## Congratulations! You passed!

**Grade received** 100%

**Latest Submission Grade** 100%

**To pass** 78% or higher

Go to next item

**1.** Which of the following represents the derivative of a function $f(x)$ (check all that apply)? **1 / 1 point**

- [ ] $F(x)$
- [x] $f'(x)$

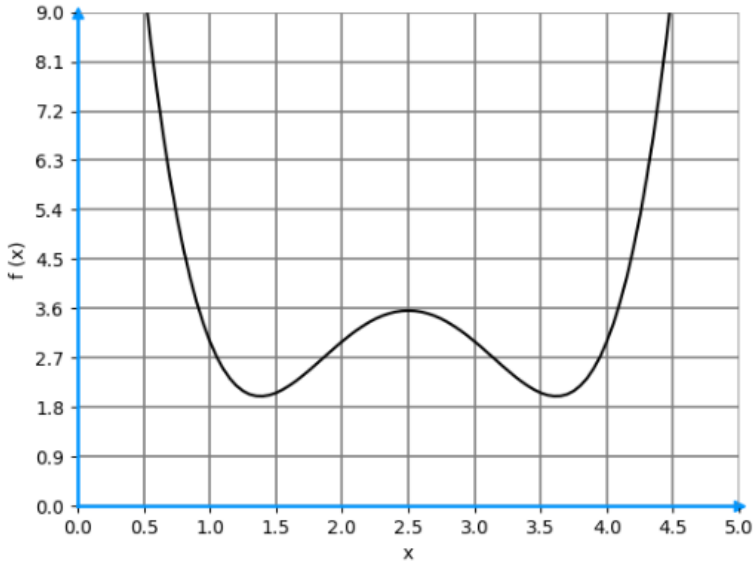
**Correct**
Correct!

- [ ] $f'(x^2)$
- [x] $\frac{df(x)}{dx}$

**Correct**
Correct! This is known as the Leibniz notation.

- [ ] $\frac{f(x)}{df(x)}$

**2.** Consider the graph of the following function $f(x)$. **1 / 1 point**




Regarding **its derivative**, $f'(x)$, where $x \in [0, 5]$: (check all that apply)

- [ ] $f'(x)$ is always positive.
- [x] $f'(x)$ has three zeros, i.e., $f'(x) = 0$ three times.

**Correct**
Correct! $f$ has two local minima and one local maximum in the interval.

- [ ] $f'(x)$ has two zeros, i.e., $f'(x) = 0$ twice.
- [x] $f'(1) < 0$.

**Correct**
Correct! $f$ is decreasing when $x = 1$, therefore its derivative must be negative at this point.

- [x] $f'(4) > 0$.

**Correct**
Correct. $f$ is increasing when $x = 4$, therefore its derivative must be positive at this point.

**3.** What is the derivative of $3x^3 - 2x + 1$? **1 / 1 point**

- ○ $3x^2 - 2$
- ○ $9x^2 - 2 + 1$
- ◉ $9x^2 - 2$
- ○ $9x^3 - 1$

**Correct**
Correct!

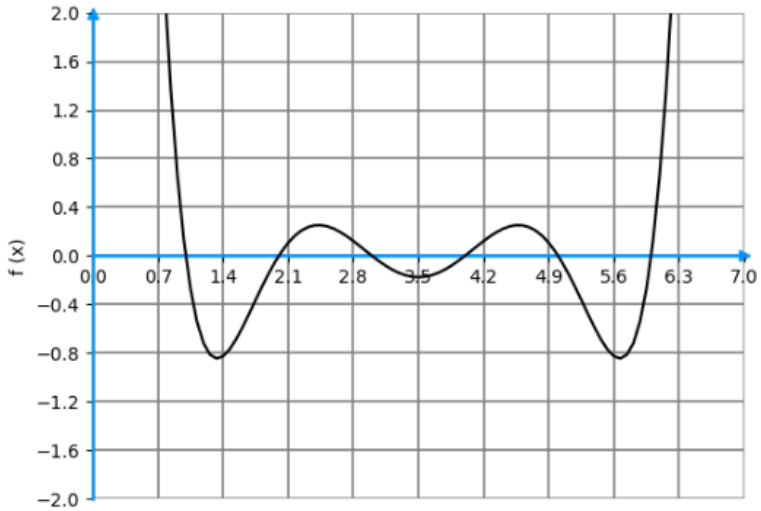
**4.** Suppose you have a game where you toss a coin $20$ times and win if you get, in this exact order, 16 heads and 4 tails. However, in this game, you can choose any coin and toss it 20 times. **1 / 1 point**

