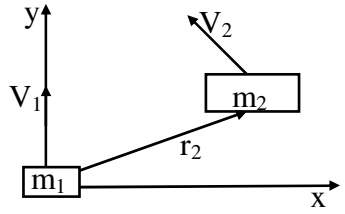
Phys 101 Final Exam H. Beker Fall '80

***Question* 1 :** For the particles in the figure

$\mathbf{M_1}$ = 4 kg , $\mathbf{M_2}$ = 6 kg , $\vec{r}_1 = 0$ $\vec{r}_2 = 2\vec{i} + 4\vec{j}$ m . $\vec{v}_1 = 4\vec{j}$ m/sec ,

$\vec{v}_2 = -3\vec{i} + 4\vec{j}$ m/sec.



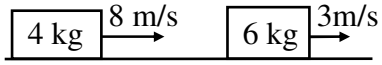
a) Find $\vec{R}_{cm}$, the position of center of mass,

b) Find $\vec{v}_{cm}$, the velocity of center of mass,

c) Find the angular momentum of the system with respect to the origin.

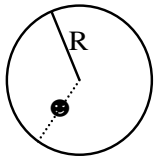
Phys 101 Final Exam H. Beker Fall '80

***Question* 2 :** A mass m_1 =6 kg is moving to the right with a velocity of 3 m/sec. Another mass m_2 = 4 kg is moving to the right with a velocity of 8 m/sec. Find the final velocities of m_1 and m_2 : (a) When they make a perfectly inelastic collision. (b) When they make a imperfectly inelastic collision.



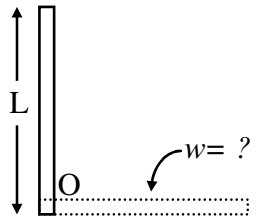
Phys 101 Final Exam H. Beker Fall '80

***Question* 3 :** A bug of mass *m* is at the center of a disk. The disc has a mass M, radius R, moment of inertia $I = \frac{1}{2}mR^2$, and is rotating with angular velocity w_0 . Find the angular velocity of the disk when the bug walks to the edge of the disk and stops there .



Phys 101 Final Exam H. Beker Fall '80

***Question* 4 :** A thin uniform rod of length L, is pivoted at its lower edge so as to rotate in a vertical circle. It begins to fall from a vertical position. Find the angular velocity when it reaches a horizontal position. $I_{cm} = \frac{1}{12}mL^2$

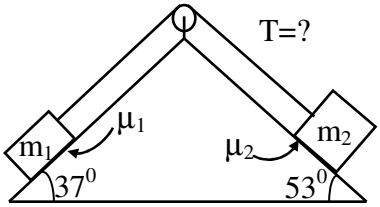


Phys 101 Final Exam H. Beker Fall '80

***Question* 5 :** In the arrangement shown, Find the tension in the cord, neglecting the mass of the pulley. Given:

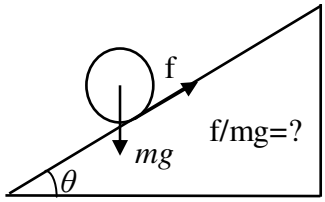
M_1 = 5 kg , M_2 = 15 kg , μ_1 = 0,2 , μ_2 = 0,4

Sin 37^0 = 0,6 , cos 37^0 =0,8

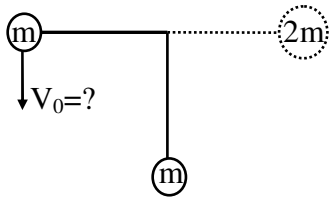


Phys 101 Final Exam H. Beker Fall '80

***Question* 6 :** If a sphere of a mass m rolls without slipping down an inclined plane of angle θ . Find the ratio f/mg where f is the magnitude of the rolling friction on the sphere. $I_{CM} = \frac{2}{5}Mr^2$

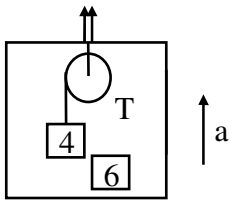


Phys 101 Final Exam H. Beker Fall '80



***Question* 7 :** Two masses m are tied to cords of length L. one of the masses is release from a horizontal position with an initial velocity V_0. It makes a perfectly inelastic collision with the second mass, and the combination barely reaches a horizontal position. Find V_0 .

Phys 101 Final Exam H. Beker Fall '80



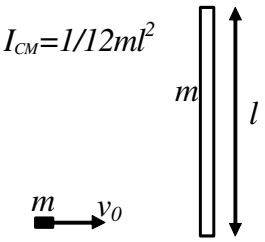
***Question* 8 :** An Atwood machine consists of two masses, M_1 =4 kg , M_2 =6 kg (neglect the mass of the pulley). The system is placed in an elevator and it is observed that the acceleration of the 6kg mass relative to the earth is zero.

a)Find the tension in the cord.

b)Find the acceleration of the 4 kg , relative to the earth

c)Find the acceleration of the elevator.

Phys 101 Final Exam H. Beker Spring '85

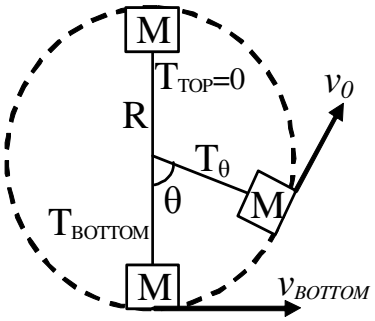


***Question* 5** A bullet embeds itself on one end of a uniform stick lying on a frictionless horizontal table as shown.

a) Which quantities are conserved and which are not conserved?
b) Find the velocities of the stick and the bullet before the collision with respect to their common center of mass,
c) What is the angular momentum with respect to the common center of mass before the collision?
d) Find I_{TOTAL} about the common center of mass after the collision,

Find the angular velocity ω, of the combined system after the collision.

Phys 101 Final Exam H. Beker Spring '85



***Question* 4 :** A block of mass *M* is whirled around in a vertical circle such that $T = 0$ at the very top. Find:

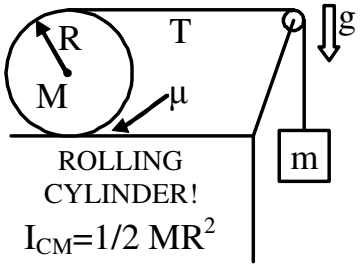
a) The velocity at the top,
b) The velocity at the bottom,
c) The tension at the bottom,

The velocity when the co

d) rd makes an angle θ with the vertical.

The tension when the cord makes an angle θ with the vertical.

Phys 101 Final Exam H. Beker Spring '85

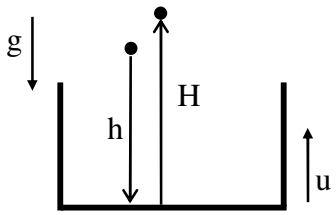


***Question* 3 :** For the system shown in the figure :

a) Draw the force diagram and write the equation of motion for *m*,
b) Draw the force diagram and write the equation of motion for *M*,
c) Write the equation of the rotational motion of *M*,
d) What is the relation between the acceleration of *m* and *M*,
e) Find the tension in the cord

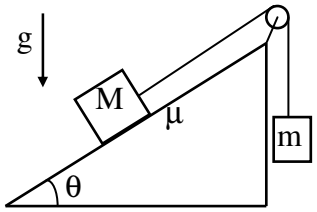
Phys 101 Final Exam H. Beker Spring '96

***Question* 2 :** Find the height H reached by the ball after an elastic collision with the elevator which is moving up .



