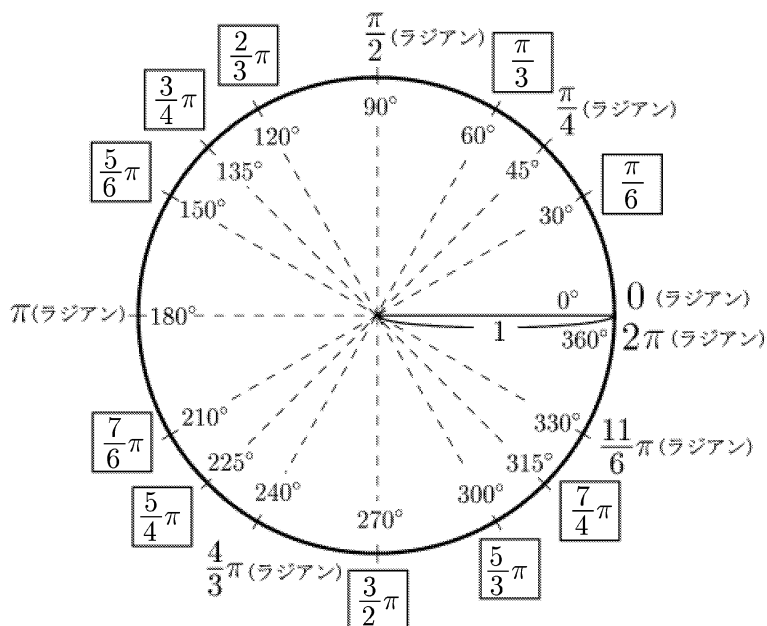


< 1 ページ , 三角関数の復習 1 >

解答 問1



問2

角度 θ	度数法	0°	30°	45°	60°	90°	120°	135°	150°	180°
	弧度法	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	$\frac{2\pi}{3}$	$\frac{3\pi}{4}$	$\frac{5\pi}{6}$	π
$\sin \theta$	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0	
$\cos \theta$	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0	$-\frac{1}{2}$	$-\frac{\sqrt{2}}{2}$	$-\frac{\sqrt{3}}{2}$	-1	
$\tan \theta$	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	\times	$-\sqrt{3}$	-1	$-\frac{\sqrt{3}}{3}$	0	

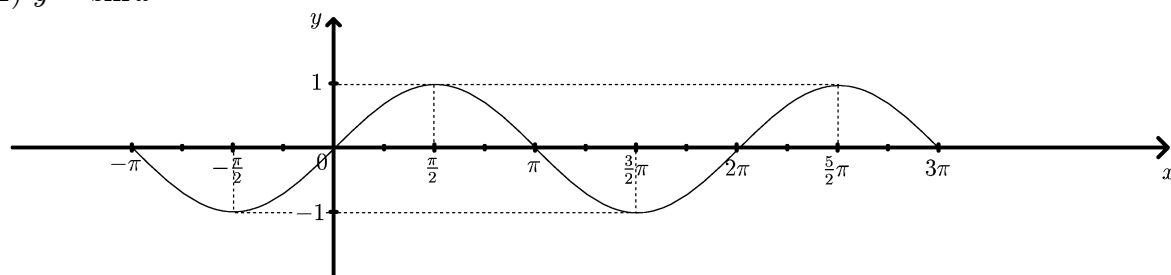
角度 θ	度数法	210°	225°	240°	270°	300°	315°	330°	360°
	弧度法	$\frac{7\pi}{6}$	$\frac{5\pi}{4}$	$\frac{4\pi}{3}$	$\frac{3\pi}{2}$	$\frac{5\pi}{3}$	$\frac{7\pi}{4}$	$\frac{11\pi}{6}$	2π
$\sin \theta$	$-\frac{1}{2}$	$-\frac{\sqrt{2}}{2}$	$-\frac{\sqrt{3}}{2}$	-1	$-\frac{\sqrt{3}}{2}$	$-\frac{\sqrt{2}}{2}$	$-\frac{1}{2}$	0	
$\cos \theta$	$-\frac{\sqrt{3}}{2}$	$-\frac{\sqrt{2}}{2}$	$-\frac{1}{2}$	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1	
$\tan \theta$	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	\times	$-\sqrt{3}$	-1	$-\frac{\sqrt{3}}{3}$	0	

