Qn 1; $\int x\sqrt{x+3}\,dx$

Let $u = x + 3$

Then $x = u - 3$ and $du/dx = 1$

$\therefore \int (u-3)u^{1/2} \Rightarrow \int (u^{3/2} - 3u^{1/2})\,du = \frac{2}{5}u^{5/2} - 2u^{3/2} + C$

Ans; $\underline{\underline{\frac{2}{5}u^{5/2} - 2u^{3/2}}} + C \Rightarrow \frac{2}{5}(x+3)^{5/2} - 2(x+3)^{3/2} + C$

Qn 2; $\int \frac{x^2}{(x^3+1)^2}\,dx$

Let $u = x^3 + 1$

$du/dx = 3x^2 \Rightarrow \frac{du}{3x^2} = \frac{\cancel{3x^2}\,dx}{\cancel{3x^2}} \Rightarrow dx = du/3x^2$

$\int \frac{\cancel{x^2}}{(u)^2} \cdot \frac{1}{3\cancel{x^2}}\,du \Rightarrow \frac{1}{3}\int \frac{1}{(u)^2}\,du$

$= \frac{1}{3}\int u^{-2}\,du \Rightarrow \frac{1}{3} - u^{-1} + C \Rightarrow -\frac{1}{3u} + C$

Thus; Ans $= \frac{-1}{3(x^3+1)} + C$

Question 3

$$\int \frac{1}{1+e^x}\, dx = \int \frac{e^{-x}}{e^{-x}+1}\, dx$$

$$u = e^{-x}+1 \Rightarrow \frac{du}{dx} = -e^{-x} \Rightarrow du = -e^{-x} dx$$

$$e^{-x} dx = -du$$

$$\int \frac{e^{-x}}{e^{-x}+1}\, dx = \int \frac{-du}{u} = -\int \frac{du}{u} = -\ln|u| + c$$

$$-\ln|e^{-x}+1| + c$$

<u>Question 4</u>

$$\int x^2 e^x\, dx$$

$u = x^2$ $\quad dv = e^x dx$

$du = 2d\,\cancel{d}x$ $\quad v = e^x$

$$\int u\, dv = uv - \int v\, du$$

$$\int x^2 e^x\, dx = x^2 e^x - \int e^x (2x)\, dx$$

$$= e^x x^2 - 2\int x e^x\, dx$$

$u = x$ $\quad dv = e^x dx$

$du = dx$ $\quad v = e^x$

$$\int x e^x\, dx = xe^x - \int e^x\, dx = xe^x - e^x + c$$

$$\int x^2 e^x\, dx = e^x x^2 - 2(xe^x - e^x) + c$$

$$= e^x x^2 - 2xe^x + 2e^x + C$$

$$= e^x (x^2 - 2x + 2) + C$$

5. $\int x^2 \ln(x)\,dx$

$\int u\,dv = uv - \int v\,du$

$u = \ln(x) \quad du = \frac{1}{x}dx$

$dv = x^2\,dx \quad v = \frac{x^3}{3}$

$\int x^2 \ln(x)\,dx = \frac{x^3}{3}\ln(x) - \int \frac{x^3}{3}\cdot\frac{1}{x}\,dx$

$= \frac{x^3}{3}\ln(x) - \frac{1}{3}\int x^2\,dx$

$= \frac{x^3}{3}\ln(x) - \frac{1}{3}\cdot\frac{x^3}{3} + c$

$= \frac{x^3}{3}\ln(x) - \frac{x^3}{9} + c$

6. $\int e^x \cos x\,dx$

$I = \int e^x \cos x\,dx$

Let $u = e^x$, $dv = \cos x\,dx$, $v = \sin x$

$du = e^x dx$ ~~$\sin x$~~

$\therefore I = e^x \sin x - \int e^x \sin x\,dx$

$J = \int e^x \sin x\,dx$

Let $u = e^x$, $dv = \sin x\,dx$, $v = -\cos x$

$du = e^x\,dx$

$\therefore J = -e^x \cos x + \int e^x \cos x\,dx$

But $\int e \cos x\,dx = I$

$\therefore J = -e^x \cos x + I$

$I = e^x \sin x - J$

$= e^x \sin x - (-e^x \cos x + I)$

$I = e^x \sin x + e^x \cos x - I$

$\therefore 2I = e^x \sin x + e^x \cos x$

$\therefore I = \frac{e^x}{2}(\sin x + \cos x) + c$

7. ~~$0 = x$~~ $0 = x^3 - 3x^2 + 2x$

$0 = x(x^2 - 3x + 2)$ $p = 2$ $s = -3$

$0 = x(x-2)(x-1)$

$x = 0, 2, 1$

$$\text{Area} = \int_0^1 x^3 - 3x^2 + 2x\,dx - \int_1^2 x^3 - 3x^2 + 2x$$

$$= \int_0^1 \frac{x^4}{4} - \frac{3x^3}{3} + \frac{2x^2}{2} - \int_1^2 \frac{x^4}{4} - \frac{3x^3}{3} + \frac{2x^2}{2}$$

$$= \int_0^1 \frac{x^4}{4} - x^3 + x^2 - \int_1^2 \frac{x^4}{4} - x^3 + x^2$$

$$= \left[\frac{x^4}{4} - x^3 + x^2\right]_0^1 - \left[\frac{x^4}{4} - x^3 + x^2\right]_1^2$$

$$= \left[\frac{1}{4} - 1 + 1\right] - 0 - \left[\frac{16}{4} - 8 + 4\right] - \left[\frac{1}{4}\right]$$

$= 1/4 - [-1/4] = 1/4 + 1/4 = 1/2$

= ~~0 units~~ $1/2$ units

8 $e^{-x} = 1$

~~the~~ They

$e^{-x} = 1 - x$ $x = 0$ only point of intersection

The only point of intersection is 0 hence the area between the curves and their intersections is zero

$= 0$

9) $\int \frac{x+5}{x^2+2x+3} dx$

Sln

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

$\frac{x+5}{(x-1)(x+3)} = \frac{A}{x-1} + \frac{B}{(x+3)} = \frac{A(x+3)+B(x-1)}{(x-1)(x+3)}$

$x+5 = Ax+3A+Bx-B$

$A+B=1 \Rightarrow A=3$

$3A-B=5 \qquad B=-2$

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

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

$= 3 \ln|x-1| - 2 \ln|x+3| + C$

10. $\int \frac{x^2+3x+2}{x^3+2x^2} dx$

Sln

$x^3+2x^2 = x^2(x+2)$

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

$x^2+3x+2 = Ax(x+2)+B(x+2)+Cx^2$

$A+C=1 \qquad A=1$

$2A+B=3 \Rightarrow B=1$

$2B=2 \qquad C=0$

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

$= \ln|x| + \frac{1}{x} + C$

9) $\int \frac{x+5}{x^2+}$

x^2+2x

$\frac{x+5}{(x-1)}$

$x+5$

$A+$

$3A$

$\Rightarrow \int$

10|

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