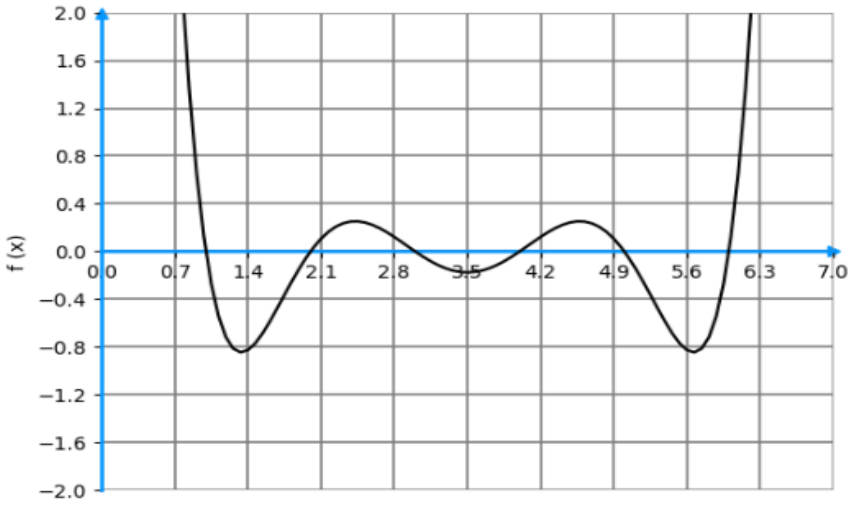
Which of the following functions you need to maximize in order to find the best coin for this game? Consider $p$ being the probability of a given coin being heads.

- ○ $16\log(p) + 4\log(p)$
- ◉ $16\log(p) + 4\log(1-p)$
- ○ $4\log(p) + 16\log(1-p)$
- ○ $4\log(1-p) + 16\log(1-p)$

**Correct**
Correct! The probability of having 16 heads is $p^{16}$ and the probability of having 4 tails is $(1-p)^4$, therefore the total desired probability is $l(p) = p^{16}(1-p)^4$. As you saw in the lecture Cost Functions in machine Learning - Part II, the same value that maximizes $l$, also maximizes $\log l$ and $\log l = 16\log(p) + 4\log(1-p)$.

**5.** Let $f(x)$ be a real valued function with the following graph. In the interval $[0, 7]$, how many zeros has its derivative $f'(x)$? **1 / 1 point**






5

**Correct**
Correct! Since $f$ has $3$ local minima and $2$ local maxima in the desired interval, it must have $5$ zeros. You can review the lecture Introduction to Optimization to get more details.

**6.** If $f(x)$ and $g(x)$ are differentiable functions, then the derivative of $f(x)g(x)$ is given by: **1 / 1 point**

- (●) $f'(x) \cdot g(x) + g'(x) \cdot f(x)$
- ( ) $f'(x) \cdot g'(x) + f(x) \cdot g(x)$
- ( ) $f'(x) \cdot g(x) - f(x) \cdot g'(x)$
- ( ) $f'(x) \cdot g'(x)$

**Correct**
Correct!

**7.** The **rate of change** of $f(x) = x^2 + 3$ at $x = 6$ is: **1 / 1 point**

12

**Correct**
Correct! $f'(x) = 2x$, therefore $f'(6) = 2 \cdot 6 = 12$.

**8.** Let $f(x)$ be a **positive** real function and $g(x) = \log f(x)$. **1 / 1 point**

Check all that apply.

- [ ] $\frac{df(x)}{dx} = \frac{dg(x)}{dx}$
- [x] If $x_{max}$ is a point where $f(x_{max})$ is a local maximum, then $g(x_{max})$ is also a local **maximum**.

**Correct**
Correct! When applying the function $log$ to $f$, even though we change its shape, the maximum points will remain the same, since $\log$ is a **crescent** function!

- [ ] If $x_{max}$ is a point where $f(x_{max})$ is a local maximum, then $g(x_{max})$ is also a local **minimum**.
- [x] If $f(x)$ is differentiable, then so is $g(x)$.

**Correct**
Correct! The result of composing two differentiable functions is differentiable, by the **chain rule**.

**9.** Using the **chain rule,**the derivative of $e^{-x}$ is: **1 / 1 point**

- ○ $e^{-x}$
- ○ $-e^{x}$
- ◉ $-e^{-x}$
- ○ $e^{x}$

**Correct**
Correct!