1.6 Exercises

1. 1 Calculate without calculator :

1) $\log_2(16)$
2) $\log_7\left(\frac{1}{49}\right)$
3) $\log_4(1)$
4) $\log_3(-9)$
5) $\log_5(5)$
6) $\log_{27}\left(\frac{1}{3}\right)$
7) $\log_{16}(8)$
8) $\log_{\sqrt{2}}(4)$

1. 2 Rewrite the following by using $\log(p)$, $\log(q)$ and $\log(r)$.

1) $\log(pqr)$
2) $\log(pq^2r^3)$
3) $\log(100pr^5)$
4) $\log\left(\sqrt{\frac{p}{q^2r}}\right)$
5) $\log\left(\frac{qr^7p}{10}\right)$
6) $\log\left(\sqrt{\frac{10p^{10}r}{q}}\right)$

1. 3 Transform the following by using the properties of logarithms, in one direction or the other.

1) $\log\left(\left(a^5\sqrt[3]{b}\right)/c\right)$
2) $\log\left(\sqrt{a\cdot\sqrt[3]{b}}\right)$
3) $2+3\log(a)$
4) $2\log(a)-\frac{1}{2}\log(b)+3\log(c)$

1. 4 Solve the following equations :

1) $10^x = 9.56$
2) $10^{3x} = -5$
3) $\log(x) = 2.5$
4) $\log(4x-1) = -2$
5) $2\log(x) = -4$
6) $\log(x^2-21) = 2$
7) $10^{3x+2} = \sqrt{10}$
8) $\log(\log(x)) = 1$
9) $2\cdot 2^{2x} - 9\cdot 2^x + 4 = 0$
10) $2^x = 10$
11) $1.03^x = 2$
12) $\log(0.5x-3) = -1$
13) $2.8^x = 5$
14) $3\log(2x) = 9$
15) $1000^{x+2} = 10^{5x+8}$
16) $\log^2(x) - \log(x) - 2 = 0$
17) $9\cdot 3^{2x} - 82\cdot 3^x + 9 = 0$
18) $2^{x^2-8} = \frac{1}{16}$
19) $\log(99+\log(8+\log(x-1))) = 2$
20) $\log(x+1)+\log(x+5) = \log(96)$
21) $\log|x+1|+\log|x+5| = \log(96)$
22) $\log_x(0.0025) = 2$

1.5 Answer the following :

1) Determine the derivative of $f(x) = \mathrm{e}^{3x}$, $g(x) = \mathrm{e}^{-x}$, $h(x) = \mathrm{e}^{3-2x}$ and $i(x) = \mathrm{e}^{\sin(2x+3)}$

2) Determine the equation of the tangent to the given curves at the point whose abscissa is given.

   a) $y = x - \mathrm{e}^{2x}$ at $x = 0$ b) $y = \mathrm{e}^{6-2x}$ at $x = 3$

3) Find the stationary point(s) of the function $y = 7x^2 - \mathrm{e}^{x^2}$.

1.6 Determine the acute angle between the curves f and g at their point of intersection

1) $f(x) = \mathrm{e}^{x+2}$ and $g(x) = \mathrm{e}^{-x}$ 2) $f(x) = \mathrm{e}^{2x}$ and $g(x) = 2\mathrm{e}^{3x}$

1.7 Differentiate the following :

1) $f(x) = x^2\mathrm{e}^{1-x}$
2) $f(x) = 5^{3x+1}$
3) $f(x) = \dfrac{\mathrm{e}^x}{x+2}$
4) $f(x) = 3^x \cdot x^3$
5) $f(x) = \dfrac{\mathrm{e}^x - 1}{\mathrm{e}^x + 1}$
6) $f(x) = \mathrm{e}^{\sqrt{x^2+1}}$
7) $f(x) = \mathrm{e}^{x\cos(x)}$
8) $f(x) = \dfrac{\mathrm{e}^x - \mathrm{e}^{-x}}{\mathrm{e}^x + \mathrm{e}^{-x}}$

1.8 Differentiate the following :

1) $f(x) = \ln(2x-1)$
2) $f(x) = \ln(ax+b)$
3) $f(x) = 3\ln(x^{-2})$
4) $f(x) = \ln\left(\dfrac{1}{3x+1}\right)$
5) $f(x) = \ln(-x^2+6)$
6) $f(x) = \ln\left(\dfrac{1}{x}\right)$
7) $f(x) = \ln\left(\dfrac{2x+1}{3x-1}\right)$
8) $f(x) = \ln(\cos(x))$

1.9 Determine the value of $a > 0$ so that the equation $x^2 - 2x + 2\log(a) = 0$ has two real solutions ?

1.10 Let's consider the function $f(x) = (x^2 + ax + b)\,\mathrm{e}^x$. Find the value of a and b given that the graph of f has only one stationary point whose abscissa is 2.

