Standard Response Questions. Show all your work to receive credit. Please $\boxed{\textbf{BOX}}$ your final answer.

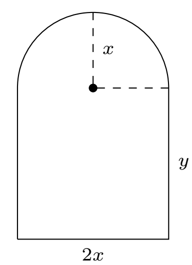
#1. (6 pts) Find the most general antiderivative of $f(x) = x^5 - \sec(c)\tan(x) + \frac{1}{2\sqrt{x}}$.

#2. (8 pts) Determine the value(s) of a such that

$$\int_a^{a+1} (2x+3)\,\mathrm{d}x = 10$$

#3. (14 pts)

A small region has the shape of a rectangle attached to a semicircle, so that the diameter of the semicircle is equal to the width of the rectangle. The perimeter is $2\,\mathrm{m}$.
What is the width of such a region which has the largest possible area?
What is the largest possible area?.
Use one of the techniques of MTH 132 to justify that your solution indeed maximizes the area.



#4. (7 pts) Given $f(x) = 5x^{2/3} - 2x^{5/3}$

(a) (4 pts) Determine all its critical points.

(b) (4 pts) Classify the critical points as local minima/maxima/neither.

#5. (7 pts) Determine the absolute extrema of the function $f(x) = x - 2\sin x$ on the interval $[0, \pi]$. ($\sqrt{3} \approx 1.73$)

#6. (6 pts) Compute $\lim_{x\to\infty} \left(\sqrt{4x^2+3x} - 2x\right)$.

#7. (8 pts) The acceleration of an object moving along the x-axis is $a(t) = 3\sin t$. What are its velocity and position functions, $v(t)$ and $s(t)$, if $v(0) = 1$ and $s(0) = 3$?

Multiple Choice. Circle the best answer. No work needed.
No partial credit available.

#8. (4 pts) Determine all values of c satisfying the Mean Value Theorem for the function $f(x) = x^3 - 4x$ on the interval $-1 \le x \le 3$.

A. $\left(\frac{7}{3}\right)^{1/2}$ B. $\pm\sqrt{\frac{7}{3}}$ C. 5 D. 3

#9. (4 pts) If the length of a side of a cube is measured to be 5 cm with a maximum error of 0.1 cm, use differentials to estimate the maximum error in the surface area.

A. $6\,\mathrm{cm}^2$ B. $11.2\,\mathrm{cm}^2$ C. $3\,\mathrm{cm}^2$ D. $60\,\mathrm{cm}^2$ E. $6\,\mathrm{cm}$

#10. (4 pts) Compute $\displaystyle\lim_{n\to\infty}\sum_{i=1}^{n}\frac{2i}{n^2}$.

A. 0 B. 1 C. 2 D. DNE

#11. (4 pts) Which function should you apply Newton's method to, in order to estimate $\sqrt{5}$?

A. $x^2 - 25$ B. $\sqrt{5} - x^2$ C. $x - 5$ D. $x^2 - 5$

#12. (4 pts) The derivative of $f(x) = \displaystyle\int_1^{2x^2} \frac{\sin t}{1+t^2}\,\mathrm{d}t$ is

A. $\frac{\sin x}{1+x^2}$ B. $\frac{\sin(2x^2)}{1+4x^4}$ C. $\frac{4x\sin x}{1+x^2}$ D. $\frac{4x\sin(x^2)}{1+4x^4}$

#13. (4 pts) Determine the value of $\int_{-5}^{0} |x+3|\,\mathrm{d}x$. (*Hint: Draw a picture of the region the integral represents, and find the area using simple formulas form geometry.*)

A. -6.5 B. -5.5 C. 0.5 D. 5.5 E. 6.5

#14. (4 pts) Using linear approximation, what is the best estimate of $\sqrt{4.1}$?

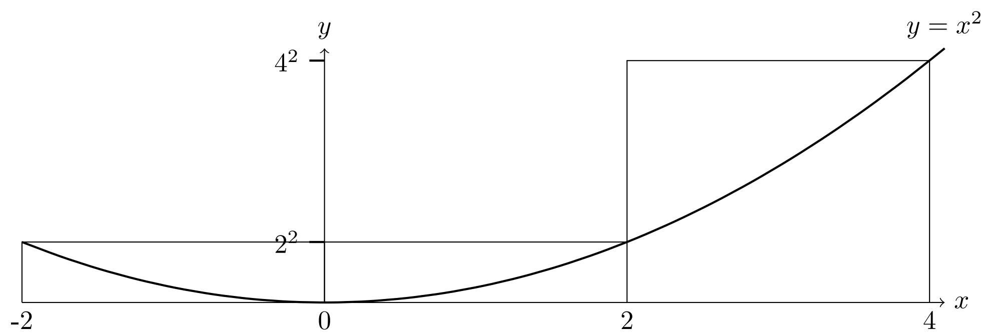
A. $2 + \frac{1}{40}$ B. $2 + \frac{1}{20}$ C. $2 + \frac{1}{10}$ D. 2.