< 3 ページ , 三角関数の復習 3 >

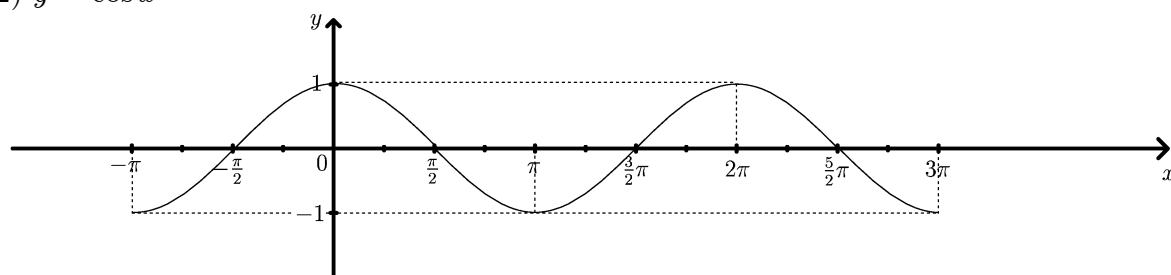
解答 問

x	度数法	-180°	-135°	-90°	-45°	0°	45°	90°	135°	180°	225°	270°	315°	360°	405°	450°	495°	540°
	弧度法	$-\pi$	$-\frac{3}{4}\pi$	$-\frac{\pi}{2}$	$-\frac{\pi}{4}$	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3}{4}\pi$	π	$\frac{5}{4}\pi$	$\frac{3}{2}\pi$	$\frac{7}{4}\pi$	2π	$\frac{9}{4}\pi$	$\frac{5}{2}\pi$	$\frac{11}{4}\pi$	3π
$\sin x$		0	$-\frac{\sqrt{2}}{2}$	-1	$-\frac{\sqrt{2}}{2}$	0	$\frac{\sqrt{2}}{2}$	1	$\frac{\sqrt{2}}{2}$	0	$-\frac{\sqrt{2}}{2}$	-1	$-\frac{\sqrt{2}}{2}$	0	$\frac{\sqrt{2}}{2}$	1	$\frac{\sqrt{2}}{2}$	0
$\cos x$		-1	$-\frac{\sqrt{2}}{2}$	0	$\frac{\sqrt{2}}{2}$	1	$\frac{\sqrt{2}}{2}$	0	$-\frac{\sqrt{2}}{2}$	-1	$-\frac{\sqrt{2}}{2}$	0	$\frac{\sqrt{2}}{2}$	1	$\frac{\sqrt{2}}{2}$	0	$-\frac{\sqrt{2}}{2}$	-1

(1) $y = \sin x$

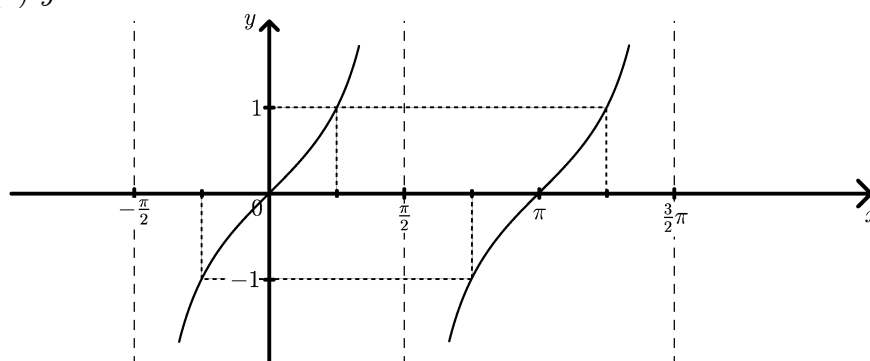


(2) $y = \cos x$



x	度数法	-90°	-60°	-45°	-30°	0°	30°	45°	60°	90°	120°	135°	150°	180°	210°	225°	240°	270°
	弧度法	$-\frac{\pi}{2}$	$-\frac{\pi}{3}$	$-\frac{\pi}{4}$	$-\frac{\pi}{6}$	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	$\frac{2}{3}\pi$	$\frac{3}{4}\pi$	$\frac{5}{6}\pi$	π	$\frac{7}{6}\pi$	$\frac{5}{4}\pi$	$\frac{4}{3}\pi$	$\frac{3}{2}\pi$
$\tan x$		\times	$-\sqrt{3}$	-1	$-\frac{\sqrt{3}}{3}$	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	\times	$-\sqrt{3}$	-1	$-\frac{\sqrt{3}}{3}$	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	\times

(2) $y = \tan x$



< 4 ページ , 三角関数の復習 4 >

解答 問 (1) $(3, 3) = (3\sqrt{2} \cos(45^\circ), 3\sqrt{2} \sin(45^\circ))$

(2) $(-1, \sqrt{3}) = (2 \cos(120^\circ), 2 \sin(120^\circ))$

(3) $(\sqrt{3}, -1) = (2 \cos(-30^\circ), 2 \sin(-30^\circ))$
 $= (2 \cos(330^\circ), 2 \sin(330^\circ))$

(4) $(-2, -2\sqrt{3}) = (4 \cos(-120^\circ), 4 \sin(-120^\circ))$
 $= (4 \cos(240^\circ), 4 \sin(240^\circ))$

