

1. (32 pts) Evaluate each of the following.

(a) $\int_0^1 \frac{2x - 5}{\sqrt[3]{x^2 - 5x + 6}} dx$

(b) $\int (\tan \theta \cos \theta + \sin \theta) d\theta$

(c) $\int_{-1}^2 |2x^2 - 4x| dx$

2. (20 pts) The following are unrelated.

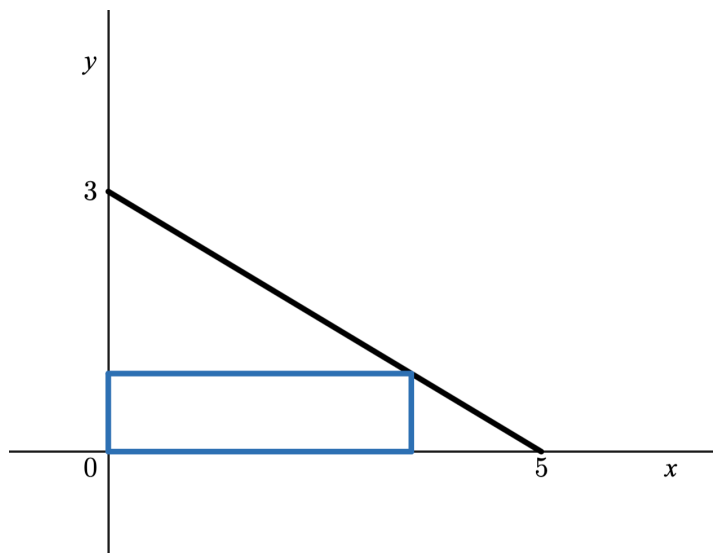
(a) Evaluate: $\sum_{i=1}^n \frac{1}{n} \left(\left(\frac{i}{n} \right)^3 + 2 \right)$.

(b) Evaluate the limit $\lim_{n \rightarrow \infty} \sum_{i=1}^n \frac{1}{n} \left(\left(\frac{i}{n} \right)^3 + 2 \right)$ using summation formulas or by evaluating an appropriate definite integral. Recall that you may not use L'Hospital's rule or dominance of powers arguments.

3. (12 pts) Clearly sketch the graph of a function $h(x)$ that satisfies the following properties (label any extrema, inflection point(s), and asymptote(s)):

- (i) $h'(x) > 0$ if $-2 < x < 2$
- (ii) $h'(x) < 0$ if $-\infty < x < -2$ or $2 < x < \infty$
- (iii) $h'(-2) = 0$
- (iv) $\lim_{x \rightarrow 2^-} h'(x) = 3$
- (v) $\lim_{x \rightarrow 2^+} h'(x) = -3$
- (vi) $h''(x) > 0$ if $x \neq 2$

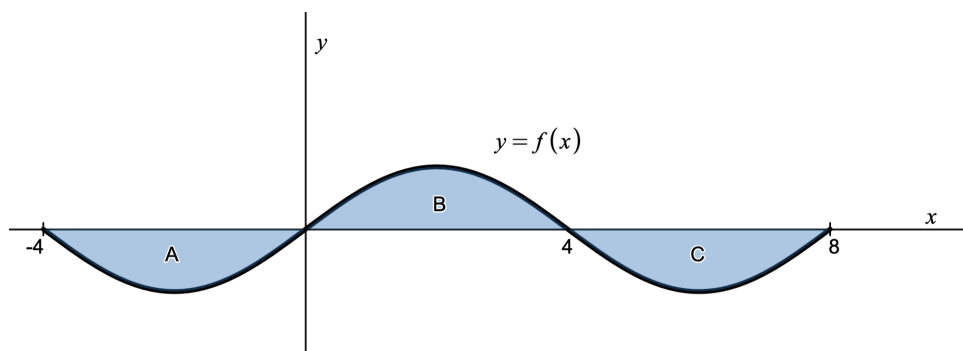
4. (12 pts) Suppose a rectangle has its left side lying on the y -axis, its bottom side lying on the x -axis, and the upper right corner touching the line that crosses through the points $(0,3)$ and $(5,0)$ (see diagram below). Find the dimensions of the rectangle that maximize the area of the rectangle. For full credit, verify that your final answer is a maximum value.



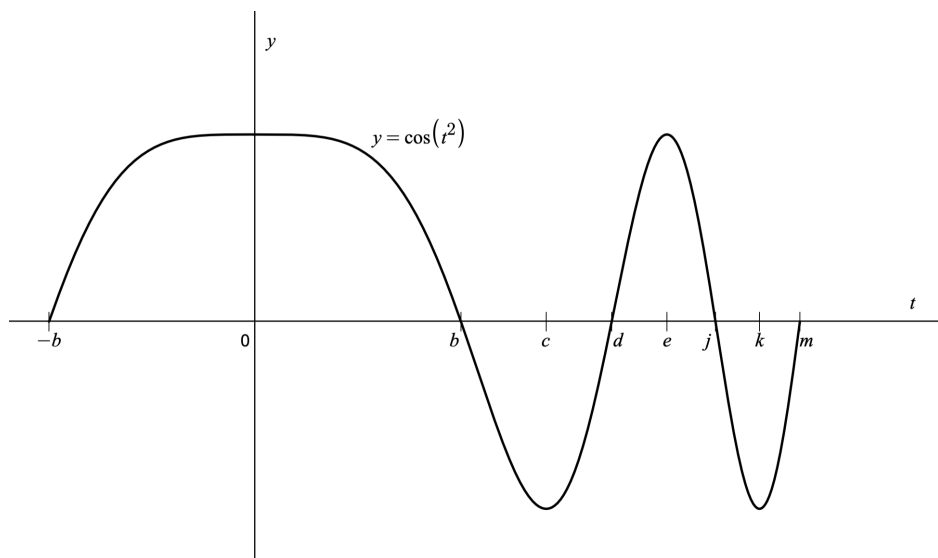
5. (24 pts) The following are unrelated:

- (a) Each of the regions, A , B , and C bounded by the graph of f and the x -axis, has an area of 5.

Find the value of $\int_{-4}^8 (f(x) + x + 5) dx$.



- (b) Consider the function $y = \cos(t^2)$ shown below on domain $[-b, m]$. Let $g(x) = \int_{-b}^x \cos(t^2) dt$. Answer the following questions. Your answers to parts (iv) and (v) will be in terms of b , c , d , e , j , k , and m . **No justification is needed for this problem.**



- i. What root (if any) of $y = \cos(t^2)$ would Newton's Method find if the initial guess was $t = c$?
- ii. Find $g'(x)$
- iii. Find $g''(x)$
- iv. On which interval(s) is g decreasing?
- v. At what x -value(s) does g have local minimum values?