① $y = 3e^{5x}$

$y' = (3e^{5x})(5)$

$\boxed{y' = 15e^{5x}}$

② $y = \dfrac{3e^{x}}{3e^{x}+2}$

distribute the $3e^{x}$
- remember to add the exponents $3e^{x} \cdot 3e^{x} = 9e^{2x}$

$y' = \dfrac{(3e^{x}+2)(3e^{x})(1) - (3e^{x})(3e^{x})(1)}{(3e^{x}+2)^2}$ Quotient Rule

$= \dfrac{9e^{2x} + 6e^{x} - 9e^{2x}}{(3e^{x}+2)^2}$

$\boxed{y' = \dfrac{6e^{x}}{(3e^{x}+2)^2}}$

③ $y = \underbrace{4x^3}\,\underbrace{e^{2x}}$ Product Rule

$y' = (1)(d2) + (2)(d1)$

$= (4x^3)(e^{2x})(2) + (e^{2x})(12x^2)$

$y' = 8x^3e^{2x} + 12x^2e^{2x}$ factor out $4x^2e^{2x}$

$\boxed{y' = 4x^2e^{2x}(2x+3)}$

4. $y = \ln(1-x^2)$

$$\boxed{y' = \frac{-2x}{1-x^2}}$$

5. $y = \ln 3x^5$

rewrite before you find y'

$y = 5\ln 3x$ now find y'

$$y' = 5 \cdot \frac{\cancel{3}}{\cancel{3}x} = \boxed{\frac{5}{x} = y'}$$

6. $y = \underbrace{x^3}\,\underbrace{\ln x^3}$ product rule

$y' = (1)(d2) + (2)(d1)$

$= \cancel{(x^3)\left(\frac{3x^2}{x^3}\right)} + (\ln x^3)(3x^2)$

can't multiply together

$= 3x^2 + 3x^2 \ln x^3$

factor out a $3x^2$

$$\boxed{y' = 3x^2(1+\ln x^3)}$$

7. $\int -5\,dx$

$$= \boxed{-5x + C}$$

8. $\int x^5\,dx$

$$\frac{x^{5+1}}{6} = \boxed{\frac{1}{6}x^6 + C}$$

9. $\int 6x^{-4}\,dx$

$$\frac{6x^{-4+1}}{-3} = -2x^{-3}$$

$$= \boxed{\frac{-2}{x^3} + C}$$

10. $\int 3x^{\frac{2}{5}}\,dx$

$$\frac{5}{7} \cdot 3x^{\frac{2}{5}+\frac{5}{5}}$$

$$\boxed{15x^{\frac{7}{5}} + C}$$

11. $\int 6x^3 - 5x^2 - 7\,dx$

$$\frac{6x^{3+1}}{4} - \frac{5x^{2+1}}{3} - 7x$$

$$= \boxed{\frac{3}{2}x^4 - \frac{5}{3}x^3 - 7x + C}$$

12. $\int x^{\frac{5}{3}} - 2x^{\frac{1}{2}}\,dx$

$\frac{3}{8}x^{\frac{5}{3}+\frac{3}{3}} - \frac{2}{3}2x^{\frac{1}{2}+\frac{2}{2}}$

$$\boxed{\frac{3}{8}x^{\frac{8}{3}} - \frac{4}{3}x^{\frac{3}{2}} + C}$$

13. $\int \frac{3}{x^2} - \frac{5}{\sqrt{x}}\,dx$

$\frac{3x^{-2+1}}{-1} - 2\,5x^{-\frac{1}{2}+\frac{2}{2}}$

$-3x^{-1} - 10x^{\frac{1}{2}}$

$$= \boxed{\frac{-3}{x} - 10\sqrt{x} + C}$$

14. $\int \frac{2\sqrt{x}+6}{x^3}\,dx$

divide the problem out first

$\int \frac{2x^{\frac{1}{2}}}{x^{3}} + \frac{6}{x^3}\,dx$

subtract exponents

$\int 2x^{\frac{1}{2}-3} + 6x^{-3}$

$-2\cdot 2x^{-\frac{5}{2}+\frac{2}{2}} + \frac{6x^{-3+1}}{-2}$

$-4x^{-1/2} - 3x^{-2}$

$$\boxed{-\frac{4}{\sqrt{x}} - \frac{3}{x^2} + C}$$

15. move this out

$\int 2(5x+1)^4\,dx$

$u = 5x+1$
$du = 5\,dx$

$\frac{1}{5}\cdot 2\int 5(5x+1)^4\,dx$

$\frac{2}{5}\int u^4\,du$

$\frac{1}{5}\cdot\frac{2}{5}u^{4+1}$

$$\frac{2}{25}u^5 = \boxed{\frac{2}{25}(5x+1)^5 + C}$$

16. $\int x^2\sqrt{x^3+2}\,dx$

$u = x^3+2$
$du = 3x^2\,dx$

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

$\frac{1}{3}\int u^{\frac{1}{2}}\,du$

$\frac{2}{3}\cdot\frac{1}{3}u^{\frac{1}{2}+\frac{2}{2}}$

$$\frac{2}{9}u^{\frac{3}{2}} = \boxed{\frac{2}{9}(x^3+2)^{\frac{3}{2}} + C}$$

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

$u = 3x^2+1$
$du = 6x\,dx$

$\frac{1}{6}\int 6x(3x^2+1)^{-3}\,dx$

$\frac{1}{6}\int u^{-3}\,du$

$-\frac{1}{2}\cdot\frac{1}{6}u^{-3+1}$

$$-\frac{1}{12}u^{-2} = \boxed{\frac{-1}{12(x^3+2)^2} + C}$$

18. move this out

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

$$3\int e^{2x}\,dx \qquad u = 2x \qquad du = 2\,dx$$

$$\tfrac{1}{2}\,3\int 2e^{u}$$

$$\frac{3}{2}\int e^{u}\,du = \frac{3}{2}e^{u} + C = \boxed{\frac{3}{2}e^{2x} + C}$$

19. move this out

$$\int 5x^{2}e^{-6x^{3}}\,dx$$

$$-\frac{1}{18}\cdot 5\int -18x^{2}e^{-6x^{3}}\,dx \qquad u = -6x^{3} \qquad du = -18x^{2}$$

$$\frac{-5}{18}\int e^{u}\,du = \frac{-5}{18}e^{u}$$

$$= \boxed{\frac{-5}{18}e^{-6x^{3}} + C}$$

20. move this out

$$\int \frac{7}{3+4x}\,dx$$

$$7\int \frac{1}{3+4x}\,dx \qquad u = 3+4x \qquad du = 4\,dx$$