< 5 ページ , 指数の復習 >

解答 問1 (1) $25^{\frac{1}{2}} = 5$

(2) $7^0 = 1$

(3) $3^{-2} = \frac{1}{9}$

(4) $4^{-\frac{1}{2}} = \frac{1}{\sqrt{4}} = \frac{1}{2}$

(5) $16^{\frac{5}{4}} = 2^5 = 32$

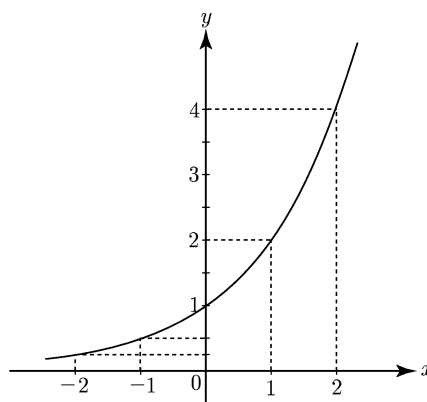
(6) $8^{-\frac{2}{3}} = \frac{1}{2^2} = \frac{1}{4}$

(7) $\left(\frac{1}{4}\right)^{\frac{1}{2}} = \sqrt{\frac{1}{4}} = \frac{1}{2}$

(8) $(0.01)^{-1.5} = \left(\frac{1}{100}\right)^{-\frac{3}{2}} = 100^{\frac{3}{2}} = 1000$

問2

x	-2	-1	0	1	2
2^x	$\frac{1}{4}$	$\frac{1}{2}$	1	2	4



< 6 ページ , 対数の復習 >

解答 問1 (1) $\log_3 81 = 4$

(2) $\log_5 25 = 2$

(3) $\log_7 1 = 0$

(4) $\log_2 \left(\frac{1}{8}\right) = -3$

(5) $\log_4 2 = \frac{1}{2}$

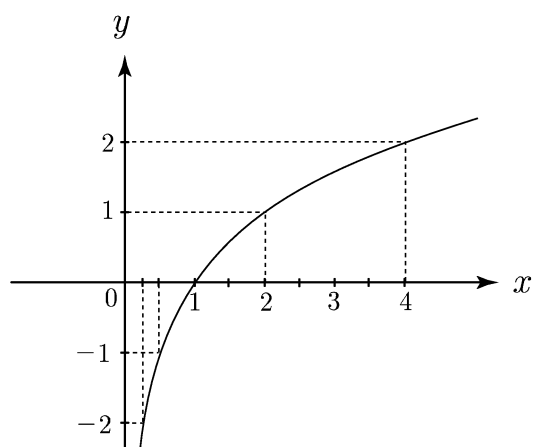
(6) $\log_8 2 = \frac{1}{3}$

(7) $\log_{10} (0.1) = -1$

(8) $\log_2 (0.25) = -2$

問2

x	$\frac{1}{4}$	$\frac{1}{2}$	1	2	4
$\log_2 x$	-2	-1	0	1	2

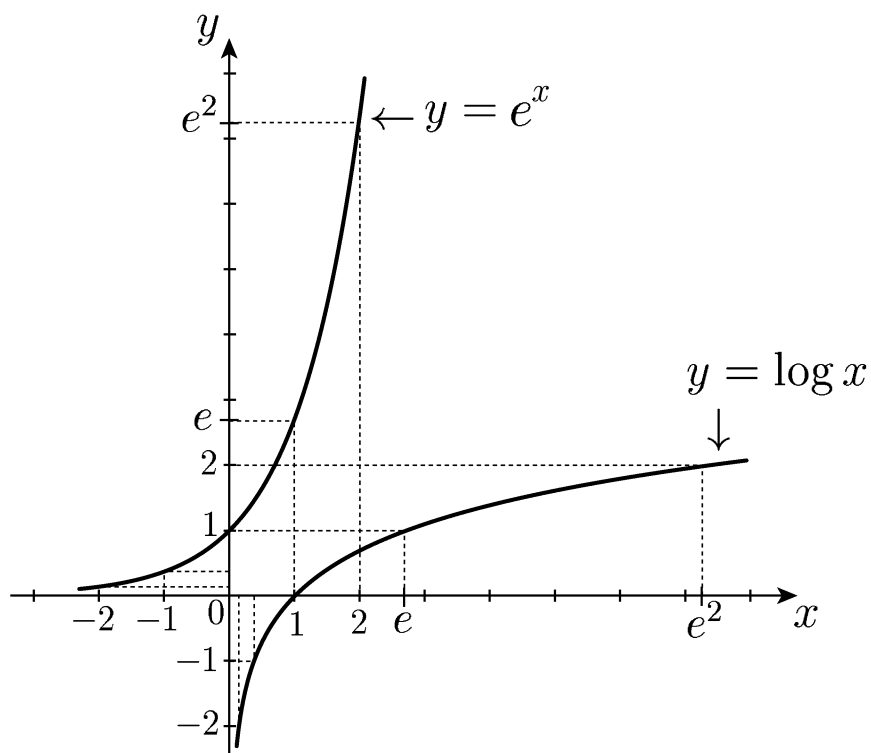


< 7ページ , e の復習 >

解答 問

x	-2	-1	0	1	2
e^x	$\frac{1}{e^2}$	$\frac{1}{e}$	1	e	e^2

x	$\frac{1}{e^2}$	$\frac{1}{e}$	1	e	e^2
$\log x$	-2	-1	0	1	2



< 8 ページ , 微分の復習 1 >

解答 問 (1) $(5x^4 + 6x^3)' = 20x^3 + 18x^2$

(2) $(7x^5 - 4x + 5)' = 35x^4 - 4$

(3) $(\sqrt[3]{x})' = (x^{\frac{1}{3}})' = \frac{1}{3}x^{-\frac{2}{3}} = \frac{1}{3\sqrt[3]{x^2}}$

