

50 multiple-choice questions

Question 1 (Level 1) — *Antiderivative of x*

Find $\int x^2 dx$.

- (A) $\frac{x^3}{3} + c$
- (B) $\frac{x^3}{2} + c$
- (C) $2x + c$
- (D) $x^3 + c$

Question 2 (Level 1) — *Antiderivative of x*

Find $\int x dx$.

- (A) $\frac{x^2}{2} + c$
- (B) $x^2 + c$
- (C) $1 + c$
- (D) $\frac{x^2}{3} + c$

Question 3 (Level 1) — *Antiderivative of constant*

Find $\int 5 dx$.

- (A) $5x + c$
- (B) $5 + c$
- (C) $\frac{5x^2}{2} + c$
- (D) $0 + c$

Question 4 (Level 1) — *Antiderivative of $3x$*

Find $\int 3x^2 dx$.

- (A) $x^3 + c$
- (B) $3x^3 + c$
- (C) $\frac{3x^3}{2} + c$
- (D) $6x + c$

Question 5 (Level 1) — *Antiderivative of x*

Find $\int x^3 dx$.

- (A) $\frac{x^4}{4} + c$
- (B) $\frac{x^4}{3} + c$

(C) $3x^2 + c$

(D) $x^4 + c$

Question 6 (Level 1) — *Antiderivative of $2x + 1$* Find $\int (2x + 1) dx$.

(A) $x^2 + x + c$

(B) $x^2 + 1 + c$

(C) $2x^2 + x + c$

(D) $x^2 + c$

Question 7 (Level 1) — *Antiderivative of $4x$* Find $\int 4x^3 dx$.

(A) $x^4 + c$

(B) $4x^4 + c$

(C) $12x^2 + c$

(D) $\frac{x^4}{4} + c$

Question 8 (Level 1) — *Sum of terms*Find $\int (x^2 + x) dx$.

(A) $\frac{x^3}{3} + \frac{x^2}{2} + c$

(B) $\frac{x^3}{3} + x^2 + c$

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

(D) $2x + 1 + c$

Question 9 (Level 1) — *Antiderivative of 1*Find $\int 1 dx$.

(A) $x + c$

(B) $0 + c$

(C) $1 + c$

(D) $\frac{x^2}{2} + c$

Question 10 (Level 1) — *Meaning of $+ c$* Why do we add $+c$ when finding an antiderivative?

(A) Because any constant has derivative zero, giving a family of solutions

- (B) Because the integral is always positive
- (C) Because c represents the coefficient
- (D) It is optional and can be omitted

Question 11 (Level 2) — *Negative power*Find $\int x^{-2} dx$.

- (A) $-\frac{1}{x} + c$
- (B) $\frac{1}{x} + c$
- (C) $-\frac{1}{x^2} + c$
- (D) $\ln|x| + c$

Question 12 (Level 2) — *Fractional power*Find $\int \sqrt{x} dx$.

- (A) $\frac{2x^{3/2}}{3} + c$
- (B) $\frac{x^{3/2}}{3} + c$
- (C) $\frac{1}{2\sqrt{x}} + c$
- (D) $\frac{2\sqrt{x}}{3} + c$

Question 13 (Level 2) — *Polynomial integration*Find $\int (3x^2 - 4x + 1) dx$.

- (A) $x^3 - 2x^2 + x + c$
- (B) $x^3 - 4x^2 + x + c$
- (C) $3x^3 - 2x^2 + x + c$
- (D) $x^3 - 2x^2 + c$

Question 14 (Level 2) — *Finding c* If $f'(x) = 2x$ and $f(1) = 3$, find $f(x)$.

- (A) $f(x) = x^2 + 2$
- (B) $f(x) = x^2 + 3$
- (C) $f(x) = x^2 + 1$
- (D) $f(x) = 2x + 1$

Question 15 (Level 2) — *Antiderivative of $1/x$* Find $\int \frac{3}{x^2} dx$.

- (A) $-\frac{3}{x} + c$
- (B) $\frac{3}{x} + c$
- (C) $3 \ln |x| + c$
- (D) $-\frac{6}{x^3} + c$

Question 16 (Level 2) — *Integrate $1/x$* Find $\int \frac{1}{\sqrt{x}} dx$.