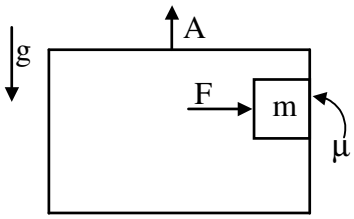
Phys 101 Final Exam H. Beker Spring '96

***Question* 3 :** Find the range of μ for which the system will not move.



Phys 101 Final Exam H. Beker Spring '96

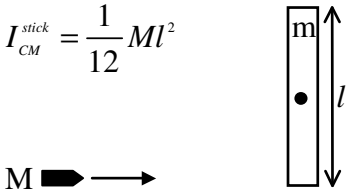
***Question* 4 :** An elevator is accelerating up with acceleration A . Find the minimum force F so that the block does not slide down.



Phys 101 Final Exam H. Beker Spring '96

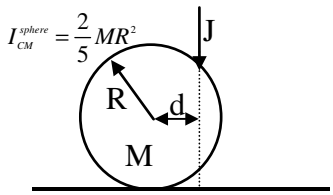
***Question* 5** A bullet embeds itself on one end of uniform stick lying on a frictionless horizontal table. Find the amount of mechanical energy loss

$$I_{CM}^{stick} = \frac{1}{12}Ml^2$$



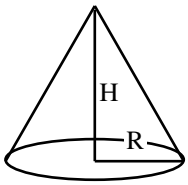
Phys 101 Final Exam H. Beker Spring '96

***Question* 6 :** A vertical impulse J eventually causes the ball to roll on the horizontal surface. Find the energy loss due to friction.



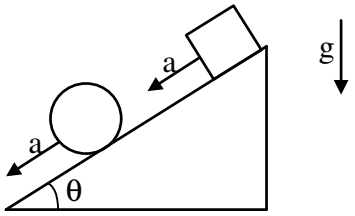
Phys 101 Final Exam H. Beker Spring '96

***Question* 7 :** Find the moment of inertia of a uniform cone around its axis.



Phys 101 Final Exam H. Beker Spring '96

***Question* 8 :** A block slides and a sphere rolls without slipping down and inclined plane with the same acceleration. Find μ .



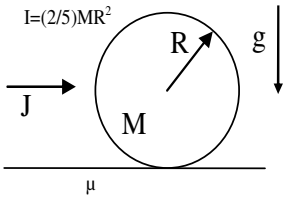
Phys 101 Final Exam H. Beker Fall '97

Question: A stick of mass M and length l has a linear mass density $\lambda(x) = Ax^N$, where A is a constant and N is a positive integer.

a) Calculate M in terms of A, l and N,
b) Calculate X_{CM} in terms of M, l and N,
c) Calculate I around the y-axis in terms of M, l and N,
d) Which N corresponds to the uniform stick case? Check your answers!

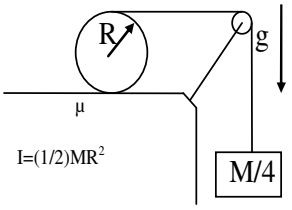
Phys 101 Final Exam H. Beker Fall '97

Question: A billiard ball initially at rest is given a sharp impulse passing through its center. Calculate the time it takes for the ball to reach its final velocity, in terms of J, μ, M, g.



Phys 101 Final Exam H. Beker Fall '97

Question: Find the direction and the magnitude of the friction force acting on cylinder that rolls without slipping, shown in figure.



Phys 101 Final Exam H. Beker Fall '97

Question: A particle of mass 0.2 kg has apposition vector $\vec{r} = (20t)i + (15t - 5t^2)j$ (MKS units). When t = 2 sec., find a) The angular momentum with respect to the point $\vec{r}_0 = 60i$. b) The torque with respect to the point $\vec{r}_0 = 60i$

Phys 101 Final Exam H. Beker Fall '01

***Question* 1 :** For a particle of mass M the kinetic energy is given by $K(x) = \frac{A}{x^2}$.

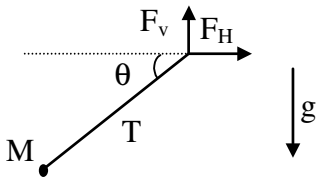
Calculate x(t) if x=0 when t = 0.

Phys 101 Final Exam H. Beker Fall '01

***Question* 2 :** Calculate the velocity $\vec{v}(t)$ and the angular momentum $\vec{L}(t)$, given that $\vec{r}(t) = At\hat{i} + B\hat{j} + Ct^2\hat{k}$ for a particle of mass M.

Phys 101 Final Exam H. Beker Fall '01

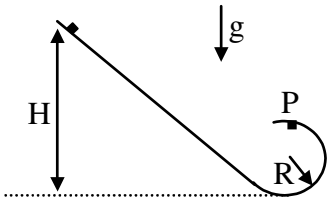
***Question* 3 :**A particle of mass M at the end of a cord of length R is released from horizontal position.



a) find the T as $T(\theta)$,
b) Find the forces $F_v(2)$ and $F_H(2)$ of the nail holding the cord.

Phys 101 Final Exam H. Beker Fall '01

***Question* 4 :** A small block of mass M slides along a frictionless loop-the- loop track. At what height H above the bottom of loop should the block be released so that the track exerts a force twice its weight on M at the top point P.



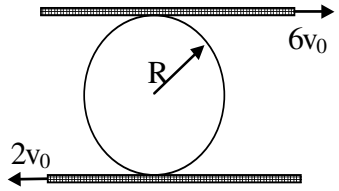
Phys 101 Final Exam H. Beker Fall '01

***Question* 5 :** A stick of mass M , length l lies on the x axis, with one end at the origin. Its linear mass density is given by $\lambda(x) = a + bx$. calculate in terms of a , b and l :

a) M
b) x_{cm}
c) the rotational inertia around the y-axis

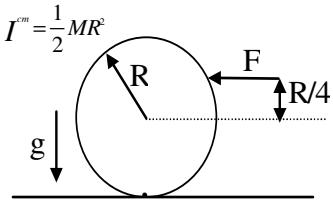
Phys 101 Final Exam H. Beker Fall '01

***Question* 6 :** A cylinder rolls without slipping between two planks with velocities as shown . Calculate V_{cm} and ω of cylinder. Indicate directions clearly.



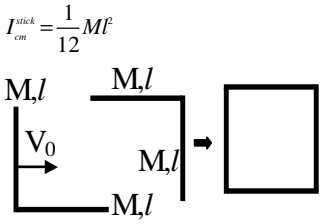
Phys 101 Final Exam H. Beker Fall '01

***Question* 7 :** A cylinder, initially at rest, is given a sharp impulse by a cue. The cue is held horizontally a distance R/4 above the centerline. The cylinder leaves the cue with a speed V_0. a) at that instant, find the net velocity of the bottom point P in terms of V_0 (Magnitude and direction). The disk skids for time T before it starts to roll. b) Find the magnitude and direction of the force of friction in terms of T , V_0 and M .



