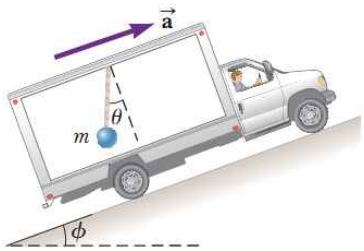
SUNG KYUN KWAN UNIVERSITY(SKKU)

2018학년도 학점취득특별시험

학기 Semester	2018 년	1 학기	시험구분 Exam Type	학점취득특별시험	시험시간 Exam Time	90 분/Minutes
학과/계열 Dept./Division			학번 Student PIN		성명 Name	
과목명 Subject	일반물리학1		학수번호 Course Code	GEDB008	분반 Section Number	
수업정보 Class Time	요일 Day	시간 Time	담당교수 Instructor	채경육	감독자확인 Proctor's Signature	
유의사항 Note	1. Electronic calculator is not allowed! 2. Answer the questions in English or Korean.					

[1][25 points]

A truck is moving with constant acceleration a up a hill that makes an angle ϕ with the horizontal as in the figure. A small sphere of mass m is suspended from the ceiling of the truck by a light cord. If the pendulum makes a constant angle θ with the perpendicular to the ceiling, what is a?



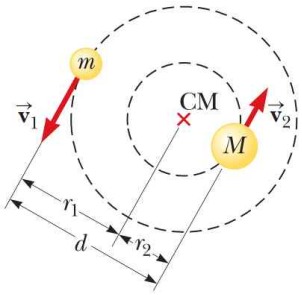
[2][25 points]

Two stars of masses M and m, separated by a distance d, revolve in circular orbits about their center of mass.

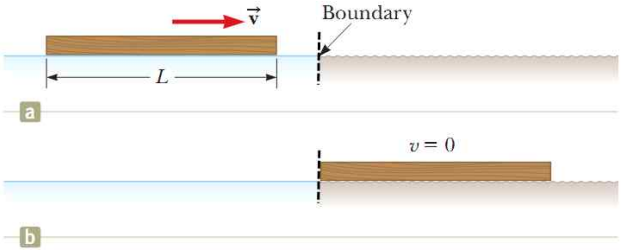
Show that each star has a period given by

$$T^2 = \frac{4\pi^2 d^3}{G(M+m)}.$$

Notice that the position of the center of mass is fixed in space during the motions of the stars.



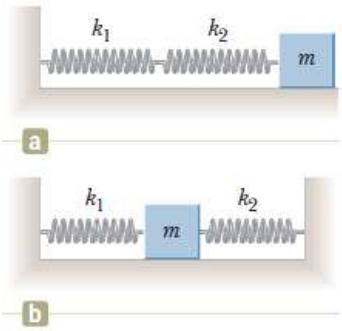
[3][25 points]



A uniform board of length L is sliding along a smooth, frictionless, horizontal plane as shown in the Figure [a] above. The board then slides across the boundary with a rough horizontal surface. The coefficient of kinetic friction between the board and the second surface is μ_k.

(a) Find the acceleration of the board at the moment its front end has traveled a distance x beyond the boundary.

(b) The board stops at the moment its back end reaches the boundary as shown in the Figure [b] above. Find the initial speed v of the board.



[4][25 points]

A block of mass m is connected to two springs of force constants k_1 and k_1 in two ways as shown in the figure. In both cases, the block moves on a frictionless table after it is displaced from equilibrium and released. Show that in the two cases the block exhibits simple harmonic motion, and find the periods for both cases.

