

CUET Mathematics Test

Chapter: Integrals

SOLUTIONS

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Solutions

- Solution:** Using the formula $\int \frac{dx}{x^2-a^2} = \frac{1}{2a} \log \left| \frac{x-a}{x+a} \right|$. Here $a = 4$, so $\frac{1}{8} \log \left| \frac{x-4}{x+4} \right| + C$.
Correct Option: (B)
- Solution:** Put $\cos x = t$, then $-\sin x dx = dt$. Integral becomes $-\int \frac{dt}{1+t^2} = -\tan^{-1}(t) = -\tan^{-1}(\cos x) + C$. **Correct Option: (B)**
- Solution:** Using $\int e^x(f(x) + f'(x))dx = e^x f(x)$. Here $f(x) = \sin x$ and $f'(x) = \cos x$. Result is $e^x \sin x + C$. **Correct Option: (B)**
- Solution:** $\int \frac{dx}{\sqrt{5^2((3/5)^2-x^2)}} = \frac{1}{5} \int \frac{dx}{\sqrt{(3/5)^2-x^2}} = \frac{1}{5} \sin^{-1}\left(\frac{x}{3/5}\right) = \frac{1}{5} \sin^{-1}\left(\frac{5x}{3}\right) + C$. **Correct Option: (A)**
- Solution:** ILATE rule: $u = x, dv = \sec^2 x dx \Rightarrow du = dx, v = \tan x$. $\int x \sec^2 x = x \tan x - \int \tan x dx = x \tan x - \log |\sec x| + C$ or $x \tan x + \log |\cos x| + C$. **Correct Option: (A)**
- Solution:** Since degree of numerator is equal to degree of denominator, we must perform long division first to make it a proper fraction. **Correct Option: (C)**
- Solution:** $\int \frac{dx}{(x+1)^2+1}$. Put $x+1 = t, dx = dt$. $\int \frac{dt}{t^2+1} = \tan^{-1}(t) = \tan^{-1}(x+1) + C$. **Correct Option: (A)**
- Solution:** $\int 1 \cdot \log x dx$. $u = \log x, dv = dx$. Result is $x \log x - \int x \cdot \frac{1}{x} dx = x \log x - x + C$. **Correct Option: (C)**
- Solution:** $\frac{1}{x(x^2+1)} = \frac{A}{x} + \frac{Bx+C}{x^2+1}$. $1 = A(x^2+1) + (Bx+C)x$. $A = 1, B = -1, C = 0$. $\int \left(\frac{1}{x} - \frac{x}{x^2+1}\right) dx = \log|x| - \frac{1}{2} \log(x^2+1) + C$. **Correct Option: (A)**
- Solution:** Put $x^3 = t, 3x^2 dx = dt$. $\int \frac{dt}{t^2+1} = \tan^{-1}(t) = \tan^{-1}(x^3) + C$. $f(x) = x^3$. **Correct Option: (B)**
- Solution:** $\int \frac{dx}{\sqrt{(x+1)^2+4}}$. Use $\int \frac{dx}{\sqrt{x^2+a^2}} = \log|x + \sqrt{x^2+a^2}|$. Result is $\log|x+1 + \sqrt{(x+1)^2+4}|$. **Correct Option: (A)**
- Solution:** Divide numerator and denominator by e^x : $\int \frac{e^x - e^{-x}}{e^x + e^{-x}} dx$. Put $e^x + e^{-x} = t$, then $(e^x - e^{-x})dx = dt$. $\int \frac{dt}{t} = \log|t| = \log|e^x + e^{-x}| + C$. **Correct Option: (A)**
- Solution:** $\frac{x}{(x-1)(x-2)} = \frac{A}{x-1} + \frac{B}{x-2} \Rightarrow x = A(x-2) + B(x-1)$. $x = 1 \Rightarrow A = -1$. $x = 2 \Rightarrow B = 2$. $\int \left(\frac{-1}{x-1} + \frac{2}{x-2}\right) dx = 2 \log|x-2| - \log|x-1| = \log \left| \frac{(x-2)^2}{x-1} \right|$. **Correct Option: (D)**
- Solution:** Put $\tan x = t, \sec^2 x dx = dt$. $\int \frac{dt}{\sqrt{t^2+4}} = \log|t + \sqrt{t^2+4}| = \log|\tan x + \sqrt{\tan^2 x + 4}| + C$. **Correct Option: (A)**
- Solution:** Standard substitution for this form is $e^x = t$ or $e^x = \sin \theta$ to simplify the square root. However, $e^x = t$ is the primary technique to convert to algebraic. **Correct Option: (C)**
- Solution:** By parts twice: $\int x^2 e^x = x^2 e^x - \int 2x e^x = x^2 e^x - (2x e^x - \int 2e^x) = x^2 e^x - 2x e^x + 2e^x = e^x(x^2 - 2x + 2) + C$. **Correct Option: (A)**
- Solution:** $\frac{1}{9} \int \frac{dx}{x^2 - (1/3)^2} = \frac{1}{9} \cdot \frac{1}{2(1/3)} \log \left| \frac{x-1/3}{x+1/3} \right| = \frac{1}{6} \log \left| \frac{3x-1}{3x+1} \right| + C$. **Correct Option: (A)**

18. **Solution:** Put $\sqrt{x} = t$, $\frac{1}{2\sqrt{x}}dx = dt \Rightarrow \frac{1}{\sqrt{x}}dx = 2dt$. $2 \int \cos t dt = 2 \sin t = 2 \sin \sqrt{x} + C$.
Correct Option: (A)
19. **Solution:** This is a standard formula: $\frac{1}{a} \tan^{-1}\left(\frac{x}{a}\right) + C$. **Correct Option: (A)**
20. **Solution:** For linear over quadratic, we use $px + q = A \frac{d}{dx}(ax^2 + bx + c) + B$ to split into log form and standard square form. **Correct Option: (A)**

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