1.11 Answer the following :

1) Determine the equation of the tangent to the curve $y = \ln(-x)$ at $x = -\frac{1}{3}$.

2) Determine the equation of the normal to the curve $y = \ln(2x-3)$ at $x = 2$.

1.12 Find the stationary point(s) of the following functions.

1) $y = x^2 - \ln(x^2)$ 2) $y = \frac{1}{2}x^2 - \ln(2x)$

1. 13 Analyse the asymptotic behaviour (when $x \longrightarrow \pm\infty$) of the following :

1) $f(x) = \dfrac{\ln(x^2+1)}{x}$
3) $f(x) = \dfrac{e^x}{x^{1000}+2}$
5) $f(x) = \dfrac{2e^x - 1}{e^x + 2}$
2) $f(x) = \dfrac{e^x}{x^2 - 3x + 2}$
4) $f(x) = \dfrac{\ln(x^2)}{\ln^2(x)}$
6) $f(x) = \dfrac{e^x - 2e^{-x}}{e^x + e^{-x}}$

1. 14 Analyse the following :

1) $f(x) = (x-1)^2 \cdot e^x$
3) $f(x) = \dfrac{\ln^2(x)}{x}$
2) $f(x) = (2x^2 - 4) \cdot e^{-x}$
4) $f(x) = \dfrac{1}{x-3} \cdot e^{-x}$

1. 15 Determine the general expression for the function $f(x)$ given by its derivative :

1) $f'(x) = 4x^3$
4) $f'(x) = 9x^2 - 4x - 5$
2) $f'(x) = 2x$
5) $f'(x) = 2x^2 - 3x - 4$
3) $f'(x) = 10x^9 - 8x^7 - 1$
6) $f'(x) = 1 - 5x - 7x^3$

1. 16 In each case, determine the general expression for $f(x)$:

1) $f(x)$ passes through $(-4; 9)$ and is such that $f'(x) = \frac{1}{2}x^3 + \frac{1}{4}x + 1$
2) $f(x)$ is such that $f'(x) = 15x^2 - 6x + 4$ and $f(1) = 0$

1. 17 Calculate the indefinite integrals here below :

1) $\displaystyle\int 4x\,dx$
2) $\displaystyle\int 1\,dx$
3) $\displaystyle\int 9\,dx$
4) $\displaystyle\int a\,dx$
5) $\displaystyle\int x^2 dv$
6) $\displaystyle\int t^5 dt$
7) $\displaystyle\int \frac{1}{2}x^8\,dx$
8) $\displaystyle\int \frac{1}{x^3}\,dx$
9) $\displaystyle\int 6x^2 - 2x - 5\,dx$
10) $\displaystyle\int x(x+2)(x-2)\,dx$
11) $\displaystyle\int \sqrt{x}\,dx$
12) $\displaystyle\int \frac{1}{\sqrt{x}}\,dx$
13) $\displaystyle\int e^{3x}\,dx$
14) $\displaystyle\int e^{-x}\,dx$
15) $\displaystyle\int e^{3-2x}\,dx$
16) $\displaystyle\int \sin(5x)\,dx$

1. 18 Calculate the definite integrals here below :

1) $\int_2^5 x^2\,dx$

2) $\int_1^2 \frac{4}{3}x^3\,dx$

3) $\int_0^8 12\sqrt[3]{x}\,dx$

4) $\int_1^8 \frac{1}{\sqrt[3]{x^2}}\,dx$

5) $\int_1^2 \frac{8}{x^3}+x^3\,dx$

6) $\int_1^4 \frac{1}{x^2}\,dx$

7) $\int_0^\pi \sin(x)\,dx$

8) $\int_4^9 \frac{2\sqrt{x}+3}{\sqrt{x}}\,dx$

9) $\int_0^{\ln(2)} 2\mathrm{e}^{1-2x}\,dx$

10) $\int_0^1 \mathrm{e}^{\ln(2)x}\,dx$

1. 19 Calculate the following :

