Math 1172 mastery practice questions

Each quiz will include one question per section. I am giving you two here to give some idea of what your question might be like.

1 Simple derivatives & antiderivatives

Question 1.1. Please do the integral and simplify all trig functions in your answer:

$$\int_{\pi/6}^{3\pi/2} \frac{3}{\sqrt{x}} + \sin x \, dx$$

Question 1.2. a) Please find the derivative of $f(x) = \frac{5x}{\sin^2 x}$

b) Please find the antiderivative of $f(x) = 5x^2 - \frac{3}{x^4}$

2 u-substitution

Question 2.1. Please find the integral:

$$\int_0^1 \frac{x^2}{\sqrt{4-x^3}} \, dx$$

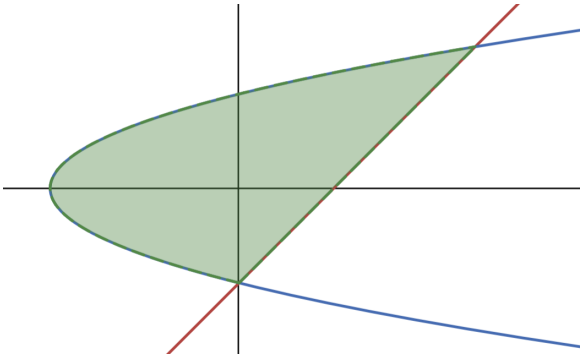
Question 2.2. Please do the integral:

$$\int x(x+2)^5 \, dx$$

3 Area between curves

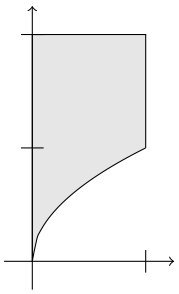
Question 3.1. Please find the area bounded between the curves $y = x + 1$ and $y = x^2 - 1$.

Question 3.2. Please find the shaded area. The curves are $y = x - 2$ and $x = y^2 - 4$

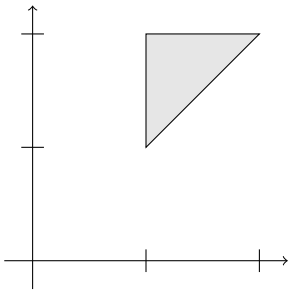


4 Washers

Question 4.1. Please use washers to find the volume obtained by revolving the shaded area around the line $y = -1$. The curve is $y = \sqrt{x}$.

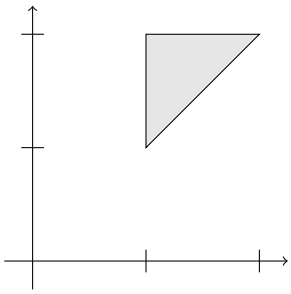


Question 4.2. Please use washers to find the volume obtained when revolving the shaded region around the y-axis. (Each mark along the axes is 1 unit.)

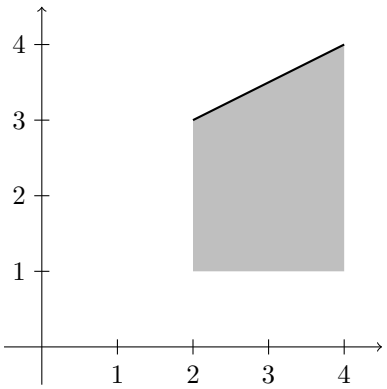


5 Shells

Question 5.1. Please use shells to find the volume obtained when revolving the shaded region around the line $x = 3$. (Each mark along the axes is 1 unit.)



Question 5.2. Please use the shells method to find the volume obtained when revolving the shaded area around the line $x = -1$. The line at the top is $y = \frac{x}{2} + 2$.



6 Natural log

Question 6.1. a) Please find the derivative of $x\cos(\ln x)$

b) Please find the integral:

$$\int_1^3 \frac{x^2}{5x^3-1}\,dx$$

Question 6.2. a) For $f(x) = \ln((2x-3)^2)$, please find $f'(2)$, and simplify as much as you can.

b) Please solve for x in: $3e^{2x+1} = 6$

7 Exponential function

Question 7.1. a) Please find the derivative of $f(x) = \dfrac{e^{5x}}{x^2}$.

b) Please find the integral:

$$\int xe^{4x^2-3}\,dx$$

Question 7.2. a) Please find $f'(\ln 3)$ for $f(x) = x^2e^x$ and simplify as much as you can.

b) Please find the integral: $\displaystyle\int e^x\sqrt{4+e^x}\,dx$

8 Other logs & exps

Question 8.1. a) Please find the derivative of $y = \sqrt{\log_3 x}$

b) In each part find the logarithm by hand. One of them is impossible to do by hand— for that one just say "impossible".