Phys 101 Final Exam H. Beker Fall '01

***Question* 8** An L shaped object constructed of two sticks each of mass M , length l , collides and sticks to an identical object on a frictionless, horizontal table. Calculate V_{cm} and ω of the square formed after this completely inelastic collision

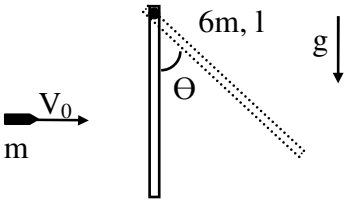


Phys 121 Final Exam ?? Fall '06

Question 1: Two masses 6 kg and 12 kg are connected by a meter long massless stick. Calculate I_{min} , the minimum value of I, through an axis $\perp$ to the stick.

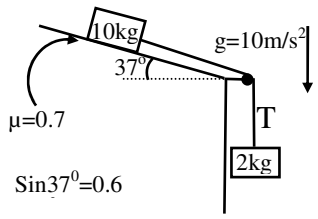
Phys 121 Final Exam ?? Fall '06

***Question* 3 :** A bullet of mass *m* embeds at the CM of a uniform stick of mass 6 m hanging vertically from a pivot. Calculate Θ_{max} in terms of g, v_0 and l .



Phys 121 Final Exam ?? Fall '06

***Question* 5 :** Calculate
a) The acceleration of the blocks
b) The tension of string

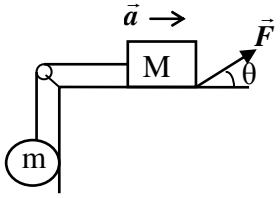


Phys 101 Final Y. SKARLATOS SPRING 08

Question 1: A particle moves along a path, and its speed increases with time. In which of the following cases are its acceleration and velocity vectors perpendicular everywhere along the path? (a) the path is circular (b) the path is straight (c) the path is parabola (d) never (e) always.

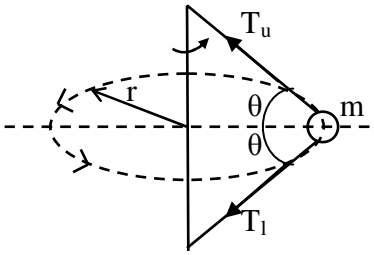
Phys 101 Final Y. SKARLATOS SPRING 08

Question 2: A block of mass *M* on a rough, horizontal surface is connected to a ball of mass *m* by a lightweight cord over a lightweight, frictionless pulley as shown in the figure. A force of magnitude *F* at an angle θ is applied to the block, which accelerates to the right. The coefficient of kinetic friction between the block and the surface is μ. Draw a free body diagram of the block, showing all the forces acting on it.



Phys 101 Final Y. SKARLATOS SPRING 08

***Question* 3 :** A ball of mass *m* is attached to a vertical rod by two strings as shown in the figure, and it rotates at constant speed *v*. Find the tension in the upper and lower strings.



Phys 101 Final Y. SKARLATOS SPRING 08

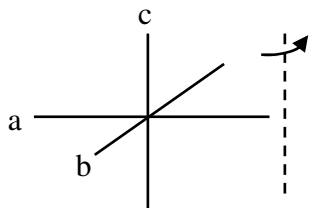
***Question* 4 :** An object is pulled by a force $F=15{,}000+10{,}000x-30{,}000x^2$ Newtons along a 1 meter track in the *x*-direction. The force is also directed in the *x*- direction. What is the total work done by the force?

Phys 101 Final Y. SKARLATOS SPRING 08

Question 5: A 3 kg particle has velocity (**3***i*+**4***j*) m/s and a 4 kg particle has velocity (**2***i*-3*j*) m/s. Find the velocity of their center of mass.

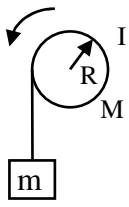
Phys 101 Final Y. SKARLATOS SPRING 08

Question 6: Calculate the moment of inertia of an object consisting of three identical, mutually perpendicular rods of mass *M* and length *L*, connected through their centers and rotating about an axis pasing through the end of one rod and parallel to another rod. ($I_{CM}=\frac{1}{12}ML^2$)

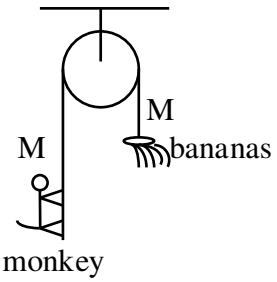


Phys 101 Final Y. SKARLATOS SPRING 08

Question 7: A wheel of radius *R*, mass *M*, and moment of inertia *I* is mounted on a frictionles, horizontal axle. A light cord wrapped around the wheel supports an object of mass *m*. Calculate the tension in the cord.



Phys 101 Final Y. SKARLATOS SPRING 08



Question 8: A light rope passes over a light, frictionless pulley. One end fastened to a bunch of bananas of mass *M*, and a monkey of mass *M* clings to the other end. The monkey climbs the rob in an attempt to reach the bananas. Will the monkey reach the bananas before they get tangled in the pulley? Explain your answer.

Phys 121 Final M. Mungan SPRING 08

Question 1: (Two questions) Your answers must be short but to the point!!!
a) If global warming continues over the next one hundred years, it is likely that some polar ice will melt and the water will be distributed closer to the equator. How would that change the moment of inertia of the earth? Would the length of the day (one revolution) increase or decrease?
b) When alcohol (e.g. "Limon Kolonyası"), is rubbed on your body it lowers your skin temperature. Explain this effect.

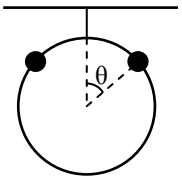
Phys 121 Final M. Mungan SPRING 08

Question 2: *N* men, each of mass *m*, stand on a railway car with a flat platform that has mass *M*. They jump off one end of the railway car with velocity *v* relative to the car. The car rolls in the opposite direction without friction.
a) What is the final velocity of the railway car, if all the men jump at the same time?

b) What is the final velocity of the railway car, if the men jump of one at the time?

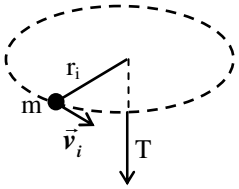
Hint: In part b, let V_i denote the velocity of the car after the i^{th} man has jumped off and try to find a relation between V_{i+1} and V_i. The answer can be left in the form of a sum of terms. You do not have to sum the series.

Phys 121 Final M. Mungan SPRING 08



Question 3: A ring of mass *M* hangs from a thread, and two beads of mass *m* slide on it without friction, as shown in the figure. The beads are released simultaneously from the top of the ring and slide down opposites sides. Show that the ring will start to rise if *m>3M/2* and find the angle at which this occurs.

Phys 121 Final M. Mungan SPRING 08



Question 4: A mass *m* is attached to a massless cord passing through a small hole in a frictionless horizontal table (See figure). The mass is initially orbiting with a speed v_i in a circle of radius r_i. The cord is then pulled slowly from below, decreasing radius to *r*.

a) What is the speed of *m* when the radius is *r?*
b) Find the tension *T* in the cord as a function of *r*.
c) Find the work *W* done in moving *m* from r_i to *r*.