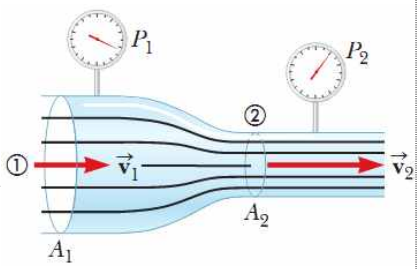
SUNG KYUN KWAN UNIVERSITY(SKKU)

2017학년도 학점취득특별시험

학기 Semester	2017 년	1 학기	시험구분 Exam Type	학점취득특별시험	시험시간 Exam Time	90 분/Minutes
학과/계열 Dept./Division			학번 Student PIN		성명 Name	
과목명 Subject	일반물리학1		학수번호 Course Code	GEDB008	분반 Section Number	
수업정보 Class Time	요일 Day	시간 Time	담당교수 Instructor	채경육	감독자확인 Proctor's Signature	
유의사항 Note	1. Electronic calculator is not allowed!! 2. Answer the questions in English or Korean.					

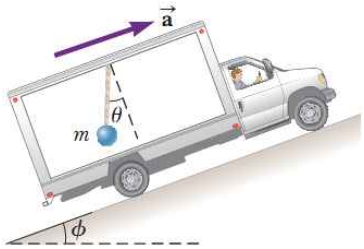
[1][25 points]

The horizontal constricted pipe illustrated in the figure can be used to measure the flow speed of an incompressible fluid. Let ρ be the density of the fluid. Determine the flow speed at point ② of the figure if the pressure difference $P_1 - P_2$ is known. (i.e. express v_2 in terms of P_1, P_2, A_1, A_2 and ρ)



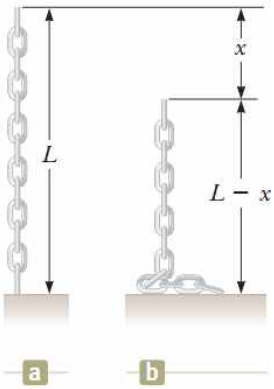
[2][25 points]

A truck is moving with constant acceleration a up a hill that makes an angle ϕ with the horizontal as in the figure. A small sphere of mass m is suspended from the ceiling of the truck by a light cord. If the pendulum makes a constant angle θ with the perpendicular to the ceiling, what is a?

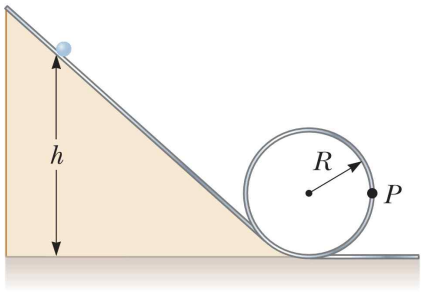


[3][25 points]

A chain of length L and total mass M is released from rest with its lower end just touching the top of a table as shown in the figure a. Find the force exerted by the table on the chain after the chain has fallen through a distance x as shown in figure b. (Assume each link comes to rest the instant it reaches the table.)



[4][25 points]



A solid sphere 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 sphere at height h above the bottom of the loop of radius R, much larger than r ($R \gg r$).

(a) What is the minimum value of h (in terms of R) such that the sphere completes the loop? Use $I = \frac{2}{5}mr^2$ for the sphere.

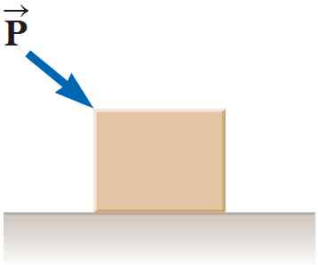
(b) What is the vertical force component on the sphere at the point P if $h = 3R$?

SUNG KYUN KWAN UNIVERSITY(SKKU)

2016학년도 학점취득특별시험

학기 Semester	2016 년	1 학기	시험구분 Exam Type	학점취득특별시험	시험시간 Exam Time	90 분/Minutes
학과/계열 Dept./Division			학번 Student PIN		성명 Name	
과목명 Subject	일반물리학1		학수번호 Course Code	GEDB008	분반 Section Number	
수업정보 Class Time	요일 Day	시간 Time	담당교수 Instructor	채경육	감독자확인 Proctor's Signature	
유의사항 Note	1. Electronic calculator is not allowed!! 2. Answer the questions in English or Korean.					

