This exam has five questions, with each question worth 5 marks.
The exam lasts for one-and-a-half hours. No calculators, books etc. are allowed.

1. Sketch the curve \( y = |x^2 - 2| \). Find the equation of the tangent line to the curve at the point \((-1, 1)\). At what point does this tangent line cross the \(y\)-axis?

2. Using the rules of differentiation, differentiate the following functions:
   (i) \( y = (\tan x + x^2)^{3/2} \),
   (ii) \( u(t) = \frac{\sec t}{t} \),
   (iii) \( f(\theta) = \sqrt{\theta}e^{2\theta} + 1 \),
   (iv) \( y = \sin^{-1}(2x) \),
   (v) \( g(t) = \frac{\cos 2t}{t^2} \).

3. The piece-wise function \( s(x) \) is given by:

\[
s(x) = \begin{cases} 
1 & \text{when } x < -1; \\
x & \text{when } -1 \leq x < 2; \\
x^2 & \text{when } x \geq 2.
\end{cases}
\]

   (i) Sketch a graph of \( y = s(x) \). State the domain and range.

   (ii) Evaluate the following limits:
       (a) \( \lim_{x \to -1^-} s(x) \),
       (b) \( \lim_{x \to -1^+} s(x) \),
       (c) \( \lim_{x \to -2^-} s(x) \),
       (d) \( \lim_{x \to -2^+} s(x) \).

   (iii) When is \( s(x) \) continuous? Give a brief justification for your answer.

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4. (i) State a definition of derivative in terms of limits.

(ii) Using your definition in (i), calculate the derivative of:

\[ f(t) = 9 + 5t - 2t^2. \]

(iii) When is \( f'(t) = 0 \)?

5. Evaluate the following limits, or give a reason why they do not exist:

(i) \( \lim_{t \to 3^+} \frac{2}{\sqrt{t - 3}} \),

(ii) \( \lim_{x \to 0} \left( 7x + \frac{\sin(3x)}{7x} \right) \),

(iii) \( \lim_{t \to 2} \frac{t^2 - 3t + 2}{t^2 - t - 2} \),

(iv) \( \lim_{x \to \infty} \frac{x^2 - 5}{3x^2 + 2x - 1} \).