Phys 101 Final N.İnci, A.Kaya, F.Neyzi FALL 08

Question 1: The position vector for a particle of mass *m* is given by $\vec{r} = b\sin\omega t\,\vec{i} + 2b\cos\omega t\,\vec{j}$. Calculate
a) acceleration $\vec{a}$

b) the angle between velocity $\vec{v}$ and acceleration $\vec{a}$ at $t = \dfrac{\pi}{2\omega}$

c) angular momentum $\vec{L}$

Phys 101 Final N.İnci, A.Kaya, F.Neyzi **FALL 08**

Question 2: A student stands in an elevator that is continuously accelerating upward with acceleration *A*. Her backpack is sitting on the floor next to the wall. The width of the elevator car is *L*. The student gives her backpack a quick kick at t=0, imparting to it speed v_0 and making it slide across the elevator floor. At time *t*, the backpack hits the opposite wall. Find the coefficient of kinetic friction μ between the backpack and the elevator floor in terms of v_0, *t, L,g,* and *A*.

Phys 101 Final N.İnci, A.Kaya, F.Neyzi **FALL 08**

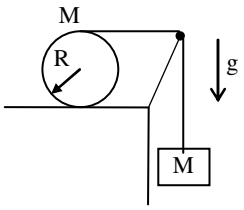
Question 3: A single conservative force acting on a particle varies as $\vec{F} = (-Ax + BX^2)\vec{i}$ N, where *A* and *B* are constants and *x* is in meters.

a) Calculate the potential energy function *U(x)* associated with this force, taking *U=0* at *x=0*.
b) Find the change in potential energy and the change in kinetic energy of the system as the particle moves from *x=1.00* m to *x=2.00* m.

Phys 101 Final N.İnci, A.Kaya, F.Neyzi **FALL 08**

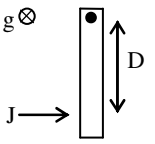
Question 4: A rod of mass *M* and length *L* has a mass density of $\lambda(x)=ax^2$, where *a* is a constant with appropriate dimensions. Find the centre of mass of the rod as a function of *L*.

Phys 101 Final N.İnci, A.Kaya, F.Neyzi **FALL 08**



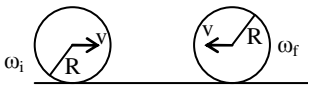
Question 5: A disk of mass *M* and radius *R* is connected to a block of mass *M* by a massless string over a frictionless pulley. The system is allowed to move and the disk rolls without slipping. Find the magnitude and the direction of the frictional force *f* between the disk and the floor.(I_{cm}=1/2 MR^2)

Phys 101 Final N.İnci, A.Kaya, F.Neyzi **FALL 08**



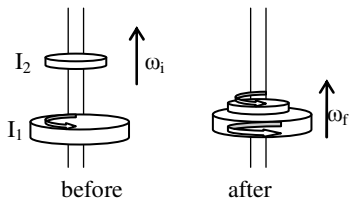
Question 6: A stationary uniform rod of mass *M* and length *L* is pivoted on a frictionless table from one end about a frictionless axle. Suddenly a horizontal pulse ***J*** is applied at a distance *D* from the pivot. Find a) ω, b) V_{CM}, c) the horizontal impulse reaction at the pivot. (I_{pivot}=1/3 ML^2)

Phys 101 Final N.İnci, A.Kaya, F.Neyzi **FALL 08**



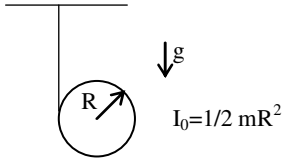
Question 7: A disk is released with *v* and ω_i observed to slip for a while and eventually rolls without slipping in the opposite direction. a) Is there a conserved quantity? b) Find, magnitude and direction, in terms of *v* and R.

Phys 101 Final N.İnci, A.Kaya, F.Neyzi **FALL 08**



Question 8: A cylinder with moment of inertia I_1 rotates about a vertical, frictionless axle with angular speed. A second cylinder, this one having moment of inertia I_2 and initially not rotating, drops onto the first cylinder. Because of friction between the surfaces, the two eventually reach the same angular speed a) Calculate ω_f. b) Calculate the ratio of the final rotational kinetic energy to the initial rotational kinetic energy.

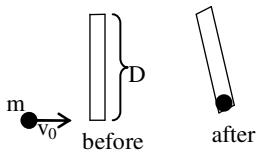
Phys 121 Final A.Sevgen **FALL 08**



Question 1: A massless string is wound around a uniform disk of radius *R* and mass *m*. The disk is released from rest with the string vertical and its top tied to the fixed ceiling. Find a) the acceleration of the center of mass, b) the tension in the string, c) the speed of the center of mass after the disk has descended through a distance *h*.

Phys 121 Final A.Sevgen FALL 08

Question 2: A thin rod of mass *m* and length D rests on a frictionless surface, and is free to move. A particle, also of mass *m*, and with a velocity v_0 directed perpendicularly to the rod, strikes and sticks to the rod immediately, making a completely inelastic collision.



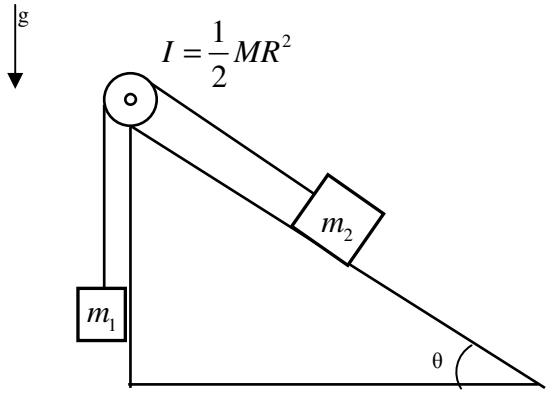
a) What is the velocity of the center of mass of the system *S*=[*rod*+*particle*] before and after the collision?
b) What is the angular momentum $L^{[S]}_{CM,i}$ of the system [S] about its center of mass just before the collision?
c)What is the angular momentum $L^{[S]}_{CM,f}$ of the system [S] about its center of mass just after the collision?
d) How much kinetic energy is lost in the collision?
(Hint: Thin rod has moment of inertia $I_0 = (1/12)mD^2$ about its own CM.)

Phys 101 Final L. Akant, T. Turgut SPRING 09

Question 1: A projectile is fired from the origin with initial velocity v_0 which makes an angle θ with the horizontal. Find the angular momentum of the projectile relative to the origin as it passes the highest point of its trajectory.

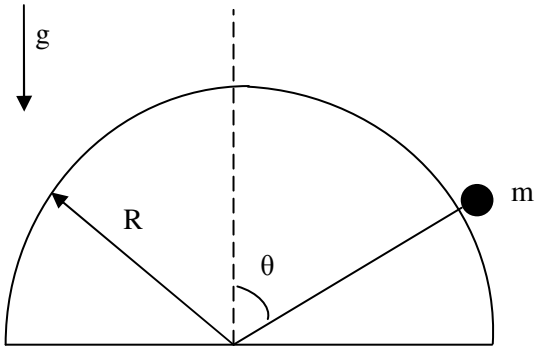
Phys 101 Final L. Akant, T. Turgut SPRING 09

Question 2: As shown in the figure, two blocks of masses m_1 and m_2 are connected by a massless string which passes over a uniform pulley of mass M and radius R. The angle of the inclined plane is θ. Assume that the block of mass m_1 is moving up the inclined plane and that string is not slipping over the pulley. Determine the acceleration of the system. The moment of inertia of disk of mass M and radius R around its center of mass is $\frac{1}{2}MR^2$. The inclined plane is fixed and is surface is frictionless.



