[25] 1. Find the following limits. You must show all your work.

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

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

c) $\lim_{x\to 4} \dfrac{x^2-x-12}{x^2-6x+8}$

d) $\lim_{x\to 4} \dfrac{\sqrt{x+5}-3}{x-4}$

e) $\lim_{h\to 0} \dfrac{\tan\left(\frac{\pi}{4}+h\right)-1}{h}$

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

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

a) $y = 3x^2 - \dfrac{1}{\sqrt{x}} + \sin x - \cosh x$

b) $y = (\ln(x^2+1))(\tan(2x+3))$

c) $y = \cos^3(x+e^x)$

d) $y = \dfrac{x^2+3x+5}{x^3-x}$

e) $y = x^{\sin x}$

f) $y = \displaystyle\int_x^3 \frac{dt}{1+t^4}$

[5] 4. Let $y(x)$ be defined implicitly by $x^2y^2 - e^x + y = 4$. Find $\dfrac{dy}{dx}$.

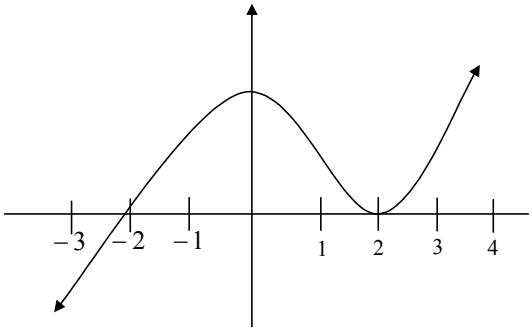
[10] 5. Determine an equation of the tangent line to the curve of $f(x)=e^{2x}$ at the point where the curve crosses the line $y=1$.

[10] 6. A ladder 15 ft. long rests against a vertical wall. If the bottom of the ladder slides away from the wall at a speed of 2 ft/min, how fast is the ladder sliding down the wall when the base of the ladder is 9 feet from the wall?

[10] 7. A box with a square base and an open top has a surface area of 1875 cm^2 of material. Find the largest possible volume of the box.

[10] 8. Find the absolute maximum and absolute minimum of $f(x) = x^3 - 12x + 5$ on $[0, 3]$. **Give both *x* and *y* coordinates.**

[15] 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) If $f(0) = 0$, draw a plausible graph of f.

[25] 10. Evaluate the following indefinite integrals.

a) $\int \left(e^x + 3x - \sinh x + \sqrt[3]{x}\right) dx$

b) $\int (x^2 + 1)^2 \, dx$

c) $\int \sec^2 x e^{\tan x} \, dx$

d) $\int \frac{x}{\sqrt{1+x}} dx$

e) $\int \frac{dx}{x \ln x}$

[15] 11. Evaluate the following definite integrals.

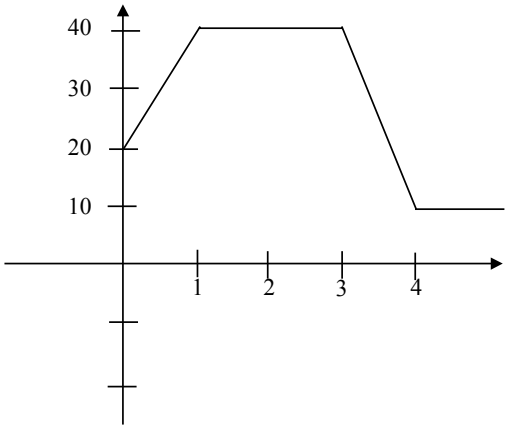
a) $\int_0^4 \left(xe^{x^2}\right) dx$

b) $\int_0^{(\pi/4)^2} \frac{\sec^2 \sqrt{x} \, dx}{\sqrt{x}}$

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

[10] 12. Find the area of the region between the graphs of $y = x^2$ and $y = -x$.

[10] 13. Let the velocity of a particle be given by the following graph.

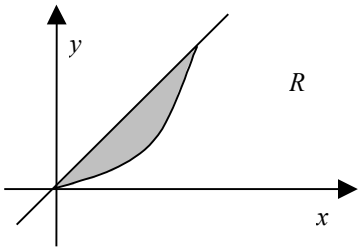


a) Sketch the acceleration.

b) What is the total distance traveled between $t = 1$ and $t = 4$?

[7] 14. Let R be the region bounded by the curves $y = \sqrt{x}$ and $y = \frac{1}{2}x$. Find the volume of the solid obtained by revolving the region around the *y*-axis.

[8] 15. Let R be the region bounded by the curves $y = x^2$ and $y = 3x$.



a) Set up, but DO NOT EVALUATE, the integral for the volume of the solid obtained by revolving this region around the x-axis.

b) Set up, but DO NOT EVALUATE, the integral for the volume of the solid obtained by revolving this region around the line $x = 3$.