D. **Partial fraction decomposition.** Partial fraction decomposition is a method of breaking a complicated rational expression into the sum of simpler ones. When using partial fraction decomposition the rational expression must be proper.

a. First factor the denominator of the rational expression. Based on the chart below determine what terms will be in your decomposition.

Factor in denominator:	Term(s) in decomposition:
$ax+b$ first power of a linear	$\frac{A}{ax+b}$
$(ax+b)^m$ mth power of a linear	$\frac{A_1}{ax+b}+\frac{A_2}{(ax+b)^2}+\frac{A_3}{(ax+b)^3}+\ldots+\frac{A_m}{(ax+b)^m}$
ax^2+bx+c irreducible quadratic (has no real zeros)	$\frac{Ax+B}{ax^2+bx+c}$
$(ax^2+bx+c)^m$ mth power of an irreducible quadratic	$\frac{A_1x+B_1}{ax^2+bx+c}+\frac{A_2x+B_2}{(ax^2+bx+c)^2}+\frac{A_3x+B_3}{(ax^2+bx+c)^3}+\ldots+\frac{A_mx+B_m}{(ax^2+bx+c)^m}$

b. Multiply both sides of the resulting equation by the least common denominator, which is the original denominator.

c. At this point you have 2 options: Heavyside method or Equating coefficients.

i. Heavyside method: Substitute in a value that makes one of the factors in the L.C.D. equal to 0, then solve for one of the unknowns. Continue this process until all of the unknowns are determined.

ii. Equating coefficients: Distribute, collect like terms, then factor out each power of x until you have an equation that looks like:

$3x^2-5=(3A-2B)x^2+(A-C)x+(5C)$ Then equate coefficients:

$$\begin{cases}3A-2B=3\\A-C=0\\5C=-5\end{cases}$$ Solve this system to determine the unknowns.

15. $\int\frac{2}{(x-1)(x^2+1)}dx$

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

E. Integration by parts

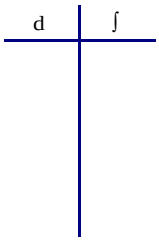
This is a technique that will allow us to integrate many more types of integrals, especially those consisting of a product of two functions. It is like a product rule for integrals. To derive the formula, we will use the product rule for derivatives:

Let $u = u(x)$ and $v = v(x)$ be differentiable functions of x.

General guideline for choosing **u** and **dv**: Try letting **dv** be the most complicated part of the integrand that fits a basic integration rule. Then **u** will be the remaining factor in the integrand.

We can also choose the factor for **u** based on the acronym LIATE (Logarithmic, Inverse trig, Algebraic, Trigonometric, Exponential) in that order.

Develop tabular method:



When using the tabular method, stop when either the derivatives reach zero or the integral of the product of the terms in a row fits an integration rule or is a multiple of the original integral.

17. $\int x^3 \sin x \, dx$

18. $\int x^2 \ln x \, dx$

19. $\int e^{3x} \cos 2x \, dx$