

CHAPTER 05 적분

SECTION 5.1 정적분

유제 5-1

$$A = \lim_{n \rightarrow \infty} \frac{\pi}{n} \sum_{k=1}^n \tan \frac{k\pi}{4n}$$

유제 5-2

$$\int_0^1 \sqrt{\pi} \sin^2(\pi x) dx$$

유제 5-3

$$7$$

유제 5-4

$$\frac{9}{2}\pi$$

유제 5-5

$$1 + \frac{\pi}{4}$$

유제 5-6

$$0 \leq \int_1^{\sqrt{e}} \ln(x^2) dx \leq \sqrt{e} - 1$$

5.1 연습문제

01

$$\int_2^7 (5x^3 + 4x) dx$$

02

$$\int_0^1 \frac{1}{1+x} dx$$

03

$$\int_0^1 \sqrt{2x} dx$$

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04

$$\int_0^1 x^3 dx$$

05

$$\int_0^1 x e^x dx$$

06

$$\int_0^1 (x^4 + x^2) dx$$

07

48

08

27

09

증명 생략

10

π

11

$$\frac{9\pi}{2}$$

12

$$\pi \times \frac{1}{2} = \frac{\pi}{2}$$

13

21

14

2

15

0

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SECTION 5.2 미분적분학의 기본정리

유제 5-7

$$\frac{2^x}{\ln x} - 4 \sec x + C$$

유제 5-8

$$-x + 2 \tan^{-1} x + C$$

유제 5-9

$$\sin(x^2) \cos(x^3)$$

유제 5-10

$$3x^2 \sqrt{1+x^6} - 2x \sqrt{1+x^4}$$

유제 5-11

$$1$$

유제 5-12

$$5$$

유제 5-13

$$c = \sqrt{3}$$

5.2 연습문제

01

$$\frac{1}{2}x^4 + \frac{1}{2}x^2 + \frac{1}{3}x + C$$

02

$$\frac{4}{3}x\sqrt{x} - \ln|x| + C$$

03

$$\frac{-2}{\sqrt{x}} + \frac{1}{x} + C$$

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04

$$\frac{1}{6}x^6 + x^3 + C$$

05

$$\frac{1}{3}x^3 + 2x - 4\ln|x| + C$$

06

$$\frac{1}{3}x^3 - \frac{1}{2}x^2 + x + C$$

07

$$\frac{1}{4}x^4 - \frac{2}{3}x^3 + 2x^2 - 8x + C$$

08

$$\frac{3}{11}x^{\frac{11}{3}} + \frac{6}{13}x^{\frac{13}{6}} - 3x^{\frac{2}{3}} + C$$

09

$$\tan x + \cot x + C$$

10

$$-e^{-x} + 2e^{2x} + C$$

11

$$\frac{4^x}{\ln 4} - \frac{2^{x+1}}{\ln 2} + x + C$$

12

$$\sec x - \csc x + C$$

13

$$-\frac{1}{3}x^{-3} - \sin^{-1}x + C \text{ 또는 } -\frac{1}{3}x^{-3} + \cos^{-1}x + C$$