Phys 101 Final L. Akant, T. Turgut SPRING 09

Question 3: A small block of mass m which is initially at rest on top of a fixed frictionless spherical surface of radius R starts sliding down the surface. Find the angle θ at which the block loses contact with the surface of the sphere.



Phys 101 Final L. Akant, T. Turgut SPRING 09

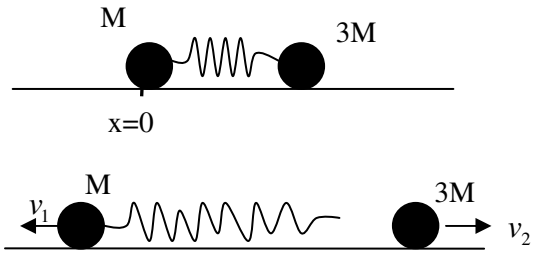
Question 4 **:** A constant horizontal force **F** is applied to the rim of a uniform disk of mass M and radius R as shown in the figure. Assuming the disk is rolling without slipping find
a) the acceleration of the center of mass,
b) the force of friction, and
c) the velocity of the center of mass after the disk is rolled through a distance d. The moment of inertia of a disk of mass M and radius R around its center of mass is $\frac{1}{2}MR^2$.

Phys 101 Final L. Akant, T. Turgut **SPRING 09**

Question 5: Two small blocks of masses M and 3M stand on a horizontal, frictionless surface. A light spring of equilibrium length L is attached to one of them, and the blocks are pushed together compressing the spring by a distance d. Assume the block of mass M is initially at the origin of the x-axis. The system is then released from rest. Find:

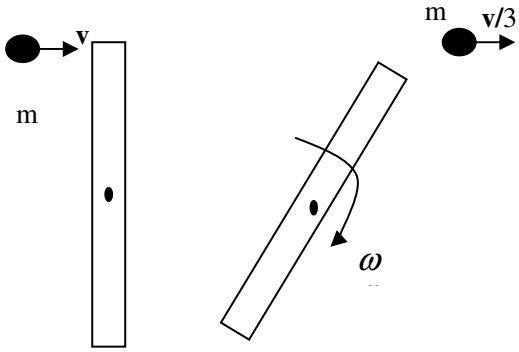
a) Final velocities of the blocks , and

b) The position of the center of mass as a function of time.



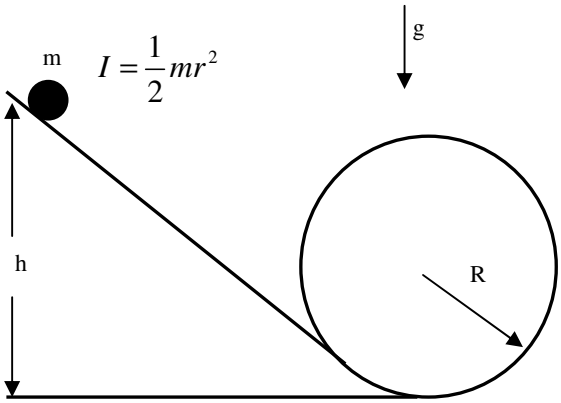
Phys 101 Final L. Akant, T. Turgut **SPRING 09**

Question 6: A uniform rod of length L and mass M is pivoted and free to rotate around its center of mass. A bullet of mass m and horizontal velocity **v** hits the upper edge of the rod and continues with horizontal velocity **v**/3. Find the angular velocity of the rod. Is linear momentum conserved ? The moment of inertia of a rod of mass M and length L around its center of mass is $\frac{1}{12}ML^2$



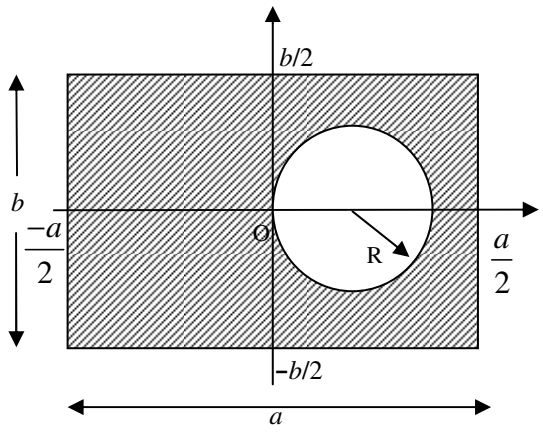
Phys 101 Final L. Akant, T. Turgut **SPRING 09**

Question 7: A uniform disk of mass m and radius r rolls without slipping along the track shown in the figure. It starts from rest with the lowest point of the disk at height h above the bottom of the loop of radius R. What is the minimum value of h (in terms of R) such that the disk completes the loop. Assume r << h and r << R. The moment of inertia of a disk of mass m and radius r around its center of mass is $\frac{1}{2}mr^2$



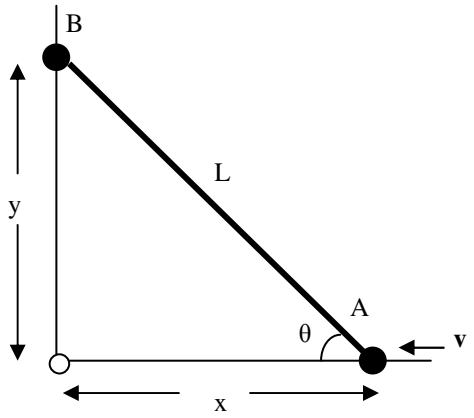
Phys 101 Final L. Akant, T. Turgut **SPRING 09**

Question 8: Find the center of mass of the uniform rectangular plate of mass M and dimension a and b with a circular hole of radius r inside. See the figure



Phys 121 Final F.Neyzi Spring '09

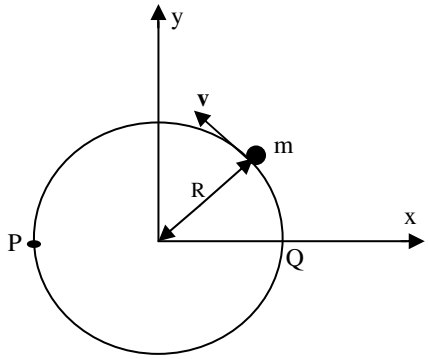
Question 1: Two objects A and B, are connected by a rigid rod that has length L. The objects slide along perpendicular guide rails. If A slides to the left with a constant speed **v**, find the velocity of B when θ=β.



Phys 121 Final F.Neyzi Spring '09

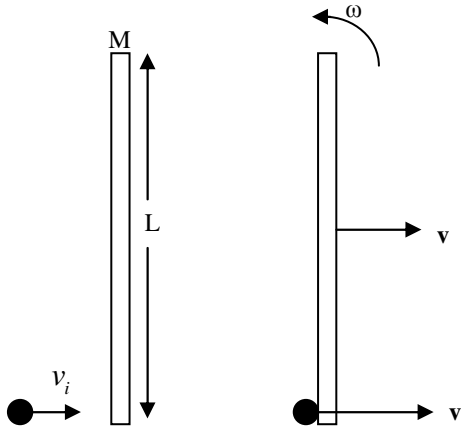
Question 2: A particle of mass m moves in a circle of radius R at a constant speed **v** as shown. If the motion begins at point Q at time t=0, determine the angular momentum of the particle about point P as a function of time .

.



