1. (20 points) Multiple Choice: **Circle your answer.**

(a) Evaluate $g(x)$ at $x = 6$.

$$g(x) = \begin{cases} \sqrt{x^2 - 4} & \text{if } x \geq 3 \\ 2x & \text{if } x < 3 \end{cases}$$

(i) 12  
(ii) 4  
(iii) $\sqrt{32}$  
(iv) not listed

(b) The domain of the function defined by $f(x) = \frac{\sqrt{x + 5}}{x - 7}$ is:

(i) $(-\infty, 7) \cup (7, \infty)$  
(ii) $[-5, \infty)$  
(iii) $[-5, 7) \cup (7, \infty)$  
(iv) not listed

(c) The range of the function defined by $g(x) = 2x^3 + 1; -2 \leq x \leq 3$ is:

(i) $[1, \infty]$  
(ii) $[-15, 55]$  
(iii) $[-2, 3]$  
(iv) not listed

(d) For all functions $f$ and $g$, the compositions $g \circ f$ and $f \circ g$ are always equal.

(i) true  
(ii) false

(e) The function $f$ defined by $f(x) = (x - 3)^2; x > 3$ is one to one.

(i) true  
(ii) false
2. (20 points) Circle your answer or fill in the blank.

(a) Compute \( f \circ g(x) \) for \( f(x) = \sqrt{x^2 - 1} \) and \( g(x) = 3|x| \).

i) \( 3x - 1 \)  
ii) \( \sqrt{9x^2 - 1} \)  
iii) \( \sqrt{3x^2 - 1} \)  
iv) not listed

(b) What is the domain of \( \frac{f}{g} \), if \( f(x) = 2x + 1 \) and \( g(x) = \frac{1}{3x} \)?

i) \( (-\infty, \infty) \)  
ii) all real numbers except 0

(c) Express the function \( F(x) = \sqrt{2x - 1} \) in the form \( f \circ g \).

\[ f(x) = \quad g(x) = \]

(d) A function \( f \) is given, and the indicated transformations are applied to its graph in the given order. Circle the equation for the final transformed graph.

\( f(x) = x^7 \); shift 2 units to the left and reflect in the \( x \)-axis:

i) \( -(x + 2)^7 \)  
ii) \( -x^7 + 2 \)  
iii) \( -(x - 2)^7 \)  
iv) not listed

\( f(x) = \sqrt[3]{x} \); stretch vertically by a factor of 3 and shift down 5 units:

i) \( 3(\sqrt[3]{x} - 5) \)  
ii) \( 3\sqrt[3]{x} - 5 \)  
iii) not listed
3. (10 points) Let \( P(x) = x^3 - 5.6x^2 + 6.79x \).

a) What is the end behaviour of \( P \)? **Fill in the blank.**

\[ y \rightarrow \underline{\quad} \text{ as } x \rightarrow \infty \quad \text{and} \quad y \rightarrow \underline{\quad} \text{ as } x \rightarrow -\infty \]

b) Use your graphing calculator to find the local maximum and minimum values of \( P \) correct to two decimal places. Use the viewing rectangle \([-10, 10]\) by \([-10, 10]\).

local maximum value(s) \underline{\quad}

local minimum value(s) \underline{\quad}

c) Find the interval(s) on which the function is increasing.

Interval(s) of increase: \underline{\quad}

4. (10 points) Find the inverse function \( f^{-1} \) of \( f(x) = \frac{1}{2 + \sqrt{3} + x} \). Show your work.

\[ y = \underline{\quad} \]
5. (20 points) Multiple choice. **Circle your answers or fill in the blank.**

(a) The vertex of the parabola given by the equation \( y = 3x^2 - 12x + 9 \) is:

(i) \((-2, 45)\)  
(ii) \((4, 9)\)  
(iii) \((2, -3)\)  
(iv) Not listed

(b) The graph of the inverse function \( f^{-1} \) is obtained from the graph of \( f \) by symmetry about:

(i) the \( x \)-axis  
(ii) the \( y \)-axis  
(iii) the line \( y = x \)

(c) The rational function \( y = \frac{-6x^2 + 7}{(3x + 1)(x - 2)} \) has the following asymptotes. **Circle all that apply and fill in the blank.**

(i) One vertical asymptote  \( x = \) ____

(ii) Two vertical asymptotes  \( x = \) ____ and \( x = \) ____

(iii) One horizontal asymptote  \( y = \) ____

(iv) One slant asymptote  \( y = \) ____

(d) The average of the function \( f(x) = x^3 + 5x \) between \( x = 2 \) and \( x = 4 \) is:

(i) 33  
(ii) 51  
(iii) 66  
(iv) not listed
6. (12 points) Let \( Q(x) = x^5 - x^3 - 12x. \)

a) Factor \( Q \) completely into linear factors with complex coefficients.

b) Find all the zeros of \( Q \), real and complex.

7. (8 points) Sketch a possible graph of a rational function with the properties:

(a) Domain \( \{ x \mid x \neq -2, x \neq 1 \} \);
(b) three \( x \)-intercepts \((-3, 0); (0, 0); (2, 0)\), and one \( y \)-intercept \((0, 0)\);
(c) a slant asymptote \( y = x \);
(d) two vertical asymptotes \( x = -2 \) and \( x = 1 \) such that:

\[
\begin{align*}
y & \to -\infty \text{ as } x \to 1^+ \quad \text{and} \quad y \to \infty \text{ as } x \to 1^- \\
y & \to -\infty \text{ as } x \to -2^+ \quad \text{and} \quad y \to \infty \text{ as } x \to -2^-
\end{align*}
\]