[1][25 points]

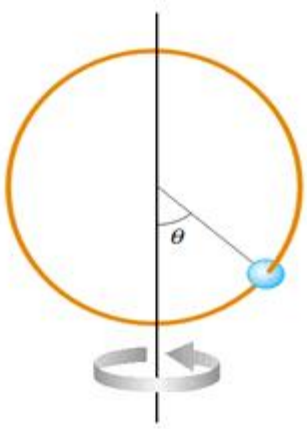


A crate of weight F_g is pushed by a force $\vec{P}$ on a horizontal floor as shown in the figure. The coefficient of static friction is μ_s, and $\vec{P}$ is directed at angle θ below the horizontal.

(a) Find the minimum value of P that will move the crate.

(b) Find the condition on θ in terms of μ_s for which motion of the crate is impossible for any value of P.

[2][25 points]



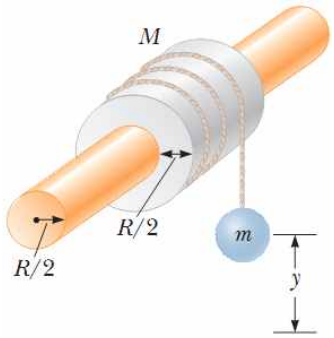
A single bead can slide with negligible friction on a stiff wire that is bent into a circular loop of radius R, as shown in figure. The circle is always in a vertical plane and rotates steadily about its vertical diameter with a period of T. The position of the bead is described by the angle θ that the radial line, from the center of the loop to the bead, makes with the vertical.

(a) [10 points] At what angle up from the bottom of the circle can the bead stay motionless relative to the turning circle? Assume $\theta > 0^\circ$ and $4\pi^2 R > g T^2$. Write your answer in terms of R, g, and T.

(b) [5 points] Is it possible for the angle θ to have higher value than 90°? Assume $\theta < 180^\circ$.

(c) [10 points] What happens when $4\pi^2 R < g T^2$?

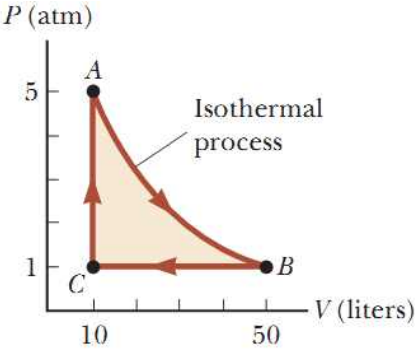
[3][25 points]



A uniform, hollow, cylindrical spool has inside radius $R/2$, outside radius R, and mass M. It is mounted so that it rotates on a fixed, horizontal axle. A counterweight of mass m is connected to the end of a string wound around the spool. The counterweight falls from rest at $t = 0$ to a position y at time t. Show that the torque due to the friction forces between spool and axle is

$$\tau_f = R\left[m\left(g - \frac{2y}{t^2}\right) - M\frac{5y}{4t^2}\right]$$

[4][25 points]



A 1.00−mol sample of an ideal monatomic gas is taken through the cycle shown in the figure. The Process A→B is a reversible isothermal expansion. Calculate (a) the net work done by the gas, (b) the energy added to the gas by heat, (c) the energy exhausted from the gas by heat, and (d) the efficiency of the cycle.

SUNG KYUN KWAN UNIVERSITY(SKKU)

2015학년도 학점취득특별시험

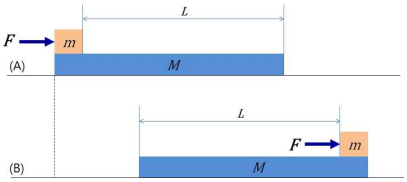
성 적

과목명	일반물리학1	학위 과정	학사	담당교수명	황정식

학부(대) 전공(학과) 학년 학번	성 명		검 인	

1. 전자계산기 사용 불가
2. 답안은 한글 또는 영문으로 작성

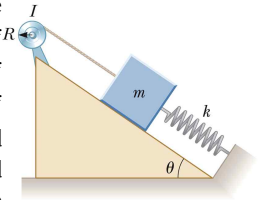
1. **[25 points]** A block of mass m is on the edge of a block of mass M [see Figure (A)]. The coefficient of kinetic friction between the two blocks is μ_k and the block M is on a frictionless surface. A constant horizontal force F is applied to the block m, which was at rest before applying the force. g is the gravitational acceleration.



