Announcements

- Homework 4 due on Monday
  - I'll get HW5 posted this weekend
- CompDay 4 on Monday
  - Will be on using using Sympy for helping take gradients/line integrals and visualization
- Read through Ch 5.6 for Friday
- We've picked up a day from what I have on the schedule, so I'm looking for how to best utilize that time (mainly looking at how to try to minimize the amount of work around the midterm)
- Responses: `rembold-class.ddns.net`

MECHANICS

Swing to the Left, Swing to the Right

Midterm Shakeup?

How would you feel about having the midterm over just the Ch 1-5 material (leaving Ch 7-11 for the final)?

A) I'm all for it!

B) I'd really prefer it the originally scheduled way.

C) I really don't care.

Today's Objectives

- Understand how any stable equilibrium point can look like a spring
- Identify the various forms of simple harmonic motion solutions
- Be able to correctly determine constants from initial conditions
- Show an intuitive understanding of the motion of 2D oscillators

Q1

Which of the following correctly describes both the location and stability of an equilibrium point for the potential given by:

$$U(x) = \frac{-x^2(ax - b)}{b}$$

where a and b are positive constants?

A) $x = \frac{b}{a}$ and is unstable
B) $x = \frac{2b}{a}$ and is stable
C) $x = 0$ and is stable
D) None of the above, but $U(x)$ does have one stable equilibrium point

Q2

Suppose you wanted to look at oscillations in the vicinity of the stable equilibrium point $x = 0$. What would be the effective spring constant for oscillations in this region?

A) $k_{eff} = 1$
B) $k_{eff} = 2$
C) $k_{eff} = 2b$
D) $k_{eff} = \frac{2b}{a}$

Q3

We'll make the substitution that $\omega = \sqrt{\frac{k_{eff}}{m}}$. Which of the below general solutions could not describe the motion of a particle of mass m placed near the point $x = 0$?

A) $C_1 \cos(\omega t) + C_2 \sin(\omega t)$

B) $C_1 \sin(\omega t + C_2)$

C) $C_1 e^{i\omega t} + C_2 e^{-i\omega t}$

D) $C_1 e^{i(\omega t + C_2)}$

Q4

Recall than $k_{eff} = 2$ and let the small mass be 8 kg. If we start the mass at the position $x = 0.1\,\text{m}$ and give it a small push with speed of $10\,\text{cm/s}$ to the left, which of the following solutions describes the resulting motion of our mass?

A) $0.1\cos(2t) + 0.5\sin(2t)$

B) $0.1\cos\left(\frac{t}{2}\right) + 0.1\sin\left(\frac{t}{2}\right)$

C) $0.1\cos\left(\frac{t}{2}\right) - 0.2\sin\left(\frac{t}{2}\right)$

D) $0.1\cos\left(\frac{t}{2}\right) - 0.05\sin\left(\frac{t}{2}\right)$

Q5

Which plot below best describes the motion of the 2D oscillator whose solutions are given by:

$$x(t) = 2\cos(2t)$$
$$y(t) = 4\cos\left(2t - \frac{\pi}{2}\right)$$

A B C D