(4) $\left(\frac{1}{x^2}\right)' = (x^{-2})' = -2x^{-3} = -\frac{2}{x^3}$

(5) $\left(\frac{1}{\sqrt{x}}\right)' = (x^{-\frac{1}{2}})' = -\frac{1}{2}x^{-\frac{3}{2}} = -\frac{1}{2x\sqrt{x}}$

(6) $(x\sqrt{x})' = (x^{\frac{3}{2}})' = \frac{3}{2}x^{\frac{1}{2}} = \frac{3}{2}\sqrt{x}$

(7) $\left(\frac{4}{x^3}\right)' = -\frac{12}{x^4}$

(8) $\left(\frac{x^3 - 3x + 4}{x}\right)' = \left(x^2 - 3 + \frac{4}{x}\right)' = 2x - \frac{4}{x^2}$

(9) $\left(\frac{x-1}{\sqrt{x}}\right)' = \left(\sqrt{x} - \frac{1}{\sqrt{x}}\right)' = \frac{1}{2\sqrt{x}} + \frac{1}{2x\sqrt{x}}$

< 9 ページ , 微分の復 2 >

解答 問 (1) $(x^3 \sin x)' = 3x^2 \sin x + x^3 \cos x$

(2) $(e^x \cos x)' = e^x \cos x - e^x \sin x$

(3) $(x^5 e^x)' = 5x^4 e^x + x^5 e^x$

(4) $(-x + x \log x)' = -1 + \log x + x \times \frac{1}{x} = \log x$

(5) $\left(\frac{1}{x+1}\right)' = -\frac{1}{(x+1)^2}$

(6) $\left(\frac{x}{x+1}\right)' = \left(1 - \frac{1}{x+1}\right)' = \frac{1}{(x+1)^2}$

(7) $\left(\frac{3}{x^2+1}\right)' = -\frac{6x}{(x^2+1)^2}$

(8) $\left(\frac{1}{e^x}\right)' = (e^{-x})' = -e^{-x} = -\frac{1}{e^x}$

(9) $\left(\frac{\cos x}{\sin x}\right)' = \frac{(\cos x)' \sin x - \cos x (\sin x)'}{\sin^2 x} = \frac{-\sin^2 x - \cos^2 x}{\sin^2 x} = -\frac{1}{\sin^2 x}$

< 10 ページ , 微分の復習 3 >

解答 問

$$(1) (\cos(5x - 3))' = -5 \sin(5x - 3)$$

$$(2) (\sin(x^2 + 3x))' = (2x + 3) \cos(x^2 + 3x)$$

$$(3) (e^{4x+5})' = 4e^{4x+5}$$

$$(4) ((3x + 2)^6)' = 18(3x + 2)^5$$

$$(5) (\sqrt{4x + 3})' = ((4x + 3)^{\frac{1}{2}})' = \frac{1}{2} \times (4x + 3)^{-\frac{1}{2}} \times 4 = \frac{2}{\sqrt{4x + 3}}$$

$$(6) (\sin(4x) + e^{5x})' = 4 \cos(4x) + 5e^{5x}$$

$$(7) (e^{2x} \cos(3x))' = 2e^{2x} \cos(3x) - 3e^{2x} \sin(3x)$$

$$(8) (e^{-3x} \sin(2x))' = -3e^{-3x} \sin(2x) + 2e^{-3x} \cos(2x)$$

$$(9) (\sin(2x) \cos(3x))' = 2 \cos(2x) \cos(3x) - 3 \sin(2x) \sin(3x)$$

< 11 ページ , 微分の復習 4 >

解答 問1 (1) $(\tan^{-1} x)' = \frac{dy}{dx} = \frac{1}{\frac{dx}{dy}} = \frac{1}{(\tan y)'} = \frac{1}{\frac{1}{\cos^2 y}} = \frac{1}{1 + \tan^2 y} = \frac{1}{1 + x^2}$

(2) $(\log_a x)' = \frac{dy}{dx} = \frac{1}{\frac{dx}{dy}} = \frac{1}{(a^y)'} = \frac{1}{a^y \log a} = \frac{1}{x \log a}$