(a) (15 pts) in what time interval will the block m make it to the right side of the block M [shown in Figure (B)]? Ignore the static friction between the two blocks.

(b) (10 pts) How far does the block M move during the time interval?

2. **[25 points]** The reel shown in the Figure has radius R and moment of inertia I. One end of the block of mass m is connected to a spring of force constant k and the other end is fastened to a cord wrapped around the reel. The reel axle and the incline are frictionless. g is the gravitational acceleration.

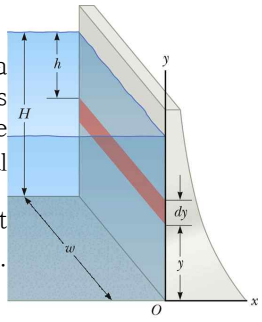


(a) (15 pts) The reel is wound counterclockwise so that the spring stretches a distance d from its unstretched position and the reel is then released from rest. Find the speed of the block when the spring is again unstretched.

(b) (10 pts) If the reel is wound clockwise so that the spring suppresses a distance d from its unsuppressed position and the reel is then released from rest. Describe the motion of the block.

(다음 장에 계속)

3. **[25 points]** Water is filled to a height H behind a dam of width w as shown in the Figure. ρ_w and g are the density of water and the gravitational acceleration, respectively.

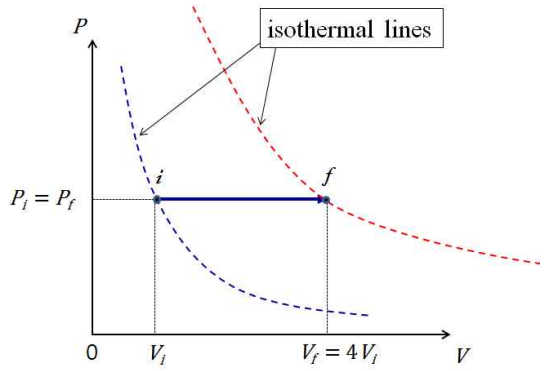


(a) (10 pts) Determine the resultant force exerted by the water on the dam.

(b) (10 pts) Determine the total torque exerted by the water about a horizontal axis through O.

(c) (5 points) Show that the effective line of action of the total force exerted by the water is at a distance $H/3$ above O.

4. **[25 points]** A sample consisting of n mole of an ideal gas undergoes a reversible isobaric expansion from volume V_i to $V_f = 4\,V_i$ as shown in the Figure below.



(a) (15 pts) Find the change in entropy of the gas by calculating $\int_i^f \frac{dQ}{T}$, where $dQ = nC_P dT$. Here C_P is the molar specific heat at constant pressure.

(b) (10 pts) How much heat is needed for the isobaric expansion process from i to f states?

SUNG KYUN KWAN UNIVERSITY(SKKU)

2014학년도 학점취득특별시험

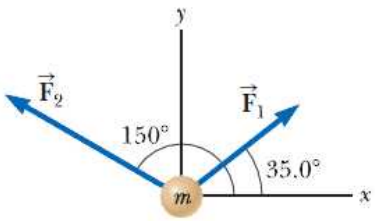
성 적

과목명	일반물리학1	학위 과정	학사	담당교수명	강대준

학부(대) 전공(학과) 학년 학번	성 명		검 인	

1. 전자계산기 사용 불가
2. 답안은 한글 또는 영문으로 작성

1. [25pts] Two constant forces act on an object of mass $m = 10.00\,\text{kg}$ moving in the $x-y$ plane as shown in the Figure below.



