1. 

2. 

3. 
\[(f+g)(x) = 2x + e^{-x} + 2x^2 - x = x + e^{-x} + 2x^2\]
\[(f\circ g)(x) = f(g(x)) = 2(2x^2 - x) + e^{-(2x^2-x)} = 4x^2 - 2x + e^{-2x^2} + x - 2x^2\]

4. 
\[10^{x+2} = 3^{100}\]
\[(x+2) \log_{10} 10 = 100 \log_{10} 3\]
\[x+2 = 100 \log_{10} 3 \Rightarrow x = 100 \log_{10} 3 - 2 \approx 45.71\]

5. 
\[y = \frac{1-2x}{1+2x}, \quad y(1+2x) = 1-2x, \quad y + 2xy = 1-2x, \quad 2x + 2xy = 1 - y\]
\[x(2 + 2y) = 1 - y, \quad x = \frac{1 - y}{2 + 2y}\]
\[\text{inverse is} \quad \frac{1 - x}{2 + 2x}\]

6. 
\[\lim_{x \to 2} \frac{x-4}{x-2} = \lim_{x \to 2} \frac{\frac{(x-2)(x+2)}{x-2}}{x-2} = \lim_{x \to 2} \frac{x+2}{x-2} = 4\]
\[\lim_{x \to 2} \frac{x^2-4}{x+2} = \frac{0}{4} = 0\]
7. \( f(x) = \begin{cases} x - 1 & x \leq 1 \\ -x + 1 & x > 1 \end{cases} \)

\[
\lim_{x \to 0} f(x) = \lim_{x \to 0} x - 1 = -1
\]

\( g(x) = \begin{cases} x + 1 & x \leq 0 \\ x - 1 & x > 0 \end{cases} \)

\[
\lim_{x \to 0^+} g(x) = \lim_{x \to 0^-} x - 1 = -1 \quad \text{so} \quad \lim_{x \to 0} g(x) \text{ does not exist.}
\]

\[
\lim_{x \to 0^-} g(x) = \lim_{x \to 0^+} x + 1 = 1
\]

8. To be continuous at 2, we must have \( \lim_{x \to 2^-} f(x) = \lim_{x \to 2^+} f(x) = f(2) \)

Now \( f(2) = 1 - 2 = -1 \)

\[
\lim_{x \to 2^-} f(x) = \lim_{x \to 2^-} 1 - x = -1
\]

\[
\lim_{x \to 2^+} f(x) = \lim_{x \to 2^+} x^2 - 2x = 4 - 2 \cdot 2
\]

so we need \( -1 = 4 - 2k \) which yields \( k = 2.5 \)

9. \[
\lim_{x \to \infty} \frac{-2x^2}{x - 1} = \lim_{x \to -\infty} \frac{-2}{1 - \frac{1}{x^2}} = \frac{-2}{1 - 0} = -2
\]

\( \therefore y = -2 \) is the horizontal asymptote.

Since \( x - 1 = 0 \) at \( x = 1 \) and \( -2x^2 \) at \( x = \pm 1 \) is not zero, the vertical asymptotes are \( x = 1 \) and \( x = -1 \).

10. \[
f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h} = \lim_{h \to 0} \frac{1}{h} \left( \frac{1}{2(x+h)-3} - \frac{1}{2x^3} \right)
\]

\[= \lim_{h \to 0} \frac{-2h}{h \cdot (2x+2h-3)(2x-3)} = \lim_{h \to 0} \frac{-2}{(2x+2h-3)(2x-3)} = \frac{-2}{(2x-3)^2}\]

11. \[
8x^3 - 6x + 1 - 2x^3 = 8x^3 - 6x + 1 - \frac{2}{x^2}
\]

\[
x^5 \cos(x^2) - 2x + 2x \sin(x^2) = 2x^3 \cos(x^2) + 2x \sin(x^2)
\]
\[
\frac{\frac{x \cos(x^2)}{x^2} - 2x \sin(x^2)}{x^4} = \frac{x \left( 2x \cos(x^2) - 2 \sin(x^2) \right)}{x^4} = \frac{2x \cos(x^2) - 2 \sin(x^2)}{x^2}
\]

\[
4(x^2 - 2x^2)(2x^2 - 2x) = 8(x-2)(x^2 - 2x)^3
\]

\[
\sec(2x) \cdot 2 = 2 \sec^2(2x)
\]

12. \[
\frac{dy}{dx} = 6x
\]

\[
\frac{dy}{dx} = 6x = 12 \quad \text{at} \quad x = 2
\]

Tangent line at (2, 11) : \[
y - 11 = 12(x - 2) = 12x - 24
\]

\[
y = 12x - 13
\]

13. \[
\lim_{x \to 0} \frac{\sqrt{2x} - \sqrt{2}}{x} = \lim_{x \to 0} \frac{(\sqrt{2x} - \sqrt{2})(\sqrt{2x} + \sqrt{2})}{x(\sqrt{2} + \sqrt{2})} = \lim_{x \to 0} \frac{2 + x - 2}{x(\sqrt{2} + \sqrt{2})}
\]

\[
= \lim_{x \to 0} \frac{x}{\sqrt{2}x + \sqrt{2}} = \lim_{x \to 0} \frac{\sqrt{2}}{\sqrt{2}x + \sqrt{2}} = 0
\]

\[
\lim_{x \to 0} \frac{\sqrt{2x} + \sqrt{2}}{x} = \ldots \quad \text{as above} = \lim_{x \to 0} \frac{x}{(\sqrt{2}x + \sqrt{2})^2} = \lim_{x \to 0} \frac{1}{\sqrt{2}x + \sqrt{2}} = \frac{1}{2\sqrt{2}}
\]

\[
\lim_{x \to 0} \frac{\sin x}{x+1} = \frac{0}{1} = 0
\]

\[
\lim_{x \to 0} \frac{\sin x}{x^2} = \lim_{x \to 0} \frac{\sin x}{x} \cdot \frac{1}{x} \quad \text{does not exist because}
\]

\[
\lim_{x \to 0^+} \frac{\sin x}{x} \cdot \frac{1}{x} = 1 \cdot \infty = \infty
\]

\[
\lim_{x \to 0^-} \frac{\sin x}{x} \cdot \frac{1}{x} = 1 \cdot (-\infty) = -\infty
\]

\[
\lim_{x \to 0} \frac{\sin(x^2)}{x} = \lim_{x \to 0} \frac{\sin(x^2)}{x^2} \cdot x = 1 \cdot 0 = 0
\]

\[
\frac{6}{\sqrt{c}} \lim_{x \to 0} \frac{\sin(x^2)}{x^2} = -1
\]