問2 (1) $(\{f(x)\}^n)' = n\{f(x)\}^{n-1} \times f'(x)$

(2) $(\log(f(x)))' = \frac{f'(x)}{f(x)}$

(3) $(e^{f(x)})' = e^{f(x)} \times f'(x)$

(4) $(\sin(f(x)))' = \cos(f(x)) \times f'(x)$

(5) $(\cos(f(x)))' = -\sin(f(x)) \times f'(x)$

(6) $(\tan(f(x)))' = \frac{f'(x)}{\cos^2(f(x))}$

< 12 ページ , 微分の復習 5 >

解答 問 $f'(x) = 12x^3 - 48x^2 + 36x$
 $= 12(x^2 - 4x + 3)$
 $= 12(x - 1)(x - 3)$

$$f(4) = 40 \quad , \quad f'(4) = 144$$

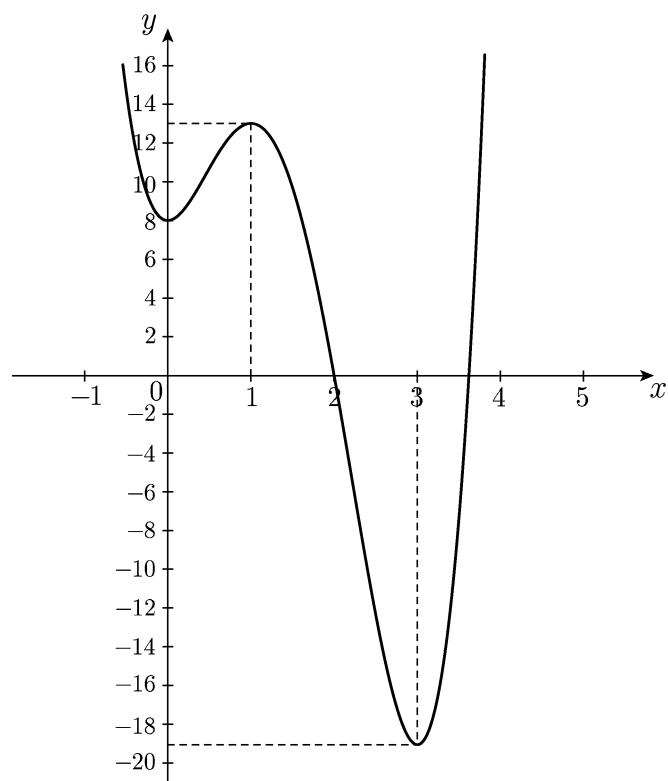
$$f(3) = -19 \quad , \quad f'(3) = 0$$

$$f(2) = 0 \quad , \quad f'(2) = -24$$

$$f(1) = 13 \quad , \quad f'(1) = 0$$

$$f(0) = 8 \quad , \quad f'(0) = 0$$

$$f(-1) = 45 \quad , \quad f'(-1) = -96$$

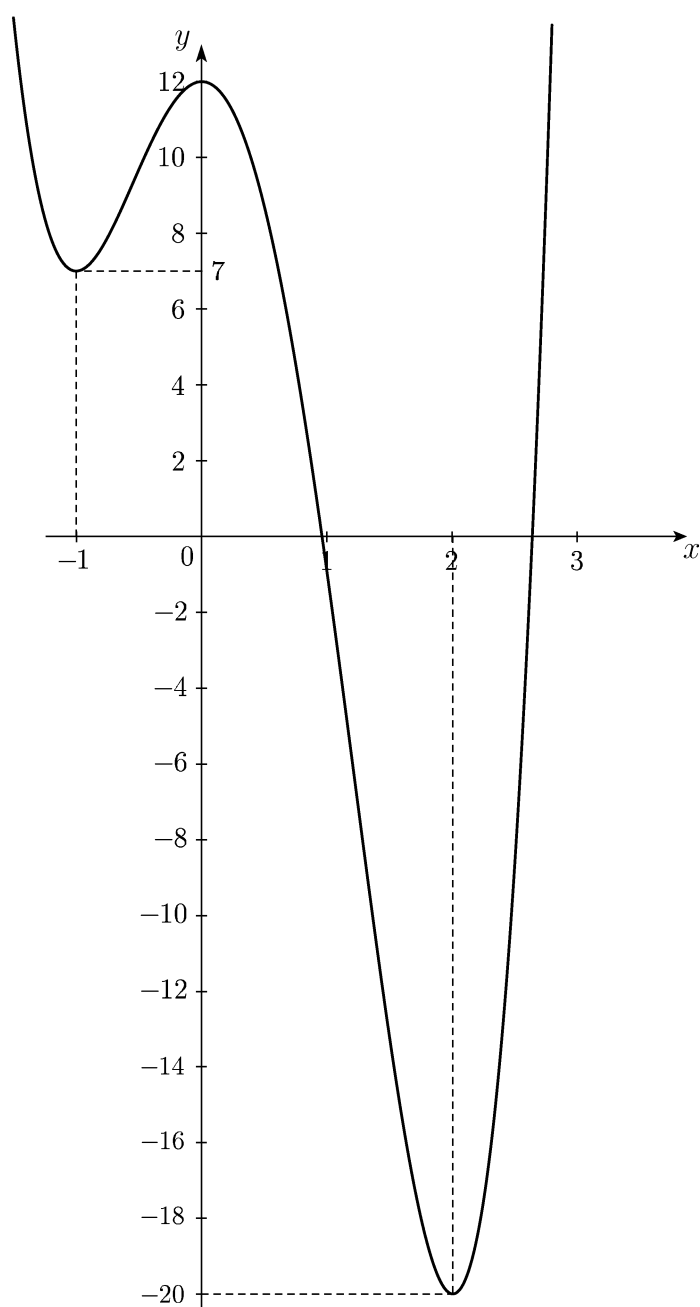


< 13 ページ , 微分の復習 6 >

解答 問

x	...	-1	...	0	...	2	...
y'	-	0	+	0	-	0	+
y	↘	7	↗	12	↘	-20	↗

$x = 0$ のとき極大値 $y = 12$
 $x = 2$ のとき極小値 $y = -20$
 $x = -1$ のとき極小値 $y = 7$



< 14 ページ , 接線の方程式 >

解答 問1 $y = m(x - a) + b$

問2 $y' = 2x + 1$
 $x = 1$ のとき $y' = 2 + 1 = 3$

接線 $y' = 3(x - 1) + 2 = 3x - 1$

問3 $y = f'(a)(x - a) + b$

< 15 ページ , 関数の一次近似 >

解答 問 $f(x) = \sqrt{x}$, $f'(x) = \frac{1}{2\sqrt{x}}$

$$x \doteq a \text{ のとき } \sqrt{x} \doteq \sqrt{a} + \frac{1}{2\sqrt{a}}(x - a)$$

$$x = 1.1 , a = 1 \quad \sqrt{1.1} \doteq \sqrt{1} + \frac{1}{2\sqrt{1}}(1.1 - 1) = 1 + \frac{1}{2} \times 0.1 = 1.05$$

< 16 ページ , 高階導関数 >

解答 問1

(1) $f(x) = 3x^2 - x + 1$	(2) $f(x) = \cos x$	(3) $f(x) = \log x$