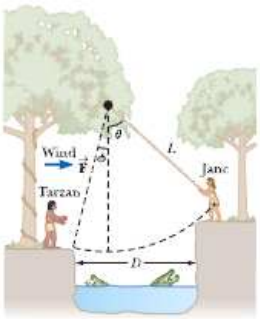
Force $\overrightarrow{F_1}$ is 25.0 N at 35°, and force $\overrightarrow{F_2}$ is 42.0 N at 150°. At time t = 0, the object is at the origin and has velocity $(4.00\hat{i}+2.50\hat{j})$ m/s.

(a) (5 points) Find the total force exerted on the object.

(b) (5 points) Find the object's acceleration. Now, considering the instant t = 5.00 s, (c) (5 points) the object's velocity, (d) (5 points) its position, and (e) (5 points) its kinetic energy from $\frac{1}{2}mv_f^2$.

2. [25pts] Jane, whose mass is 50.0 kg, needs to swing across a river (having width D) filled with person-eating crocodiles to save Tarzan from danger. She must swing into a wind exerting constant horizontal force $\vec{F}$, on a vine having length L and initially making an angle θ with the vertical (as shown in the figure below).

Take D = 50.0 m, F = 100 N, L = 40.0 m, and $\theta = 60^\circ$.

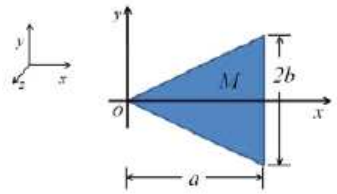


(a) (10 points) With what minimum speed must Jane begin her swing to just make it to the other side?

(b) (15 points) Once the rescue is complete, Tarzan and Jane must swing back across the river. With what minimum speed must they begin their swing? Assume Tarzan has a mass of 100.0 kg.

(다음 장에 계속)

3. **[25pts]** An isosceles triangle is on the $x-y$ plane with its symmetric axis along the positive x direction and one of its corners on the axis located at origin (as shown in the figure). a and $2b$ are the height and base of the triangle, respectively. The mass, M, of the triangle is uniformly distributed. (Hint: The moment of inertia of a rod of mass m and length L about the axis perpendicular to the rod and through the center of mass is given by $I=\frac{1}{12}mL^2$.)

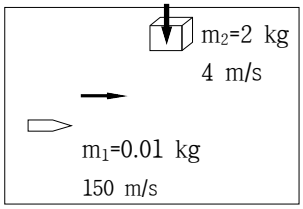


(a) (15 points) Calculate the moment of inertia of the triangle about the z - axis. Express the result in terms of M, a, and b.

(b) (5 points) Using the result in (a), identify (or calculate) the moment of inertia of the triangle about the x- axis and y - axis.

(c) (5 points) Show as a special case of (a) that the moment of inertia of an equilateral triangle with its side c about the z - axis is given by $I=\frac{5}{12}Mc^2$.

4. **[25pts]** Consider the frictionless horizontal table shown below shown below. A block of mass m_2=2 kg moves in the downward direction at 4 m/s and is shot by a 0.01 kg bullet initially travelling at 150 m/s in the x-direction. The bullet slows to 20 m/s after it passes out of the other side of the block in 0.05 seconds.



a) (10 points) Find the final velocity of the block.

b) (10 points) What is the force of contact between the block and the bullet?

c) (5 points) Is the collision elastic or inelastic? Show your reasoning for full credit.

SUNG KYUN KWAN UNIVERSITY(SKKU)

2013학년도 1학기 학점취득특별시험

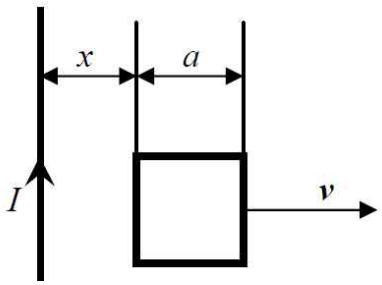
성 적

과목명	일반물리학1	학위 과정	학사	담당교수명	강대준

학부(대) 전공(학과) 학년 학번	성 명		검 인	

1. 전자계산기 사용 불가
2. 답안은 한글 또는 영문으로 작성

1. [25pts] A square conductive loop and a very long straight wire carrying electric current I are placed on a smooth horizontal non-magnetic and dielectric surface as shown in figure from the top view. The loop is pulled to the right at a constant velocity v, perpendicular to the wire.



