

Name: OGIMI BLESSING OGHENEFEJIKO
 Dept: MBBS
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$$(1) \int \frac{11-3x}{x^2+2x-3} dx = \int \frac{11-3x}{(x+3)(x-1)} dx$$

$$\frac{11-3x}{(x+3)(x-1)} = \frac{A}{x+3} + \frac{B}{x-1}$$

$$\frac{11-3x}{(x+3)(x-1)} = \frac{A(x-1) + B(x+3)}{(x+3)(x-1)} \quad \text{multiply through}$$

$$11-3x = A(x-1) + B(x+3)$$

$$\text{At } x=1$$

$$11-3(1) = B(1+3)$$

$$8 = 4B$$

$$B = \frac{8}{4} = 2$$

$$\text{At } x=-3$$

$$11-3(-3) = A(-3-1)$$

$$11+9 = A(-4)$$

$$20 = A(-4)$$

$$A = \frac{20}{-4} = -5$$

Substituting

$$\int \frac{11-3x}{x^2+2x-3} dx = \int \frac{-5}{x+3} dx + \int \frac{2}{x-1} dx$$

$$u = x+3 \quad u = x-1$$

$$\frac{du}{dx} = 1 \quad \frac{du}{dx} = 1$$

$$dx = du \quad dx = du$$

Substituting

$$\int \frac{11-3x}{x^2+2x-3} dx = -5 \int \frac{du}{u} + 2 \int \frac{du}{u}$$

$$\int \frac{11-3x}{x^2+2x-3} dx = -5 \ln u + 2 \ln u + C$$

$$(2) \int \frac{4x-16}{x^2-2x-3} dx = \int \frac{4x-16}{(x-3)(x+1)} dx$$

$$\frac{4x-16}{(x-3)(x+1)} = \frac{A}{x-3} + \frac{B}{x+1}$$

$$\frac{4x-16}{(x-3)(x+1)} = \frac{A(x+1) + B(x-3)}{(x-3)(x+1)} \quad \text{multiply thro}$$

$$4x-16 = A(x+1) + B(x-3)$$

$$\text{At } x = -1$$

$$4(-1)-16 = A(-1+1) + B(-1-3)$$

$$-20 = B(-4)$$

$$B = \frac{-20}{-4} = 5$$

$$\text{At } x = 3$$

$$4(3)-16 = A(3+1) + B(3-3)$$

$$12-16 = A(4)$$

$$-4 = A(4)$$

$$A = \frac{-4}{4} = -1$$

$$\int \frac{4x-16}{x^2-2x-3} = \int \frac{A}{x-3} dx + \int \frac{B}{x+1} dx$$

$$\int \frac{4x-16}{x^2-2x-3} = \int \frac{-1}{x-3} dx + \int \frac{5}{x+1} dx$$

$$u = x-3$$

$$u = x+1$$

$$\frac{du}{dx} = 1$$

$$\frac{du}{dx} = 1$$

$$dx$$

$$dx$$

$$\int \frac{4x-16}{x^2-2x-3} dx = \int \frac{-1 du}{u} + \int \frac{5 du}{4}$$

$$\int \frac{4x-16}{x^2-2x-3} dx = -1 \ln u + 5 \ln u + c$$

$$\int \frac{4x-16}{x^2-2x-3} dx = -1 \ln(x-3) + 5 \ln(x+1) + c$$

$$(3) \int \frac{2x^2 - 9x - 35}{(x+1)(x-2)(x+3)} dx = \frac{A}{x+1} + \frac{B}{x-2} + \frac{C}{x+3}$$

$$\frac{2x^2 - 9x - 35}{(x+1)(x-2)(x+3)} = \frac{A}{x+1} + \frac{B}{x-2} + \frac{C}{x+3}$$

$$= \frac{A(x-2)(x+3) + B(x+1)(x+3) + C(x+1)(x-2)}{(x+1)(x-2)(x+3)}$$

$$\frac{2x^2 - 9x - 35}{(x+1)(x-2)(x+3)} = \frac{A(x^2 + x - 6) + B(x^2 + 4x + 3) + C(x^2 - x - 2)}{(x+1)(x-2)(x+3)}$$

multiply through by $(x+1)(x-2)(x+3)$

$$2x^2 - 9x - 35 = A(x^2 + x - 6) + B(x^2 + 4x + 3) + C(x^2 - x - 2)$$

$$2x^2 - 9x - 35 = Ax^2 + Ax - 6A + Bx^2 + 4Bx + 3B + Cx^2 - Cx - 2C$$

$$2x^2 - 9x - 35 = (A+B+C)x^2 + x(A+4B-C) + (-6A+3B-2C)$$

$$(A+B+C)x^2 = 2x^2$$

$$A+B+C = 2 \quad \text{--- (1)}$$

$$(A+4B-C)x = -9x$$

$$A+4B-C = -9 \quad \text{--- (2)}$$

$$-6A+3B-2C = -35 \quad \text{--- (3)}$$

from (1) $A = 2 - B - C$

substitute into (2) and (3)

$$2 - B - C + 4B - C = -9$$

$$2 + 3B - 2C = -9 \implies 3B - 2C = -11 \quad \text{--- (4)}$$

$$-6(2 - B - C) + 3B - 2C = -35$$

$$-12 + 6B + 6C + 3B - 2C = -35$$

$$6B + 3B + 6C - 2C = -35 + 12 \implies 9B + 4C = 23 \quad \text{--- (5)}$$

$$3B - 2C = -11 \quad \text{--- (4)} \times 4$$

$$9B + 4C = 23 \quad \text{--- (5)} \times 2$$

$$12B - 8C = -44 \quad \text{--- (6)}$$

$$18B + 8C = 46 \quad \text{--- (7)}$$

eg. (6) - (7)

$$-6B = -90$$

$$B = \frac{-90}{-6} = 15$$

$$3(15) - 2C = -11$$

$$45 - 2C = -11$$

$$-2C = -11 - 45$$

$$-2C = -56$$

$$C = \frac{56}{2} = 28$$

$$A = 2 - B - C$$

$$A = 2 - 15 - 28$$

$$A = -41$$

$$\int \frac{2x^2 - 9x - 35}{(x+1)(x-2)(x+3)} dx = \int \frac{-41}{x+1} dx + \int \frac{15}{x-2} dx + \int \frac{28}{x+3} dx$$

$$u = x+1$$

$$u = x-2$$

$$u = x+3$$

$$\frac{du}{dx} = 1$$

$$\frac{du}{dx} = 1$$

$$\frac{du}{dx} = 1$$

$$\int \frac{2x^2 - 9x - 35}{(x+1)(x-2)(x+3)} dx = \int \frac{-41 du}{u} + \int \frac{15 du}{u} + \int \frac{28 du}{u}$$

$$\int \frac{2x^2 - 9x - 35}{(x+1)(x-2)(x+3)} dx = -41 \int \frac{du}{u} + 15 \int \frac{du}{u} + 28 \int \frac{du}{u}$$

$$\int \frac{2x^2 - 9x - 35}{(x+1)(x-2)(x+3)} dx = -41 \ln u + 15 \ln u + 28 \ln u$$

$$\int \frac{2x^2 - 9x - 35}{(x+1)(x-2)(x+3)} dx = -41 \ln(x+1) + 15 \ln(x-2) + 28 \ln(x+3) + C$$