1) Determine the values of the constants $a$ and $b$ so that the function

$$g(x) = \begin{cases} 
1 - x^2 & \text{if } x < 0 \\
ax + b & \text{if } 0 \leq x \leq 1 \\
3/x & \text{if } x > 1
\end{cases}$$

is continuous for all values of $x \in \mathbb{R}$. 
2) Evaluate the derivative of the function \( f(x) = 1/x \) at \( x = 2 \) by using the definition of derivative as a limit.
3) Compute the equation of the tangent line to the curve $y = \frac{5x}{1 + x^2}$ at the point with coordinate $x = 2$. 
4) Find the derivative of the function \( f(x) = x^2 \sin(3x) \).
5) The volume of a cube is increasing at a rate of 20\(\text{in}^3/\text{min}\). How fast is the surface area of the cube changing when the side is 2\(\text{in}\)?
6) Show that $e^x \geq 1 + x$ for $x \geq 0$. *Hint.* Compare the slopes of both functions.
7) Evaluate \( \lim_{x \to 0} (1 - 4x)^{5/x} \).
8) A car leaves a parking lot and travels due south at a speed of 20m/h. A second car has been heading due east at 15m/h and reaches the same parking lot one hour later. Find the closest distance between the two cars.
9) Evaluate the integral

\[ \int (1 + \tan \theta)^5 \sec^2 \theta \, d\theta. \]
10) Find the area bounded by the curves $y = x^3$, the tangent line to this curve at $(2, 8)$, and the $x$-axis.
11) Let $S$ be the solid of revolution obtained by rotating the area between the curve $y = 1 - x^2$ and the coordinate axes about the $y$-axis. Find a height $h$ so that if $S$ is cut by a plane parallel to its base at level $h$, the two resulting pieces have the same volume.
12) Evaluate the integral

\[ \int_0^e \sqrt{x} \ln x \, dx. \]
13) Evaluate the integral
\[ \int \frac{dx}{\sqrt{x^2 - 6x + 13}}. \]
14) Evaluate the integral
\[ \int_0^1 \frac{x + 9}{x^2 + 3x + 2} \, dx. \]
15) Express the length of the curve \( y = x^2 + 2x \), for \( 1 \leq x \leq 2 \) as an integral. Do not evaluate.
16) Solve the differential equation

\[ y' + 2xy = 3x^2 e^{-x^2} \]

with the condition \( y(0) = 1 \).
17) Determine the interval of convergence of the power series
\[ \sum_{n=0}^{\infty} \frac{(x + 2)^n}{n^3 + 1}. \]
Describe what happens at the endpoints of the interval.
18) Determine if the series

\[ \sum_{k=0}^{\infty} \frac{k^2 + 7}{3k^4 + 5k + 11} \]

is convergent or not.
19) Compute the first 3 nonzero terms of the Taylor series for \( f(x) = e^x \).
20) Find the value of $c$ such that
\[ \sum_{n=1}^{\infty} e^{nc} = 2. \]