1) $\int_{-1}^1 \mathrm{e}^{-x}\,dx$

2) $\int_{-3}^9 \mathrm{e}^{\ln(3)x}\,dx$

3) $\int_{\ln(3)}^{\ln(9)} \mathrm{e}^x\,dx$

4) $\int_0^1 a^x\,dx$

5) $\int_{-3}^{-1} \frac{1}{x}\,dx$

6) $\int_1^3 \frac{1}{x-5}\,dx$

7) $\int_0^8 \sqrt[3]{x}\,dx$

1. 20 We consider the function $f(x)=\mathrm{e}^{0.75x}-3x+c$.

1) Determine the value of c so that f passes through the origin.

2) For $c=-1$ compute the coordinates of the stationary point.

3) For $c=-1$ determine the value of $\int_{-1}^0 f(x)\,dx$

1. 21 Answer the following :

1) Calculate the area under the graph of $f(x)=x^4+5$ from $x=-1$ to $x=1$.

2) Determine the area between the x-axis and the curve $f(x)=x^2-5$ from $x=-3$ to $x=2$.

3) Calculate the area under the curve $y=\frac{6}{x^4}$ between $x=1$ and $x=2$.

4) Calculate the value of the area delimited by the curve $y=\mathrm{e}^{2x}$, the axes and the line $x=2$.

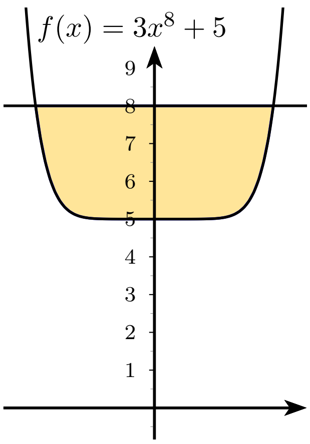
1. 22 Answer the following :

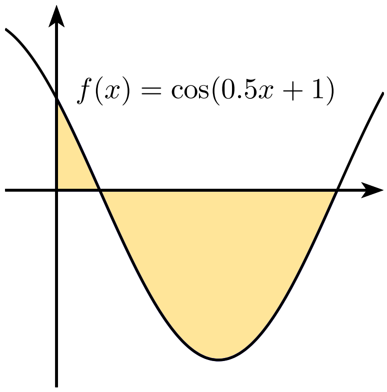
1) Calculate $A = \int_1^b \frac{1}{x^2}\, dx$

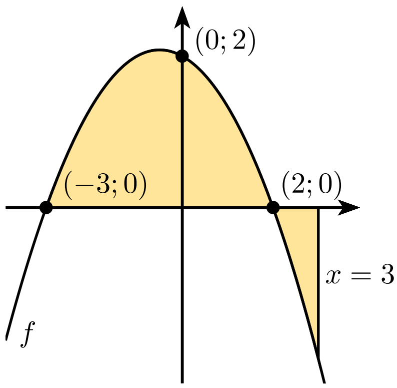
2) Find the value of b so that $A = \frac{1}{2}$

3) Calculate the value of A when $b \longrightarrow +\infty$.

1. 23 In each case, determine the area of the shaded region :







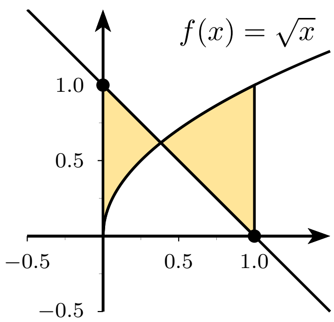
1. 24 In each situation, plot the graphs of f and g on the same coordinate system, hatch the surface delimited by the two curves and determine its area.

1) $f(x) = \frac{1}{2}x^2$ and $g(x) = 4 - x$

2) $f(x) = 1 + \frac{1}{9}x^2$ and $g(x) = 3 - \frac{1}{9}x^2$

1. 25 In the first quadrant we consider the area bounded by the axes, the line $y = 8$ and the graph of the function $f(x) = \frac{4 - x^2}{x^2}$. Sketch the situation and calculate the value of that area.

