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Integrals — CBSE Class 12 Mathematics Chapter Test

FREE CHAPTER TEST · CLASS XII · MATHEMATICS (041) · PATTERN OF THE CBSE SAMPLE QUESTION PAPER 2026-27

TIME ALLOWED	MAXIMUM MARKS	QUESTIONS	NAME / ROLL NO.
1½ hours	40	19 (A 10 · B 3 · C 2 · D 2 · E 2)	

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 19 questions. All questions are compulsory.
2. This question paper is divided into five sections: A, B, C, D and E.
3. In Section A, Questions 1 to 8 are multiple choice questions (MCQs) and Questions 9 and 10 are assertion-reason based questions of 1 mark each.
4. In Section B, Q11–13 are very short answer (VSA) type questions, carrying 2 marks each.
5. In Section C, Q14–15 are short answer (SA) type questions, carrying 3 marks each.
6. In Section D, Q16–17 are long answer (LA) type questions, carrying 5 marks each.
7. In Section E, Q18–19 are case study based questions, carrying 4 marks each, with sub-parts of the values of 1, 1 and 2 marks.
8. There is no overall choice. However, an internal choice has been provided in 1 question of Section B, 1 question of Section C, 1 question of Section D and in the 2-mark sub-part of each question of Section E.
9. Use of calculators is not allowed. log x denotes the natural logarithm of x.
10. This chapter test follows the section structure, question types and marks per question of the CBSE Class XII Mathematics (041) Sample Question Paper 2026-27, released on 21 September 2026 at cbseacademic.nic.in, at half the length of the 80-mark board paper: 40 marks in 1½ hours.
11. The answer key and the marking scheme are at the end of this booklet. Attempt the paper in 1½ hours before you look at them.

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Chapter: Integrals · **Topics:** Integration by substitution · Integration by partial fractions · Integration by parts · Integrals of special forms · Fundamental theorem of calculus · Properties of definite integrals

SECTION A

This section comprises 10 questions of 1 mark each: 8 multiple choice questions (MCQs) and 2 assertion-reason based questions.

1. $\int e^x(\cos x - \sin x)\,dx$ is equal to 1

(A) $e^x \sin x + C$ (B) $e^x \cos x + C$

(C) $-e^x \cos x + C$ (D) $e^x(\sin x + \cos x) + C$

2. $\int \frac{dx}{x^2 + 4}$ is equal to 1

(A) $\tan^{-1}(x/2) + C$ (B) $2\tan^{-1}(x/2) + C$

(C) $\frac{1}{4}\tan^{-1}(x/2) + C$ (D) $\frac{1}{2}\tan^{-1}(x/2) + C$

3. The value of $\int_{-\pi/2}^{\pi/2} \sin^5 x \cos^2 x\,dx$ is 1

(A) 0 (B) 2

(C) 1 (D) π

4. The value of $\int_0^{\pi/2} \frac{\cos^3 x}{\sin^3 x + \cos^3 x}\,dx$ is 1

(A) $\frac{\pi}{2}$ (B) 0

(C) $\frac{\pi}{4}$ (D) 1

5. $\int \log x\,dx$ is equal to 1

(A) $\frac{1}{x} + C$ (B) $x \log x + C$

(C) $x \log x - x + C$ (D) $\log x - x + C$

6. The value of $\int_0^1 x\,e^x\,dx$ is 1

(A) 1 (B) e

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

7. $\int \frac{\sec^2 x}{\tan x}\,dx$ is equal to 1

(A) $\log|\sec x| + C$ (B) $\tan x + C$

(C) $\log|\sin x| + C$ (D) $\log|\tan x| + C$

8. The value of $\int_0^{\pi/2} \sin^2 x\,dx$ is 1

(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{4}$

(C) 1 (D) π

9. **Assertion (A):** $\int_{-1}^{1} |x|\, dx = 1$. 1

Reason (R): If f is an even function, then $\int_{-a}^{a} f(x)\, dx = 2\int_{0}^{a} f(x)\, dx$.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

10. **Assertion (A):** $\int \frac{1}{x}\, dx = \log x + C$ for every real $x \neq 0$. 1

Reason (R): $\frac{d}{dx}(\log |x|) = \frac{1}{x}$ for every real $x \neq 0$.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

SECTION B

This section comprises 3 very short answer (VSA) type questions of 2 marks each.

11. Find $\int \frac{2x + 3}{x^2 + 3x + 5}\, dx$. 2

12. (a) Evaluate $\int_{0}^{\pi/3} \tan^2 x\, dx$. 2

OR

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

13. Find $\int \frac{dx}{x^2 - 16}$. 2

SECTION C

This section comprises 2 short answer (SA) type questions of 3 marks each.

14. (a) Find $\int \frac{x}{(x - 1)(x + 3)}\, dx$. 3

OR

(b) Find $\int e^x \left(\frac{1}{x + 1} - \frac{1}{(x + 1)^2}\right) dx$.

15. Evaluate $\int_{1}^{4} |x - 2|\, dx$. 3

SECTION D

This section comprises 2 long answer (LA) type questions of 5 marks each.

