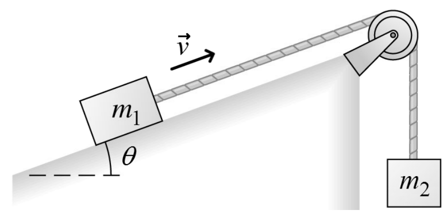
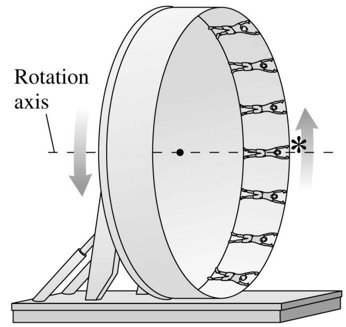
Version A | Quiz #3 Form #231 | Name:____________________
Physics 2211 A & B Fall 2016 | Recitation Section:____________________

- Print your name, quiz form number (3 digits at the top of this form), and student number (9 digit Georgia Tech ID number) in the section of the answer card labeled "Student Identification."
- Bubble the Quiz Form Number in columns 1–3, skip column 4, then bubble your Student Number in columns 5–13.
- Free-response questions are numbered I–III. For each, make no marks and leave no space on your card. Show all your work clearly, including all steps and logic. Box your answer.
- Multiple-choice questions are numbered 1–7. For each, select the answer most nearly correct, circle this answer on your quiz, and bubble it on your answer card. Do not put any extra marks on the card.
- Turn in your quiz and answer card as you leave. Your score will be posted when your quiz has been graded. Quiz grades become final when the next quiz is given.
- You may use a calculator that cannot store letters, but no other aids or electronic devices.

I. (16 points) A block of mass m_1 is connected by an ideal rope passing over an ideal pulley to a block of mass m_2. The block of mass m_1 slides up a plane that makes an angle θ with the horizontal, as shown. If each block has an acceleration magnitude a, what is the coefficient of kinetic friction between m_1 and the plane? Express your answer in terms of parameters defined in the problem, and physical or mathematical constants. (*On Earth.*)



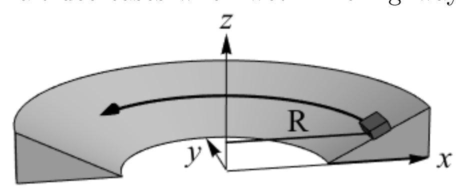
II. (16 points) In an amusement park ride called *The Roundup*, passengers stand inside a ring of radius R. After the ring has acquired sufficient angular speed, it tilts into a vertical plane, as shown. If the wall of the ride exerts a normal force $mg/3$ on a passenger of mass m at the topmost position, what normal force is exerted on that same passenger at the bottom position? Express your answer in terms of parameters defined in the problem, and physical or mathematical constants. (*On Earth.*)



1. (6 points) Once the ride has moved into the vertical plane, what is the direction of the **total** force exerted **by** the ride **on** a passenger who is exactly halfway between the top and bottom, as marked with an asterisk in the figure? (*Hint:* consider the direction of the net force on the passenger.)

   (a) Between horizontal and vertically downward.
   (b) Vertically downward.
   (c) Vertically upward.
   (d) Between horizontal and vertically upward.
   (e) Horizontally toward the center.

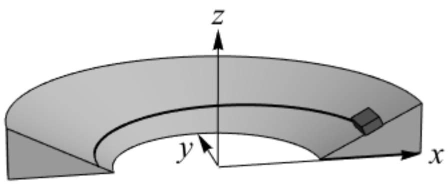
III. (16 points) There is a turn on the road (of radius R) out to Sweetwater Creek State Park that was designed for traffic traveling at the speed limit, but most people take it faster. When it rains, this causes a lot of accidents because the coefficient of static friction μ_s between rubber and asphalt decreases when wet. The highway engineers want to minimize accidents, so they they change the bank of the curve to an angle θ from the horizontal. What is the maximum speed at which a vehicle could safely make it around the curve with wet asphalt? Express your answer in terms of parameters defined in the problem, and physical or mathematical constants. (*On Earth.*)



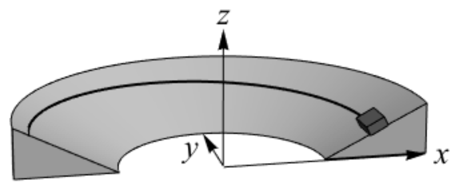
Note: A related multiple-choice question is at the top of the next page.