(a) Find the electromotive force in the loop as a function of distance x and explain the origin of *emf.*

(b) Identify the direction of current in the loop.

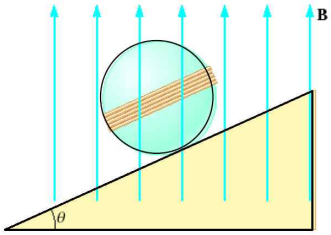
2. [25pts] Calculate the electric field due to two infinite nonconducting oppositely charged sheets brought together to a distance a.

(a) if the magnitude of the positive charge density σ_+ is twice larger than the negative charge density σ_- (i.e., $\sigma_+ = -2\sigma_-$).

(b) if the magnitudes of charge densities are the same (i.e., $\sigma_+ = -\sigma_-$)

(다음 장에 계속)

3. **[25pts]** A nonconducting sphere has mass 80.0 g and radius 20.0 cm. A flat compact coil of wire with 5 turns is wrapped tightly around it, with each turn concentric with the sphere. The sphere is placed on an inclined plane that slopes downward to the left, making an angle θ with the horizontal, so that the coil is parallel to the inclined plane. A uniform magnetic field of 0.350 T

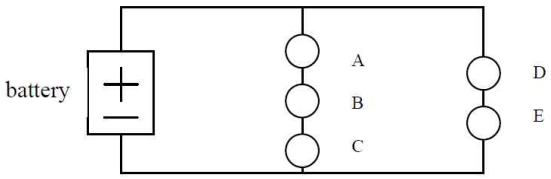


vertically upward exists in the region of the sphere.

(a) What current in the coil will enable the sphere to rest in equilibrium on the inclined plane?

(b) Does the result depend on the value of θ?

4. **[25pts]** When the following circuit is connected, how bright are the bulbs A, B, C, D, and E relative to one another? The bulbs are identical. If bulb A is removed from the circuit, what happens to the brightness of B, C, D, and E? If bulb A is replaced by two new bulbs, what happens to the brightness of the remaining bulbs?



2012학년도 1학기 학점취득특별시험

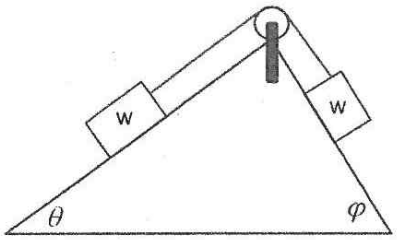
성 적

과목명	일반물리학1	학위 과정	학사	담당교수명	한정훈

학부(대) 전공(학과) 학년 학번	성 명		검 인	

1. Electronic calculators are not allowed.
2. Answer the questions in English or Korean.
(답안은 한글로 작성가능합니다.)

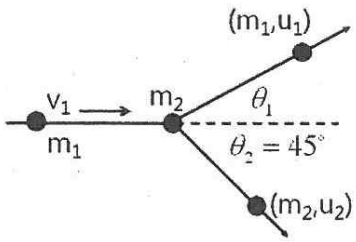
1. [25 pts] In the figure, the weights are equal and there is no friction. If the system is released from rest, how fast are the weights moving when they have gone a distance D ? The two angles of the triangle are θ and φ.



2. [25 pts] A particle of mass m is moving in a two-dimensional space (xy plane) where it experiences a force proportional to its velocity and directed at right angles to its velocity $\vec{v}$. If the particle is initially moving at speed V, show that it moves in a circular path and find the radius of the path. Show that the speed of the particle does not change with time. Express the magnitude of the force as $F = \beta v$.

