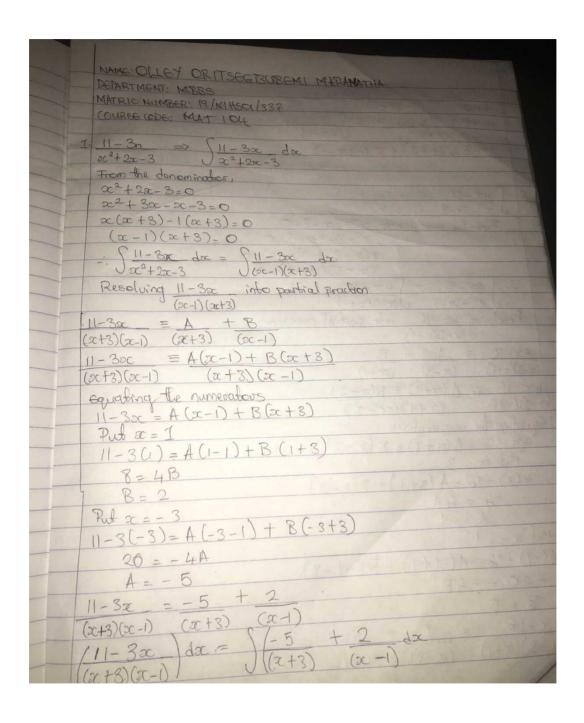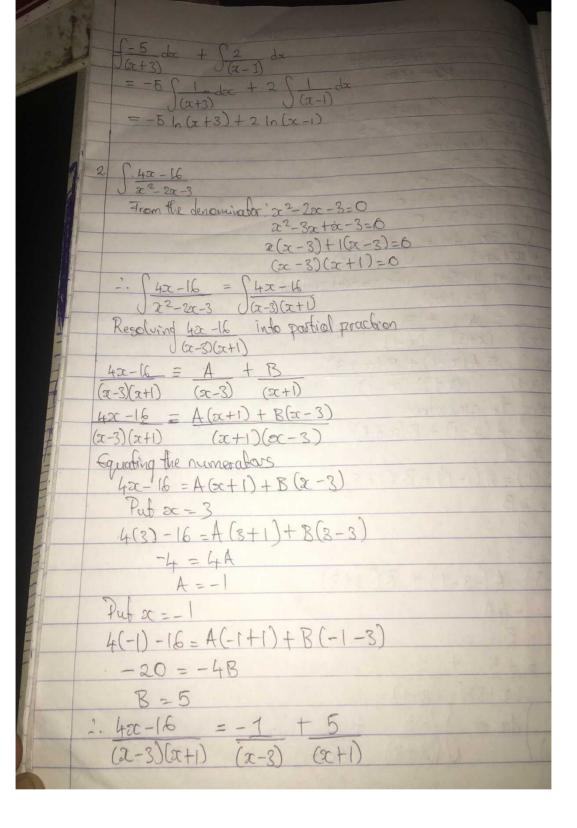NAME: OLLEY ORITSEGBUBEMI MARANATHA
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1. $\dfrac{11-3n}{x^2+2x-3} \Rightarrow \displaystyle\int \dfrac{11-3x}{x^2+2x-3}\, dx$

From the denominator,

$x^2+2x-3=0$

$x^2+3x-x-3=0$

$x(x+3)-1(x+3)=0$

$(x-1)(x+3)=0$

$\therefore \displaystyle\int \dfrac{11-3x}{x^2+2x-3}\, dx = \int \dfrac{11-3x}{(x-1)(x+3)}\, dx$

Resolving $\dfrac{11-3x}{(x-1)(x+3)}$ into partial fraction

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

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

equating the numerators

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

Put $x=1$

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

$8 = 4B$

$B = 2$

Put $x=-3$

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

$20 = -4A$

$A = -5$

$\dfrac{11-3x}{(x+3)(x-1)} = \dfrac{-5}{(x+3)} + \dfrac{2}{(x-1)}$

$\displaystyle\int \dfrac{11-3x}{(x+3)(x-1)}\, dx = \int \dfrac{-5}{(x+3)} + \dfrac{2}{(x-1)}\, dx$

$$\int \frac{-5}{(x+3)} dx + \int \frac{2}{(x-1)} dx$$

$$= -5 \int \frac{1}{(x+3)} dx + 2 \int \frac{1}{(x-1)} dx$$

$$= -5 \ln(x+3) + 2 \ln(x-1)$$

2. $\int \frac{4x-16}{x^2-2x-3}$

From the denominator: $x^2-2x-3=0$

$$x^2-3x+x-3=0$$
$$x(x-3)+1(x-3)=0$$
$$(x-3)(x+1)=0$$

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

Resolving $\frac{4x-16}{(x-3)(x+1)}$ into partial fraction

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

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

Equating the numerators

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

Put $x = 3$

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

Put $x = -1$

$$4(-1)-16 = A(-1+1) + B(-1-3)$$
$$-20 = -4B$$
$$B = 5$$

$\therefore \frac{4x-16}{(x-3)(x+1)} = \frac{-1}{(x-3)} + \frac{5}{(x+1)}$

$$\int \left(\frac{4x-16}{(x-3)(x+1)}\right) dx = \int \left(\frac{-1}{(x-3)} + \frac{5}{(x+1)}\right) dx$$

$$= \int \frac{-1}{(x-3)} dx + \int \frac{5}{(x+1)} dx$$

$$= -1 \int \frac{1}{(x-3)} dx + 5 \int \frac{1}{(x+1)} dx$$

$$= -1 \ln(x-3) + 5 \ln(x+1)$$

3. $\int \frac{2x^2 - 9x - 35}{(x+1)(x-2)(x+3)}$

Resolving into partial fraction

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

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

Equating the numerators

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

Put $x = 2$

$-45 = 15B$

$B = -3$

Put $x = 1$

$-24 = -6A$

$A = 4$

Put $x = -3$

$10 = 10C$

$C = 1$

$$\therefore \frac{2x^2 - 9x - 35}{(x+1)(x-2)(x+3)} = \frac{4}{(x+1)} - \frac{3}{(x-2)} + \frac{1}{(x+3)}$$

$$\int \frac{2x^2 - 9x - 35}{(x+1)(x-2)(x+3)} = \int \left(\frac{4}{(x+1)} - \frac{3}{(x-2)} + \frac{1}{(x+3)}\right) dx$$

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

$$\Rightarrow 4 \ln(x+1) - 3 \ln(x-2) + \ln(x+3)$$