- (A) $2\sqrt{x} + c$
- (B) $\sqrt{x} + c$
- (C) $-\frac{1}{2\sqrt{x}} + c$
- (D) $\frac{\sqrt{x}}{2} + c$

Question 17 (Level 2) — *Expand then integrate*Find $\int (x+1)^2 dx$.

- (A) $\frac{x^3}{3} + x^2 + x + c$
- (B) $\frac{(x+1)^3}{3} + c$
- (C) $\frac{x^3}{3} + 2x + c$
- (D) $x^3 + x^2 + x + c$

Question 18 (Level 2) — *Particular solution*If $\frac{dy}{dx} = 3x^2 + 2$ and $y = 5$ when $x = 0$, find y .

- (A) $y = x^3 + 2x + 5$
- (B) $y = x^3 + 2x + 2$
- (C) $y = 3x^3 + 2x + 5$
- (D) $y = x^3 + x^2 + 5$

Question 19 (Level 2) — *Velocity to position*A particle's velocity is $v = 4t - 2$. If its position $x = 0$ at $t = 0$, find $x(t)$.

- (A) $x = 2t^2 - 2t$
- (B) $x = 4t^2 - 2t$
- (C) $x = 2t^2 - t$
- (D) $x = t^2 - 2t$

Question 20 (Level 2) — *Coefficient matching*Find $\int (6x^2 - 2x + 4) dx$.

- (A) $2x^3 - x^2 + 4x + c$
- (B) $6x^3 - x^2 + 4x + c$
- (C) $2x^3 - 2x^2 + 4x + c$
- (D) $2x^3 - x^2 + 4 + c$

Question 21 (Level 3) — *Antiderivative of e* Find $\int e^x dx$.

- (A) $e^x + c$
- (B) $xe^{x-1} + c$
- (C) $\frac{e^{x+1}}{x+1} + c$
- (D) e^x

Question 22 (Level 3) — *Antiderivative of $1/x$* Find $\int \frac{1}{x} dx$ for $x > 0$.

- (A) $\ln(x) + c$
- (B) $-\frac{1}{x^2} + c$
- (C) $x^0 + c$
- (D) $\frac{x^0}{0} + c$

Question 23 (Level 3) — *Antiderivative of $\sin(x)$* Find $\int \sin(x) dx$.

- (A) $-\cos(x) + c$
- (B) $\cos(x) + c$
- (C) $-\sin(x) + c$
- (D) $\tan(x) + c$

Question 24 (Level 3) — *Antiderivative of $\cos(x)$* Find $\int \cos(x) dx$.

- (A) $\sin(x) + c$
- (B) $-\sin(x) + c$
- (C) $\cos(x) + c$
- (D) $-\cos(x) + c$

Question 25 (Level 3) — *Antiderivative of e* Find $\int e^{2x} dx$.

- (A) $\frac{e^{2x}}{2} + c$
- (B) $2e^{2x} + c$
- (C) $e^{2x} + c$
- (D) $\frac{e^{2x+1}}{2x+1} + c$

Question 26 (Level 3) — *Antiderivative of $\sin(2x)$* Find $\int \sin(2x) dx$.

- (A) $-\frac{\cos(2x)}{2} + c$
- (B) $-2\cos(2x) + c$
- (C) $\frac{\cos(2x)}{2} + c$
- (D) $-\cos(2x) + c$

Question 27 (Level 3) — *Linear substitution*Find $\int (3x+1)^4 dx$.

- (A) $\frac{(3x+1)^5}{15} + c$
- (B) $\frac{(3x+1)^5}{5} + c$
- (C) $\frac{(3x+1)^5}{3} + c$
- (D) $\frac{3(3x+1)^5}{5} + c$

Question 28 (Level 3) — *Antiderivative of e^{-x}* Find $\int e^{-x} dx$.

- (A) $-e^{-x} + c$
- (B) $e^{-x} + c$
- (C) $\frac{e^{-x}}{-x} + c$
- (D) $-xe^{-x} + c$

Question 29 (Level 3) — *Mixed integral*Find $\int (e^x + \frac{1}{x}) dx$ for $x > 0$.

- (A) $e^x + \ln(x) + c$
- (B) $e^x - \frac{1}{x^2} + c$
- (C) $e^x + \frac{1}{x} + c$

(D) $xe^x + \ln(x) + c$

Question 30 (Level 3) — *Particular solution with e*

If $f'(x) = e^x$ and $f(0) = 2$, find $f(x)$.