2. (6 points) Now that they've set the angle to θ, cars want to take it even faster. If there were no friction between the tires and the road, which of the following describes the path of a car going too fast?

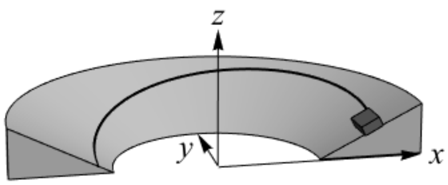
(a)



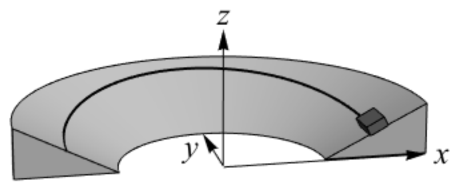
(b)



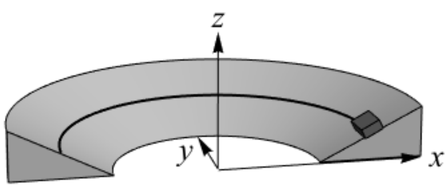
(c)



(d)



(e)



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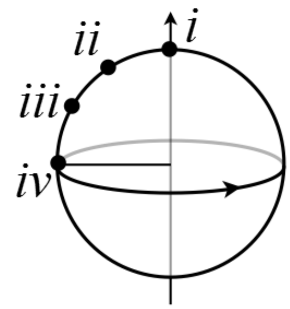
3. (8 points) If I weigh 883 N on earth, how much would I weigh on another planet with 6 times the mass and 2.5 times the radius?

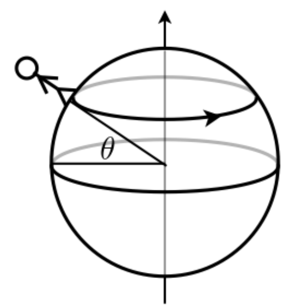
(a) 1320 N
(b) 848 N
(c) 883 N
(d) 2120 N
(e) 920 N

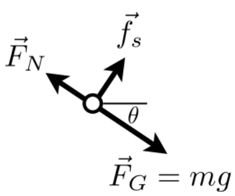
4. (8 points) Which of the following objects of mass m have the largest apparent weight on the rotating earth?

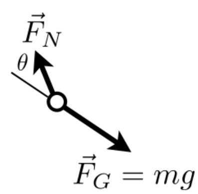


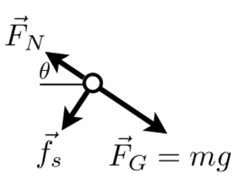
(a) Object i
(b) Object iii
(c) All of the objects have the same apparent weight.
(d) Object iv
(e) Object ii

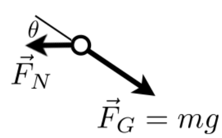
5. (8 points) Which of the following free body diagrams best describes a person of mass m standing on the rotating earth at θ degrees north of the equator?

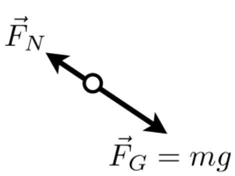


(a) 

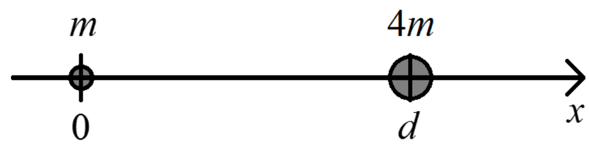
(b) 

(c) 

(d) 

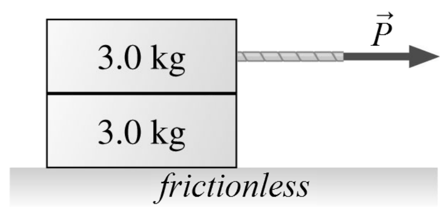
(e) 

6. (8 points) A small sphere of mass m is placed at the origin. Another small sphere, this of mass $4m$, is placed at a position $+d$ on the x axis. At what location could a third small sphere be placed, so the net gravitational force on it was zero? *Think about this before (or even instead of) writing equations! If you do write equations, be sure to check your answer.*



(a) At $x = -d$.
(b) At $x = +d/2$.
(c) At $x = +d/3$.
(d) At $x = +d/4$.
(e) At $x = +d/5$.

7. (8 points) Two identical blocks are stacked, as shown. A horizontal pulling force $\vec{P}$ is applied to the top block, and the two blocks slide together across the level frictionless surface. How does the magnitude of the static friction force **from** the bottom block **on** the top block, $\vec{f}_{\text{BonT}}$, compare to the magnitude of $\vec{P}$? (*On Earth*.)



