Formulæ & Constants

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

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

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

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

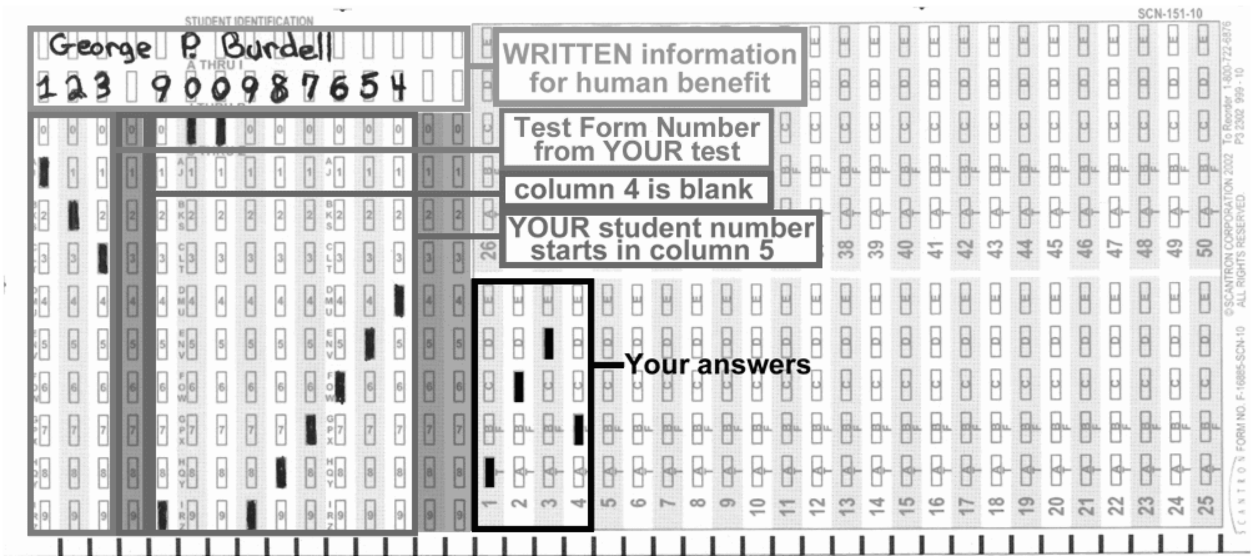
Physical Constants:

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

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

A

Please remove this sheet from your Quiz or Exam



YOUR form number is **115**

Recitation Sections

	Room 123	Room 125	Room 325
Tuesday			
12:30–1:20 pm	M01 Gaire, Vinod		
2:35–3:25 pm		M02 Gaire, Vinod	
Wednesday			
12:30–1:20 pm			M03 Pallantla, Ravi Kumar
2:25–3:15 pm			M04 Pallantla, Ravi Kumar
4:30–5:20 pm			M05 Pallantla, Ravi Kumar
Thursday			
12:30–1:20 pm	M06 Gaire, Vinod		
2:35–3:25 pm		M07 Gaire, Vinod	

Version

A

Quiz #1 Form #115

Physics 2211 M Summer 2017

Name:______________________________

Recitation Section:______________________

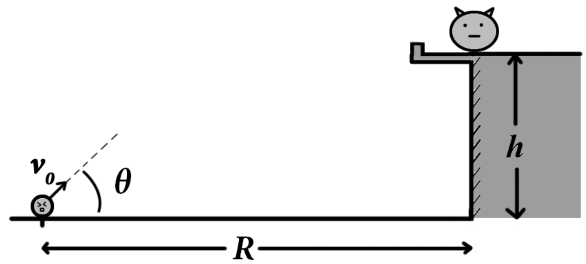
- Print your name, quiz form number (3 digits at the top of this form), and student number (9 digit Georgia Tech ID number) in the section of the answer card labeled "Student Identification."
- Bubble the Quiz Form Number in columns 1–3, skip column 4, then bubble your Student Number in columns 5–13.
- 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) An object starts from rest at the origin at time $t = 0\,\text{s}$, then moves along the x axis with acceleration that depends on time according to

$$a_x(t) = 6.0\,\text{m/s}^4\,t^2$$

What is the object's *average acceleration* between time $t = 1.0\,\text{s}$ and $t = 3.0\,\text{s}$?

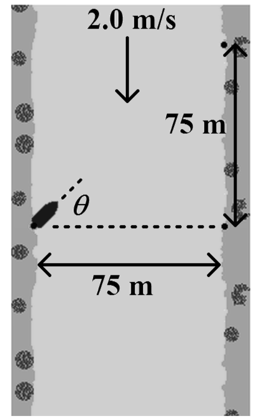
II. (16 points) An angry, ball-shaped animal is trying to attack a target on a building 38 meters high, as shown. By using a slingshot, it can fire a ball with fixed initial speed $v_0 = 35\,\text{m/s}$ and launch angle $\theta = 55°$, so the ball comes down to land on the target. What is the horizontal range R to the target? (*On Earth*.)



1. (6 points) In what direction is the ball travelling when it hits the target?