(A) $f(x) = e^x + 1$

(B) $f(x) = e^x + 2$

(C) $f(x) = e^x$

(D) $f(x) = 2e^x$

Question 31 (Level 4) — *Integrate $\cos(3x)$*

Find $\int \cos(3x) dx$.

(A) $\frac{\sin(3x)}{3} + c$

(B) $3\sin(3x) + c$

(C) $-\frac{\sin(3x)}{3} + c$

(D) $\sin(3x) + c$

Question 32 (Level 4) — *Integrate $1/(2x+1)$*

Find $\int \frac{1}{2x+1} dx$ for $x > -\frac{1}{2}$.

(A) $\frac{1}{2} \ln(2x+1) + c$

(B) $\ln(2x+1) + c$

(C) $2 \ln(2x+1) + c$

(D) $\frac{1}{2} \ln(x) + c$

Question 33 (Level 4) — *Integrate e^{3x+1}*

Find $\int e^{3x+1} dx$.

(A) $\frac{e^{3x+1}}{3} + c$

(B) $3e^{3x+1} + c$

(C) $e^{3x+1} + c$

(D) $\frac{e^{3x}}{3} + c$

Question 34 (Level 4) — *Integrate $\sin(x)$*

Find $\int \sin(\pi x) dx$.

(A) $-\frac{\cos(\pi x)}{\pi} + c$

(B) $-\pi \cos(\pi x) + c$

- (C) $\frac{\cos(\pi x)}{\pi} + c$
(D) $-\cos(\pi x) + c$

Question 35 (Level 4) — *Rewrite then integrate*

Find $\int \frac{x^2+1}{x} dx$ for $x > 0$.

- (A) $\frac{x^2}{2} + \ln(x) + c$
(B) $\frac{x^2}{2} + \frac{1}{x} + c$
(C) $x + \ln(x) + c$
(D) $\frac{x^2}{2} - \ln(x) + c$

Question 36 (Level 4) — *Integrate $(2x+3)$*

Find $\int (2x+3)^5 dx$.

- (A) $\frac{(2x+3)^6}{12} + c$
(B) $\frac{(2x+3)^6}{6} + c$
(C) $\frac{(2x+3)^6}{2} + c$
(D) $\frac{5(2x+3)^4}{2} + c$

Question 37 (Level 4) — *Second antiderivative*

If $f''(x) = 6x$, $f'(0) = 2$, and $f(0) = 1$, find $f(x)$.

- (A) $f(x) = x^3 + 2x + 1$
(B) $f(x) = 3x^2 + 2x + 1$
(C) $f(x) = x^3 + x + 1$
(D) $f(x) = x^3 + 2x + 2$

Question 38 (Level 4) — *Integrate $3/(x-2)$*

Find $\int \frac{3}{x-2} dx$ for $x > 2$.

- (A) $3 \ln(x-2) + c$
(B) $\frac{3}{(x-2)^2} + c$
(C) $3 \ln(x) - 6 + c$
(D) $\ln(x-2)^3 + c$

Question 39 (Level 4) — *Particular solution trig*

If $f'(x) = \cos(x)$ and $f(\frac{\pi}{2}) = 0$, find $f(x)$.

- (A) $f(x) = \sin(x) - 1$
- (B) $f(x) = \sin(x) + 1$
- (C) $f(x) = \cos(x) - 1$
- (D) $f(x) = \sin(x)$

Question 40 (Level 4) — *Integrate $(3x+2)$*

Find $\int \sqrt{3x+2} \, dx$.

- (A) $\frac{2(3x+2)^{3/2}}{9} + c$
- (B) $\frac{(3x+2)^{3/2}}{3} + c$
- (C) $\frac{3(3x+2)^{3/2}}{2} + c$
- (D) $\frac{2\sqrt{3x+2}}{3} + c$

Question 41 (Level 5) — *Integrate xe*

Using integration by parts, find $\int xe^x \, dx$.

- (A) $e^x(x-1) + c$
- (B) $xe^x + c$
- (C) $e^x(x+1) + c$
- (D) $\frac{x^2 e^x}{2} + c$

Question 42 (Level 5) — *Integrate $\ln(x)$*

Find $\int \ln(x) \, dx$.

- (A) $x \ln(x) - x + c$
- (B) $\frac{1}{x} + c$
- (C) $x \ln(x) + c$
- (D) $x \ln(x) + x + c$

Question 43 (Level 5) — *Integrate xe*

Find $\int x^2 e^x \, dx$.

