

How to use this sheet. Every question is one of three tasks: recall a standard antiderivative directly, evaluate a definite integral by subtracting the antiderivative at the lower limit from its value at the upper limit, or recognise that a substitution or integration by parts is needed. Identify which of the three applies before doing anything else.

Quick reference — Power rule: $x^n dx$ integrates to $x^{(n+1)}/(n+1) + C$, except $n = -1$, which gives $\ln|x| + C$ · Definite integral = $F(\text{upper}) - F(\text{lower})$ · By parts: $u dv = uv - v du$

Section A · Level 1

Ten questions. None should take more than twenty seconds.

1. An antiderivative of a function f is another function F such that:

(1) $F(x) = f(x)$ (2) $F'(x) = f(x)$ (3) $f'(x) = F(x)$ (4) $F(x) \times f(x) = 1$

2. $\int x^4 dx$ equals:

(1) $4x^3 + C$ (2) $x^5/5 + C$ (3) $5x^5 + C$ (4) $x^4/4 + C$

3. $\int (1/x) dx$ equals:

(1) $x + C$ (2) $1/x^2 + C$ (3) $\ln|x| + C$ (4) $-1/x^2 + C$

4. $\int e^n dx$ equals:

(1) $e^n + C$ (2) $xe^n + C$ (3) $e^n/x + C$ (4) $1 + C$

5. $\int \cos x dx$ equals:

(1) $\sin x + C$ (2) $-\sin x + C$ (3) $\cos x + C$ (4) $-\cos x + C$

6. $\int \sin x dx$ equals:

(1) $\cos x + C$ (2) $-\cos x + C$ (3) $\sin x + C$ (4) $-\sin x + C$

7. $\int \sec^2 x dx$ equals:

(1) $\tan x + C$ (2) $\sec x + C$ (3) $\cot x + C$ (4) $-\tan x + C$

8. $\int 1/(1+x^2) dx$ equals:

(1) $\sin^{-1}x + C$ (2) $\tan^{-1}x + C$ (3) $\cos^{-1}x + C$ (4) $\sec^{-1}x + C$

9. $\int 1/\sqrt{1-x^2} dx$ equals:

(1) $\cos^{-1}x + C$ (2) $\sin^{-1}x + C$ (3) $\tan^{-1}x + C$ (4) $-\sin^{-1}x + C$

10. $\int 1/x^2 dx$ equals:

(1) $-1/x + C$ (2) $1/x + C$ (3) $\ln|x| + C$ (4) $-2/x^3 + C$

Section B · Level 2

Five questions. Evaluate the antiderivative at both limits, then subtract.

11. The definite integral of $x^2 dx$, taken from $x = 0$ to $x = 2$, equals:

(1) 2 (2) 4 (3) $8/3$ (4) $4/3$

12. The definite integral of $\sin x dx$, taken from $x = 0$ to $x = \pi$, equals:

(1) 0 (2) 1 (3) 2 (4) π

13. The definite integral of $\cos x \, dx$, taken from $x = 0$ to $x = \pi/2$, equals:

- (1) 0 (2) $\frac{1}{2}$ (3) 1 (4) $\sqrt{2}/2$

14. The definite integral of $1/(1+x^2) \, dx$, taken from $x = 0$ to $x = 1$, equals:

- (1) $\pi/2$ (2) $\pi/4$ (3) π (4) 1

15. If $\int f(x) \, dx = F(x) + C$, then the definite integral of $f(x) \, dx$ from $x = a$ to $x = b$ equals:

- (1) $F(a) + F(b)$ (2) $F(b) - F(a)$ (3) $F(a) - F(b)$ (4) $F(a) \times F(b)$

Section C · Level 3

Five questions. Spot which piece is the derivative of another piece before choosing a method.

16. Using the substitution $u = x^2$, $\int 2x \cdot e^{x^2} \, dx$ equals:

- (1) $e^n + C$ (2) $e^{n^2} + C$ (3) $2e^{n^2} + C$ (4) $x^2 e^{n^2} + C$

17. Using integration by parts, $\int x \cdot e^n \, dx$ equals:

- (1) $xe^n + C$ (2) $(x-1)e^n + C$ (3) $(x+1)e^n + C$ (4) $e^n + C$

18. Using integration by parts, $\int x \cdot \sin x \, dx$ equals:

- (1) $-x \cos x + \sin x + C$ (2) $x \cos x - \sin x + C$ (3) $-x \cos x - \sin x + C$ (4) $x \cos x + \sin x + C$

19. $\int \tan x \, dx$ equals:

- (1) $\ln|\sec x| + C$ (2) $\ln|\cos x| + C$ (3) $\sec^2 x + C$ (4) $-\ln|\sec x| + C$

20. When choosing which factor to call u in integration by parts, a common guideline is to prefer, in order, functions from the group:

- (1) Trigonometric, then exponential, then algebraic, then logarithmic (2) Logarithmic, then inverse trig, then algebraic, then trigonometric, then exponential (3) Exponential, then trigonometric, then logarithmic, then algebraic (4) Algebraic, then exponential, then logarithmic, then trigonometric

Answer key: 1. (2) 2. (2) 3. (3) 4. (1) 5. (1) 6. (2) 7. (1) 8. (2) 9. (2) 10. (1) 11. (3) 12. (3) 13. (3) 14. (2) 15. (2) 16. (2) 17. (2) 18. (1) 19. (1) 20. (2)

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