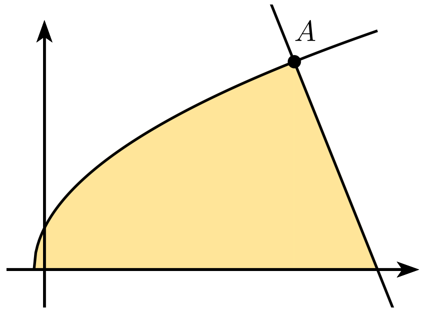
1. 26 Calculate the value of the grey area :



1. 27 Here opposite is represented the curve $y = \sqrt{4x+1}$ as well as the normal line to this curve at the point $A(6;5)$.

1) Determine the equation of that normal line.

2) Calculate the value of the grey area.



1. 28 Determine antiderivatives of the following functions, by using the integration by parts :

1) $f(x) = x \cdot \mathrm{e}^x$
2) $f(x) = \ln(x)$
3) $f(x) = x^2\mathrm{e}^{-2x}$
4) $f(x) = x^2 \sin(x)$
5) $f(x) = x \ln(x)$
6) $f(x) = x(1-x)^4$
7) $f(x) = x^2 \ln(x)$
8) $f(x) = \mathrm{e}^x \cdot \sin(x)$
9) $f(x) = x\sqrt{x+1}$

1. 29 By substitution, find an antiderivative of the following :

1) $f(x) = \cos(2x+1)$
2) $f(x) = (2x+5)^4$
3) $f(x) = \sin(-5x+3)$
4) $f(x) = \sin(x)\cos(x)$
5) $f(x) = xe^{-x^2}$
6) $f(x) = x^2\mathrm{e}^{-x^3}$
7) $f(x) = \dfrac{3}{1-3x}$
8) $f(x) = \dfrac{\ln(x)}{x}$
9) $f(x) = \dfrac{\mathrm{e}^x}{1+\mathrm{e}^x}$
10) $f(x) = \dfrac{2x+1}{x^2+x+4}$
11) $f(x) = \dfrac{\sin(\sqrt{x})}{2\sqrt{x}}$
12) $f(x) = x(1-x^2)^4$
13) $f(x) = x\cos(\pi x^2)$
14) $f(x) = x^3\sqrt{1+x^4}$

1. 30 Find an antiderivative of the following :

1) $f(x) = \dfrac{2x^2-5x+7}{x-3}$
2) $f(x) = \dfrac{5x^2+4x-8}{3x-1}$

1. 31 The antiderivative of

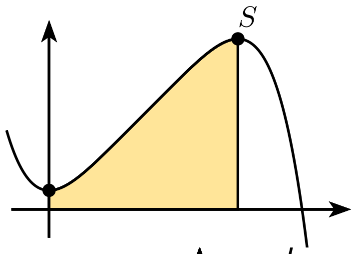
1) $f(x) = (2x^2-3x+1)\mathrm{e}^x$ is of the form $F(x) = (ax^2+bx+c)\mathrm{e}^x$. Find it !

2) $f(x) = (x^2+4x-3)\mathrm{e}^{-x}$ is of the form $F(x) = (ax^2+bx+c)\mathrm{e}^{-x}$. Find it !

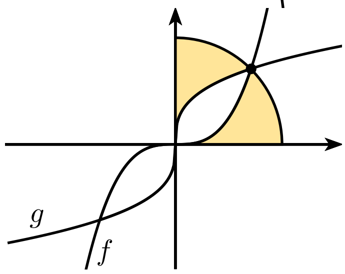
3) $f(x) = (-5x^2-2x+7)\mathrm{e}^{2x}$ is of the form $F(x) = (ax^2+bx+c)\mathrm{e}^{2x}$. Find it !

4) $f(x) = 3\cos(x) + 7\sin(x))\mathrm{e}^{(}-x)$ is of the form
$F(x) = (a\cos(x) + b\sin(x))\mathrm{e}^{-x}$. Find it !

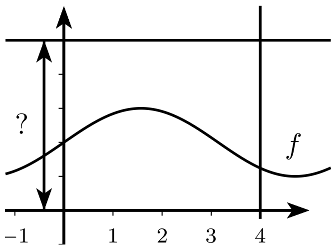
1. 32 Here opposite is represented the curve $y = (1 - 4x)^5 + 20x$. Prove that this curve has a minimum located on the y-axis. Then calculate the value of the grey area.



1. 33 Here opposite are partially represented the graphs of $f(x) = x^3$ and $g(x) = \sqrt[3]{x}$. Calculate the grey area.