16. (a) Evaluate $\int_0^{\pi} \frac{x}{1 + \sin x}\, dx$. 5

OR

(b) Find $\int \frac{3x^2 + x + 2}{(x + 1)(x^2 + 1)}\, dx$.

17. Evaluate $\int_0^{\pi} \log (1 + \cos x)\, dx$. 5

SECTION E

This section comprises 2 case study based questions of 4 marks each, with sub-parts of 1, 1 and 2 marks.

18. A teacher writes $I = \int_0^{\pi/2} \frac{\sin^4 x}{\sin^4 x + \cos^4 x}\, dx$ on the board and asks the class to use the property $\int_0^a f(x)\, dx = \int_0^a f(a - x)\, dx$.

(i) Write I after applying the property. [1]

(ii) Find the value of 2I by adding the two forms of I. [1]

(iii) Hence find I. [2]

OR

(iii) Using the same property, evaluate $\int_0^1 x^2(1 - x)^3\, dx$. [2]

19. Water flows into an empty tank at the rate $r(t) = 6t - t^2$ litres per minute, $0 \le t \le 6$, where t is the time in minutes. The volume that enters between t = a and t = b is the definite integral of r(t) from a to b.

(i) Find the rate of flow at t = 2 minutes. [1]

(ii) Find the volume of water that enters in the first 3 minutes. [1]

(iii) Find the total volume of water in the tank at t = 6 minutes. [2]

OR

(iii) Find the volume of water that enters between t = 3 and t = 6 minutes. [2]

END OF THE QUESTION PAPER

ANSWER KEY — SECTION A

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
(B)	(D)	(A)	(C)	(C)	(A)	(D)	(B)	(A)	(D)

MARKING SCHEME AND WORKED SOLUTIONS

Marks for each step are shown in brackets, as in the CBSE marking scheme. Any correct alternative method earns full marks.

Q1. Answer (B). $\int e^x\{f(x) + f'(x)\}\,dx = e^x f(x) + C$ with $f(x) = \cos x$, $f'(x) = -\sin x$.

Q2. Answer (D). $\int dx/(x^2 + a^2) = (1/a)\tan^{-1}(x/a) + C$ with $a = 2$.

Q3. Answer (A). $\sin^5 x \cos^2 x$ is an odd function, so its integral over $[-a, a]$ is 0.

Q4. Answer (C). Using $\int_0^a f(x)\,dx = \int_0^a f(a - x)\,dx$, $I = \int_0^{\pi/2} \sin^3 x/(\sin^3 x + \cos^3 x)\,dx$; adding, $2I = \pi/2$, so $I = \pi/4$.

Q5. Answer (C). By parts: $\int 1 \cdot \log x\,dx = x \log x - \int x \cdot (1/x)\,dx = x \log x - x + C$.

Q6. Answer (A). $[x e^x - e^x]_0^1 = (e - e) - (0 - 1) = 1$.

Q7. Answer (D). Put $t = \tan x$, $dt = \sec^2 x\,dx$: $\int dt/t = \log|t| + C = \log|\tan x| + C$.

Q8. Answer (B). $\sin^2 x = (1 - \cos 2x)/2$; $\int_0^{\pi/2} = (1/2)(\pi/2 - 0) = \pi/4$.

Q9. Answer (A). $|x|$ is even, so $\int_{-1}^{1} |x|\,dx = 2\int_0^1 x\,dx = 2 \times 1/2 = 1$. Both are true and R gives the reason. Answer (A).

Q10. Answer (D). $\log x$ is not defined for $x < 0$, so A is false; the correct result is $\log|x| + C$, which R justifies. Answer (D).

Q11. (2 marks) Answer: $\log(x^2 + 3x + 5) + C$.
Put $t = x^2 + 3x + 5$, $dt = (2x + 3)\,dx$. [1]
$\int dt/t = \log|t| + C = \log(x^2 + 3x + 5) + C$ ($x^2 + 3x + 5 > 0$ for all x). [1]

Q12. (2 marks) Answer: (a) $\sqrt{3} - \pi/3$; (b) $x \sin x + \cos x + C$.
(a) $\tan^2 x = \sec^2 x - 1$, so the integral is $[\tan x - x]_0^{\pi/3}$. [1] $= \sqrt{3} - \pi/3$. [1]
OR (b) By parts with $u = x$, $dv = \cos x\,dx$: $\int x \cos x\,dx = x \sin x - \int \sin x\,dx$ [1] $= x \sin x + \cos x + C$. [1]

Q13. (2 marks) Answer: $(1/8)\log|(x - 4)/(x + 4)| + C$.
$\int dx/(x^2 - a^2) = (1/2a)\log|(x - a)/(x + a)| + C$, with $a = 4$. [1]
$= (1/8)\log|(x - 4)/(x + 4)| + C$. [1]

