Exam 2 review sheet (revised)

When, where, what

The exam will be on Thursday Oct 1, 9:40-11:10am in Galileo 112.

A table of derivatives, relevant constants and conversions will be provided. No equations will be provided. No calculators or cellphones allowed. You are allowed a 3"x5" card of notes, both sides.

Instructions and grading

Present clear *and* complete *answers.* Show your work in a coherent fashion. Unjustified answers will earn no points. Well-reasoned answers can receive partial credit.

Start solutions with definitions (*e.g.* $\vec{v} = \frac{d\vec{r}}{dt}$), facts (*e.g.* Newton's laws), or theorems (*e.g.* constant acceleration equations). Vector quantities and require magnitude and direction, or must presented in component form.

This exam covers the following chapters

2 - Cause of motion
3 - Work and energy, skip equilibrium and 3.4
4.1 - Momentum

1. What are the SI units for force, work, energy, power, center of mass, and momentum?
2. Represent a vector as (a) a magnitude and a direction and (b) in component form. (c) Move from one representation to the other.
3. Identify the forces on an object and draw a force diagram. Include a coordinate system.
4. Calculate the acceleration of an object due to multiple forces.

   Alternatively, given the acceleration of an object due to multiple forces, calculate the magnitude and direction of a particular force.
5. Calculate the kinetic and static frictional forces, the normal force, and spring force on an object.
6. Calculate the gravitational force on an object. Be able to identify which form of the gravitational force is most appropriate:
   - the general form between any two masses $F_G = G\frac{m_1 m_2}{r^2}$
   - or the special case of a mass near the surface of the earth $\vec{F}_G = -mg\hat{j}$
7. Describe the process of walking, jumping, swimming, and boat-rowing using Newton's 3rd law and forces. Specify what applies each force and each force's magnitude and direction.
8. Consider a compound or connected system.
   (a) Draw a force diagram for each object.
   (b) Identify which forces are interaction forces.
   (c) Determine the relationship between accelerations.
   (d) Given the forces on a compound system, calculate the acceleration and the interaction forces between objects.
9. Apply Newton's second law to an object undergoing uniform circular motion.

   This means being able to calculate forces (such as the normal force), accelerations and speeds.
10. Calculate the
    (a) work done by a force on an object.
    (b) net work done on an object.
    (c) Be able to do this for both constant forces and non-constant forces in one-dimension.
    (d) Be able to do this for a non-constant force in one-dimension.
11. What is the difference between a conservative and a non-conservative force? Include potential energy in your explanation.
12. Apply the work-energy theorem to calculate
    (a) initial and final velocities
    (b) initial and final positions
    (c) the average value of a force (typically non-constant and non-conservative).
13. Calculate the power delivered by a force, or the power used by an object.
14. Calculate the center of mass of an object or system of objects.
15. Calculate the total momentum of a system.
16. Identify whether a force is internal or external to a system.

    Which kind affects the motion of the center of mass?

Provided on the exam

$\frac{d}{dx}[\mathrm{c}x^{\mathrm{n}}] = \mathrm{c}\mathrm{n}x^{\mathrm{n}-1}$
$\frac{d}{dx}[\mathrm{c}e^{\mathrm{a}x}] = \mathrm{c}\mathrm{a}e^{\mathrm{a}x}$
$\frac{d}{dx}[\ln(x)] = \frac{1}{x}$
$\frac{d}{dx}[\mathrm{c}\sin(\mathrm{k}x)] = \mathrm{c}\mathrm{k}\cos(\mathrm{k}x)$
$\frac{d}{dx}[\mathrm{c}\cos(\mathrm{k}x)] = -\mathrm{c}\mathrm{k}\sin(\mathrm{k}x)$
$g = 9.8\mathrm{m/s}^2$

Unless otherwise noted, answers should be given in units of m, kg, s, or combinations thereof (*e.g.*. m/s, N). Relevant conversions will be provided.