

50 multiple-choice questions

Question 1 (Level 1) — *Basic definite integral*

Evaluate $\int_0^2 x \, dx$.

- (A) 2
- (B) 4
- (C) 1
- (D) $\frac{1}{2}$

Question 2 (Level 1) — *Integral of constant*

Evaluate $\int_1^4 3 \, dx$.

- (A) 9
- (B) 12
- (C) 3
- (D) 15

Question 3 (Level 1) — *Integral of x*

Evaluate $\int_0^3 x^2 \, dx$.

- (A) 9
- (B) 27
- (C) 3
- (D) 6

Question 4 (Level 1) — *Integral of $2x$*

Evaluate $\int_1^3 2x \, dx$.

- (A) 8
- (B) 6
- (C) 10
- (D) 4

Question 5 (Level 1) — *Same limits*

What is $\int_3^3 x^2 \, dx$?

- (A) 0
- (B) 9
- (C) 27

(D) 3

Question 6 (Level 1) — *Integral of x*

Evaluate $\int_0^2 x^3 dx$.

(A) 4

(B) 8

(C) 16

(D) 2

Question 7 (Level 1) — *Simple area*

$\int_0^4 2 dx$ represents the area of what shape?

(A) A rectangle with area 8

(B) A triangle with area 4

(C) A rectangle with area 2

(D) A square with area 4

Question 8 (Level 1) — *Integral of $4x$*

Evaluate $\int_0^1 4x dx$.

(A) 2

(B) 4

(C) 1

(D) 8

Question 9 (Level 1) — *Negative lower limit*

Evaluate $\int_{-1}^1 1 dx$.

(A) 2

(B) 0

(C) 1

(D) -2

Question 10 (Level 1) — *Integral of 5*

Evaluate $\int_2^6 5 dx$.

(A) 20

(B) 30

(C) 10

(D) 25

Question 11 (Level 2) — *Polynomial integral*

Evaluate $\int_0^2 (x^2 + x) dx$.

(A) $\frac{14}{3}$

(B) $\frac{10}{3}$

(C) 6

(D) $\frac{8}{3}$

Question 12 (Level 2) — *Reversed limits*

If $\int_1^5 f(x) dx = 7$, what is $\int_5^1 f(x) dx$?

(A) -7

(B) 7

(C) 0

(D) $\frac{1}{7}$

Question 13 (Level 2) — *Sum property*

If $\int_0^3 f(x) dx = 4$ and $\int_3^5 f(x) dx = 6$, find $\int_0^5 f(x) dx$.

(A) 10

(B) 24

(C) 2

(D) -2

Question 14 (Level 2) — *Constant multiple*

If $\int_0^2 f(x) dx = 5$, find $\int_0^2 3f(x) dx$.

(A) 15

(B) 8

(C) 5

(D) 6

Question 15 (Level 2) — *Quadratic integral*

Evaluate $\int_1^3 (3x^2 - 2x) dx$.

(A) 18

(B) 20

(C) 16

(D) 24

Question 16 (Level 2) — *Symmetric integral*

Evaluate $\int_{-2}^2 x^3 dx$.

(A) 0

(B) 8

(C) -8

(D) 4

Question 17 (Level 2) — *Even function integral*

Evaluate $\int_{-1}^1 x^2 dx$.

(A) $\frac{2}{3}$

(B) 0

(C) $\frac{1}{3}$

(D) 2

Question 18 (Level 2) — *Integral with negative values*

Evaluate $\int_0^3 (x - 2) dx$.

(A) $-\frac{3}{2}$

(B) $\frac{3}{2}$

(C) 3

(D) -3

Question 19 (Level 2) — *Fundamental theorem*

If $F(x) = \int_0^x 2t dt$, find $F(3)$.

(A) 9

(B) 6

(C) 3

(D) 18

Question 20 (Level 2) — *Sum of integrals*

Evaluate $\int_0^1 (x^2 + 3x + 2) dx$.

- (A) $\frac{23}{6}$
- (B) $\frac{11}{3}$
- (C) 4
- (D) $\frac{17}{6}$

Question 21 (Level 3) — *Integral of e*
Evaluate $\int_0^1 e^x dx$.

- (A) $e - 1$
- (B) e
- (C) $e + 1$
- (D) 1

Question 22 (Level 3) — *Integral of $1/x$*
Evaluate $\int_1^e \frac{1}{x} dx$.

- (A) 1
- (B) e
- (C) 0
- (D) $e - 1$

Question 23 (Level 3) — *Trig integral*
Evaluate $\int_0^\pi \sin(x) dx$.

