Staple!

Ord: ___ ___

Differential Eqns MAP2302 | **X-Class** | Prof. JLF King Wedn, 26Feb2020

Hi. **Write expressions unambiguously e.g, "$1/a+b$" should be bracketed either $[1/a]+b$ or $1/[a+b]$. (Be careful with negative signs!)**

Use "$f(x)$ notation" when writing fncs; in particular, for trig and log fncs. E.g, write "$\sin(x)$" rather than the horrible $\sin x$ or $[\sin x]$.

X1: Show no work.

___ a The visual representation of $\mathbb{C}$ is sometimes called "the ? plane", where ? is [Circle]: **Unreal Higher Snakes-on-a Argand Krypton Radon Xenon Euler Gauss Please-x y-com Air Sea De Rain-in-Spain-stays-mainly-on-the** .

___ b A [frictionless] 2-meter long pendulum swings on planet with surface acceleration $10\frac{\mathsf{m}}{\mathsf{sec}^2}$. The pendulum has small deflection, so it's DE can be approximated by a harmonic [oscillating spring] DE. The spring's period is ⌊.....⌋ sec.

When the pendulum's max-deflection [from vertical] is $\pm 2°$, the pendulum's period is [*circle*]

longer-than equal-to shorter-than

the spring's period.

___ c A *critically-damped* unforced spring has DE

∗: $\mathbf{M}y''+\mathbf{B}y'+\mathbf{K}y = 0\,\frac{\mathsf{kg}\cdot\mathsf{m}}{\mathsf{sec}^2}$, *where* $\mathbf{M}:=3\mathsf{kg}$, *and the Hooke's constant is* $\mathbf{K}:=75\frac{\mathsf{kg}}{\mathsf{sec}^2}$.

The damping constant **B**= ⌊.....⌋.

The *general soln* to critically-damped (∗) is

$y(t)=\Big[\alpha\cdot$ ⌊.....⌋ $+\beta\cdot$ ⌊.....⌋ $\Big]\,\mathsf{m}.$

Here, $\alpha,\beta\in\mathbb{R}$, *dimensionless.* [*The above blanks have numbers &* [*units*] *in various places; the bracketed quantity is dimensionless.* Is exp(?) is more convenient than $\mathsf{e}^?$ notation?] The **specific** soln with $y(0\mathsf{sec})=2\mathsf{m}$ and $y'(0\mathsf{sec})=0\frac{\mathsf{m}}{\mathsf{sec}}$ has

$\alpha=$ ⌊.....⌋, $\beta=$ ⌊.....⌋.

___ d Bacteria with birth-multiplier **B** are in a petri dish with carrying capacity **C**. The population, $p(t)$, satisfies the Logistic DE [write $p(t)$ rather than p, etc.] which is ⌊.....⌋.

For *Skyleria* bacteria, $\mathbf{B}=\frac{1/5}{\mathsf{min}}$. This petri dish has **C**=16oz, with initial population $\mathbf{p}_0=2\mathsf{oz}$. The time when *Skyleria* has reached half the carrying capacity is ⌊.....⌋ min $\overset{\text{decimal}}{\approx}$ ⌊....⌋ min.

[NB: You may use exp() and log() to express your answer.]

OYOP: *In grammatical English* ***sentences****, write your essay on every 2nd line (usually), so I can easily write between the lines.*

X2: On a $10\frac{\mathsf{m}}{\mathsf{sec}^2}$ planet, a hanging cable has vertex [i.e, lowest point] Tension=Horiz.Tension equal to

$$\mathsf{T} := 5\mathsf{N}. \quad (\text{Newton} = \mathsf{N} = [\mathsf{kg}\cdot\mathsf{m}]/[\mathsf{sec}^2].)$$

The cable's mass-density is $2\frac{\mathsf{kg}}{\mathsf{m}}$. Use $\boldsymbol{\tau}(x)$ for the tension in the cable above horiz.-position x, with $\boldsymbol{\tau}_{\text{Ver}}(x)$ and $\boldsymbol{\tau}_{\text{Hor}}(x)$ its vert/horiz components.

With SENTENCES and LARGE labeled diagrams, *derive* the 2nd-order DE for the hanging cable $h=h(x)$, where $h'(0\mathsf{m})=0$. [Do not solve the DE; simply carefully derive the DE.]

End of X-Class

X1:	___ ___ ___	135pts
X2:	___ ___	85pts
Total:	___ ___ ___	220pts

Please PRINT your name and ordinal. Ta:

Ord:

⌊.....⌋

HONOR CODE: *"I have neither requested nor received help on this exam other than from my professor."*

Signature: ⌊.....⌋