NOTICE: Course topics change slightly from one semester to the next, so students should always consult with their instructor.

[30] 1. Find $\frac{dy}{dx}$ for the following functions. You do not need to simplify your answer.

a) $y = 3x^{1/3} + \sec x$

b) $y = \left(e^x + x^2\right)\tan^{-1} x$

c) $y = \dfrac{\ln x}{x}$

d) $y = (3x^2 + \cos x)^{1/4}$

e) $y = x^x$

f) $y = \int_1^{x^2} e^{t^2}\,dt$

[20] 2. Find the following limits. You must show all your work.

a) $\lim_{x\to 1} \dfrac{x-1}{x^2 - 6x + 5}$

b) $\lim_{x\to\infty} \dfrac{2 + x + 3x^2}{7x^2 + 6x - 1}$

c) $\lim_{h\to 0} \dfrac{\sin\left(\frac{\pi}{4} + h\right) - \sin\frac{\pi}{4}}{h}$

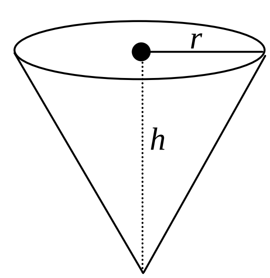
d) $\lim_{x\to 0} \dfrac{\sin 5x}{2x}$

[10] 3. Use the <u>definition</u> of the derivative to find $f'(x)$ where $f(x) = \dfrac{1}{10x}$.

[8] 4. Let $y(x)$ be defined implicitly by $x^2 + y^2 + \sin(y^2) = 1$. Find $y'(x)$.

[12] 5. Determine an equation of the tangent line to the curve of $f(x) = 2e^{2x} - 4$, at the point where the curve crosses the y-axis.

[15] 6. Water is flowing at the rate of 5 cubic meters/min. into a tank in the form of a cone of height 20 meters and base radius 10 meters and with the vertex in the downward direction. How fast is the water level rising when the water is 8 meters deep?

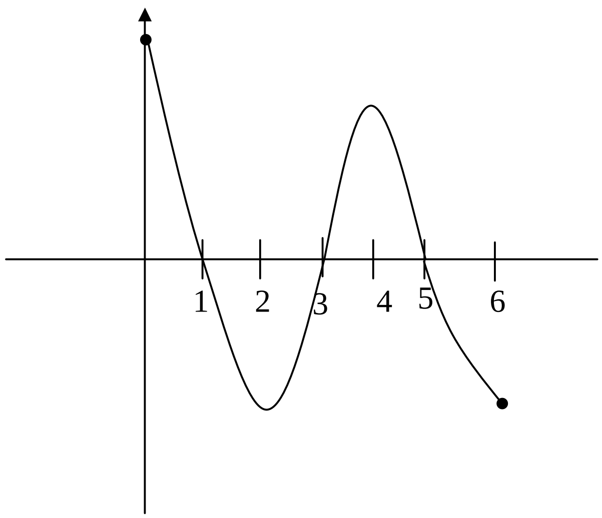


$$V = \frac{\pi}{3} r^2 h$$

[15] 7. A box, with a top, is to have length twice its width and be made from 48 square feet of material. Find the dimensions that maximize the volume.

[10] 8. Find the absolute maximum and absolute minimum of $f(x) = 8x^3 - 2x^4$ on the interval $[-1, 4]$.

[10] 9. Suppose that the DERIVATIVE of f' of a function *f* is given by



(This graph is not the graph of the function. It is the graph of the derivative of f).

a) Find the open intervals where f is increasing and those where f is decreasing.
b) Find the open intervals where f is concave up and those where f is concave down.
c) Find the *x*-coordinates for relative maxima and minima for *f*. Clearly state which are the maximum and which are the minimum.

[25] 10. Evaluate the following indefinite integrals.

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

d) $\int \left(x^3 - 2\right)^2 dx$

b) $\int x e^{x^2} dx$

e) $\int \sec^2(2x) dx$

c) $\int x\left(1 + x^2\right)^{10} dx$

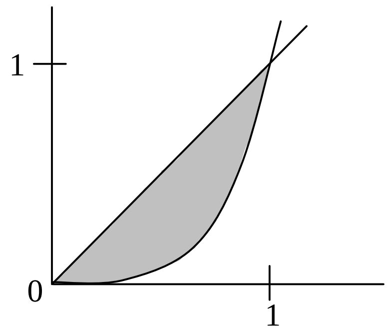
[15] 11. Evaluate the following definite integrals.

a) $\int_1^6 |x-2|dx$ (Hint: Graph $y=|x-2|$ and interpret the integral as an area problem.)

b) $\int_0^{\pi/6} \sin(2x)\ dx$

c) $\int_0^{\pi/2} e^{\sin x} \cos x\ dx$

[30] 12. Consider the area between the graphs of $y = x$ and $y = x^4$.



a) Determine the area between the curves.

b) Write down an integral which gives the volume of the solid obtained by revolving this region around the *x*-axis. Do not evaluate.

c) Write down an integral for the volume of the solid obtained by revolving this area around the *y*-axis. Do not evaluate.