Q14. (3 marks) Answer: (a) $(1/4)\log|x - 1| + (3/4)\log|x + 3| + C$; (b) $e^x/(x + 1) + C$.
(a) $x/((x - 1)(x + 3)) = A/(x - 1) + B/(x + 3)$ with $x = A(x + 3) + B(x - 1)$. [1] $x = 1$ gives $A = 1/4$; $x = -3$ gives $B = 3/4$. [1]
So the integral is $(1/4)\log|x - 1| + (3/4)\log|x + 3| + C$. [1]
OR (b) With $f(x) = 1/(x + 1)$, $f'(x) = -1/(x + 1)^2$, the integrand is $e^x\{f(x) + f'(x)\}$. [2] So $\int = e^x f(x) + C = e^x/(x + 1) + C$. [1]

Q15. (3 marks) Answer: 5/2.
$|x - 2| = 2 - x$ on $[1, 2]$ and $x - 2$ on $[2, 4]$. [1]
$\int_1^2 (2 - x)\,dx = [2x - x^2/2]_1^2 = 2 - 3/2 = 1/2$. [1]
$\int_2^4 (x - 2)\,dx = [x^2/2 - 2x]_2^4 = 0 - (-2) = 2$. Total $= 5/2$. [1]

Q16. (5 marks) Answer: (a) π; (b) 2 log |x + 1| + (1/2) log (x² + 1) + C.

(a) Let I be the integral. Using $\int_0^a f(x)\,dx = \int_0^a f(a-x)\,dx$ and sin(π − x) = sin x, $I = \int_0^{\pi} (\pi - x)/(1 + \sin x)\,dx$. [1] Adding, $2I = \pi \int_0^{\pi} dx/(1 + \sin x)$. [1] Since d/dx [−cos x/(1 + sin x)] = (sin x + sin²x + cos²x)/(1 + sin x)² = 1/(1 + sin x), [1] $\int_0^{\pi} dx/(1 + \sin x) = [-\cos x/(1 + \sin x)]_0^{\pi} = 1 - (-1) = 2$. [1] So 2I = 2π and I = π. [1]

OR (b) Write (3x² + x + 2)/((x + 1)(x² + 1)) = A/(x + 1) + (Bx + C)/(x² + 1), so 3x² + x + 2 = A(x² + 1) + (Bx + C)(x + 1). [1] x = −1 gives 4 = 2A, A = 2; comparing x² terms, 3 = A + B, B = 1; comparing constants, 2 = A + C, C = 0 (the x terms, B + C = 1, agree). [2] So ∫ = 2 ∫ dx/(x + 1) + ∫ x dx/(x² + 1) [1] = 2 log |x + 1| + (1/2) log (x² + 1) + C. [1]

Q17. (5 marks) Answer: −π log 2.

1 + cos x = 2 cos²(x/2), so log (1 + cos x) = log 2 + 2 log cos(x/2), and $I = \pi \log 2 + 2\int_0^{\pi} \log \cos(x/2)\,dx$. Putting x = 2t, $I = \pi \log 2 + 4J$, where $J = \int_0^{\pi/2} \log \cos t\,dt$. [1]

By the property f(a − x), $J = \int_0^{\pi/2} \log \sin t\,dt$; adding, $2J = \int_0^{\pi/2} \log(\sin t \cos t)\,dt = \int_0^{\pi/2} \log \sin 2t\,dt - (\pi/2)\log 2$. [1]

Putting 2t = u, $\int_0^{\pi/2} \log \sin 2t\,dt = (1/2)\int_0^{\pi} \log \sin u\,du = \int_0^{\pi/2} \log \sin u\,du = J$ (as sin(π − u) = sin u), so $2J = J - (\pi/2)\log 2$ and $J = -(\pi/2)\log 2$. [2]

Hence $I = \pi \log 2 + 4(-(\pi/2)\log 2) = -\pi \log 2$. [1]

Q18. (4 marks) Answer: (i) as shown; (ii) π/2; (iii) π/4, or 1/60.

(i) $I = \int_0^{\pi/2} \cos^4 x/(\cos^4 x + \sin^4 x)\,dx$, as sin(π/2 − x) = cos x. [1]

(ii) $2I = \int_0^{\pi/2} 1\,dx = \pi/2$. [1]

(iii)(a) From (ii), I = (1/2)(π/2) [1] = π/4. [1]

OR (iii)(b) $\int_0^1 x^2(1-x)^3\,dx = \int_0^1 (1-x)^2 x^3\,dx = \int_0^1 (x^3 - 2x^4 + x^5)\,dx$ [1] = 1/4 − 2/5 + 1/6 = 1/60. [1]

Q19. (4 marks) Answer: (i) 8 L/min; (ii) 18 L; (iii) 36 L, or 18 L.

(i) r(2) = 12 − 4 = 8 litres per minute. [1]

(ii) $\int_0^3 (6t - t^2)\,dt = [3t^2 - t^3/3]_0^3 = 27 - 9 = 18$ litres. [1]

(iii)(a) $\int_0^6 (6t - t^2)\,dt = [3t^2 - t^3/3]_0^6$ [1] = 108 − 72 = 36 litres. [1]

OR (iii)(b) $\int_3^6 (6t - t^2)\,dt = [3t^2 - t^3/3]_3^6$ [1] = 36 − 18 = 18 litres. [1]

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