Phys 121 Final F.Neyzi Spring '09

Question 3: A very small ball of mass m moves with speed v_i and strikes one of a stationary rod of mass M and length L lying flat on a frictionless surface. Assume the collision is elastic. What is the M/m ratio if the translational speed of the center of the stick and the speed of the ball are the same after the collision?

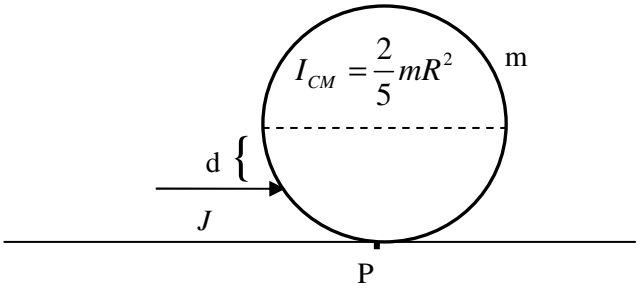


$$I_{CM} = \frac{1}{12} ML^2$$

Phys 121 Final F.Neyzi Spring '09

Question 4 : An impulse *J* is delivered to a ball of mass m and radius R at a distance d from its center. Find the velocity of the center of mass, angular speed and the net linear velocity of the contact point P.

$$I_{CM} = \frac{1}{12} ML^2$$

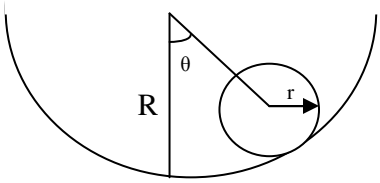


Phys 121 Final F.Neyzi Spring '09

Question 5 : A solid disk of radius r rolls without slipping in a cylindrical trough of radius R. For small displacements from the equilibrium,
a) Write down the total energy of the disk at any angle θ from equilibrium.
b) Obtain the equation of motion.

$$I_{CM} = \frac{mr^2}{2}$$

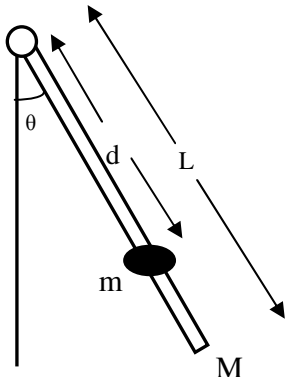
$$\ln(1+x) = x - \frac{1}{2}x^2 \ldots \quad , \quad \cos(x) = 1 - \frac{x^2}{2} \ldots \quad , \quad \sin(x) = x - \frac{x^3}{3!}$$



Phys 121 Final F.Neyzi Spring '09

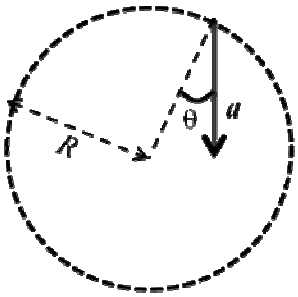
Question 6 **:** A uniform rod of mass M and length L is pivoted about one end and oscillates in a vertical plane.

a) Derive the equation of motion by taking torques about the pivot
b) Where should one place a mass m so that the frequency of the harmonic motion remains unchanged?



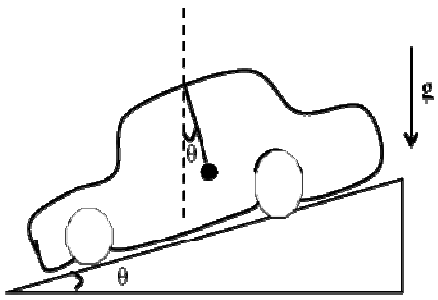
Phys 101 Final N.İnci , F.Neyzi Fall '10

Question* 1 :** The total acceleration ***a of a particle moving clockwise in a circle of radius *R* at a certain instant of time is shown in the figure. At this instant, find (a) the radial acceleration, (b) the speed of the particle, and (c) its tangential acceleration.



Phys 101 Final N.İnci F.Neyzi Fall '10

***Question* 2 :** A car accelerates down a hill, going from rest to velocity v in time *t*. During the acceleration, a toy of mass *m* hangs by a string from the car's ceiling. The acceleration is such that the string remains perpendicular to the ceiling. Determine (a) the angle θ, and (b) the tension in the string, in terms of *m*, *g*, v, and *t*.

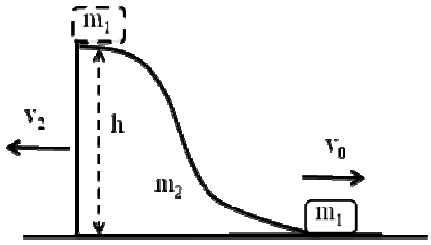


Phys 101 Final N.İnci F.Neyzi Fall '10

***Question* 3 :** A potential energy function for a system in which a two-dimensional force acts is of the form $U(x,y) = 3x^3y - 7x$.
(a) Find the force that acts at the point (*x*, *y*).
(b) Find the work done by this force as it moves from the point (0, 0) m to the point (1, 1) m.
(c) Is this force conservative? Why?

Phys 101 Final N.İnci F.Neyzi Fall '10

***Question* 4 :** A small block of mass m_1 is released from rest at the top of a curve-shaped frictionless wedge of mass m_2, which sits on a frictionless horizontal surface as shown in the figure. When the block leaves the wedge, its velocity is measured to be v_0 with respect to an outsider observer, as in figure.

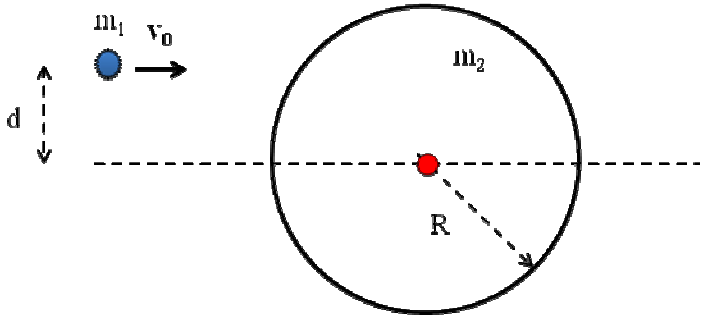


(a) What is the velocity of the wedge after the block reaches the horizontal surface?

(b) What is the height *h* of the wedge?

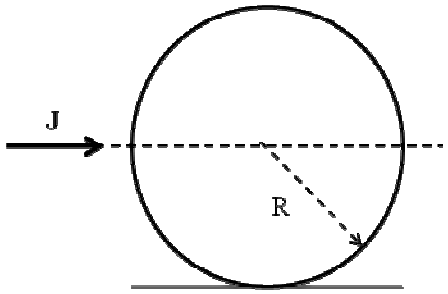
Phys 101 Final N.İnci F.Neyzi Fall '10

***Question* 5 :** A wad of sticky clay with mass m_1 and velocity v_0 is fired at a solid cylinder of mass m_2 and radius R. The cylinder is initially at rest and is mounted on a fixed horizontal axle that runs through its center of mass. The line of motion of the projectile is perpendicular to the axle and at a distance $d<R$ from the center. Find the angular speed of the system just after the clay strikes and sticks to the surface of the cylinder. [$I_{CM} = \frac{1}{2} m_2 R^2$]