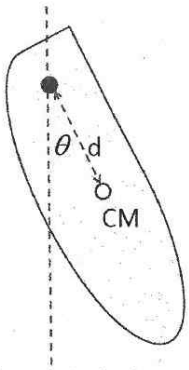
(Continue on the other side of the paper)

3. [25 pts] A particle of mass m_1 and velocity $\vec{v}_1$ collides elastically with another particle of mass $m_2 = 3m_1$ which is at rest ($\vec{v}_2 = 0$). After the collision, m_2 moves at angle $\theta_2 = 45^\circ$ with respect to the original direction of m_1. Find θ_1 (angle of scattering of mass m_1) and $\vec{u}_1, \vec{u}_2$ the final velocities.



4. [25 pts] A rigid body of mass M is placed vertically as shown in the figure and oscillating. The point of support (dark circle) is at a distance d from the body's center of mass (CM) position (empty circle).

(a) Write down the differential equation which describes the variation of the angle θ with time t, where θ is measured



from the equilibrium position of the body.

(b) The moment of inertia of the rigid body about its CM is I_C . Find an expression for the period of small oscillations as a function of d and I_C.

SUNG KYUN KWAN UNIVERSITY(SKKU)

2011학년도 1학기 학점취득특별시험

성 적

과목명	일반물리학1	학위 과정	학사	담당교수명	김범준, 한정훈

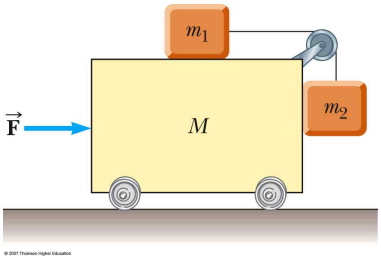
학부(대) 전공(학과) 학년 학번	성 명		검 인	

1. Electronic calculators are not allowed.
2. Answer the questions in English or Korean.
(답안은 한글로 작성가능합니다.)

1. **[25 pts]** (1) There are two objects a and b: The object a has mass M_a and its center of mass is at $\vec{r}_a$, and b has M_b and $\vec{r}_b$, respectively. Find the center of mass of the composite system composed of a and b.

(2) Find the center of mass (X_{CM}, Y_{CM}) of the object in the figure: Disc of the radius $R/2$ is taken out from the disc of the radius R. Assume that the mass distribution of the object is uniform.

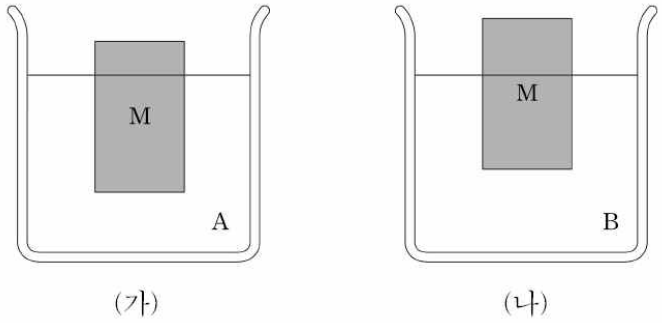
2. **[25 pts]** Find the magnitude of the horizontal force $\vec{F}$ applied to the cart if the two blocks in the figure remain stationary relative to the cart.



Assume that the friction coefficient between m_1 and the upper surface of the cart is μ. All other contacts are frictionless. Neglect masses of the wheels of the cart, the string, and the pulley.

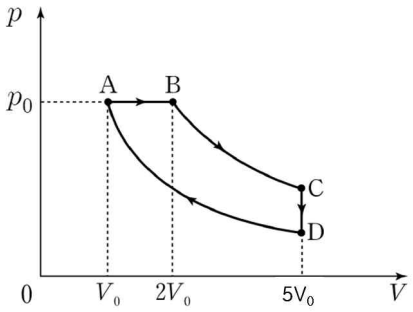
(Continue on the other side of the paper)

3. **[25 pts]** Figure (가) shows a piece of wooden block of uniform density and mass M floating on a liquid of uniform density ρ_A. Figure (나) shows the same block in different liquid of density ρ_B. In case (가) 4/5 of the block is under the water, while only 3/5 lies underneath the water for (나). What is the ratio of the liquid densities ρ_A/ρ_B ? Describe your reasoning based on Archmedes' principle.



