

Integration by Substitution ... Set 3

In problems 1 through 13, find the indicated integral. Check your answers by differentiation.

1. $\int x^5 dx$
2. $\int x^{\frac{3}{4}} dx$
3. $\int \frac{1}{x^2} dx$
4. $\int 5 dx$
5. $\int (x^{\frac{1}{2}} - 3x^{\frac{2}{3}} + 6) dx$
6. $\int (3\sqrt{x} - \frac{2}{x^3} + \frac{1}{x}) dx$
7. $\int (\frac{e^x}{2} + x\sqrt{x}) dx$
8. $\int (\sqrt{x^3} - \frac{1}{2\sqrt{x}} + \sqrt{2}) dx$
9. $\int (\frac{1}{3x} - \frac{3}{2x^2} + e^2 + \frac{\sqrt{x}}{2}) dx$
10. $\int \frac{x^2+2x+1}{x^2} dx$
11. $\int x^3 (2x + \frac{1}{x}) dx$
12. $\int \sqrt{x}(x^2 - 1) dx$
13. $\int x(2x + 1)^2 dx$

14. Find the function whose tangent has slope $4x + 1$ for each value of x and whose graph passes through the point $(1, 2)$.
15. Find the function whose tangent has slope $3x^2 + 6x - 2$ for each value of x and whose graph passes through the point $(0, 6)$.
16. Find a function whose graph has a relative minimum when $x = 1$ and a relative maximum when $x = 4$.
17. It is estimated that t months from now the population of a certain town will be changing at the rate of $4 + 5t^{\frac{2}{3}}$ people per month. If the current population is 10000, what will the population be 8 months from now?
18. An environmental study of a certain community suggests that t years from now the level of carbon monoxide in the air will be changing at the rate of $0.1t + 0.1$ parts per million per year. If the current level of carbon monoxide in the air is 3.4 parts per million, what will the level be 3 years from now?

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Answers

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

2. $\frac{4}{7}x^{\frac{7}{4}} + C$

3. $-\frac{1}{x} + C$

4. $5x + C$

5. $\frac{2}{3}x^{\frac{3}{2}} - \frac{9}{5}x^{\frac{5}{3}} + 6x + C$

6. $2x^{\frac{3}{2}} + \frac{1}{x^2} + \ln|x| + C$

7. $\frac{1}{2}e^x + \frac{2}{5}x^{\frac{5}{2}} + C$

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

9. $\frac{1}{3}\ln|x| + \frac{3}{2x} + e^2x + \frac{1}{3}x^{\frac{3}{2}} + C$

10. $x - \frac{1}{x} + 2\ln x + C$

11. $\frac{2}{5}x^5 + \frac{1}{3}x^3 + C$

12. $\frac{2}{7}x^{\frac{7}{2}} - \frac{2}{3}x^{\frac{3}{2}} + C$

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

14. $f(x) = 2x^2 + x - 1$

15. $f(x) = x^3 + 3x^2 - 2x + 6$

16. $f(x) = \frac{1}{3}x^3 - \frac{5}{2}x^2 + 4x$; not unique

17. 10128

18. 4.15 parts per million

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19. After its brakes are applied, a certain car decelerates at the constant rate of 6 meters per second per second. If the car is traveling at 108 kilometers per hour when the brakes are applied, how far does it travel before coming to a complete stop? (Note: 108 kmph is the same as 30 mps.)
20. Suppose a certain car supplies a constant deceleration of A meters per second per second. If it is traveling at 90 kilometers per hour (25 meters per second) when the brakes are applied, its stopping distance is 50 meters.
- What is A ?
 - What would the stopping distance have been if the car had been traveling at only 54 kilometers per hour when the brakes were applied?
 - At what speed is the car traveling when the brakes are applied if the stopping distance is 56 meters?

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Answers

19. 75 meters

20. (a) $A = 6.25$

(b) 42 meters

(c) 120.37 kilometers per hour