1. 34 What must the height of that rectangular target be so that a dart thrown randomly has the same probability to hit the target above and below the curve $f(x) = \sin(x) + 2$?



1.7 Solutions

1. 1

1) 4
2) -2
3) 0
4) $\varnothing$
5) 1
6) $-\frac{1}{3}$
7) $\frac{3}{4}$
8) 4

1. 2

1) $\log(p) + \log(q) + \log(r)$
2) $\log(p) + 2\log(q) + 3\log(r)$
3) $2 + \log(p) + 5\log(r)$
4) $\frac{1}{2}\log(p) - \log(q) - \frac{1}{2}\log(r)$
5) $\log(q) + 7\log(r) + \log(p) - 1$
6) $\frac{1}{2} + 5\log(p) + \frac{1}{2}\log(r) - \frac{1}{2}\log(q)$

1. 3

1) $5\log(a) + \frac{1}{3}\log(b) - \log(c)$
2) $\frac{1}{2}\log(a) + \frac{1}{6}\log(b)$
3) $\log(100a^3)$
4) $\log\left(\frac{a^2c^3}{\sqrt{b}}\right)$

1. 4

1) $x = \log(9.56) \cong 0.98$
2) $\varnothing$
3) $x = 10^{2.5} \cong 316.23$
4) $x = \frac{101}{400} = .2525$
5) $x = \pm 0.01$
6) $x_{1.2} = \pm 11$
7) $x = -0.5$
8) $x = 10^{10}$
9) $x_1 = 2 \quad x_2 = -1$
10) $x = \frac{1}{\log(2)} \cong 3.32$
11) $x = \frac{\log(2)}{\log(1.03)} \cong 23.45$
12) $x = 6.2$
13) $x = \frac{\log(5)}{\log(2.8)} \cong 1.56$
14) $x = 500$
15) $x = -1$
16) $x_1 = 100$ $x_2 = 10^{-1} = 0.1$
17) $x_{1,2} = \pm 2$
18) $x_{1,2} = \pm 2$
19) $x = 101$
20) $x = 7$
21) $x_1 = 7 \quad x_2 = -13$
22) $x = 0.05$

1. 5

1) $f'(x) = 3e^{3x} \quad g'(x) = -e^{-x} \quad h'(x) = -2e^{3-2x} \quad i'(x) = 2\cos(2x+3)e^{\sin(2x+3)}$
2) $y = -x - 1 \quad y = -2x + 7$
3) $P_1(-1.39; 6.62)$ maximum $\quad P_2(0; -1)$ minimum $\quad P_3(1.39; 6.62)$ maximum

1. 6

1) $\alpha \cong 40.40°$
2) $\alpha \cong 10.30°$

1. 7

1) $f'(x) = e^{1-x}(-x^2 + 2x)$
2) $f'(x) = 3\ln(5)5^{3x+1}$
3) $f'(x) = \dfrac{e^x(x+1)}{(x+2)^2}$
4) $f'(x) = 3^x \cdot x^2(\ln(3)x + 3)$
5) $f'(x) = \dfrac{2e^x}{(e^x+1)^2}$
6) $f'(x) = \dfrac{x}{\sqrt{x^2+1}}e^{\sqrt{x^2+1}}$
7) $f'(x) = (\cos(x) - x\sin(x))e^{x\cos(x)}$
8) $f'(x) = \dfrac{4}{(e^x+e^{-x})^2}$

1. 8

1) $f'(x) = \dfrac{2}{2x-1}$

2) $f'(x) = \dfrac{a}{ax+b}$

3) $f'(x) = -\dfrac{6}{x}$

4) $f'(x) = \dfrac{-3}{3x+1}$

5) $f'(x) = \dfrac{-2x}{-x^2+6}$

6) $f'(x) = -\dfrac{1}{x}$

7) $f'(x) = \dfrac{-5}{6x^2+x-1}$

8) $f'(x) = -\tan(x)$

1. 9 $a \in]0; \sqrt{10}[$

1. 10 $a = -6 \quad b = 10$

1. 11 1) $y = -3x + \ln\left(\frac{1}{3}\right) - 1 \cong -3x - 2.10$ 2) $y = -\frac{1}{2}x + 1$

1. 12 1) $MIN(-1; 1) \quad MIN(1; 1)$ 2) $MIN(1; -0.19)$

1. 13

1) $\lim\limits_{x\to-\infty} f(x) = 0 \quad \lim\limits_{x\to+\infty} f(x) = 0$

2) $\lim\limits_{x\to-\infty} f(x) = 0 \quad \lim\limits_{x\to+\infty} f(x) = +\infty$