(가) (나)

4. **[25 pts]** A mole of ideal gas undergoes a thermodynamic process according to $A \rightarrow B \rightarrow C \rightarrow D \rightarrow A$ in the graph below. Here p is the pressure, and V is the volume of the ideal gas. $A \rightarrow B$ represents a isobaric (constant pressure) process, $C \rightarrow D$ is the constant-volume process, and $B \rightarrow C$ and $D \rightarrow A$ are iso-thermal (constant temperature) processes. Calculate the amount of work done by the ideal gas through the cyclic process $A \rightarrow B \rightarrow C \rightarrow D \rightarrow A$. Describe your reasoning.



2010학년도 일반물리학1(신입생 학점취득시험)

[유의사항: 전자계산기 사용금지, 풀이과정을 전부 쓸 것.답안은 한글로 작성가능함]

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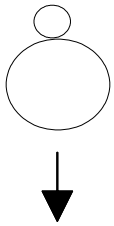
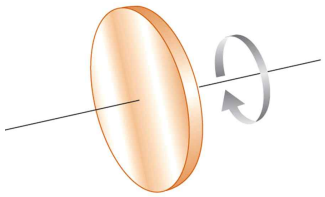
1. [25점] A ball of mass m is held just above the heavier ball of mass M at height h. With their centers perfectly aligned in vertical direction, both balls are released in the uniform gravity g. When the heavier ball hits the ground, it bounces back. The heavier ball moving upward then makes the second collision with the small ball that is still moving down. To what height does the small ball rebound? What is the maximum height if $m \ll M$? (Hint: Assume that all collisions are elastic and ignore the sizes of the balls to make calculation simpler.)



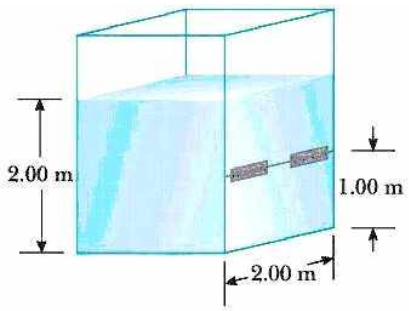
2. [25점] A uniform solid disc has a radius R and a mass M.

(1) Calculate the moment of inertia of the disc about its central axis (Hint: Use the moment of inertia for a circular shell and perform integral to get the answer.)



(2) The disc is rotating with an initial angular speed ω_i when it is put on a horizontal surface at time $t=0$. Assume that the coefficient of friction between the disc and the surface is μ. The disc first slides and after some time it begins the pure rolling motion without sliding. At what time t does the pure rolling motion occur? How long distance does the disk travel before the pure rolling motion? (Hint: You need to write two equations of motion, one for the rotational motion around the center of mass, and the other for the translational motion of the center of mass. The gravitational acceleration is g.)

3. [25점] The tank in figure below is filled with water 2.00 m deep. At the bottom of one side wall is a rectangular hatch 1.00 m high and 2.00 m wide, which is hinged at the top of the hatch. Determine the force the water exerts on the hatch. (Hint: The air outside and water inside both exert atmospheric pressure, so only the excess water pressure $P=\rho gh$ counts for the net force.)



4. [25점] A thermal engine having 3 moles of monoatomic gas as its working fluid undergoes the cycle depicted in Figure (note the (p, T) coordinates). The temperatures in the "corners" are known: T_1 = 400 K, T_2 = 800 K, T_3 = 2400 K, and T_4 = 1200 K. Find the mechanical work output (W) over one cycle.