PLEASE NOTE: THIS PROBLEM SET ONLY CONTAINS QUESTIONS ON MATERIAL COVERED AFTER EXAM 3. THE FINAL EXAM IS CUMULATIVE.

While the final exam will certainly contain questions about topics that you are used to working with at this point, such as:

- derivatives and derivative rules understanding the shape of graph from derivatives/ increasing/decreasing/ concavity.
- Finding critical numbers (x values in the domain where the derivative is 0 or undefined)
- finding absolute extrema (and know where/when they can occur)
- related rates
- optimization
- area between curves and under a curve
- integral, net change, substitution
- Fundamental Theorems of Calculus
- L'Hospital's Rule
- volumes of revolution/known cross section (newest topic)

It will also have questions about topics you might have forgotten at this point, like:

- Evaluating limits using algebraic techniques (factoring, multiplying by the conjugate, etc)
- Reading one and two sided limits from a graph.
- Limit definition for continuity (and how to check if a piecewise function is continuous).
- Limit definition for horizontal and vertical asymptotes
- Limit definition for derivatives
- Find the equation of a tangent line to a curve, including using implicit differentiation
- Linear Approximations
- Newton's method
- Mean Value Theorem
- Riemann sums/Rectangular Approximation
- Exponential Growth and Decay

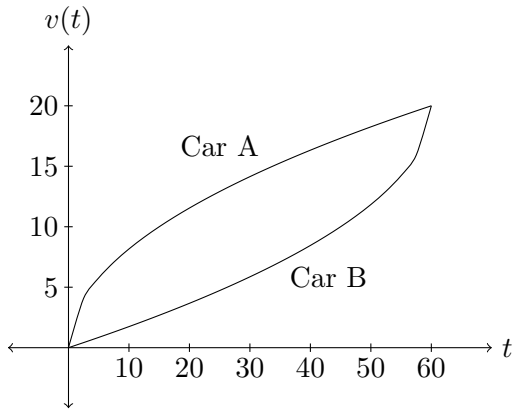
Note: This list is not meant to be a complete list of topics. Instead it will hopefully remind you of SOME topics that you might have forgotten.

Be sure to look over the practice problems for previous exams and to review that material. Also **review previous exams. We often repeat questions!**

1. A certain function $f(x)$ satisfies $f''(x) = 2 - 3x$ with $f'(0) = -1$ and $f(0) = 1$. Compute $f(2)$.

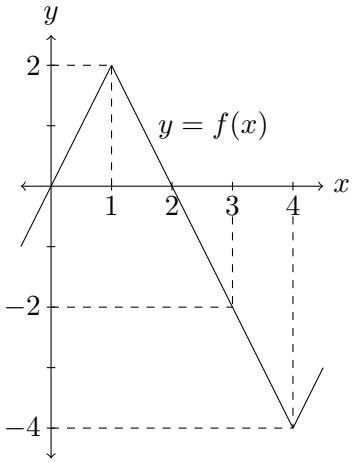
2. Find $f(x)$ if $f'(x) = 3x^2 + \dfrac{2}{x}$ for $x > 0$ and $f(1) = 3$.

3. Below is the graph of the velocity (measured in ft/sec) over the interval $0 \le t \le 60$ for two cars, Car A and Car B. How do the distances traveled by each compare at over this interval?



4. If we use a right endpoint approximation with four subintervals (i.e., R_4), then what is the resulting approximation for

$$\int_0^4 f(x)\,dx?$$



5. Evaluate the definite integral $\displaystyle\int_{-1}^{1} (x^2 + 2x + 1)\,dx$.

6. Assume that $\displaystyle\int_{-2}^{3} f(x)\,dx = 4$. What is the value of $\displaystyle\int_{-2}^{3} (f(x) + 1)\,dx$?

7. Determine a formula (in terms of x) for the derivative, $f'(x)$, of the function

$$f(x) = \int_1^{x^2} \frac{1}{t^3+1}\,dt.$$

8. If $w'(t) = \dfrac{\ln(t)}{t}$ is the rate of growth of a child in pounds per year, find $\displaystyle\int_5^{10} w'(t)\,dt$ and give an interpretation of your answer.

9. Evaluate the following definite and indefinite integrals:
   (a) $\displaystyle\int_0^{\pi/4} \frac{1+\cos^2(x)}{\cos^2(x)}\,dx$
   (b) $\displaystyle\int_0^1 (x^{10}+10^x)\,dx$
   (c) $\displaystyle\int \left(\frac{1+r}{r}\right)^2 dr$
   (d) $\displaystyle\int \frac{e^{\sqrt{x}}}{\sqrt{x}}\,dx$
   (e) $\displaystyle\int_5^{10} \frac{dt}{(t-4)^2}$
   (f) $\displaystyle\int_0^1 \frac{e^x}{1+e^{2x}}\,dx$

10. Sketch the region bounded by $y = \sqrt{x-1}$ and $x - y = 1$. Then find the area of the region.

11. Use calculus to find the area of the triangle with the given vertices.

$$(0,0) \qquad (3,1) \qquad (1,2)$$

12. Consider the graph of the curve $y = \dfrac{1}{x}$.
   (a) Find the area under the curve from $x = 1$ to $x = 100$.
   (b) What happens to the area under the curve as the right hand endpoint goes to ∞?
   (c) Find the volume of the solid obtained by rotating this curve around the x-axis from $x = 1$ to $x = 100$.
   (d) What happens to the volume in part (c) as the right hand endpoint goes to ∞?
   (e) Find the volume of the solid whose base is this region bounded by the curves $y = 1/x$, $y = 0$, $x = 1$ and $x = 100$ and whose cross-sections perpendicular to the x-axis are right triangles whose height (shorter leg) is half their base (longer leg).
   (f) What happens to the volume in part (e) as the right hand endpoint goes to ∞?

13. Consider the region bounded by $y = \sqrt{x}, y = 1$ and $x = 4$. Set-up, but do not evaluate, integrals to find the following:
   (a) Area of region

(b) Volume of solid obtained by rotating the region around the x-axis.

(c) Volume of solid obtained by rotating the region around the y-axis.

(d) Volume of solid obtained by rotating the region around the line $y = 1$.

(e) Volume of solid obtained by rotating the region around the line $x = 5$.