$f'(x) = 6x - 1$	$f'(x) = -\sin x$	$f'(x) = \frac{1}{x}$
$f''(x) = 6$	$f''(x) = -\cos x$	$f''(x) = -\frac{1}{x^2}$

問2

(1) $f(x) = 2x^4 + x^3 + 3x$	(2) $f(x) = \sin x$
$f'(x) = 8x^3 + 3x^2 + 3$	$f'(x) = \cos x$
$f''(x) = 24x^2 + 6x$	$f''(x) = -\sin x$
$f'''(x) = 48x + 6$	$f'''(x) = -\cos x$
(3) $f(x) = 3x \log x$	(4) $f(x) = e^{3x}$
$f'(x) = 3 \log x + 3$	$f'(x) = 3e^{3x}$
$f''(x) = \frac{3}{x}$	$f''(x) = 9e^{3x}$
$f'''(x) = -\frac{3}{x^2}$	$f'''(x) = 27e^{3x}$

< 17 ページ , グラフの凹凸1 >

解答 問

(1) $y = x^3 + 3x$
 $y' = 3x^2 + 3$
 $y'' = 6x$

x	...	0	...
y''	-	0	+
y	凸	0	凹

(2) $y = -x^4 + 4x^3 - 15$
 $y' = -4x^3 + 12x^2$
 $y'' = -12x^2 + 24x$
 $= -12x(x - 2)$

x	...	0	...	2	...
y''	-	0	+	0	-
y	凸	-15	凹	1	凸

< 19 ページ , グラフの凹凸3 >

解答 問 (解)

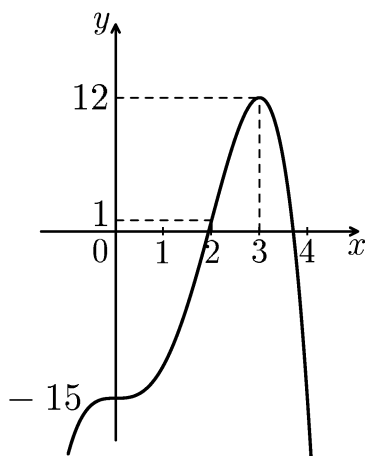
$$y' = -4x^3 + 12x^2$$

$$= -4x^2(x - 3)$$

$$y'' = -12x^2 + 24x$$

$$= -12x(x - 2)$$

x	...	0	...	2	...	3	...
y'	+	0	+	+	+	0	-
y''	-	0	+	0	-	-	-
y	↷	-15	↶	1	↷	12	↶



< 20 ページ , ロピタル定理 1 >

解答 問 (1) $\lim_{x \rightarrow 0} \frac{\log(1+x)}{x} = \lim_{x \rightarrow 0} \frac{\frac{1}{1+x}}{1} = 1$

(2) $\lim_{x \rightarrow 0} \frac{\sin x}{x} = \lim_{x \rightarrow 0} \frac{\cos x}{1} = 1$

(3) $\lim_{x \rightarrow 0} \frac{x - \sin x}{x^3} = \lim_{x \rightarrow 0} \frac{1 - \cos x}{3x^2} = \lim_{x \rightarrow 0} \frac{\sin x}{6x} = \lim_{x \rightarrow 0} \frac{\cos x}{6} = \frac{1}{6}$

