Instructions: Work must be shown to receive credit. No calculators. Question 3 is the only question for which you are required to use the definition of the derivative.

Question 1. (15 points) Find the equation of the tangent line to the curve \( y = x^3 - 3x^2 \) at the point (1,-2).
Question 2. Let \( f(x) = \frac{2x - 4}{x^2 - 4} \). If any of the limits below is \( \infty \) or \( -\infty \), say so as your answer ("does not exist" or DNE is insufficient in this case.)

A. (5 points) Find \( \lim_{x \to -\infty} f(x) \)

B. (5 points) Find \( \lim_{x \to 2} f(x) \)

C. (5 points) Find \( \lim_{x \to 2^-} f(x) \)
Question 3.

A. **(5 points)** In the box, state the **definition** of the derivative \( f'(x) \):

\[
f'(x) =
\]

B. **(10 points)** Using the definition, prove that if \( f(x) = \sqrt{x+3} \), then \( f'(x) = \frac{1}{2\sqrt{x+3}} \).
Question 4. Find the derivatives of the following functions. You are not required to use the definition for these computations.

A. (5 points) \( f(t) = t^5 - 4t^3 + 7 \)

B. (5 points) \( g(x) = \sqrt{3}x + x^{-6} \)

C. (5 points) \( h(x) = \frac{1}{2}\sin(x) + \cos(x) \)
Question 5. (15 points) The function \( y = f(x) \) is graphed below. An arrowhead near a dashed line indicates asymptotic behavior.

For statements A through E, place an ‘X’ in each box that corresponds to a value of \( c \) such that the statement is true at \( c \). The first row has already been filled in for you as an example.
Question 6. **(10 points)** The piecewise definition of $f(x)$ and graph of $y = f(x)$ defined on (0,7) are given below:

$$f(x) = \begin{cases} 
1 - \frac{1}{2}x^2, & 0 < x \leq 2 \\
\cos(\pi/2), & 2 < x \leq 6 \\
x - 7, & 6 < x < 7 
\end{cases}$$

For statements A through E, place an 'X' in each box that corresponds to a value of $c$ such that the statement is true at $c$. The first row has already been filled in for you as an example.

<table>
<thead>
<tr>
<th>Statement</th>
<th>c=1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>The function itself satisfies $f(x) = 0$ at $x = c$</td>
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<td>A. $f(x)$ has a horizontal tangent at $x = c$</td>
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<td>B. $f'(c)$ exists</td>
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<td>C. $f''(x)$ is continuous at $x = c$</td>
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<td>D. $f''(c) &gt; 0$</td>
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<td>E. $f'(c) &lt; 0$</td>
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Question 7. At $t=0$, a ball is thrown straight up from the surface of the dwarf planet Ceres. Its height (in meters) as a function of $t$ (in seconds) is given by the function

$$s(t) = 10t - \frac{1}{4} t^2.$$ 

A. (5 points) Find the velocity of the ball at $t=6$. You may use any method.

B. (5 points) Find the maximum height that the ball reaches (hint: how fast is the ball traveling at its maximum height?).

C. (5 points) Find the acceleration of the ball.