NAME:________________________

Physics 10, Kintner Fall 2020

Cover Sheets for Final Exam

posted Nov 22, 2020

Final Exam will be: Weds, Dec 2, 2020

Sec 1: Final time: 8:00-10:00am (normal class time MWF 9:15-10:20)

Sec 2: Final time: 10:30am-12:30pm (normal class time MWF 11:45-12:50)

Instructions:

Logistics of online exams:

Your answers to this exam must be submitted to Moodle by the end of class time. You might want to set a timer or alarm to alert you 15 mins before the end of class time. (Sec 1: 8:00-10:00am, and Sec 2: 10:30am-12:30pm)

- I will email you the exam right before the start of class.
- Most of you will write the solutions on your own paper, scan them, and turn them in.
  - **Please space them as they are spaced on the exam.**. (I grade them page by page for consistency and anonymity.)
  - Please also number them and label parts. For problems (not short answers), put a box around, or circle, your final answer.
  - If you need more space, one problem per page is fine.
  - If you can print and write on the exam, even better. If you can use a tablet to annotate the PDF file, that's great too.
  - If you have handwritten them, use a scanner app to clean them up and put them in one PDF file.
- Submit the PDF file to Moodle. I will put the link at the top of the page for the day.

I will be in zoom. If there is any confusion about what a question is asking, you may ask in zoom–either in chat (to not disturb everyone) or in a breakout room. You do not have to be in zoom if you do not wish to be. You may be there with your camera and mic off. (Added for exam 3:) **I strongly encourage you to be in zoom so that you can hear me announce time, just in case there's a typo, and so you can tell me right away if you have any problem scanning/submitting.**

Rules of the exam:

This exam is open book, open note, open everything except talking to another person (in any form, see below.) If you use a reference book or website other than our course textbook and course Moodle page (and any info linked from there), you must cite it.

You may not work with anyone else in any form. No talking, texting, typing etc to another human about this exam. This includes posting to forums or sites like Chegg.

You may use a calculator. Please plug in numbers (and do the calculation) for numerical answers and keep three sig figs regardless of the actual correct number of sig figs in the problem. Do not use apps/sites like Desmos or Wolfram Alpha to do the algebra or calculus for you. You should show all your work in your own writing.

Numerical answers should have units.

Present clear and complete answers:

Explain your answers clearly but briefly. You want to aim for a level of solution that someone taking this class would be able to understand. A diagram and a few words may help.

Start calculations with first principles: things like definitions ($\vec{a} \equiv \frac{d\vec{v}}{dt}$) or empirical laws (like Newton's Laws) or any equation from the equation list given here on the cover pages.

Check time:

The point values for each problem are shown next to the question number. Time yourself accordingly. There are X problems on the exam, for a total value of 100 points. **Good luck!**

Some constants:

$g = 9.8 \text{ m/s}^2$
$G = 6.67 \times 10^{-11} \text{N m}^2/\text{kg}^2$

Derivative table from class:

f	$\frac{df}{dt}$
A	0
At^n	nAt^{n-1}
$A\cos\omega t$	$-\omega A \sin\omega t$
$B\sin\omega t$	$\omega B\cos\omega t$

Equations from Exam 1:

$$\Delta\vec{r} \equiv \vec{r}_f - \vec{r}_i$$

$$\vec{v} \equiv \frac{d\vec{r}}{dt} \qquad \vec{v}_{AVE} \equiv \frac{\Delta\vec{r}}{\Delta t}$$

$$\vec{a} \equiv \frac{d\vec{v}}{dt} \qquad \vec{a}_{AVE} \equiv \frac{\Delta\vec{v}}{\Delta t}$$

$$\vec{v} = \vec{v_0} + \vec{a}t$$

$$\vec{r} = \vec{r_0} + \vec{v_0}t + \frac{1}{2}\vec{a}t^2$$

$$\Sigma\vec{F} = m\vec{a}$$

$$\vec{F}_g \equiv m\vec{g}$$

Equations from Exam 2:

