Short answer:

1. The domain of the function: $f(x) = \frac{\ln(3x+6)}{x-2}$ is:
2. Solve for x in $e^{\frac{1}{2}\ln(x^4)} + \ln(x) + \ln(x+2) - \ln(x^2+2x) = 9$
3. If $Cos(\theta) = \frac{2}{5}$ and $\frac{3\pi}{2} \leq x \leq 2\pi$, then $Tan(\theta) =$
4. $\arccos\left(\frac{1}{\sqrt{2}}\right) =$
5. $\lim_{x\to\infty} \frac{\sqrt{x^2-4}}{2x+1} =$
6. $\lim_{x\to 3} \frac{x^3-4x^2+9}{2x-6} =$
7. $\lim_{x\to 0} \frac{1-\cos(2x)}{\sin(3x)} =$
8. $\frac{d}{dx} 3^{x^2+1} =$
9. $\lim_{x\to 1^+} (\mathrm{x}-1)\ln(x-1) =$
10. The absolute minimum value of $f(x) = x^3 - 6x + 1$ on $[-1, 3]$ is
11. The general antiderivative of $f(x) = 4e^{2x} + \sqrt{x} - \sin(x)$ is
12. $\frac{d}{dx}\int_0^{x^2} e^t \sin(t)\, dt =$
13. $\int_0^{\frac{\pi}{4}} \frac{1}{1+x^2} dx =$
14. The inverse of $f(x) = (x-1)^3 + 4$ is
15. $\int 3x - x^3 + e^{4x} + 3\sin(x) =$

Long Answer:

1. A) Determine the values of c and k that make the following function continuous. (Justify all reasoning)

$$f(x) = \begin{cases} 3x + k & x < 0 \\ x^2 - 1 & 0 \leq x \leq 2 \\ \sqrt{cx+3} & x > 2 \end{cases}$$

   B) Find the following limit $\lim_{x\to 0}\left(1 + \frac{3}{x}\right)^{2x}$

   C) Find the following limit $\lim_{x\to\infty} \sqrt{2x+1} - \sqrt{2x+7}$

2. A) Find the derivatives of the following three functions:

$$f(x) = \ln(x)\,(\sin(x)), \quad g(x) = \frac{2x+1}{x^2-1}, \quad h(x) = \log_3(2\mathrm{e}^{3\mathrm{x}^2} + 1)$$

   B) Find the equation of the tangent line of $e^y - x^2 y = 2x$ at $(1,0)$

   C) Determine the linearization of $g(x) = \sqrt[3]{x}$ at $x = 27$ and use this equation to approximate the value of $\sqrt[3]{26}$

   D) Using logarithmic differentiation, find the derivative of: $f(x) = \frac{e^{2x}(x^3-1)^3}{x^5(1-3x)^6}$

3. A) Consider a function $f(x) = 12\sqrt[3]{x^2}e^{\frac{1}{6}x}$ which has the derivative given as:

$$f'(x) = 2x^{-\frac{1}{3}}e^{\frac{1}{6}x}(4+x)$$

i) Determine the intervals which f is increasing and decreasing.

ii) Find all critical points and classify the points as local max, local min or neither.

B) Consider a function $g(x) = \frac{(x^2-1)}{2x^2-8}$ that has the following properties:

$D = (-\infty,-2) \cup (-2,2) \cup (2,\infty)$

Intercepts: $(0,0.125)$, $(-1,0)$, and $(1,0)$

Critical points $x = 0$

g is increasing on $(-\infty,-2)$ and $(-2,0)$; decreasing on $(0,2)$ and $(2,\infty)$

f is concave up $(-\infty,-2)$ and $(2,\infty)$; concave down on $(-2,2)$

Vertical asymptotes: x=2 and x=-2; horizontal asymptotes: y = 0.5

Provide a sketch of the function.

4. A) Given $f(x) = x^2 - 1$ and $g(x) = 2x + 7$, determine the points of intersection of the two functions.

B) Determine the contained area between the two curves.

C) Let $H(x)$ be the antiderivative of $f(x)$, determine the function $H(x)$ given that the point $(-3,1)$ lies on the graph of $H(x)$.