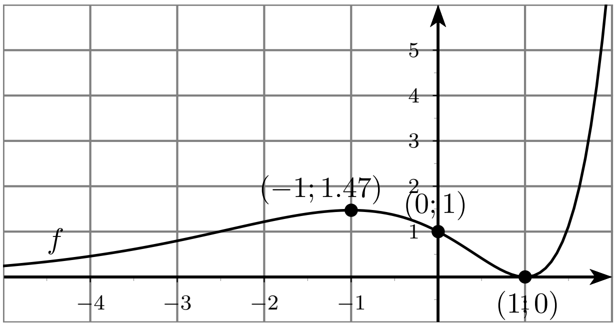
3) $\lim\limits_{x\to-\infty} f(x) = 0 \quad \lim\limits_{x\to+\infty} f(x) = +\infty$

4) $\lim\limits_{x\to-\infty} f(x)$ can't be considered $\quad \lim\limits_{x\to+\infty} f(x) = 0$

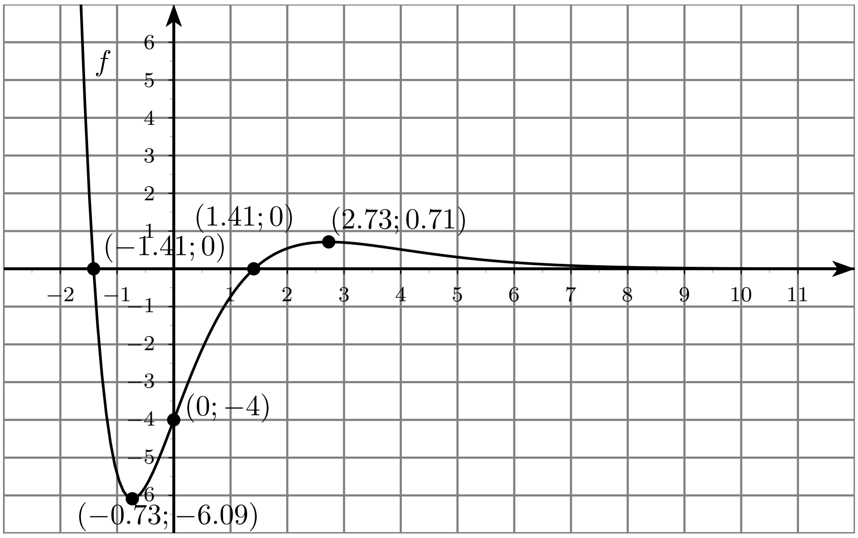
5) $\lim\limits_{x\to-\infty} f(x) = -\frac{1}{2} \quad \lim\limits_{x\to+\infty} f(x) = 2$

6) $\lim\limits_{x\to-\infty} f(x) = -2 \quad \lim\limits_{x\to+\infty} f(x) = 1$

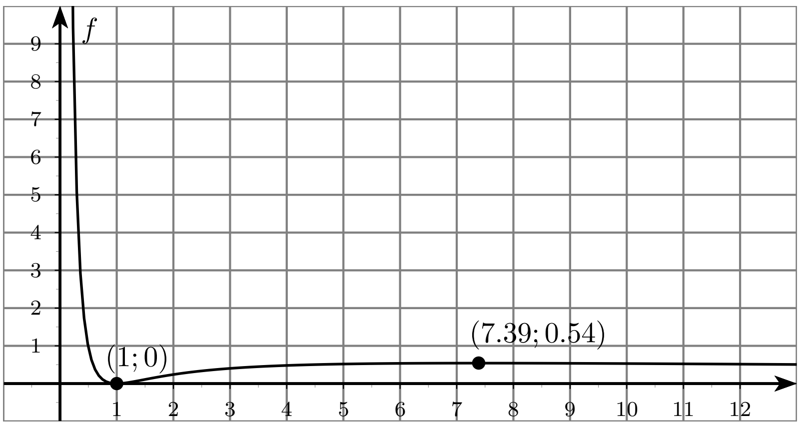
1. 14 1)


f
(−1; 1.47)
(0; 1)
(1; 0)

