Final Exam Formulæ & Constants

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

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

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

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

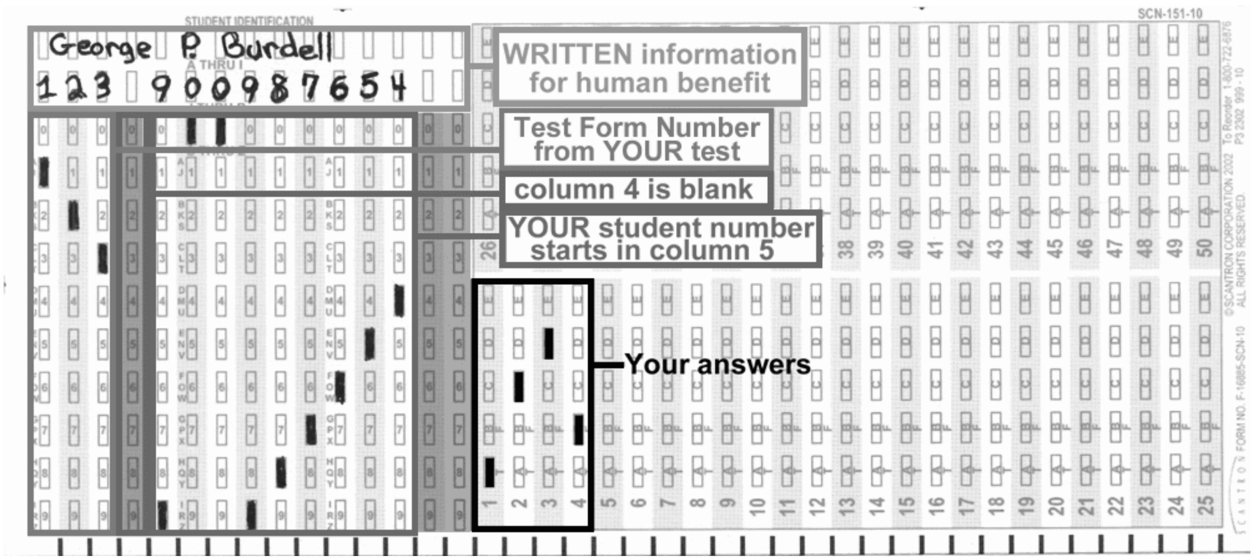
Physical Constants:

Gravitational Acceleration at Earth's Surface $g = 9.81\,\mathrm{m/s^2}$

Unless otherwise directed, all problems take place on Earth, and drag is to be neglected.

A

Please remove this sheet from your Quiz or Exam



YOUR form number is **221**

Recitation Sections

	Clough 123	Clough 125	Clough 127	Clough 131	Clough 325
Wednesday					
1:05 – 1:55 pm					B01 Roberts, Kelli
2:05 – 2:55 pm		A01 Roberts, Kelli			
3:05 – 3:55 pm				A06/B05 Gaire, Vinod	
4:05 – 4:55 pm	A02 Tregoning, Brett	A07 Whitley, Lee	B08 Biewer, John	B02 Gaire, Vinod	
5:05 – 5:55 pm				A05 Gaire, Vinod	B06 Ibnamasud, Shadman
Thursday					
1:05 – 1:55 pm					
2:05 – 2:55 pm					A03 Gaire, Vinod
3:05 – 3:55 pm		B07 Gaire, Vinod	B03 Tregoning, Brett		
4:05 – 4:55 pm	A04 Walia, Saumya	B04 Gaire, Vinod	A09 Tregoning, Brett		
5:05 – 5:55 pm	A08 Walia, Saumya				

Version A

Quiz #2 Form #221

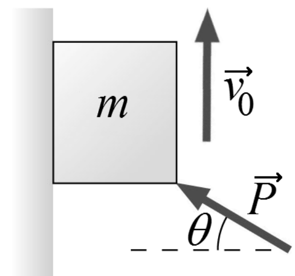
Physics 2211 A & B Fall 2016

Name:____________________

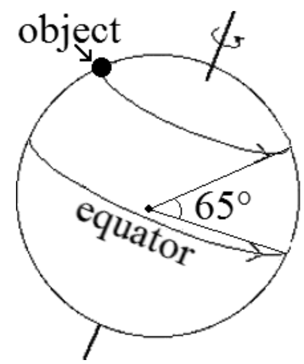
Recitation Section:____________________

- 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 is sliding up a vertical wall at constant non-zero velocity $\vec{v}_0$, due to an applied force $\vec{P}$ pushing against it at an angle θ above the horizontal, as shown. The coefficient of static friction between the block and the wall is μ_s, and the coefficient of kinetic friction is μ_k. What is the magnitude of the applied force? Express this magnitude of $\vec{P}$ in terms of other parameters defined in the problem, and physical or mathematical constants. (*On Earth.*)



II. (16 points) Mars has a radius of 3397 km and rotates once on its axis every 1.03 days (or 88,990 seconds). What is the centripetal acceleration magnitude, in m/s^2, of an object on Mars' surface, located as shown at 65° latitude? Sketch the direction of the object's centripetal acceleration on the diagram.



1. (6 points) In the problem above, compare the angular speed and centripetal acceleration magnitude of the object at 65° latitude, to those of an object on Mars' equator.