   (a) 63° below horizontal.
   (b) 63° above horizontal.
   (c) 55° below horizontal.
   (d) 24° above horizontal.
   (e) 24° below horizontal.

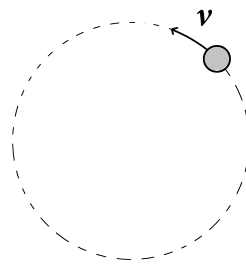
III. (16 points) A powerboater wants to cross a river that is flowing 2.0 m/s down the page. The river is 75 m wide, and the boater wants to land at a point 75 m upstream from the starting point. If the boat can move at 6.3 m/s through the water, at what angle θ upstream from straight across should the bow of the boat be aimed? *Hint:* You **shouldn't** need to know the identity $2\sin\phi\cos\phi = \sin 2\phi$, but there are situations in which it may be useful.



2. (6 points) If, instead, the boater wished to land at a point 75 m *downstream* from straight across, the bow of the boat must be aimed at an angle ϕ downstream from straight across. How are the magnitudes of ϕ and θ related?

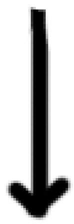
   (a) $\phi < \theta$
   (b) $\phi > \theta$
   (c) $\phi = \theta$
   (d) This is a meaningless question, as it is impossible for that boat to land at a point 75 m downstream from straight across.
   (e) The relationship between ϕ and θ cannot be determined from the information provided.

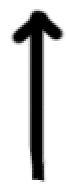
3. (8 points) A car is moving with a decreasing speed to around a circle with radius 10 m. The speed v of the car depends on time t according to



$$v(t) = 40\,\mathrm{m/s} - \left(10\,\mathrm{m/s^2}\right) t$$

At time $t = 3\,\mathrm{s}$ the car is at the location as shown. What is the direction of the acceleration of the car at this particular moment?

(a) 

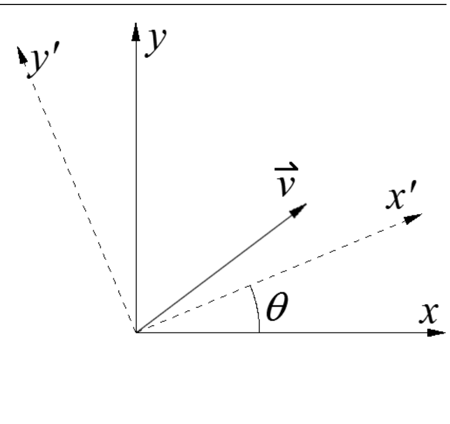
(b) 

(c) 

(d) 

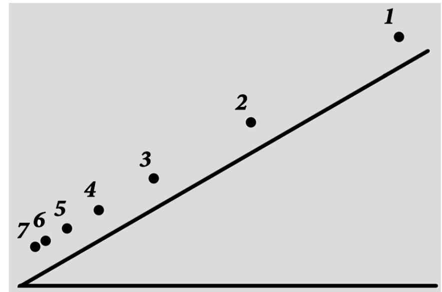
(e) 

4. (8 points) A velocity vector $\vec{v}$ has components $v_x = 4.0\,\mathrm{m/s}$ and $v_y = 3.0\,\mathrm{m/s}$ in the $x{-}y$ coordinate system. What is the magnitude of this velocity vector in the $x'{-}y'$ coordinate system, which is rotated an angle $\theta = 25°$ as shown from the $x{-}y$ system?



(a) 1.0 m/s
(b) 6.6 m/s
(c) 5.0 m/s
(d) 4.9 m/s
(e) 5.9 m/s

5. (8 points) A driver is driving a car down hill with a constant acceleration, and the position can be described with a motion diagram as shown. What is the direction of the car's acceleration?



(a) 

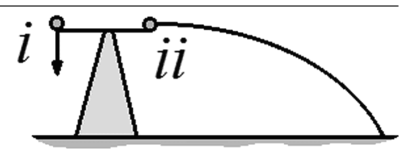
(b) 

(c) 

(d) 

(e) 

6. (8 points) A device atop a tower drops an object (i) while simultaneously throwing an identical object (ii) horizontally. Which object, if either, reaches the level ground first? Which object, if either, strikes the ground with greater speed? (*On Earth.*)



(a) Object i reaches the ground first. Object i strikes the ground with greater speed.
(b) Both objects reach the ground at the same time. Both objects strike the ground with the same speed.
(c) Object ii reaches the ground first. Object ii strikes the ground with greater speed.
(d) Both objects reach the ground at the same time. Object i strikes the ground with greater speed.
(e) Both objects reach the ground at the same time. Object ii strikes the ground with greater speed.

7. (8 points) In which of these situations *must* an object's speed be increasing?

I. The object has a positive acceleration.
II. A component of the object's acceleration is in the same direction as its velocity.
III. A component of the object's acceleration is perpendicular its velocity.

(a) Only in situation I
(b) Only in situation III
(c) Only in situation II.
(d) In situation I and III.
(e) In situation I and II.