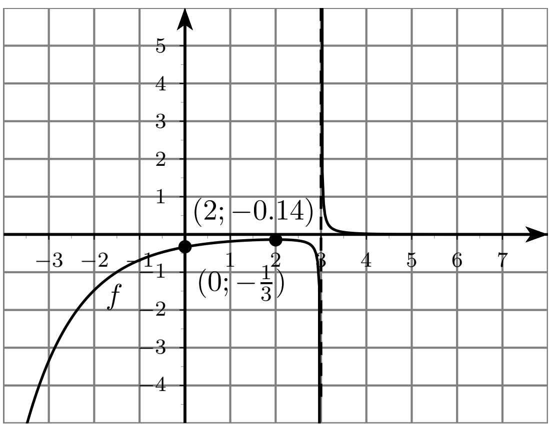
2)


f
(1.41; 0)
(2.73; 0.71)
(−1.41; 0)
(0; −4)
(−0.73; −6.09)

3)


f
(1; 0)
(7.39; 0.54)

4)


(2; −0.14)
$(0; -\frac{1}{3})$
f

1.15

1) $f(x) = x^4 + c$
2) $f(x) = x^2 + c$
3) $f(x) = x^{10} - x^8 - x + c$
4) $f(x) = 3x^3 - 2x^2 - 5x + c$
5) $f(x) = \frac{2}{3}x^3 - \frac{3}{2}x^2 - 4x + c$
6) $f(x) = c + x - \frac{5}{2}x^2 - \frac{7}{4}x^4$

1.16

1) $f(x) = \frac{1}{8}x^4 + \frac{1}{8}x^2 + x - 21$
2) $f(x) = 5x^3 - 3x^2 + 4x - 6$

1.17

1) $2x^2 + c$
2) $x + c$
3) $9x + c$
4) $ax + c$
5) $x^2 v + c$
6) $\frac{1}{6}t^6 + c$
7) $\frac{1}{18}x^9 + c$
8) $-\frac{1}{2}x^{-2} + c$
9) $2x^3 - x^2 - 5x + c$
10) $\frac{1}{4}x^4 - 2x^2 + c$
11) $\frac{2}{3}x^{\frac{3}{2}} + c$
12) $2x^{\frac{1}{2}} + c$
13) $\frac{1}{3}\mathrm{e}^{3x} + c$
14) $-\mathrm{e}^{-x} + c$
15) $-\frac{1}{2}\mathrm{e}^{3-2x} + c$
16) $-\frac{1}{5}\cos(5x) + c$

1.18

1) 39
2) 5
3) 144
4) 3
5) $\frac{27}{4} = 6.75$
6) $\frac{3}{4} = 0.75$
7) 2
8) 16
9) $\frac{3}{4}e \cong 2.04$
10) $\frac{1}{\ln(2)} \cong 1.44$

1.19

1) $\frac{\mathrm{e}^2-1}{e} \cong 2.35$
2) $\frac{531'440}{27\ln(3)} \cong 17'916.2$
3) 6
4) $\frac{a-1}{\ln(a)}$
5) $\ln\left(\frac{1}{3}\right) \cong -1.10$
6) $\ln\left(\frac{1}{2}\right) \cong -0.70$
7) 12

1.20

1) $c = -1$
2) $S(1.85; -2.55)$
3) $I \cong 1.2$

1.21

1) $A = 10.4$
2) $A \cong 16.24$
3) $A = \frac{7}{4}$
4) $A \cong 26.8$

1.22

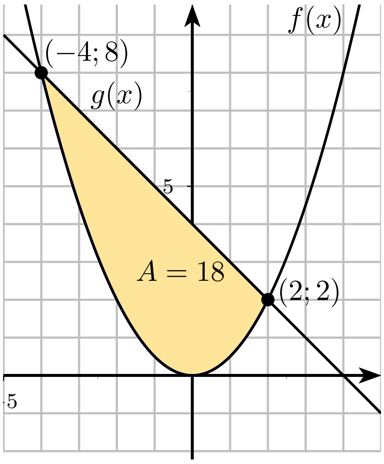
1) $A = -\frac{1}{b} + 1$
2) $b = 2$
3) $A = 1$

1.23

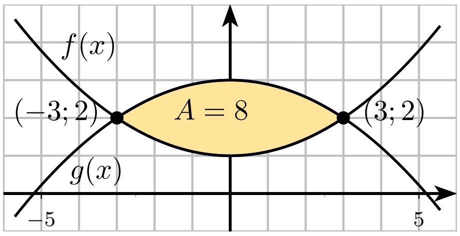
1) $A = \frac{16}{3}$
2) $A \cong 4.32$
3) $A = \frac{71}{9}$

