

STEP III, 2016 , Q3

- 3 (i) Given that

$$\int \frac{x^3 - 2}{(x + 1)^2} e^x dx = \frac{P(x)}{Q(x)} e^x + \text{constant},$$

where $P(x)$ and $Q(x)$ are polynomials, show that $Q(x)$ has a factor of $x + 1$.

Show also that the degree of $P(x)$ is exactly one more than the degree of $Q(x)$, and find $P(x)$ in the case $Q(x) = x + 1$.

- (ii) Show that there are no polynomials $P(x)$ and $Q(x)$ such that

$$\int \frac{1}{x + 1} e^x dx = \frac{P(x)}{Q(x)} e^x + \text{constant}.$$

You need consider only the case when $P(x)$ and $Q(x)$ have no common factors.



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