- (A) $e^x(x^2 - 2x + 2) + c$
- (B) $e^x(x^2 + 2x + 2) + c$
- (C) $e^x(x^2 - 2x) + c$
- (D) $x^2 e^x - 2e^x + c$

Question 44 (Level 5) — *Integrate $2x/(x+1)$*

Find $\int \frac{2x}{x^2+1} dx$.

- (A) $\ln(x^2 + 1) + c$
- (B) $\frac{1}{x^2+1} + c$
- (C) $2\ln(x^2 + 1) + c$
- (D) $\arctan(x) + c$

Question 45 (Level 5) — *Integrate $x\cos(x)$*

Find $\int x \cos(x) dx$.

- (A) $x \sin(x) + \cos(x) + c$
- (B) $x \sin(x) - \cos(x) + c$
- (C) $-x \sin(x) + \cos(x) + c$
- (D) $x \cos(x) + \sin(x) + c$

Question 46 (Level 5) — *Integrate $e^x \sin(x)$*

Find $\int e^x \sin(x) dx$.

- (A) $\frac{e^x(\sin x - \cos x)}{2} + c$
- (B) $e^x \sin(x) + c$
- (C) $\frac{e^x(\sin x + \cos x)}{2} + c$
- (D) $\frac{e^x \cos x}{2} + c$

Question 47 (Level 5) — *Partial fractions*

Find $\int \frac{1}{x^2-1} dx$.

- (A) $\frac{1}{2} \ln \left| \frac{x-1}{x+1} \right| + c$
- (B) $\ln |x^2 - 1| + c$
- (C) $\frac{1}{2} \ln |x^2 - 1| + c$
- (D) $\arctan(x) + c$

Question 48 (Level 5) — *Integrate $x/(x+1)$*

Find $\int \frac{x}{(x+1)^2} dx$.

- (A) $\ln |x + 1| + \frac{1}{x+1} + c$
- (B) $\ln |x + 1| - \frac{1}{x+1} + c$
- (C) $-\frac{x}{x+1} + c$

(D) $\frac{\ln|x|}{(x+1)} + c$

Question 49 (Level 5) — *Particular solution ODE*

If $f'(x) = \frac{f(x)}{x}$ and $f(1) = 2$, determine $f(x)$ for $x > 0$.

(A) $f(x) = 2x$

(B) $f(x) = x^2$

(C) $f(x) = 2 \ln(x)$

(D) $f(x) = e^{2x}$

Question 50 (Level 5) — *Integrate $x \ln(x)$*

Find $\int x \ln(x) dx$.

(A) $\frac{x^2}{2} \ln(x) - \frac{x^2}{4} + c$

(B) $\frac{x^2}{2} \ln(x) + \frac{x^2}{4} + c$

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

(D) $\frac{x^2 \ln(x)}{2} + c$

Solutions

Q1: (A)

$$\int x^2 dx = \frac{x^3}{3} + c.$$

Q2: (A)

$$\int x dx = \frac{x^2}{2} + c.$$

Q3: (A)

$$\int 5 dx = 5x + c.$$

Q4: (A)

$$\int 3x^2 dx = x^3 + c.$$

Q5: (A)

$$\int x^3 dx = \frac{x^4}{4} + c.$$

Q6: (A)

$$\int (2x + 1) dx = x^2 + x + c.$$

Q7: (A)

$$\int 4x^3 dx = x^4 + c.$$

Q8: (A)

$$\frac{x^3}{3} + \frac{x^2}{2} + c.$$

Q9: (A)

$$\int 1 dx = x + c.$$

Q10: (A)

Because any constant differentiates to 0, so there are infinitely many antiderivatives differing by a constant.

Q11: (A)

$$\int x^{-2} dx = -x^{-1} + c = -\frac{1}{x} + c.$$

Q12: (A)

$$\int x^{1/2} dx = \frac{x^{3/2}}{3/2} = \frac{2x^{3/2}}{3} + c.$$

Q13: (A)

$$x^3 - 2x^2 + x + c.$$

Q14: (A)

$$f(x) = x^2 + c. \quad f(1) = 1 + c = 3, \text{ so } c = 2. \quad f(x) = x^2 + 2.$$