1. 24

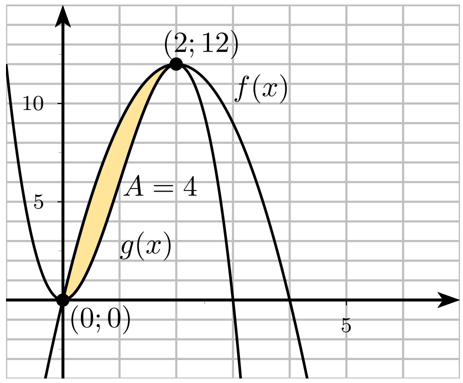
1)



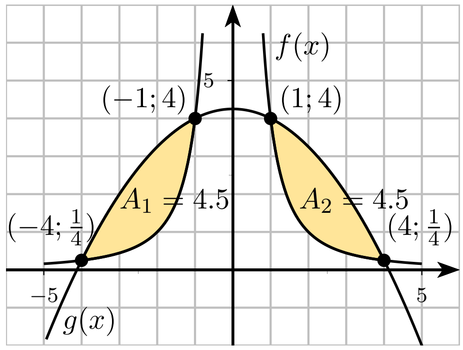
2)



3)



4)



1. 25 $A = 8$

1. 26 $A \cong 0.47$

1. 27 1) $y = -\frac{5}{2}x + 20$ 2) $A \cong 25.83$

1. 28

1) $F(x) = (x-1)e^x + c$

2) $F(x) = x(\ln(x) - 1) + c$

3) $F(x) = (x^2 - 3x + 4)e^x + c$

4) $F(x) = 2x\sin(x) - (x^2 - 2)\cos(x) + c$

5) $F(x) = \frac{x^2}{4}(2\ln(x) - 1) + c$

6) $F(x) = -\frac{1}{5}(1-x)^5(x + \frac{1}{6}(1-x)) + c$

7) $F(x) = \frac{1}{9}x^3(3\ln(x) - 1) + c$

8) $F(x) = \frac{1}{2}e^x(\sin(x) - \cos(x)) + c$

9) $f(x) = \frac{2}{3}x(x+1)^{\frac{3}{2}} - \frac{4}{15}(x+1)^{\frac{5}{2}} + c$

1. 29

1) $F(x) = \frac{1}{2}\sin(2x+1) + c$

2) $F(x) = \frac{1}{10}(2x+5)^5 + c$

3) $F(x) = \frac{1}{5}\cos(-5x+3) + c$

4) $F(x) = \frac{1}{2}\sin^2(x) + c$

5) $F(x) = -0.5e^{-x^2} + c$

6) $F(x) = -\frac{1}{3}\mathrm{e}^{-x^3} + c$

7) $F(x) = -\ln|1-3x| + c$

8) $F(x) = \frac{1}{2}\ln^2(x) + c$

9) $F(x) = \ln|1+\mathrm{e}^x| + c$

10) $F(x) = \ln|x^2+x+4| + c$

11) $F(x) = -\cos(\sqrt{x}) + c$

12) $F(x) = -\frac{1}{10}(1-x^2)^5 + c$

13) $F(x) = \frac{1}{2\pi}\sin(\pi x^2) + c$

14) $F(x) = \frac{1}{6}\left(1+x^4\right)^{\frac{3}{2}} + c$

1. 30

1) $F(x) = x^2 + x + 10\ln|x-3| + c$

2) $F(x) = \frac{5}{6}x^2 + \frac{17}{9}x - \frac{55}{27}\ln|3x-1| + c$

1. 31

1) $F(x) = (2x^2 - 7x + 8)\mathrm{e}^x + c$

2) $F(x) = (-x^2 - 6x - 3)\mathrm{e}^{-x} + c$

3) $F(x) = (-\frac{5}{2}x^2 + \frac{3}{2}x + \frac{11}{4})\mathrm{e}^{2x} + c$

4) $F(x) = (-5\cos(x) - 2\sin(x))\mathrm{e}^{-x}$

1. 32 $A = 2.5$

1. 33 $A = \frac{\pi-1}{2}$

1. 34 $h \cong 4.83$