14

$$x + 2\tan^{-1}x + C$$

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15

$$\ln|x| - \sec^{-1}x + C \text{ 또는 } \ln|x| + \csc^{-1}x + C$$

16

$$\frac{1}{3}x^3 - \sec^{-1}x + C \text{ 또는 } \frac{1}{3}x^3 + \csc^{-1}x + C$$

17

$$3x^2 \cos^2(x^3)$$

18

$$-3x^2 + 4x - 1$$

19

$$4x^7 \cos(x^4) - \frac{1}{2} \cos(\sqrt{x})$$

20

$$3^x \ln 3 \sqrt{1+3^x} - \frac{\sqrt{1+\ln x}}{x}$$

21

$$1$$

22

$$\frac{\pi}{2}$$

23

$$c = \frac{3}{\sqrt[3]{4}}$$

24

$$c = \frac{16}{9}$$

25

$$c = 4\sqrt[3]{\frac{4}{25}}$$

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SECTION 5.3 치환적분법

유제 5-14

$$-\frac{1}{3(x^3 + 3x + 2)} + C$$

유제 5-15

$$\frac{1}{3} \tan(3x + 1) + C$$

유제 5-16

$$\frac{1}{\cos x} + C$$

유제 5-17

$$\frac{2}{3}(1 + x^3)\sqrt{1 + x^3} - 2\sqrt{1 + x^3} + C$$

유제 5-18

$$\ln |\ln x| + C$$

유제 5-19

$$\frac{1}{2}$$

유제 5-20

$$\frac{26}{3}$$

유제 5-21

(a) 2

(b) 0

5.3 연습문제

01

$$\frac{1}{18}(2x + 1)^9 + C$$

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02

$$-\frac{1}{3} \ln |1-3x| + C$$

03

$$-\frac{1}{12} (1-2x)^6 + C$$

04

$$\frac{2}{15} (6x+2)^{\frac{5}{4}} + C$$

05

$$-\frac{1}{4} \cos 4x + C$$

06

$$-2 \tan \left(-\frac{1}{2} x \right) + C$$

07

$$-\frac{1}{2} \cot(1+2x) + C$$

08

$$\frac{1}{3} \sec(3x+1) + C$$

09

$$\frac{1}{18} (x^3-1)^6 + C$$

10

$$\frac{1}{8} (x^2+4x+3)^4 + C$$

11

$$\frac{1}{12} (x^2-1)^6 + \frac{1}{10} (x^2-1)^5 + C$$

12

$$\frac{1}{16} (x^2+1)^8 - \frac{1}{7} (x^2+1)^7 + \frac{1}{12} (x^2+1)^6 + C$$

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13

$$\frac{2}{5}(x+1)^2\sqrt{x+1} - \frac{2}{3}(x+1)\sqrt{x+1} + C$$

14

$$\frac{1}{5}(x^2-1)^2\sqrt{x^2-1} + \frac{1}{3}(x^2-1)\sqrt{x^2-1} + C$$

15

$$\frac{3}{8}(x^2+2x+2)\sqrt[3]{x^2+2x+2} + C$$

16

$$-\frac{2}{5}(\cos x + 1)^2\sqrt{\cos x + 1} + C$$

17

$$\frac{1}{2}\ln|2+e^{2x}| + C$$

18

$$2\ln|\sin x - 2| + C$$

19

$$\sqrt{2x+1} + C$$

20

$$\frac{4}{9}(x^3+2)^{\frac{3}{4}} + C \quad (2022-05-27 \text{ updated})$$

21

$$1 \quad (2022-06-13 \text{ updated})$$

22

$$\frac{70}{27}$$

23

$$\frac{1}{90}$$

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24

$$\frac{1}{2}$$

25

$$\frac{\pi^2}{32}$$

26

$$0$$

27

$$\frac{2\sqrt{2}}{3}$$

28

$$\frac{10}{3}$$

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SECTION 5.4 부분적분법

유제 5-22

$$-\frac{2x+1}{2}\cos(2x) + \frac{1}{2}\sin(2x) + C$$

유제 5-23

$$2x^2\ln(2x) - x^2 + C$$

유제 5-24

$$\frac{1}{3}(2x+1)e^{3x} - \frac{2}{9}e^{3x} + C$$

유제 5-25

$$\frac{1}{5}e^{2x}(2\sin x - \cos x) + C$$

유제 5-26

$$\frac{1}{2}\left(\frac{\pi}{2} - 1\right)$$

5.4 연습문제

01

$$-x\cos x + \sin x + C$$

02

$$\frac{x}{2}e^{2x} - \frac{1}{4}e^{2x} + C$$

03

$$-x^2\cos x + 2x\sin x + 2\cos x + C$$

04

$$\frac{1}{2}x^2e^{2x} - \frac{1}{2}xe^{2x} + \frac{1}{4}e^{2x} + C$$

05

$$\frac{1}{2}(x-1)^2\ln x - \frac{1}{4}x^2 + x - \frac{1}{2}\ln|x| + C$$

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06

$$\frac{1}{3}x^3 \ln x - \frac{1}{9}x^3 + C$$

07

$$x \cos^{-1} x - \sqrt{1-x^2} + C$$

08

$$x \tan^{-1} x - \frac{1}{2} \ln(1+x^2) + C$$

09

$$\frac{1}{a^2 + b^2} e^{ax} \{a \sin(bx) - b \cos(bx)\} + C$$

10

$$\frac{1}{a^2 + b^2} e^{ax} \{a \cos(bx) + b \sin(bx)\} + C$$

11

$$\frac{1}{2}$$

12

$$\frac{1}{2}$$

13

증명 생략

14

$$x(\ln x)^3 - 3x(\ln x)^2 + 6x \ln x - 6x + C$$

15

증명 생략

16

$$\frac{1}{2} \tan^2 x + \ln |\cos x| + C$$

17

$$-3$$

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SECTION 5.5 정적분의 엄밀한 정의

유제 5-27

4.705

5.5 연습문제

01

$$\int_1^3 x^3 dx$$

02

$$\int_0^4 \frac{x}{2+x} dx$$

03

60