

Questions 1-5 are Multiple-Choice questions

[K/U 1 mark each]

1. Which of the following differentiation rules is NOT correct.

- A) $(x^{n+1})' = (n+1)x^n$ B) $(gf)' = g'f - gf'$ C) $\left(\frac{g}{f}\right)' = \frac{g'f - gf'}{f^2}$ D) $[g(f(x))]' = g'(f(x))f'(x)$

2. The function $f(x) = |x-1|$ is not differentiable at $x=1$ because $P(1,0)$ is a:

- A) corner point B) cusp point C) infinite slope point D) zero slope point

3. The slope of the tangent line to the curve $y = x^4$ at the point $P(1,1)$ is

- A) 0 B) 2 C) 3 D) 4

4. The derivative function of the function $f(x) = \frac{1}{x^2+1}$ is

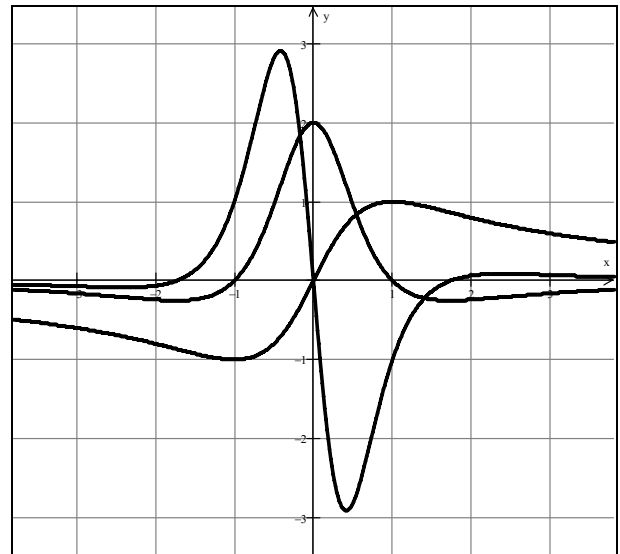
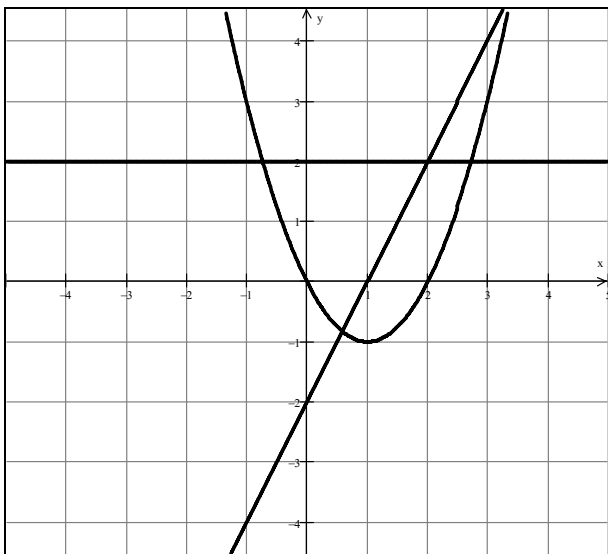
- A) $f'(x) = \frac{-2x}{(x^2+1)^2}$ B) $f'(x) = \frac{2x}{(x^2+1)^2}$ C) $f'(x) = \frac{-x}{(x^2+1)^2}$ D) $f'(x) = \frac{2x}{x^2+1}$

5. If velocity of the object is given by $v(t) = -2t + 3$, then a possible position function is

- A) $s(t) = -t^2 + 2t$ B) $s(t) = -t^2 + 3t - 1$ C) $s(t) = t^2 + 3t - 1$ D) $s(t) = -2t^2 + 3t$

6. For each case, identify the function f and its derivatives f' and f'' .

[K/U 3 marks]



Questions 7-15 are long answer questions. Show your work.

7. At what points does the curve $y = 2x^3 + 3x^2 - 36x + 1$ have a horizontal tangent?

[K/U 3 marks]

8. For each case, find $f'(x)$. Simplify your answer.

[K/U 6 marks]

[2] a) $f(x) = \sqrt{x} + \frac{3}{\sqrt[3]{x}}$

[2] b) $f(x) = \frac{x^2 + 2x}{x^2 - 1}$

[2] c) $f(x) = \left(\frac{x-1}{x+1}\right)^3$

9. For each case, find $f'(x)$, $f''(x)$ and $f'''(x)$.

[K/U 6 marks]

[3] a) $f(x) = x^5 + 2x^4$

[3] b) $f(x) = \frac{2x}{x-1}$

10. Differentiate. Simplify your answer.

[A 3 marks]

$$f(x) = x + \sqrt{(x^2 + 1)}\sqrt{x}$$

11. Show that there are no tangents to the curve $y = \frac{2x+1}{4x+3}$ with negative slope. What can be concluded about the graph?

[A 3 marks]

12. Find a quadratic function in the form $f(x) = ax^2 + bx + c$ satisfying the following conditions: $f(1) = 0$, $f'(1) = 1$, and $f''(1) = 4$. [A 3 marks]

13. For each case, explain where the function is not differentiable and why. [AC 3 marks]

[1.5] a) $f(x) = x|x-1|$

[1.5] b) $f(x) = \sqrt[3]{x^2}$

14. Use the first principles to find the derivative of the following function. [A 3 marks]

$$f(x) = 2x^2 - \frac{3}{x}$$

15. Find the equation of the tangent line to the curve $f(x) = \sqrt[3]{x-1}$ at the point $P(2,1)$. Graph the function f and the tangent line. [A 3 marks]

16. A position function of a particle is given by $s(t) = -0.5t^3 + 6t$.

[A 9 marks]

[1] a) Find the moments of time when the particle is in origin

[1.5] b) Find the velocity function and the moments of time when the particle is at rest.

[1.5] c) Find the acceleration function and the moments of time when the acceleration is zero.

[1] d) Find intervals of time when the particle is moving away from the origin.

[2] e) Find the displacement and the total distance travelled over the interval of time $[-4,2]$.

[2] d) Sketch the graph of $s(t)$, $v(t)$, and $a(t)$ on the grid provided.

