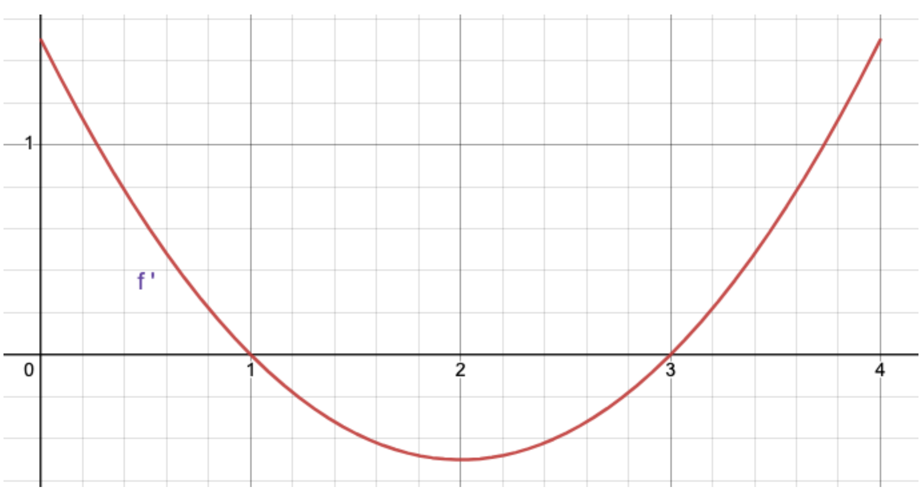
Instructions:

- Write your name and EID on **every page**.
- Put your answers on the last sheet of paper.
- No other outside resources, such as books, notes, the internet, or other people, are allowed.
- There are 110 possible points. It will be graded out of 100. The maximum score is 105.

1. (points) Let $f(x) = \dfrac{x^2-3}{x-2}$. Which of the following is the y-value of the **local minimum** of f?

(A) 1 (B) 2 (C) 3 (D) 5 (E) 6 (F) None of These

2. (6 points) The graph of the derivative f' of a continuous function f on the interval $[0,4]$ is shown below:



On what interval is f concave down?

(A) $(0,1)$ (B) $(0,2)$ (C) $(1,3)$ (D) $(2,3)$ (E) $(2,4)$ (F) $(0,4)$ (G) None

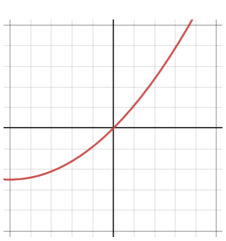
3. (6 points) Find $\lim\limits_{x\to 0}\left(\dfrac{e^{2x}+e^{-2x}-2}{e^{2x}-2x-1}\right)$.

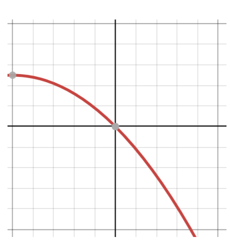
(A) 0 (B) $\dfrac{1}{2}$ (C) 1 (D) $\dfrac{3}{2}$ (E) 2 (F) Does not Exist

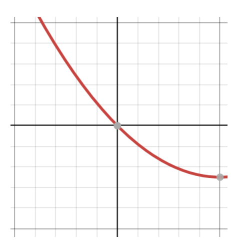
4. (6 points) Find $\lim\limits_{x\to 0}\left(\dfrac{1}{\sin(2x)}-\dfrac{1}{e^{2x}-1}\right)$.

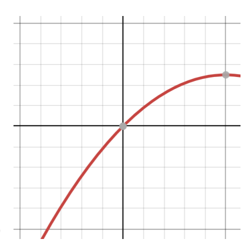
(A) 0 (B) $\dfrac{1}{4}$ (C) 2 (D) $\dfrac{1}{2}$ (E) 1 (F) Does not Exist

5. (6 points) Which choice looks most like the graph of $y = xe^{-5x}+2x^2$ at the point $(0,0)$?

(A) 

(B) 

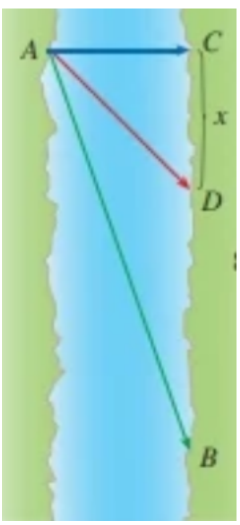
(C) 

(D) 

6. (6 points) Find the absolute max of $f(x) = \dfrac{\sin(x)}{2+\cos(x)}$ on the interval $[0, \pi]$.

(A) 0 (B) $\frac{1}{2}$ (C) $\frac{\sqrt{3}}{2}$ (D) $\frac{\sqrt{3}}{3}$ (E) $\frac{\sqrt{2}}{2}$ (F) $\frac{1}{3}$

7. (6 points) A person needs to get from point A to point B (See the image below). The distance from A to C is 4 km and the distance from C to B is 8 km. The person will first swim across the river to point D at a rate of 2 km/hr and then run to B at a rate of 6 km/hr. What is the length of x that gets this person to point B the fastest?