- (A) 2
- (B) 0
- (C) 1
- (D) -2

Question 24 (Level 3) — *Integral of $\cos(x)$*
Evaluate $\int_0^{\pi/2} \cos(x) dx$.

- (A) 1
- (B) 0
- (C) -1
- (D) $\frac{\pi}{2}$

Question 25 (Level 3) — *Integral of e* Evaluate $\int_0^1 e^{2x} dx$.

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

Question 26 (Level 3) — *Area interpretation* $\int_0^2 x dx$ gives the area of what geometric shape?

- (A) A triangle with area 2
- (B) A rectangle with area 4
- (C) A triangle with area 4
- (D) A trapezoid with area 3

Question 27 (Level 3) — *FTC Part 1*If $F(x) = \int_1^x \frac{1}{t} dt$, find $F'(x)$.

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

Question 28 (Level 3) — *Signed area*Evaluate $\int_0^{2\pi} \sin(x) dx$. Why is the result not the total area?

- (A) 0 because positive and negative areas cancel
- (B) 4 because the total area is 4
- (C) 2π
- (D) -2

Question 29 (Level 3) — *Integral of x* Evaluate $\int_0^4 \sqrt{x} dx$.

- (A) $\frac{16}{3}$
- (B) $\frac{8}{3}$
- (C) 4
- (D) $\frac{32}{3}$

Question 30 (Level 3) — *Integral of $1/x$* Evaluate $\int_1^2 \frac{1}{x^2} dx$.

- (A) $\frac{1}{2}$
- (B) $-\frac{1}{2}$
- (C) 1
- (D) $\frac{3}{2}$

Question 31 (Level 4) — *Integral of $\sin(2x)$* Evaluate $\int_0^{\pi/4} \sin(2x) dx$.

- (A) $\frac{1}{2}$
- (B) 1
- (C) $\frac{\sqrt{2}}{2}$
- (D) 0

Question 32 (Level 4) — *Integral of e^{-x}* Evaluate \int_0^∞ — actually, evaluate $\int_0^2 e^{-x} dx$.

- (A) $1 - e^{-2}$
- (B) $e^{-2} - 1$
- (C) $1 + e^{-2}$
- (D) $e^2 - 1$

Question 33 (Level 4) — *Integral of $1/(x+1)$* Evaluate $\int_0^{e-1} \frac{1}{x+1} dx$.

- (A) 1
- (B) $e - 1$
- (C) $\ln(e - 1)$
- (D) e

Question 34 (Level 4) — *Linear substitution*Evaluate $\int_0^1 (2x + 1)^3 dx$.

- (A) 10
- (B) 20
- (C) $\frac{81}{8}$
- (D) 8

Question 35 (Level 4) — *FTC with chain rule*

If $G(x) = \int_0^{x^2} e^t dt$, find $G'(x)$.

- (A) $2xe^{x^2}$
- (B) e^{x^2}
- (C) $2xe^x$
- (D) $x^2e^{x^2}$

Question 36 (Level 4) — *Integral of $\cos(x)$*

Evaluate $\int_0^\pi \cos^2(x) dx$.

- (A) $\frac{\pi}{2}$
- (B) π
- (C) 0
- (D) $\frac{\pi}{4}$

Question 37 (Level 4) — *Integral of xex*

Evaluate $\int_0^1 xe^{x^2} dx$.

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

Question 38 (Level 4) — *Split integral*

If $\int_0^4 f(x) dx = 10$ and $\int_0^2 f(x) dx = 3$, find $\int_2^4 f(x) dx$.

- (A) 7
- (B) 13
- (C) 5
- (D) 30

Question 39 (Level 4) — *Integral of $x\sin(x)$*

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

- (A) 1
- (B) 0
- (C) $\frac{1}{2}$
- (D) 2

Question 40 (Level 4) — *Integral of $\ln(x)/x$*

Evaluate $\int_1^e \frac{\ln(x)}{x} dx$.

- (A) $\frac{1}{2}$
- (B) 1
- (C) $\frac{1}{e}$
- (D) $e - 1$

Question 41 (Level 5) — *Integration by parts definite*

Evaluate $\int_0^1 xe^x dx$.

- (A) 1
- (B) $e - 1$
- (C) e
- (D) $2e - 1$

Question 42 (Level 5) — *Integral with absolute value*

Evaluate $\int_{-1}^2 |x| dx$.

