

Exam #3

November 20, 2017

Name _____

- You will be told when to begin the work and when to terminate work on the examination. You must stop when instructed. Points may be deducted in case of violations.
- Please show your work to support your answers that require calculations. Correct but unsupported answers may not be given full credit.
- The use of a cell phone or other electronic communication devices during the examination is not allowed. The exam will be canceled and a grade of "0" will be assigned to anyone who opens a cell phone during the examination or if one is found on their seat or hand.

No calculators are allowed!

Future value of an income stream: $FV = e^{rT} \int_0^T f(t)e^{-rt} dt$

Useful lifetime: $R'(t) = C'(t)$

Honor Code: On my honor, I have neither received nor given any aid during this examination.

Signature: _____

1. (10 points each) Find the indefinite integral.

(a) $\int 2 - 12x^3 \, dx$

(b) $\int (x - 1)(x + 1) \, dx$

(c) $\int t^3(t^4 - 2)^4 \, dt$

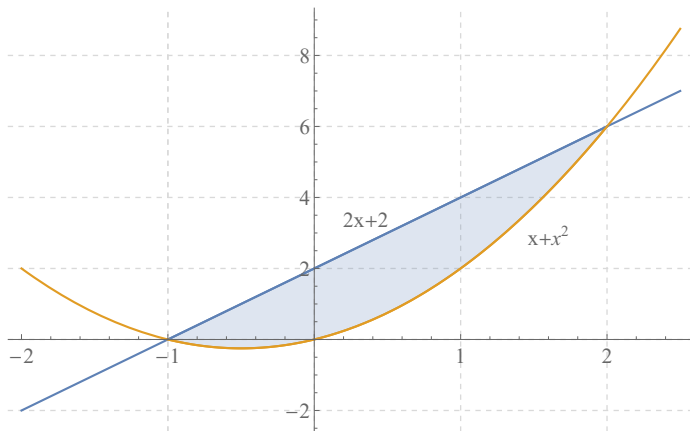
(d) $\int \frac{2}{x \ln(x)} \, dx$

2. (15 points each) Evaluate the integral and simplify your answer.

(a) $\int_3^{11} \frac{1}{\sqrt{2x+3}} dx$

(b) $\int_0^1 6x^2 e^{x^3} dx$

3. (5 points) Setup **but do not evaluate** the integral that represents the area of the shaded region.



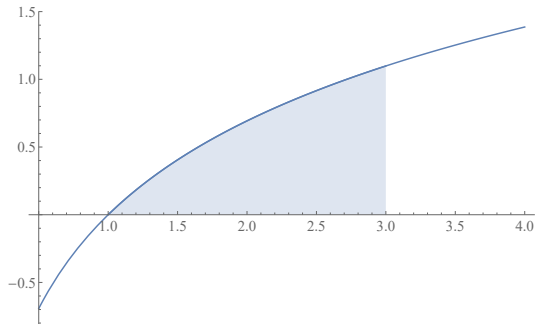
4. (5 points) Check that F is an antiderivative of f . [Hint: You have to differentiate a function.]

$$F(x) = x \ln(x) - x + 2; \quad f(x) = \ln(x)$$

5. (10 points) Find the average value of $f(x) = e^{3x}$ over the interval $[-1, 1]$.

6. (10 points) At age 25, Alice starts making annual deposits of \$3500 into an IRA account that pays interest at an annual rate of 3% compounded continuously. Assuming her payments are made as a continuous income flow, how much money will be in her account if she retires at the age of 65?

7. (5 extra credit points) Find the area under the graph of $\ln(x)$ on the interval $(1, 3)$. The function is depicted below. [Hint: You already saw an antiderivative of $\ln(x)$.]



8. (2.5 extra credit points each) Determine if the following statement is true or false.

(a) (true / false)

$$\int \frac{x^2}{x-1} dx = \frac{\frac{1}{3}x^3}{\frac{1}{2}x^2 - x} + C$$

(b) (true/false)

$$\begin{aligned} \int_0^4 \frac{2x}{\sqrt{x^2-3}} dx &= \left| \begin{array}{l} u = x^2 - 3 \\ du = 2x dx \end{array} \right| = \int_0^4 \frac{1}{\sqrt{u}} du = \int_0^4 u^{-1/2} du \\ &= 2u^{1/2} \Big|_0^4 = 2\sqrt{4} - 2\sqrt{0} = 2 \cdot 2 = 4 \end{aligned}$$