   (a) The object at 65° latitude has **the same** angular speed, but **greater** centripetal acceleration.
   (b) The object at 65° latitude has **lesser** angular speed, and **lesser** centripetal acceleration.
   (c) The object at 65° latitude has **lesser** angular speed, but **the same** centripetal acceleration.
   (d) The object at 65° latitude has **the same** angular speed, and **the same** centripetal acceleration.
   (e) The object at 65° latitude has **the same** angular speed, but **lesser** centripetal acceleration.

III. (16 points) You are playing soccer and kick the ball over a fence off the pitch. Your friend goes to retrieve the ball and has to kick it over a 10.0 m fence. She can kick a soccer ball at 28.0 m/s. She repositions the ball to minimize the angle above horizontal that she needs to kick to clear the fence. What is that minimum angle? (*On Earth.*)

2. (6 points) If θ_c is the minimum angle she must kick, is there another angle that she can kick so that the ball travels the same horizontal distance before striking the ground?

   (a) Yes, $90° - \theta_c$.
   (b) Yes, at $45°$.
   (c) Yes, $90° + \theta_c$.
   (d) No. The ball will travel a different distance at every angle she kicks it.
   (e) Yes, at $-\theta_c$.

3. (8 points) I am trying to get across an airport terminal to a gate that is 500 m away, so I take a moving sidewalk part of the way which moves at a constant speed of 1 m/s. The whole time I walk at a constant speed of 3 m/s. The trip takes me 2.5 minutes (or 150 seconds). How long was the moving sidewalk? (*Hint:* write an expression for the total distance traveled and solve for the time on the moving sidewalk. Don't forget to check your answer!)

(a) 200 m
(b) 500 m
(c) 0 m
(d) 400 m
(e) 250 m

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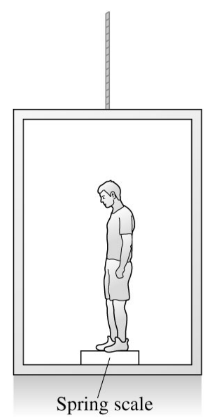
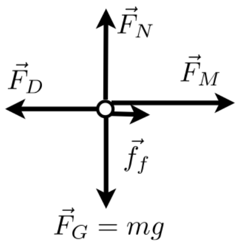
4. (8 points) A person stands on an ordinary bathroom spring scale while in an elevator. In which of these situations, if any, will the scale readings be the same? (*On Earth.*)

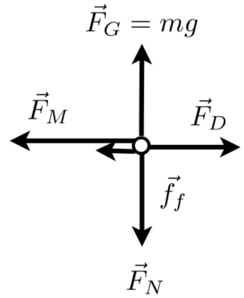
i) The elevator is moving upward at 3 m/s and the speed is increasing at $2\,\mathrm{m/s^2}$.
ii) The elevator is moving downward at 3 m/s and the speed is increasing at $2\,\mathrm{m/s^2}$.
iii) The elevator is moving downward at 3 m/s and the speed is decreasing at $2\,\mathrm{m/s^2}$.

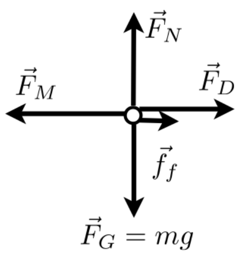


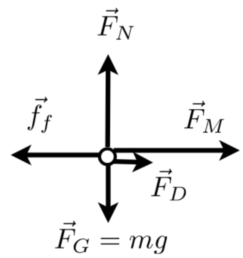
(a) In all three situations.
(b) Only situations *i* and *ii*.
(c) Only situations *ii* and *iii*.
(d) In none of these situations.
(e) Only situations *i* and *iii*.

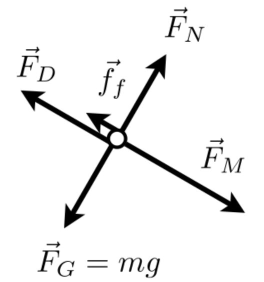
5. (8 points) A mom is trying to get her family home. Her 30 kg child is throwing a fit and won't move. In an attempt to get home, she pulls him to the left with a force of $\vec{F}_M = 400\,\mathrm{N}$. To make matters worse, the golden retriever the child is holding has seen a squirrel in the opposite direction and is pulling to the right with a force of $\vec{F}_D = 300\,\mathrm{N}$. His shoes have a coefficient of static friction of 0.5. Which free body diagram best represents this situation? (*On Earth.*)

(a) 

(b) 

(c) 

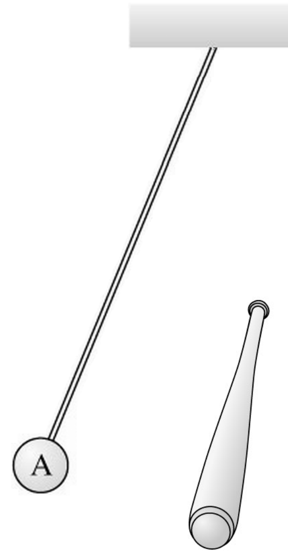
(d) 

(e) 

6. (8 points) In the problem above, how much harder, if at all, must his mom pull him to start the family moving?

(a) 147 N (for a total force of 457 N)
(b) She is already pulling hard enough
(c) 47 N (for a total force of 447 N)
(d) 94 N (for a total force of 494 N)
(e) 194 N (for a total force of 594 N)

7. (8 points) The pendulum bob, A, was struck by the bat, and is now swinging upward. How many of the items on this list are forces acting on the bob as it swings upward? (*On Earth.*)



- $m\vec{a}$
- gravitational force
- centripetal force
- normal force
- tension force
- strike force

(a) 4
(b) 3
(c) 5
(d) 1
(e) 2