- (A) $\frac{5}{2}$
- (B) $\frac{3}{2}$
- (C) 3
- (D) 2

Question 43 (Level 5) — *Tricky substitution*

Evaluate $\int_0^1 \frac{x}{\sqrt{1+x^2}} dx$.

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

Question 44 (Level 5) — *Integral of xe*

Evaluate $\int_0^1 x^2 e^x dx$.

- (A) $e - 2$
- (B) $e - 1$
- (C) $2e - 2$

(D) $e + 2$

Question 45 (Level 5) — *Integral of $\sin(x)$*

Evaluate $\int_0^{2\pi} \sin^2(x) dx$.

(A) π

(B) 2π

(C) 0

(D) $\frac{\pi}{2}$

Question 46 (Level 5) — *Derivative of integral function*

If $F(x) = \int_x^{x^2} e^{-t^2} dt$, find $F'(x)$.

(A) $2xe^{-x^4} - e^{-x^2}$

(B) $e^{-x^4} - e^{-x^2}$

(C) $2xe^{-x^2} - e^{-x}$

(D) $e^{-x^2}(2x - 1)$

Question 47 (Level 5) — *Integral equation*

Find $a > 0$ such that $\int_0^a x^2 dx = 9$.

(A) 3

(B) $\sqrt{9}$

(C) 27

(D) 9

Question 48 (Level 5) — *Integral of $x\cos(x)$*

Evaluate $\int_0^{\pi/2} x \cos(x) dx$.

(A) $\frac{\pi}{2} - 1$

(B) $\frac{\pi}{2}$

(C) $\frac{\pi}{2} + 1$

(D) 1

Question 49 (Level 5) — *Comparison of integrals*

Without evaluating, determine which is larger: $\int_0^1 x^2 dx$ or $\int_0^1 x^3 dx$.

(A) $\int_0^1 x^2 dx$ is larger

(B) $\int_0^1 x^3 dx$ is larger

- (C) They are equal
- (D) Cannot be determined

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

Evaluate $\int_1^e \ln(x) dx$.

- (A) 1
- (B) $e - 1$
- (C) e
- (D) 0

Solutions

Q1: (A)

$$\left[\frac{x^2}{2}\right]_0^2 = \frac{4}{2} - 0 = 2.$$

Q2: (A)

$$[3x]_1^4 = 12 - 3 = 9.$$

Q3: (A)

$$\left[\frac{x^3}{3}\right]_0^3 = \frac{27}{3} = 9.$$

Q4: (A)

$$[x^2]_1^3 = 9 - 1 = 8.$$

Q5: (A)

When the limits are equal, the integral is 0.

Q6: (A)

$$\left[\frac{x^4}{4}\right]_0^2 = \frac{16}{4} = 4.$$

Q7: (A)

A rectangle with width 4 and height 2, area = 8.

Q8: (A)

$$[2x^2]_0^1 = 2.$$

Q9: (A)

$$[x]_{-1}^1 = 1 - (-1) = 2.$$

Q10: (A)

$$5(6) - 5(2) = 30 - 10 = 20.$$

Q11: (A)

$$\left[\frac{x^3}{3} + \frac{x^2}{2}\right]_0^2 = \frac{8}{3} + 2 = \frac{14}{3}.$$

Q12: (A)

$$\int_5^1 f(x) dx = -\int_1^5 f(x) dx = -7.$$

Q13: (A)

$$\int_0^5 f(x) dx = 4 + 6 = 10.$$

Q14: (A)

$$\int_0^2 3f(x) dx = 3 \times 5 = 15.$$

Q15: (A)

$$[x^3 - x^2]_1^3 = (27 - 9) - (1 - 1) = 18.$$

Q16: (A)

Since x^3 is odd and the interval is symmetric, $\int_{-2}^2 x^3 dx = 0$.

Q17: (A)

$$2 \int_0^1 x^2 dx = 2 \cdot \frac{1}{3} = \frac{2}{3}.$$

Q18: (A)

$$\left[\frac{x^2}{2} - 2x\right]_0^3 = \frac{9}{2} - 6 = -\frac{3}{2}.$$

Q19: (A)

$$F(x) = x^2, \text{ so } F(3) = 9.$$

Q20: (A)

$$\left[\frac{x^3}{3} + \frac{3x^2}{2} + 2x\right]_0^1 = \frac{1}{3} + \frac{3}{2} + 2 = \frac{2+9+12}{6} = \frac{23}{6}.$$

Q21: (A)

$$[e^x]_0^1 = e - 1.$$

Q22: (A)

$$[\ln(x)]_1^e = \ln(e) - \ln(1) = 1 - 0 = 1.$$

Q23: (A)

$$[-\cos(x)]_0^\pi = -\cos(\pi) + \cos(0) = 1 + 1 = 2.$$

Q24: (A)

$$[\sin(x)]_0^{\pi/2} = 1 - 0 = 1.$$

Q25: (A)

$$\left[\frac{e^{2x}}{2}\right]_0^1 = \frac{e^2}{2} - \frac{1}{2} = \frac{e^2-1}{2}.$$

Q26: (A)

A right triangle with base 2 and height 2, area = $\frac{1}{2}(2)(2) = 2$.

