

# Answers: Introduction to differentiation and the derivative

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## Summary

Answers to questions relating to the guide on introduction to differentiation and the derivative.

*These are the answers to [Questions: Introduction to differentiation and the derivative](#).*

**Please attempt the questions before reading these answers!**

$$1.1. \quad \frac{d}{dx} (x^3 + 5x - 3) = 3x^2 + 5.$$

$$1.2. \quad \frac{d}{dx} (5x) = 5.$$

$$1.3. \quad \frac{d}{dx} (-5\sqrt{x}) = -5 \cdot \frac{1}{2}x^{-1/2} = -\frac{5}{2\sqrt{x}}.$$

$$1.4. \quad \frac{d}{dx} (-\sin(x)) = -\cos(x).$$

$$1.5. \quad \frac{d}{dx} (\cos x + 5) = -\sin(x).$$

$$1.6. \quad \frac{d}{dx} (2\sqrt{x}) = 2 \cdot \frac{1}{2}x^{-1/2} = \frac{1}{\sqrt{x}}.$$

$$1.7. \quad \frac{d}{dx} (2\ln(2x) + x^5) = \frac{2}{x} + 5x^4.$$

$$1.8. \quad \frac{d}{dx} (\ln(5x)) = \frac{1}{5x} \cdot 5 = \frac{1}{x}.$$

$$1.9. \quad \frac{d}{dx} (e^{-x}) = e^{-x} \cdot (-1) = -e^{-x}.$$

$$1.10. \quad \frac{d}{dx} (23x + 5) = 23.$$

$$1.11. \quad \frac{d}{dx} (4x + 100) = 4.$$

$$1.12. \text{ For } \sinh(5x) = \frac{e^{5x} - e^{-5x}}{2}, \text{ it follows that}$$

$$\frac{d}{dx} (\sinh(5x)) = 5 \frac{e^{5x} + e^{-5x}}{2} = 5 \cosh(5x)$$

$$\text{since } \cosh(x) = \frac{e^x + e^{-x}}{2}.$$

- 1.13.  $\frac{d}{dx} (\cos(3x) - \sin(2x)) = -3 \sin(3x) - 2 \cos(2x).$
- 1.14.  $\frac{d}{dx} (\ln(x) + \cos(x) + 3x) = \frac{1}{x} - \sin(x) + 3.$
- 1.15.  $\frac{d}{dx} \left( \frac{2}{5} \sinh(x) + \frac{2}{13} \cosh(x) \right) = \frac{2}{5} \cosh(x) + \frac{2}{13} \sinh(x).$
- 1.16.  $\frac{d}{dx} (e^{5x} + x^2 + 3) = 5e^{5x} + 2x.$
- 1.17.  $\frac{d}{dx} (\ln(x) + x^2) = \frac{1}{x} + 2x.$
- 1.18.  $\frac{d}{dx} (\ln(5x) - \ln(x)) = \frac{1}{x} - \frac{1}{x} = 0.$
- 1.19.  $\frac{d}{dx} (\cosh(x) - 5x^7) = \sinh(x) - 35x^6.$
- 1.20.  $\frac{d}{dx} (\sqrt{3x^2}) = \sqrt{3}$
- 1.21.  $\frac{d}{dx} (x^3 + 3x - \sqrt{2x}) = 3x^2 + 3 - \frac{1}{\sqrt{2x}}.$
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## Version history and licensing

v1.0: initial version created 03/25 by Sara Delgado Garcia as part of a University of St Andrews VIP project.

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