Q15: (A)

$$\int 3x^{-2} dx = -\frac{3}{x} + c.$$

Q16: (A)

$$\int x^{-1/2} dx = \frac{x^{1/2}}{1/2} = 2\sqrt{x} + c.$$

Q17: (A)

$$\int (x^2 + 2x + 1) dx = \frac{x^3}{3} + x^2 + x + c.$$

Q18: (A)

$$y = x^3 + 2x + c. \quad 5 = 0 + 0 + c, \text{ so } c = 5. \quad y = x^3 + 2x + 5.$$

Q19: (A)

$$x = 2t^2 - 2t + c. \quad x(0) = 0 \Rightarrow c = 0. \quad x = 2t^2 - 2t.$$

Q20: (A)

$$2x^3 - x^2 + 4x + c.$$

Q21: (A)

$$\int e^x dx = e^x + c.$$

Q22: (A)

$$\int \frac{1}{x} dx = \ln(x) + c.$$

Q23: (A)

$$\int \sin(x) dx = -\cos(x) + c.$$

Q24: (A)

$$\int \cos(x) dx = \sin(x) + c.$$

Q25: (A)

$$\int e^{2x} dx = \frac{e^{2x}}{2} + c.$$

Q26: (A)

$$\int \sin(2x) dx = -\frac{\cos(2x)}{2} + c.$$

Q27: (A)

$$\int (3x+1)^4 dx = \frac{(3x+1)^5}{15} + c.$$

Q28: (A)

$$\int e^{-x} dx = -e^{-x} + c.$$

Q29: (A)

$$e^x + \ln(x) + c.$$

Q30: (A)

$$f(x) = e^x + c. \quad f(0) = 1 + c = 2, \text{ so } c = 1. \quad f(x) = e^x + 1.$$

Q31: (A)

$$\int \cos(3x) dx = \frac{\sin(3x)}{3} + c.$$

Q32: (A)

$$\int \frac{1}{2x+1} dx = \frac{1}{2} \ln(2x+1) + c.$$

Q33: (A)

$$\int e^{3x+1} dx = \frac{e^{3x+1}}{3} + c.$$

Q34: (A)

$$\int \sin(\pi x) dx = -\frac{\cos(\pi x)}{\pi} + c.$$

Q35: (A)

$$\int \left(x + \frac{1}{x}\right) dx = \frac{x^2}{2} + \ln(x) + c.$$

Q36: (A)

$$\int (2x+3)^5 dx = \frac{(2x+3)^6}{12} + c.$$

Q37: (A)

$$f'(x) = 3x^2 + c_1. \quad f'(0) = 2 \Rightarrow c_1 = 2. \quad f(x) = x^3 + 2x + c_2. \quad f(0) = 1 \Rightarrow c_2 = 1. \\ f(x) = x^3 + 2x + 1.$$

Q38: (A)

$$3 \ln(x-2) + c.$$

Q39: (A)

$$f\left(\frac{\pi}{2}\right) = 1 + c = 0, \text{ so } c = -1. \quad f(x) = \sin(x) - 1.$$

Q40: (A)

$$\int (3x+2)^{1/2} dx = \frac{(3x+2)^{3/2}}{3 \cdot \frac{3}{2}} = \frac{2(3x+2)^{3/2}}{9} + c.$$

Q41: (A)

$$\int x e^x dx = x e^x - \int e^x dx = x e^x - e^x + c = e^x(x-1) + c.$$

Q42: (A)

$$\int \ln(x) dx = x \ln(x) - x + c.$$

Q43: (A)

$$\int x^2 e^x dx = x^2 e^x - 2x e^x + 2e^x + c = e^x(x^2 - 2x + 2) + c.$$

Q44: (A)

$$\int \frac{2x}{x^2+1} dx = \ln(x^2+1) + c.$$

Q45: (A)

$$\int x \cos(x) dx = x \sin(x) + \cos(x) + c.$$

Q46: (A)

$$\int e^x \sin(x) dx = \frac{e^x(\sin(x) - \cos(x))}{2} + c.$$

Q47: (A)

$$\frac{1}{2} \ln \left| \frac{x-1}{x+1} \right| + c.$$

Q48: (A)

$$\ln|x+1| + \frac{1}{x+1} + c.$$

Q49: (A)

$$\ln|f| = \ln|x| + C. \quad f = Ax. \quad f(1) = A = 2. \quad f(x) = 2x.$$

Q50: (A)

$$\int x \ln(x) dx = \frac{x^2}{2} \ln(x) - \frac{x^2}{4} + c.$$