Q27: (A)

By FTC Part 1, $F'(x) = \frac{1}{x}$.

Q28: (A)

$[-\cos(x)]_0^{2\pi} = -1 + 1 = 0$. The positive and negative areas cancel.

Q29: (A)

$$\left[\frac{2x^{3/2}}{3}\right]_0^4 = \frac{2(8)}{3} = \frac{16}{3}.$$

Q30: (A)

$$\left[-\frac{1}{x}\right]_1^2 = -\frac{1}{2} + 1 = \frac{1}{2}.$$

Q31: (A)

$$\left[-\frac{\cos(2x)}{2}\right]_0^{\pi/4} = -\frac{\cos(\pi/2)}{2} + \frac{\cos(0)}{2} = 0 + \frac{1}{2} = \frac{1}{2}.$$

Q32: (A)

$$[-e^{-x}]_0^2 = -e^{-2} + 1 = 1 - e^{-2}.$$

Q33: (A)

$$[\ln(x+1)]_0^{e-1} = \ln(e) - \ln(1) = 1.$$

Q34: (A)

$$\left[\frac{(2x+1)^4}{8}\right]_0^1 = \frac{81}{8} - \frac{1}{8} = \frac{80}{8} = 10.$$

Q35: (A)

$$G'(x) = e^{x^2} \cdot \frac{d}{dx}(x^2) = 2xe^{x^2}.$$

Q36: (A)

$$\int_0^\pi \frac{1+\cos(2x)}{2} dx = \left[\frac{x}{2} + \frac{\sin(2x)}{4}\right]_0^\pi = \frac{\pi}{2}.$$

Q37: (A)

$$\frac{1}{2} \int_0^1 e^u du = \frac{1}{2}[e^u]_0^1 = \frac{e-1}{2}.$$

Q38: (A)

$$\int_2^4 f(x) dx = 10 - 3 = 7.$$

Q39: (A)

$$\frac{1}{2} \int_0^\pi \sin(u) du = \frac{1}{2}[-\cos(u)]_0^\pi = \frac{1}{2}(1+1) = 1.$$

Q40: (A)

$$\int_0^1 u du = \left[\frac{u^2}{2}\right]_0^1 = \frac{1}{2}.$$

Q41: (A)

$$[xe^x]_0^1 - \int_0^1 e^x dx = e - [e^x]_0^1 = e - (e-1) = 1.$$

Q42: (A)

$$\left[-\frac{x^2}{2}\right]_{-1}^0 + \left[\frac{x^2}{2}\right]_0^2 = \frac{1}{2} + 2 = \frac{5}{2}.$$

Q43: (A)

$$\frac{1}{2} \int_1^2 u^{-1/2} du = \frac{1}{2}[2\sqrt{u}]_1^2 = \sqrt{2} - 1.$$

Q44: (A)

$$[e^x(x^2 - 2x + 2)]_0^1 = e(1 - 2 + 2) - 1(2) = e - 2.$$

Q45: (A)

$$\int_0^{2\pi} \frac{1-\cos(2x)}{2} dx = \left[\frac{x}{2} - \frac{\sin(2x)}{4}\right]_0^{2\pi} = \pi.$$

Q46: (A)

$$F'(x) = 2xe^{-x^4} - e^{-x^2}.$$

Q47: (A)

$$\frac{a^3}{3} = 9 \Rightarrow a^3 = 27 \Rightarrow a = 3.$$

Q48: (A)

$$[x \sin(x)]_0^{\pi/2} - \int_0^{\pi/2} \sin(x) dx = \frac{\pi}{2} - [-\cos(x)]_0^{\pi/2} = \frac{\pi}{2} - 1.$$

Q49: (A)

Since $x^2 > x^3$ for $0 < x < 1$, $\int_0^1 x^2 dx > \int_0^1 x^3 dx$.

Q50: (A)

$$[x \ln(x) - x]_1^e = (e - e) - (0 - 1) = 1.$$