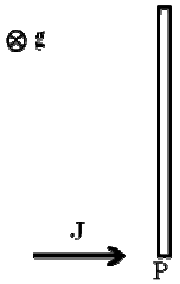
Phys 101 Final N.İnci F.Neyzi Fall '10

***Question* 6 :** A disk of mass M is hit with a sharp impulse **J** with a cue at the center as shown in the figure. The ball leaves the cue and eventually rolling starts. Coefficient of kinetic friction between the disk and the floor is μ. Find (a) the magnitude and direction for the force of friction, (b) the angular acceleration α until rolling starts, (c) the acceleration of the center of mass a_{CM}, and (d) time t it takes for the disk to start rolling with no slipping. [$I_{CM} = \frac{1}{2} MR^2$]



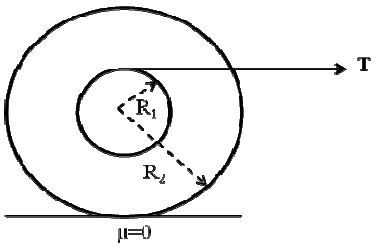
Phys 101 Final N.İnci F.Neyzi Fall '10

***Question* 7 :** A stick of length L and mass M lies on a frictionless horizontal table. A sharp impulse **J** is perpendicularly applied at one of the ends as shown in the figure. Find the followings just after the impulse: (a) the velocity of the center of mass of the stick, (b) the angular speed of the stick about its center of mass, and (c) the net velocity of one of the end points P of the stick as shown in the figure. [$I_{CM} = \frac{1}{12} ML^2$]



Phys 101 Final N.İnci F.Neyzi Fall '10

***Question* 8 :** What is the moment of inertia I of the object shown if it immediately starts rolling without slipping on ice (μ=0) when a force **T** is applied?



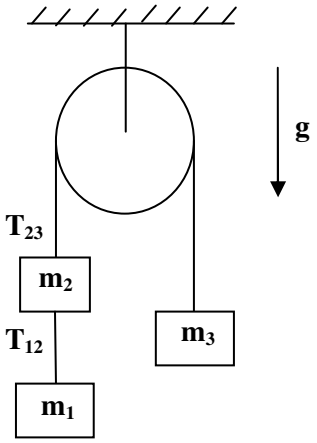
Phys 101 Final H. Beker, B. Ünlü **SPRING 10**

***Question* 1 :** Given $\vec{A} = 1\hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{B} = 6\hat{i} + 5\hat{j} + 4\hat{k}$, $\vec{C} = 7\hat{i} + 8\hat{j} + 9\hat{k}$

Calculate: **i)** $\vec{A} \times \vec{B}$, **ii)** $(\vec{A} \times \vec{B}) \cdot \vec{C}$

Phys 101 Final H. Beker, B. Ünlü **SPRING 10**

***Question* 2 :** Calculate the tension $\mathbf{T_{12}}$ and $\mathbf{T_{23}}$ for the Atwood machine if the pulley is massless and frictionless.



Phys 101 Final H. Beker, B. Ünlü **SPRING 10**

***Question* 3 :** A disk of mass M and radius R lies on the x –y plane with its center at the origin. Its surface mass density is given by $\sigma(r) = Ar^2$

a) Calculate **A** in terms of M and R

b) Calculate I_{CM} around z-axis, in terms of M and R.

Phys 101 Final H. Beker, B. Ünlü **SPRING 10**

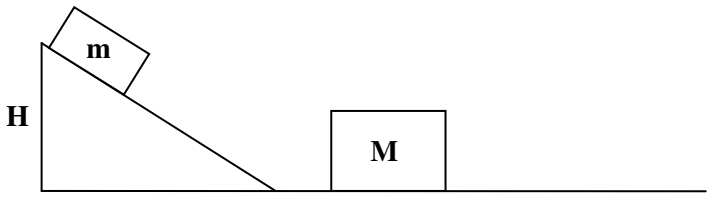
***Question* 4 :** A uniform stick of mass M, length *l* and $I_o = Ml^2/3$ is pivoted at the top end. A bullet of mass m and speed v_0 embeds at the bottom end. For the stick & bullet system calculate:

i) The angular velocity ω right after the collision,

ii) The minimum bullet E_{min} so that the system rises to horizontal position.

Phys 101 Final H. Beker, B. Ünlü **SPRING 10**

***Question* 5 :** A block of mass m slides down an incline which is H meter high, and then hits a block of mass M which is at rest on a horizontal surface (assume M > m). The collision is elastic and friction can be ignored.



a) Determine the speeds of the blocks after collision.

b) Find the maximum height h of the mass m can climb back up the incline.

Phys 101 Final H. Beker, B. Ünlü **SPRING 10**

***Question* 6 :** A wheel with diameter R, is rotating around a fixed axis such that its angular position is given by

$$\theta = 12t^2 - 2t^3$$

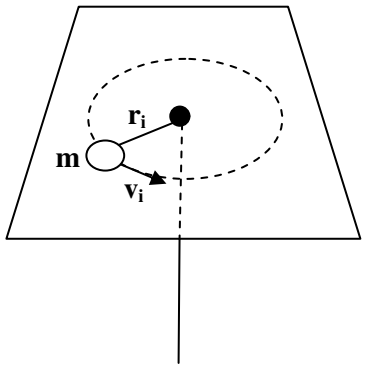
a) Find the maximum angular speed of the wheel.

b) At what time t should the driving forces be removed from the wheel does not reverse its direction of rotation.

Phys 101 Final H. Beker, B. Ünlü SPRING 10

***Question* 7 :** An elevator is moving upwards with a constant acceleration a_0. A homogeneous rod with mass m and length *l* is fastened to the ceiling of the elevator through one end ($I = ml^2/3$). The rod is released from rest in the horizontal position. Determine the angular velocity of the rod just when it is vertical.

Phys 101 Final H. Beker, B. Ünlü SPRING 10

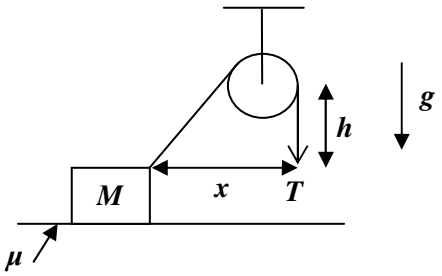


***Question* 8 :** A mass m is attached to a string passing through a small hole in a frictionless, horizontal surface. The mass initially rotating with $\mathbf{v_i}$ in a circle of radius $\mathbf{r_i}$. The string is then slowly pulled from below, decreasing the radius of the circle to $r = 2r_i/3$.

a) What is the final speed of the mass?

b) How much work done by the hand in pulling the cord?

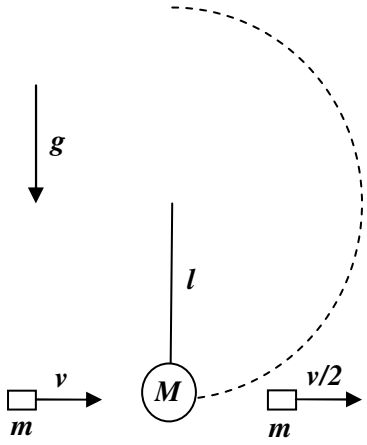
Phys 121 Final F. Neyzi Spring 10



***Question* 1 :** A block of mass M is accelerated across a rough surface by a light cord passing over a small pulley. The tension in the cord is T and the pulley is a distance h above the top of the block. The coefficient of friction is μ.