< 21 ページ , ロピタル定理 2 >

解答 問 (1)
$$\lim_{x \rightarrow a} \frac{f(x) - f(a) - f'(a)(x-a) - \frac{1}{2}f''(a)(x-a)^2}{(x-a)^3}$$
$$= \lim_{x \rightarrow a} \frac{f'(x) - f'(a) - f''(a)(x-a)}{3(x-a)^2}$$
$$= \lim_{x \rightarrow a} \frac{f''(x) - f''(a)}{6(x-a)} = \lim_{x \rightarrow a} \frac{f'''(x)}{6} = \frac{f'''(a)}{6}$$

(2)
$$\lim_{x \rightarrow a} \frac{f(x) - f(a) - f'(a)(x-a) - \frac{1}{2}f''(a)(x-a)^2 - \frac{1}{6}f'''(a)(x-a)^3}{(x-a)^4}$$
$$= \lim_{x \rightarrow a} \frac{f'(x) - f'(a) - f''(a)(x-a) - \frac{1}{2}f''(a)(x-a)^2}{4(x-a)^3}$$
$$= \lim_{x \rightarrow a} \frac{f''(x) - f''(a) - f'''(a)(x-a)}{12(x-a)^2} = \lim_{x \rightarrow a} \frac{f'''(x) - f'''(a)}{24(x-a)} = \lim_{x \rightarrow a} \frac{f''''(x)}{24}$$
$$= \frac{f''''(a)}{24}$$

< 22 ページ , 関数の高次近似 >

解答 問 4 次近似式

$$x \doteq a \text{ のとき } f(x) \doteq f(a) + f'(a)(x - a) + \frac{1}{2}f''(a)(x - a)^2 \\ + \frac{1}{6}f'''(a)(x - a)^3 + \frac{1}{24}f^{(4)}(a)(x - a)^4$$

< 23 ページ , 高階微分係数 >

解答 問 (1) $f^{(4)}(x) = e^x$, $f^{(4)}(0) = e^0 = 1$

(2) $f^{(n)}(x) = e^x$, $f^{(n)}(0) = e^0 = 1$

(3) $f^{(1)}(x) = \cos x$, $f^{(2)}(x) = -\sin x$, $f^{(3)}(x) = -\cos x$, $f^{(4)}(x) = \sin x$
 $f^{(5)}(x) = \cos x$, $f^{(6)}(x) = -\sin x$, $f^{(7)}(x) = -\cos x$, $f^{(8)}(x) = \sin x$

$f^{(1)}(0) = 1$, $f^{(2)}(0) = 0$, $f^{(3)}(0) = -1$, $f^{(4)}(0) = 0$

$f^{(5)}(0) = 1$, $f^{(6)}(0) = 0$, $f^{(7)}(0) = -1$, $f^{(8)}(0) = 0$

< 25 ページ , 関数の n 近似 >

解答 問 $f^{(n)}(x) = e^x$, $f^{(n)}(a) = e^a$

$x = a$ のとき

$$e^x = e^a + e^a(x - a) + \frac{e^a}{2!}(x - a)^2 + \frac{e^a}{3!}(x - a)^3 + \cdots + \frac{e^a}{n!}(x - a)^n$$

< 26 ページ , テーラー展開 >

解答 問1 $e^x = e^a + e^a(x-a) + \frac{e^a}{2!}(x-a)^2 + \frac{e^a}{3!}(x-a)^3 + \frac{e^a}{4!}(x-a)^4 + \dots$
 $\dots + \frac{e^a}{n!}(x-a)^n + \dots$

問2 (1) $a = 1$

$$e^x = e + e(x-1) + \frac{e}{2!}(x-1)^2 + \frac{e}{3!}(x-1)^3 + \frac{e}{4!}(x-1)^4 + \dots$$
$$\dots + \frac{e}{n!}(x-1)^n + \dots$$

(2) $a = 0$

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \dots + \frac{x^n}{n!} + \dots$$

< 27 ページ , マクローリン展開 1 >

解答 問 $f(0) = \sin(0) = 0$, $f^{(1)}(0) = 1$, $f^{(2)}(0) = 0$, $f^{(3)}(0) = -1$, $f^{(4)}(0) = 0$
 $f^{(5)}(0) = 1$, $f^{(6)}(0) = 0$, $f^{(7)}(0) = -1$, $f^{(8)}(0) = 0$

$$\sin x = x - \frac{1}{3!}x^3 + \frac{1}{5!}x^5 - \frac{1}{7!}x^7 + \frac{1}{9!}x^9 - \frac{1}{11!}x^{11} + \dots$$

< 28 ページ , マクローリン展開 2 >

解答 問1 $e = e^1 \doteq 1 + 1 + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} = 2 + \frac{1}{2} + \frac{1}{6} + \frac{1}{24} = \frac{48 + 12 + 4 + 1}{24}$
 $= \frac{65}{24} \doteq 2.708$

