

List 0. Math for Electronics.

Exercise 1. Let

$$f(x) = 2x + 1, \quad g(x) = x^2 - 3, \quad h(x) = \frac{1}{2}(x - 1), \quad j(x) = \sqrt{x + 3}$$

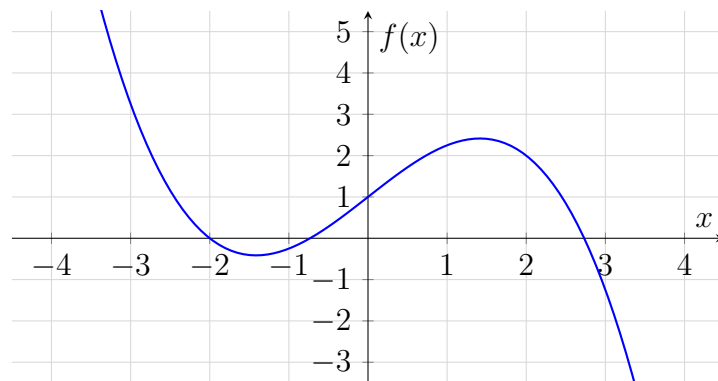
Calculate: $f(g(x))$, $g(f(x))$, $g(h(3))$, $f(f(1))$, $g(j(45 + \pi))$, $j(g(-13.451))$.

Is f bijective? Is g bijective? If they are, what are their inverses?

Exercise 2. Simplify the following expressions: $\ln(e^3)$, $e^{\ln 5}$, $\ln(ab)$, $\ln(a^2)$ (assuming $a > 0$), and solve the equation

$$e^{2x} = 7.$$

Exercise 3 Consider the function shown below.



From the graph, approximately determine:

- the domain and range shown in the graph,
- the zeros of f ,
- the value of $f(0)$,
- the local maximum and local minimum,
- the intervals on which f is increasing and decreasing,
- the approximate solutions of $f(x) = 2$.

Exercise 4. Find the derivatives of the following functions:

- $f(x) = 3x^4 - 2x^2 + 5x - 1$,
- $f(x) = 4x \cdot e^x$,
- $f(x) = \ln(x^2 + 1)$,
-

$$f(x) = \int_0^x \sin(t^3 + 2) dt$$

.

Exercise 5. Let

$$f(x) = x^3 - 3x^2 - 9x + 5.$$

- Find $f'(x)$.
- Find the critical points of f .
- Determine which critical points are local maxima and which are local minima.
- Sketch the general shape of the function.

Exercise 6. Calculate the following integrals.:

a)

$$\int (3x^2 - 4x + 1) dx,$$

d)

$$\int_0^2 (3x^2 + 1) dx.$$

b)

$$\int e^x dx,$$

e)

$$\int x e^{-x} dx.$$

c)

$$\int \frac{1}{x} dx,$$

f)

$$\int (e^{-x^2})' dx$$

Exercise 7. Consider

$$f(x) = x e^{-x}, \quad x \geq 0.$$

- a) Find $f'(x)$.
- b) Find the point where f reaches its maximum.
- c) Sketch the graph of f .
- d) Calculate

$$\int_0^1 x e^{-x} dx.$$

Exercise 8. Calculate

$$\int_0^1 \int_0^2 (x + y) dy dx.$$

Then reverse the order of integration and calculate

$$\int_0^2 \int_0^1 (x + y) dx dy.$$

Do you obtain the same result?

Exercise 9. Let

$$D = \{(x, y) : 0 \leq x \leq 1, 0 \leq y \leq x\}.$$

- a) Sketch the region D in the xy -plane.
- b) Express the integral

$$\iint_D (x + y) dA$$

as an iterated integral.

- c) Calculate the integral.

Exercise 10. For the dataset

$$2, \quad 3, \quad 3, \quad 4, \quad 5, \quad 7, \quad 10.$$

calculate:

- a) the arithmetic mean,
- b) the median,
- c) the minimum and maximum,
- d) the range,
- e) the first and third quartiles.

What happens if the value 10 is replaced by 100?