- $\log_2 8$
- $\log_5 \frac{1}{25}$
- $\log_4 40$
- $\log_4 2$

Question 8.2. a) Please simplify fully (no calculators): $\log_3(6) + \log_3(3/2)$

b) Please find the integral and simplify as much as possible:

$$\int_0^{\log_5 3} x + 5^x \, dx$$

9 Inverse trig

Question 9.1. Please find the integral, and simplify as much as you can in the answer:

$$\int_0^{2/3} \frac{2}{\sqrt{4 - 9x^2}} \, dx$$

Question 9.2. a) Please find the derivative of $5x^2 + \tan^{-1}(2x)$

b) Please give the value of each expression, or say "impossible" if it's not possible to do by hand.

i) $\sin^{-1} \frac{1}{2}$

ii) $\tan^{-1} 2\pi$

iii) $\cos^{-1} 1$

iv) $\tan^{-1} \sqrt{3}$

10 L'Hopital's rule

Question 10.1. Please find the limit:

$$\lim_{x \to 0} x \ln x$$

Question 10.2. Please find the limit:

$$\lim_{x \to \pi/6} \frac{2 \sin x - 1}{\cos 3x}$$

11 Integration by parts

Question 11.1. Please do the integral, and simplify as much as you can in the answer:

$$\int_1^3 \frac{\ln x}{x^5} \, dx$$

Question 11.2. Please do the integral:

$$\int (x^2 + 3x - 3)e^{2x} \, dx$$

12 Trigonometric integrals

Question 12.1. Please find the integral:

$$\int \sin^2 x \cos^2 x \, dx$$

Question 12.2. Please do the integral, and simplify any trig functions in your answer:

$$\int \sin^4 x \cos^3 x \, dx$$

13 Partial fractions

Question 13.1. Please do the integral:

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

Question 13.2. Please do the integral:

$$\int \frac{5x-5}{x^2-4x-21}\,dx$$

14 Improper integrals

Question 14.1. Please evaluate the integral, or show that it diverges.

$$\int_0^4 \frac{1}{3x-6}\,dx$$

Question 14.2. Please find the integral $\displaystyle\int_0^\infty x3^{-x^2}\,dx$

15 Integration gumbo

Question 15.1. In each part, say briefly how you would do the integral. You don't need to actually do it fully. Your answer in each part should be one of: "simplify, then integrate directly" (describing the simplification), "u-substitution" (say what u would be), "inverse trig function" (say how the inverse trig function would appear), "integration by parts" (say what the u and dv would be), "partial fractions" (say how you would set up the fractions to get it started). You might not use one or more of these answers, or you may use the same one twice.

- $\displaystyle\int \frac{3}{x^2+1}\,dx$
- $\displaystyle\int \frac{4+x}{x^2}\,dx$
- $\displaystyle\int xe^{4x}\,dx$

Question 15.2. In each part, say briefly how you would do the integral. You don't need to actually do it fully. Your answer in each part should be one of: "simplify, then integrate directly" (describing the simplification), "u-substitution" (say what u would be), "inverse trig function" (say how the inverse trig function would appear), "integration by parts" (say what the u and dv would be), "partial fractions" (say how you would set up the fractions to get it started). You might not use one or more of these answers, or you may use the same one twice.

- $\displaystyle\int x^2e^x\,dx$
- $\displaystyle\int \frac{3}{\sqrt{4-x^2}}\,dx$
- $\displaystyle\int \frac{x^2}{x^2-2x-3}$

16 Sequences

Question 16.1. Is the following sequence decreasing or increasing? Either way, prove it.

$$a_n = n^2 + 2n - 5$$

Question 16.2. For this sequence:

$$9, -3, 1, -1/3, 1/9, \ldots$$

a) Please find the general term for this sequence.

b) Does the sequence converge or diverge? If it converges, say what it converges to.

c) Is the sequence monotonic or not? Explain why in a few words (you don't need to prove it).

17 Series

Question 17.1. Please find the value of this geometric series, or say that it diverges:

$$\sum_{n=1}^{\infty} (-1)^n \frac{4^n}{3^{2n}}$$

Question 17.2. (Fall 2025 section 2) Please use geometric series to write $4.444\ldots$ as a fraction.

18 Integral test

Question 18.1. Please use the integral test to decide if the following series converges:

$$\sum_{n=1}^{\infty} \frac{1}{(2n)^4}$$

Question 18.2. Please use the integral test to say if this series converges or diverges: $\sum_{n=1}^{\infty} 2^{-n}$

19 Comparison test

Question 19.1. Please use one of the comparison tests to decide if the following series converges:

$$\sum_{n=1}^{\infty} \frac{5 + \sin n}{n^4}$$

Question 19.2. Please use one of the comparison tests to say if this series converges or diverges:

$$\sum_{n=1}^{\infty} \frac{n^2 + 4n + 1}{n^3 + 2}$$

20 Alternating series test

Question 20.1. Please use the alternating series test to decide if the following series converges:

$$\sum_{n=1}^{\infty} (-1)^n \frac{n}{2^n}$$

Question 20.2. Please use the alternating series test to say if this series converges or diverges:

$$\sum_{n=1} (-1)^n \frac{n}{n^2 + 1}$$

21 Ratio & root test

Question 21.1. Please use either the ratio or root test to decide if the following series converges:

$$\sum_{n=1}^{\infty}(-1)^n \frac{n}{e^n}$$

Question 21.2. Please use either the ratio test or the root test to say if this series converges or diverges:

$$\sum_{n=1} \frac{n(-3)^n}{4^n}$$

22 Power series (convergence)

Question 22.1. Please find the interval of convergence (be sure to check the endpoints) for:

$$\sum_{n=0}^{\infty} \frac{4^n}{n^2} x^n$$

Question 22.2. Please find the interval and radius of convergence for the power series:

$$\sum_{n=0}^{\infty} \frac{(x-2)^n}{n\, 3^{n+1}}$$

23 Taylor series

Question 23.1. Please find the Maclauren series for $f(x) = e^{-x/2}$. Write out the first 4 terms, and also write the entire series as a summation.

Question 23.2. Please find the Taylor series for $f(x) = 3\sin(2x)$ centered at $x = \pi/4$. Write out the first 4 nonzero terms. (You don't need to write it as a summation.)