問2 $\sin 1 \doteq 1 - \frac{1}{3!} = 1 - \frac{1}{6} = \frac{5}{6} \doteq 0.833$

< 30 ページ , 速度 2 >

解答 問 B地点からC地点の間は平均速度 $12 (m/s)$ であり
瞬間の速度も $12 (m/s)$ である。

< 31 ページ , 速度 3 >

解答 問1 (1) $x(t) = 20 + 10t - 5t^2$, $v(t) = 10 - 10t$

(2) $x(t) = 2 \sin(3t)$, $v(t) = 6 \cos(3t)$

(3) $x(t) = e^{3t} \cos(2t)$, $v(t) = 3e^{3t} \cos(2t) - 2e^{3t} \sin(2t)$

問2 (1) $v(t) = -9.8t + 9.8$

(2) $t = 1$

(3) $t = 1$ のとき $x(t) = -4.9 + 9.8 + 14.7 = 19.6$

(答) 19.6 (m)

< 33 ページ , 加速度 2 >

解答 問1 (1) $x(t) = 15 - 6t + 4t^2 - 5t^3$,

$$v(t) = -6 + 8t - 15t^2 \quad , \quad a(t) = 8 - 30t$$

(2) $x(t) = 3 \sin(2t)$,

$$v(t) = 6 \cos(2t) \quad , \quad a(t) = -12 \sin(2t)$$

(3) $x(t) = e^{3t} \cos(4t)$,

$$v(t) = 3e^{3t} \cos(4t) - 4e^{3t} \sin(4t) \quad , \quad a(t) = -7e^{3t} \cos(4t) - 24e^{3t} \sin(4t)$$

問2 $v(t) = -6 \sin(2t)$

$$a(t) = -12 \cos(2t) = -4 \times 3 \cos(2t) = -4x(t)$$

< 34 ページ , 等速円運動 1 >

解答 問 (1) ω (rad/s)

$$(2) x(t) = r \cos(\omega t + \alpha)$$

$$y(t) = r \sin(\omega t + \alpha)$$

< 35 ページ , 等速円運動 2 >

解答 問 (1) $(x(t), y(t)) = (\cos(\omega t), \sin(\omega t))$

(2) ω

(3) $\frac{2\pi}{\omega}$

< 36 ページ , 単振動 1 >

解答 問 1 (例) ふりこ時計のふりこ

問 2 $x(t) = r \sin \left(\omega t + \alpha + \frac{\pi}{2} \right)$

< 37 ページ , 単振動 2 >

解答 問 (1) $y(t) = 5 \cos(2t)$

$$v(t) = -10 \sin(2t)$$

$$a(t) = -20 \cos(2t) = -4 \times 5 \cos(2t) = -4y(t)$$

(2) $y(t) = 3 \sin(\pi t)$

$$v(t) = 3\pi \cos(\pi t)$$

$$a(t) = -3\pi^2 \sin(\pi t) = -\pi^2 y(t)$$

< 38 ページ , 単振動 3 >

解答 問 (1) $y'(t) = -\omega C_2 \sin(\omega t + \alpha)$

$$y''(t) = -\omega^2 C_2 \cos(\omega t + \alpha) = -\omega^2 y(t)$$

$$(2) u''(t) = y''(t) + x''(t)$$

$$= -\omega^2 y(t) - \omega^2 x(t)$$

$$= -\omega^2 (y(t) + x(t)) = -\omega^2 u(t)$$

< 39 ページ , 減衰振動 1 >

解答 問 (1) $y(t) = -e^{-2t} \sin(3t)$

$$y'(t) = -2e^{-2t} \sin(3t) + 3e^{-2t} \cos(3t)$$

$$\begin{aligned} y''(t) &= 4e^{-2t} \sin(3t) - 6e^{-2t} \cos(3t) - 6e^{-2t} \cos(3t) - 9e^{-2t} \sin(3t) \\ &= -5e^{-2t} \sin(3t) - 12e^{-2t} \cos(3t) \end{aligned}$$

(2) $y(t) = -e^{-2t} \cos(3t)$

$$y'(t) = -2e^{-2t} \cos(3t) - 3e^{-2t} \sin(3t)$$

$$\begin{aligned} y''(t) &= 4e^{-2t} \cos(3t) + 6e^{-2t} \sin(3t) + 6e^{-2t} \sin(3t) - 9e^{-2t} \cos(3t) \\ &= -5e^{-2t} \cos(3t) + 12e^{-2t} \sin(3t) \end{aligned}$$

(3) $y(t) = -e^{-2t} \cos(15t)$

$$y'(t) = -2e^{-2t} \cos(15t) - 15e^{-2t} \sin(15t)$$

$$\begin{aligned} y''(t) &= 4e^{-2t} \cos(15t) + 30e^{-2t} \sin(15t) + 30e^{-2t} \sin(15t) - 225e^{-2t} \cos(15t) \\ &= -221e^{-2t} \cos(15t) + 60e^{-2t} \sin(15t) \end{aligned}$$

< 40 ページ , 減衰振動 2 >

解答 問 (1) $y(t) = e^{-2t} \sin(3t)$, $y''(t) = -13y(t) - 4y'(t)$

(2) $y(t) = e^{-2t} \cos(3t)$, $y''(t) = -13y(t) - 4y'(t)$

(3) $y(t) = e^{-2t} \cos(15t)$, $y''(t) = -229y(t) - 4y'(t)$