tags: `MATA35-2021`

Quiz 1 - Thursday

Problem 1 (40pts)

Solve each of the following problems. If there are multiple potential answers, give your response in the most general form possible.

1. $\int 2dx$
2. $\int x^{-3}dx$
3. $\int \frac{2}{2x-1}dx$
4. $\int \frac{1}{2}\cos(x+1)dx$
5. $\int (x^2-4x+4)dx$
6. $\int \frac{1}{(y+1)(2y+1)}dy$
7. $\int (e^{-2u}+u^3)du$
8. $\int \left[\frac{d}{dx}((\cos(5-\sin x))e^{x^2}-4)\right]dx$

Problem 2 (30pts)

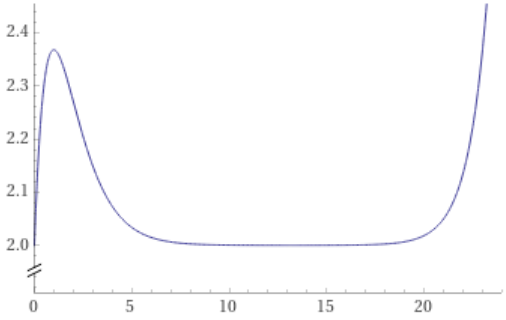
Solve each of the following definite integrals. You should simplify as much as possible without a calculator, but may leave answers in terms of $e, \ln, \sin, \sqrt{\dots}$, etc.

1. $\int_0^{\pi/2}(1+\sin x))^2\cos x dx$
2. $\int_0^{\pi} xe^{-4x}dx + \int_{\pi}^{\infty} xe^{-4x}dx$

Problem 3 (15pts)

Every day, the Gibson coal-fired power plant in Owensville, Indiana, USA produces about 50 kilotons of CO_2 into the atmosphere.

Suppose you set up a post-combustion carbon capture system set up. Starting from midnight, the instantaneous rate of carbon capture is $f(t) = te^{-t} + 2 + e^{t-24}$ kilotons/hour of CO_2.



After carbon capture, how much CO_2 would be released by the power plant into the air each day? You may approximate $e^{-24} \approx 0$.

Problem 4 (15pts)

You are King Arthur's court wizard. Your job is to determine the average airspeed of an unladen European swallow, but you only have one swallow. You decide to send it on a 2-hour round-trip journey, and you measure its speed twice an hour, for a total of 5 measurements (including the 0th-hour measurement).

- $v(0) = 22$ miles per hour
- $v(0.5) = 25$ miles per hour
- $v(1) = 18$ miles per hour
- $v(1.5) = 27$ miles per hour
- $v(2.0) = 22$ miles per hour

1. Approximate the distance traveled using rectangular Riemann sums. Use this to compute the average speed.
2. Approximate the distance traveled using the trapezoid rule. Use this to compute the average speed.