(a) $P/2 < f_{\text{BonT}} < P$
(b) $f_{\text{BonT}} = P/2$
(c) $f_{\text{BonT}} < P/2$
(d) $f_{\text{BonT}} = P$
(e) $P < f_{\text{BonT}} < 3P/2$

Final Exam Formulæ & Constants

$$\vec{v} = \frac{d\vec{r}}{dt}$$
$$\vec{\omega} = \frac{d\vec{\theta}}{dt}$$
$$\vec{a} = \frac{d\vec{v}}{dt}$$
$$\vec{\alpha} = \frac{d\vec{\omega}}{dt}$$
$$v_{\mathrm{sf}} = v_{\mathrm{si}} + a_{\mathrm{s}}\,\Delta t$$
$$\omega_{\mathrm{f}} = \omega_{\mathrm{i}} + \alpha\,\Delta t$$
$$s_{\mathrm{f}} = s_{\mathrm{i}} + v_{\mathrm{si}}\,\Delta t + \tfrac{1}{2}a_{\mathrm{s}}\,(\Delta t)^2$$
$$\theta_{\mathrm{f}} = \theta_{\mathrm{i}} + \omega_{\mathrm{si}}\,\Delta t + \tfrac{1}{2}\alpha\,(\Delta t)^2$$
$$s = r\theta$$
$$v = r\omega$$
$$a_{\mathrm{t}} = r\alpha$$

$$\sum \vec{F} = m\vec{a} = \frac{d\vec{p}}{dt}$$
$$\sum \vec{F}_{\mathrm{ext}} = M\vec{a}_{\mathrm{cm}} = \frac{d\vec{P}}{dt}$$
$$\sum \vec{\tau}_{\mathrm{ext}} = I\vec{\alpha} = \frac{d\vec{L}}{dt}$$
$$f_{\mathrm{s,max}} = \mu_{\mathrm{s}} n$$
$$f_{\mathrm{k}} = \mu_{\mathrm{k}} n$$
$$a_{\mathrm{r}} = \frac{v^2}{r}$$
$$\vec{w} = m\vec{g}$$
$$|\vec{F}_{\mathrm{G}}| = \frac{Gm_1m_2}{|\vec{r}|^2}$$
$$D = \tfrac{1}{2}C\rho A v^2$$
$$\vec{\tau} = \vec{r} \times \vec{F}$$

$$W = \int \vec{F}\cdot d\vec{s}$$
$$W_{\mathrm{ext}} = \Delta K + \Delta U + \Delta E_{\mathrm{th}}$$
$$K = \tfrac{1}{2}mv^2$$
$$K = \tfrac{1}{2}I\omega^2$$
$$U_{\mathrm{g}} = mgy$$
$$U_{\mathrm{s}} = \tfrac{1}{2}k\,(\Delta s)^2$$
$$U_{\mathrm{G}} = -\frac{Gm_1m_2}{r}$$
$$P = \frac{dE_{\mathrm{sys}}}{dt}$$
$$P = \vec{F}\cdot\vec{v}$$
$$\vec{J} = \int \vec{F}\,dt = \Delta\vec{p}$$
$$\vec{p} = m\vec{v}$$

$$\vec{r}_{\mathrm{cm}} = \frac{\sum \vec{r}_i m_i}{\sum m_i}$$
$$\vec{r}_{\mathrm{cm}} = \frac{\int \vec{r}\,dm}{\int dm}$$
$$I = \sum m_i r_i^2$$
$$I = \int r^2\,dm$$
$$I = I_{\mathrm{cm}} + Md^2$$
$$\vec{L} = \vec{r} \times \vec{p}$$
$$\vec{L} = I\vec{\omega}$$
$$x = A\cos(\omega t + \phi_0)$$
$$\vec{a}_{\mathrm{x}} = -\omega^2\vec{x}$$
$$\omega = \sqrt{k/m}$$
$$\omega = 2\pi f = \frac{2\pi}{T}$$

Physical Constants:

Universal Gravitation Constant $G = 6.673 \times 10^{-11}\,\mathrm{N{\cdot}m^2/kg^2}$
Gravitational Acceleration at Earth's Surface $g = 9.81\,\mathrm{m/s^2}$

Unless otherwise directed, use the gravitational definition of weight, all problems take place on Earth, drag is to be neglected, and all pulleys and ropes are ideal.

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Please remove this sheet from your Quiz or Exam