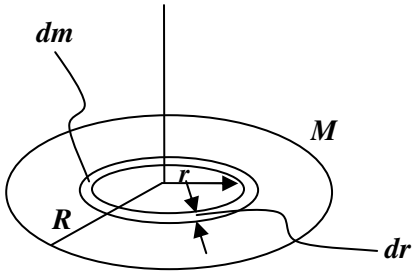
a. Draw afree-body diagram for M.
b. Find the acceleration of M as a function of x.

Phys 121 Final F. Neyzi Spring 10



***Question* 2 :** A bullet of mass m and speed v passes completely through a pendulum bob of mass M. The bullet emerges with speed v/2. The pendulum is suspended by string of length l. What is the minimum value of v such that the bob will swing through a complete circle?

Phys 121 Final F. Neyzi Spring 10



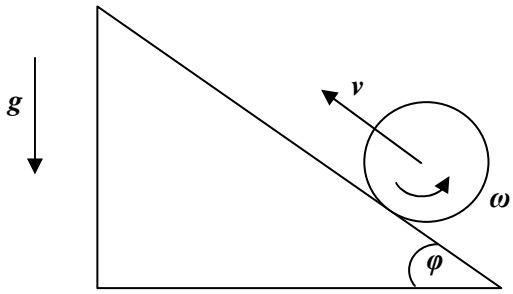
***Question* 3 :** We want to find the moment of inertia of a disk of mass M and radius R about an axis through its center and perpendicular to its surface. Consider a mass element dm in the shape of a ring of radius r with width dr.

a. What is the dm of this element expressed as a fraction of the total mass M of the disk?
b. What is the moment of inertia dI of this element?
c. What is the I of the entire disk?

Phys 121 Final F. Neyzi Spring 10

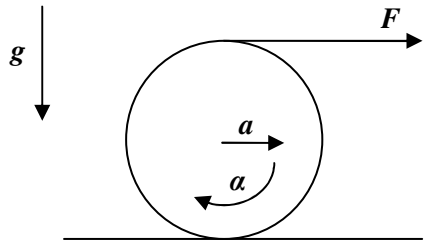
***Question* 4 :** A disk of mass M and radius R rolls up an incline of angle φ. Find the magnitude and direction of

a. The acceleration of the center of mass, a,
b. The angular acceleration, α,
c. The force of friction.



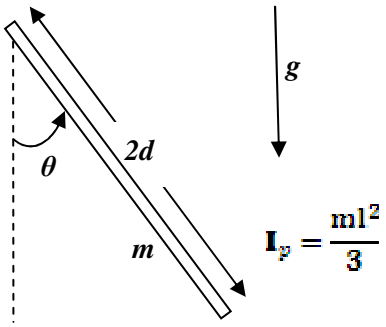
Phys 121 Final F. Neyzi Spring 10

***Question* 5 :** A spool of wire of mass M and radius R is unwound under a constant force F. Assuming the spool is a uniform solid cylinder that does not slip, and assuming that it starts from rest, what is the speed of its center of mass after it has rolled through a distance d? Is the total kinetic energy equal to 2Fd or Fd? Explain.



Phys 121 Final F. Neyzi Spring 10

***Question* 6 :** A uniform rod of mass m and length 2d is pivoted at one end. Obtain the equation motion for small θ.

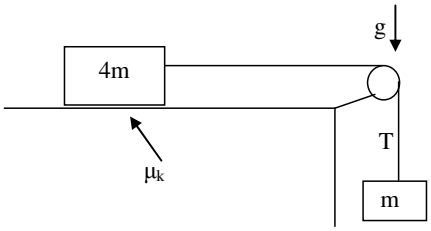


Phys 101 Final G. Aktaş, H. Beker, E. Özcan SPRING 11

1. In the figure shown below,

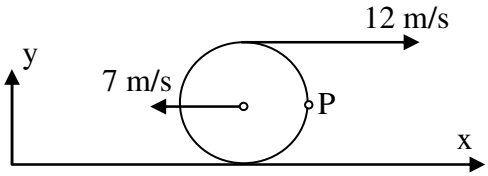
a) Calculate the tension T if $\mu_k = 0.2$

b) Calculate the tension T if $\mu_k = 0.4$



Phys 101 Final G. Aktaş, H. Beker, E. Özcan SPRING 11

2. A wheel rotates and slips as it moves along the x axis as shown. Calculate the velocity vector of point P .



Phys 101 Final G. Aktaş, H. Beker, E. Özcan SPRING 11

3. A particle of mass m=5 has a velocity **v**=(1,0,2). If its position vector is given by **r**=(3,-1,0), compute:
   (a) The angular momentum vector, **L**, of the particle.
   (b) The component of **L** along the direction of unit vector **u**=(0,3/5,4/5).

All quantities in the problem are measured in MKS units. Clearly indicate the units of your answers.

Phys 101 Final G. Aktaş, H. Beker, E. Özcan **SPRING 11**

4. A particle moves on a circular track of radius 0.5 ; the angular displacement is given by $\theta = 2t^3 + 4t$. Calculate at $t = 1$:

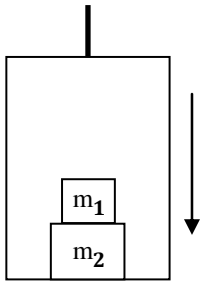
a) Radial acceleration : $a_R = ?$

b) Tangential acceleration : $a_T = ?$

(All quantities in the problem are measured in MKS units. Clearly indicate the units of your answers.)

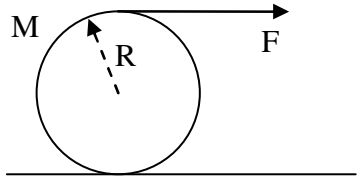
Phys 101 Final G. Aktaş, H. Beker, E. Özcan **SPRING 11**

5. Two boxes m_1 and m_2 are placed on top of each other in an elevator. If the elevator is accelerating down with a=g/3, what is the contact force between the floor and mass m_2?



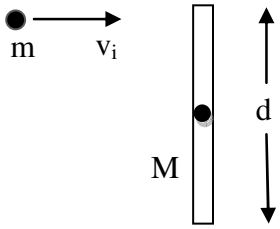
Phys 101 Final G. Aktaş, H. Beker, E. Özcan **SPRING 11**

6. A cylinder of mass M and radius R is pulled horizontally with a constant horizontal force F applied by a handle attached to the axle. If it rolls without slipping, find the acceleration and the frictional force. $I=(1/2)MR^2$



Phys 101 Final G. Aktaş, H. Beker, E. Özcan **SPRING 11**

7. A projectile of mass m moves to the right with a speed v_i. The projectile strikes and sticks to the end of a stationary rod of mass M, length d, pivoted about a frictionless axle perpendicular to the page through O. What is the angular speed ω after the collision? ($I_{cm}=Md^2/12$)



Phys 101 Final G. Aktaş, H. Beker, E. Özcan **SPRING 11**

8. A cord is wrapped around a pulley that is shaped like a disk of mass m and radius r. The cord's free end is connected to a block of mass M. The block starts from rest and then slides down an incline that makes an angle θ with the horizontal as shown in the figure. The coefficient of kinetic friction between the block and the incline is μ. Determine the kinetic energies of the mass M and the pulley in terms of **m, M, r, θ, d** and **g** after the block has moved down the incline a distance d.