

STEP II, 2009, Q7

- 7 Let $y = (x - a)^n e^{bx} \sqrt{1 + x^2}$, where n and a are constants and b is a non-zero constant. Show that

$$\frac{dy}{dx} = \frac{(x - a)^{n-1} e^{bx} q(x)}{\sqrt{1 + x^2}},$$

where $q(x)$ is a cubic polynomial.

Using this result, determine:

- (i) $\int \frac{(x - 4)^{14} e^{4x} (4x^3 - 1)}{\sqrt{1 + x^2}} dx;$
- (ii) $\int \frac{(x - 1)^{21} e^{12x} (12x^4 - x^2 - 11)}{\sqrt{1 + x^2}} dx;$
- (iii) $\int \frac{(x - 2)^6 e^{4x} (4x^4 + x^3 - 2)}{\sqrt{1 + x^2}} dx.$



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