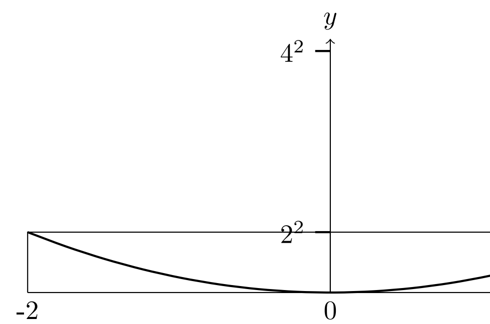
#15. (4 pts) Select the true statements about the function $f(x) = \frac{x^3+4x}{(x+2)(x-1)}$:

A. The function has no vertical asymptotes and only one slant asymptote.
B. The function has only one vertical asymptote and only one slant asymptote.
C. The function has only two vertical asymptote and no slant asymptotes.
D. The function has only two vertical asymptote and only one slant asymptote.

#16. (4 pts) Estimate the area A under the graph $y = x(x-2)$, between $x = 0$ and $x = 4$, using 4 rectangles of equal width, with heights of the rectangles determined by the height of the curve at the left endpoints and the right endpoints.

A. $A = 1$ using left endpoints; $A = 8$ using right endpoints.
B. $A = -1$ using left endpoints; $A = 9$ using right endpoints.
C. $A = 10$ using left endpoints; $A = 2$ using right endpoints.
D. $A = 2$ using left endpoints; $A = 10$ using right endpoints.





More Challenging Question(s)

#17. (14 pts) The function $f(x)$ has *all* of the following properties.

1. $\lim_{x\to 2^-} f(x) = -\infty$
2. $\lim_{x\to 2^+} f(x) = \infty$
3. $f(2)$ DNE.
4. $\lim_{x\to -\infty} f(x) = 0.$
5. $f(-2) = 1$
6. $f(5) = 1$
7. $f(0) = 0.$
8. $f'(x) > 0$ if $x < -2$ or $x > 5$.
9. $f'(x) < 0$ if $-2 < x < 2$ or $2 < x < 5$.
10. $f'(5) = 0.$
11. $f'(-2) = 0$
12. $f''(x) > 0$ if $x < -3$ or $x > 2$.
13. $f''(x) < 0$ if $-3 < x < 2$.

Complete the following sentences:

(a) The domain of the function is: ____

(b) Such function must have vertical asymptote(s), with equation(s): ____________________________

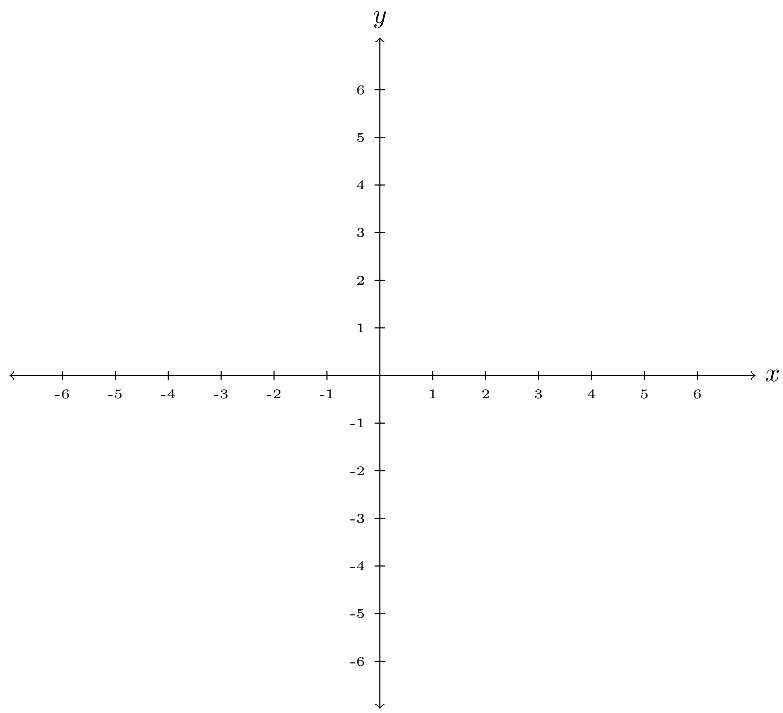
(c) There must be a horizontal asymptote with equation ____________________________

(d) There must be a local maximum of ______________, and a local minimum of ______________

(e) Such function must have inflection point(s) at $x =$ ______________.

(f) The function must be negative on ____________________________.

(g) Sketch the curve.


y
x
6
5
4
3
2
1
-1
-2
-3
-4
-5
-6
-6
-5
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-3
-2
-1
1
2
3
4
5
6