INSTRUCTIONS: Books, notes, and electronic devices are **not** permitted. Write (1) **your full name**, (2) **course number**, (3) **instructor name** and (4) **SPRING 2021** on the first page of your test. Do all problems. **Start each problem on a new page.** **Box** **your answers.** A correct answer with incorrect or no supporting work may receive no credit, while an incorrect answer with relevant work may receive partial credit. **Justify your answers, show all work.** You must start uploading your test to Gradescope by 1:01pm. Write the **honor code statement** given in the box below on the **first page** of your test and **sign** and **date it**.

On my honor, as a University of Colorado Boulder student, I have neither given nor received unauthorized assistance on this work. Signature:_____ Date:_____

1. (34pts) The following parts of this problems are not related.

   (a)(17pts) Use the Quotient Rule to find the derivative of $f(x) = \dfrac{5x-1}{\ln(x)}$. Simplify your answer.

   (b)(17pts)(*i*)(5pts) Consider the limit $\lim_{x\to\infty} (5x)^{1/x}$. What type of indeterminate form is this limit?

   (*ii*)(12pts) Evaluate the limit $\lim_{x\to\infty} (5x)^{1/x}$. Show all work.

---

2. (35pts) The following parts of this problems are not related. **Start this problem on a new page.**

   (a)(16pts) Find the linearization of $f(x) = \arctan(x)$ at the point $a = 1$. Show all work.

   (b)(16pts) Find the antiderivative: $\displaystyle\int \frac{3}{\sqrt{1-9x^2}}\,dx$. Show all work.

   (c)(3pts) For which choice of the number c will the function $f(x) = \begin{cases} cx - \dfrac{1}{5}, & \text{if } x < 2, \\ \dfrac{x^3 - 7x^2 + 10x}{x^2 + x - 6}, & \text{if } x \geq 2, \end{cases}$ be continuous?

   (**No justification necessary** - *Choose only <u>one</u> answer, copy down the entire answer.*)

   (A) $c=2$ (B) $c=-\dfrac{1}{2}$ (C) $c=-\dfrac{4}{3}$ (D) $c=5$ (E) None of these

---

3. (34pts) The following parts of this problems are not related. **Start this problem on a new page.**

   (a)(17pts) Use *logarithmic differentiation* to find $\dfrac{dy}{dx}$ if $y = x^{\sin(x)}$. Your final answer should be in terms of the x-variable.

   (b)(17pts) Given that the graph of $f(x) = 1 + 2x + \sinh^3(x)$ is one-to-one, find $(f^{-1})'(1)$. Justify.

PROBLEMS #4 & #5 ON THE OTHER SIDE

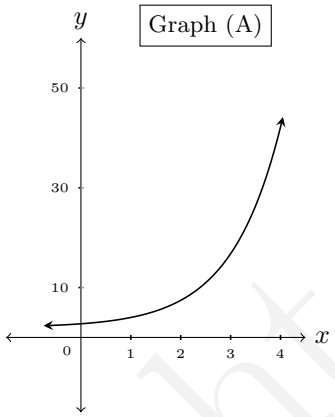
4. (35pts) The following parts of this problems are not related. **Start this problem on a new page.**

(a)(16pts) Find the derivative of $g(x) = \displaystyle\int_e^{e^{2x}} \ln(t)\,dt$. Show all work and simplify your answer.

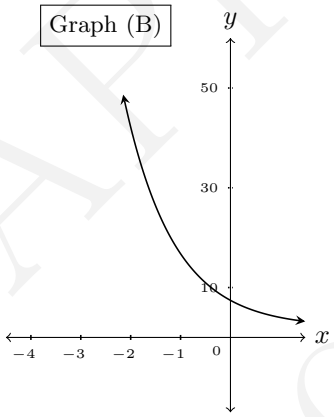
(b)(16pts) Evaluate the definite integral: $\displaystyle\int_0^{\sqrt{\pi}} x\cos(x^2)\,dx$. Show all work.

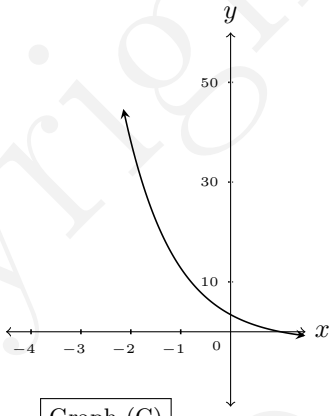
(c)(3pts) Which graph below best matches the graph of the function $f(x) = \dfrac{e}{e^x} + 1$? **Choose only <u>one</u> answer.** *No justification necessary, clearly indicate your answer otherwise points will be deducted.*

Graph (A)

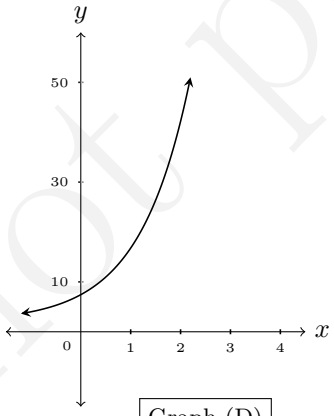


Graph (B)





Graph (C)



Graph (D)

5. (12pts) Answer either **ALWAYS TRUE** or **FALSE**. You do <u>NOT</u> need to justify your answer. (*Don't just write down "A.T." or "F", completely write out the words "ALWAYS TRUE" or "FALSE" depending on your answer.*)

(a)(3pts) The sum $4+6+8+10+12$ can be written as $\displaystyle\sum_{i=11}^{15}[2i-18]$.

(b)(3pts) We can show that $\displaystyle\lim_{h\to 0}\frac{5^{2+h}-25}{h} = 25\ln(5)$.

(c)(3pts) If, for an object moving in a straight line, we have $a(t) = 10\frac{\text{m}}{\text{s}^2}$, $v(0) = 5\frac{\text{m}}{\text{s}}$ and $s(0) = 0$, then $s(2) = 40\text{m}$.

(d)(3pts) Note that $\displaystyle\int_{-1}^{1}|2x|dx = |x^2|\Big|_{-1}^{1} = 1^2-(-1)^2 = 0$.

— **END** —
(Stay Safe.)