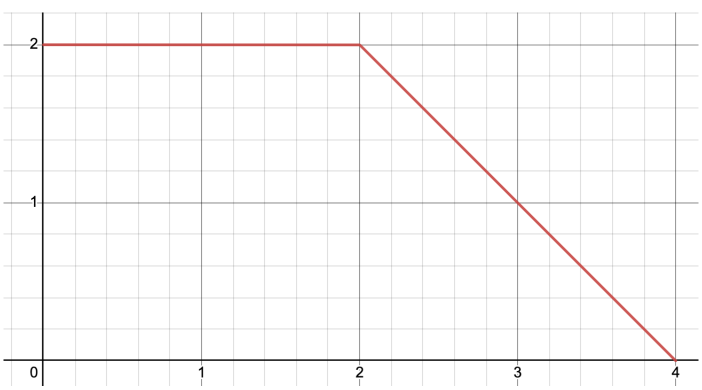


(A) 0 (B) $\frac{4}{\sqrt{3}}$ (C) $2\sqrt{3}$ (D) $\frac{\sqrt{5}}{2}$ (E) $\frac{\sqrt{10}}{4}$ (F) $\sqrt{2}$ (G) None of These

8. (6 points) Let $R(t) = 2t + 1$ be the rate at which moss grows on a rock (measured in in^2/s.) Use 2 equal subintervals and left endpoints to estimate the amount of moss (measure in in^2) that grows from $t = 1$ to $t = 7$.

(A) 12 (B) 24 (C) 36 (D) 44 (E) 72 (F) 90

9. (6 points) Let $F(x) = \left(e^{2x} \cdot \int_0^{3x} f(t)\,dt\right)$, where $f(t)$ is given in the graph below:



Find $F'(1)$.

(A) $2e^2$ (B) $5e^2$ (C) $7e^2$ (D) $8e^2$ (E) $10e^2$ (F) $14e^2$ (G) None of These

10. (6 points) Find $\displaystyle\int_0^3 \left(x^2 - |x^2 - 4|\right)\, dx$.

(A) 0 (B) $-\dfrac{1}{3}$ (C) $\dfrac{1}{3}$ (D) $\dfrac{4}{3}$ (E) $\dfrac{7}{3}$ (F) $\dfrac{8}{3}$

11. (6 points) Find $\displaystyle\int_1^{\sqrt{2}} \frac{1}{x^3} \cos\left(\frac{\pi}{x^2}\right)\, dx$.

(A) $-\dfrac{1}{2\pi}$ (B) $\dfrac{2}{\pi}$ (C) $-\dfrac{1}{\pi}$ (D) $\dfrac{3}{2\pi}$ (E) $-\dfrac{1}{3\pi}$ (F) $\dfrac{1}{4\pi}$

12. (6 points) $\displaystyle\int_0^{3/2} \frac{4x}{\sqrt{2x+1}}\,dx$

(A) $\frac{2}{3}$ (B) $\frac{8}{3}$ (C) $\frac{6}{11}$ (D) $\frac{3}{4}$ (E) $\frac{\sqrt{2}}{4}$ (F) $\frac{1}{2}$

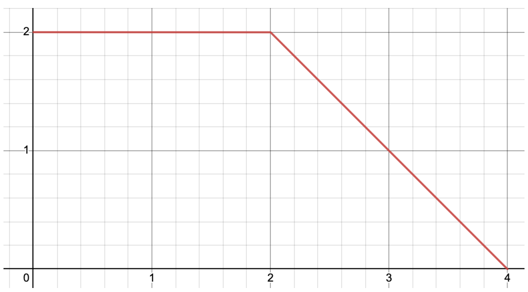
13. (6 points) If $f'(x) = \dfrac{1}{9+x^2}$ and $f(0) = 0$, find $f(1)$.

(A) $\tan^{-1}(1)$ (B) $\frac{1}{3}\tan^{-1}\left(\frac{1}{3}\right)$ (C) $\frac{1}{9}\tan^{-1}\left(\frac{1}{3}\right)$ (D) $\frac{1}{3}\tan^{-1}\left(\frac{1}{9}\right)$ (E) $\frac{1}{9}\tan^{-1}(1)$

14. (4 points): True or False: The function $f(x) = x^4 + 3x$ has an inflection point at $x = 0$.

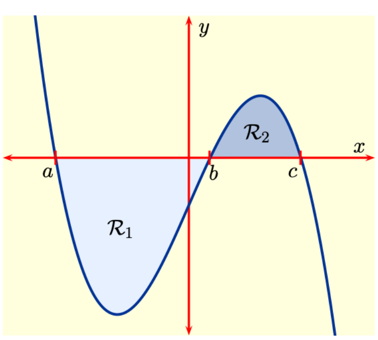
15. (4 points): True or False: $\int_{-2}^{1} \left(\frac{1}{x^2}\right)\,dx = -\frac{1}{2}$.

16. (4 points): Let $G(x) = \int_0^x f(t)\,dt$, where $f(t)$ is the function below.



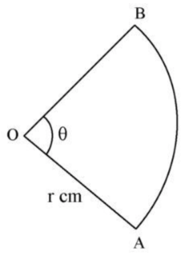
True or False: The value $G'(2)$ does **not** exist.

17. (4 points): Let f be the function below:



True or False: The sum of the area of the two regions equals $\int_a^c |f(x)|\,dx$.

18. (10 points) You must build a fence in the shape of a sector with radius r and area $15m^2$ (see image below). What is the minimum possible total length of the fence?



19. (6 points) Free Response: Let R be the region bounded by $y = 1$, $y = x^2$, and $x = 4$. Find the value k such that the vertical line $x = k$ splits R into two regions of equal area.

Multiple Choice (6 points each):

1)

2)

3)

4)

5)

6)

7)

8)

9)

10)

11)

12)

13)

True or False (4 points each):

14)

15)

16)

17)