W8 D3

Hwk Ch. 8 P. 1, 2, 3, 7, 8, 10, 11, 12, 16, 18, 21 } Due Mon.
Read 8.1 - 8.5

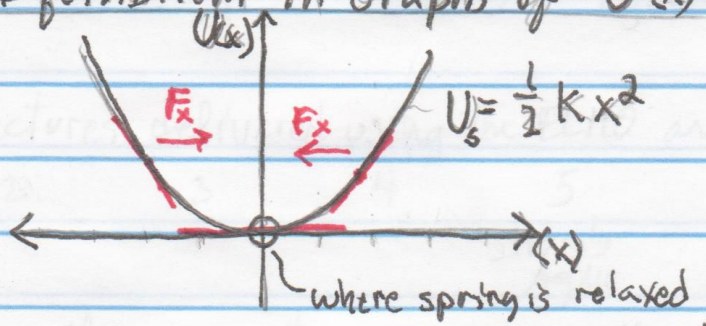
Notes: Midterms: 83%-up = A, 75-83 = B, 65-75 = C, 50-65 = D, Median = 0.695
Hwk on Ch. 7 Graded #8, #29. $\mu = 6.7/10$ (incl. 8 zeros)
Keys to Ch. 5, 6, 7 Hwk now online. [Hwk #4, 5, 6] Also Ch. 7 lecture.
Next Quiz: Wednesday, end of class. See Practice Quizzes!

TODAY: Finding F_x, F_y and F_z from $U(x, y, z)$
Stable & Unstable Equilibrium
Conservation of Energy (Ch. 8)
Big, general formula $\Delta E_{sys} = \sum T_i$
Mechanical Energy $E_{mech} = U + K$
Add friction: $f_k d$ or ΔE_{int}

Finding F_x from $U(x)$ [Back 1 page]

Stable and Unstable Equilibrium in Graphs of $U(x)$

Ex) $U(x)$ for spring:
Where is $F_s = 0$?
$F_s = -\frac{\partial U}{\partial x}$
$F_s = -Kx$
So $F_s = 0$ at $x = 0$. $x = 0$ is an equilibrium point!



Q: Is $x = 0$ a "stable" equilibrium?
Ans: Yes, because a small displacement away from $x = 0$ leads to a restoring force.

Note: imagine placing a ball on this parabolic curve - it would come to rest at $x = 0$.

Determine F_x, F_y & F_z from $U(x,y,z)$

* $F_x = -\frac{\partial U}{\partial x}$, $F_y = -\frac{\partial U}{\partial y}$, $F_z = -\frac{\partial U}{\partial z}$

(P. 36) Ex) $U = 3x^3y - 7x$ Find the force that acts at the point (x,y).

Soln: $F_x = \frac{-\partial U}{\partial x} = -\frac{\partial}{\partial x}[3x^3y - 7x] = -[9x^2y - 7]$

$= -9x^2y + 7$

$F_y = \frac{-\partial U}{\partial y} = \frac{-\partial}{\partial y}[3x^3y - 7x] = -[3x^3 + 0]$

$= -3x^3$

So $\vec{F}(x,y) = (-9x^2y + 7)\hat{i} - 3x^3\hat{j}$

Ex) A conserv. force acts on a 5kg particle according to $F_x = 2x + 4$. What is the corresponding potential energy function?

(and $F_y = 0$)

Soln: $F_x = -\frac{\partial U}{\partial x}$

$2x + 4 = -\frac{\partial U}{\partial x}$

$-2x - 4 = \frac{\partial U}{\partial x} = \frac{dU}{dx}$

$\int(-2x-4)\,dx = \int dU$

$-x^2 - 4x + C = U_x$

C: unknown constant of integration

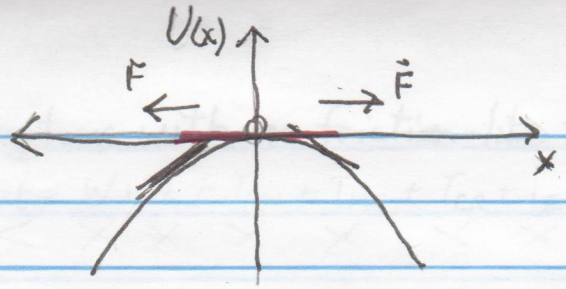
Also, $U_y = C'$ so that $-\frac{\partial U_y}{\partial y} = 0$

Equilibria (cont.)

Ex) $U(x) = -\frac{1}{2}kx^2$

$F(x) = -\frac{\partial}{\partial x}\left(-\frac{1}{2}kx^2\right)$

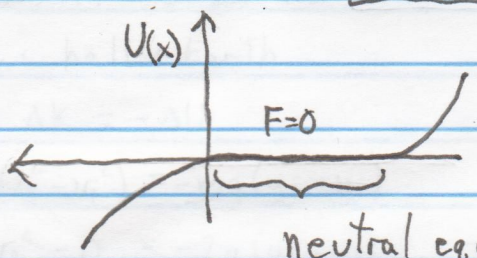
$F(x) = +kx$



Q: Where is $F(x)=0$? $\boxed{x=0}$ Equilibrium

Q: Is it stable? $\boxed{\text{Ans: no!}}$ F(x) is disruptive

Ex)



neutral equilibrium (where U is constant)

Conservation of Energy (Ch. 8)

PPT #2

See slide #2 of Ch.8 Powerpoint

In-Class Questions for attendance

Q: I can usually read the text projected by the ELMO.

1	2	3	4	5
Strongly Disagree	some	most, not all	Almost everything	Strongly Agree

Q: In general, the lectures delivered using the ELMO are effective.

1	2	3	4	5
Strongly Disagree				Strongly Agree

Q: Would you prefer all powerpoint, all Elmo or all whiteboard?

Q: Any suggestions to improve the course?

PPT: Slides 2-10