$$\vec{F}_{12} = -\vec{F}_{21}$$

$$F_{fr} = \mu F_N$$

$$a_c = \frac{v^2}{r}$$

$$F_G = G\frac{Mm}{r^2}$$

$$W \equiv \int \vec{F} \cdot d\vec{\ell}$$

$$W = \vec{F} \cdot \vec{d} = Fd\cos\theta$$

$$KE \equiv \frac{1}{2}mv^2$$

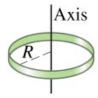
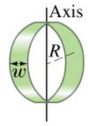
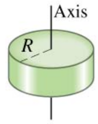
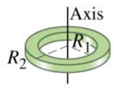
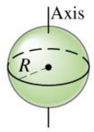
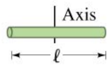
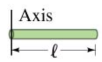
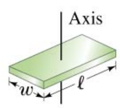
$$W_{net} = \Delta KE$$

$$\Delta U_c \equiv -W_c$$

$$U_g = mgh$$

$$E_i + W_{nc} = E_f$$

Table of moments of inertia:

	Object	Location of axis		Moment of inertia
(a)	**Thin hoop,** radius R	Through center		MR^2
(b)	**Thin hoop,** radius R width w	Through central diameter		$\frac{1}{2}MR^2 + \frac{1}{12}Mw^2$
(c)	**Solid cylinder,** radius R	Through center		$\frac{1}{2}MR^2$
(d)	**Hollow cylinder,** inner radius R_1 outer radius R_2	Through center		$\frac{1}{2}M(R_1^2 + R_2^2)$
(e)	**Uniform sphere,** radius R	Through center		$\frac{2}{5}MR^2$
(f)	**Long uniform rod,** length ℓ	Through center		$\frac{1}{12}M\ell^2$
(g)	**Long uniform rod,** length ℓ	Through end		$\frac{1}{3}M\ell^2$
(h)	**Rectangular thin plate,** length ℓ, width w	Through center		$\frac{1}{12}M(\ell^2 + w^2)$

New for Final

$$F_x \propto -x \text{ or } a_x \propto -x$$

$$x = A\cos\omega t \text{ or } A\sin\omega t$$

$$v_{max} = \omega A$$

$$E = \frac{1}{2}kA^2 = \frac{1}{2}mv_{max}^2$$

$$\omega^2 = \frac{k}{m} \text{ or } \frac{g}{L}$$

$$v = \lambda f$$

$$v = \sqrt{\frac{F_T}{\mu}}$$

$$y = A\cos\left(\frac{2\pi}{\lambda}x - \omega t\right) \text{ or}$$

$$A\sin\left(\frac{2\pi}{\lambda}x - \omega t\right)$$

$$f_n = n\frac{v}{2L}$$

Equations from Exam 3:

$$F_s = -kx$$

$$PE_s = \frac{1}{2}kx^2$$

$$\vec{p} \equiv m\vec{v}$$

$$\Sigma\vec{F} = \frac{d\vec{p}}{dt} \qquad \Sigma\vec{F}_{ave} = \frac{\Delta\vec{p}}{\Delta t}$$

$$a_t = r\alpha \qquad v = r\omega \qquad s = r\theta$$

$$\vec{\omega} = \vec{\omega}_0 + \vec{\alpha}t$$

$$\vec{\theta} = \vec{\theta}_0 + \vec{\omega}_0 t + \frac{1}{2}\vec{\alpha}t^2$$

$$\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$$

$$\vec{R}_{cm} = \frac{\Sigma\vec{r}_i m_i}{M}$$

$$I \equiv \Sigma m_i r_i^2$$

$$\vec{\tau} = \vec{r} \times \vec{F}$$

$$\tau = rF\sin\theta = r_\perp F$$

$$\Sigma\vec{\tau} = I\vec{\alpha}$$

$$KE = \frac{1}{2}I\omega^2$$

$$\vec{L} \equiv \vec{r} \times \vec{p}$$

$$L = rp\sin\theta = r_\perp p$$

$$\vec{L} = I\vec{\omega}$$