Solve:

1) Solve $\frac{dy}{dx} = \csc^2(2x)$

subject to the initial condition $y(\pi/8) = -1$.

$\int \csc^2(2x)dx$ $\quad u=2x \quad \frac{du}{dx}=2 \quad dx=\frac{du}{2}$

$\int \csc^2 u \cdot \frac{du}{2}$

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

$y=-\frac{1}{2}\cot(2x)+C$

$y=-\frac{1}{2}\cot(2x)+C$

$-1=-\frac{1}{2}\cot\left(\frac{\pi}{4}\right)+C$

$-1=-\frac{1}{2}\cdot 1+C$

$C=-\frac{1}{2}$

$\boxed{y=-\frac{1}{2}\cot(2x)-\frac{1}{2}}$

2) Solve $\frac{dy}{dx} = -\sec^2(-3x)$

subject to the initial condition $y(-\pi/12) = 2$.

$\int -\sec^2(-3x)dx$ $\quad u=-3x \quad \frac{du}{dx}=-3 \quad dx=-\frac{du}{3}$

$-\int \sec^2 u \cdot -\frac{du}{3}$

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

$y=\frac{1}{3}\tan(-3x)+C$

$2=\frac{1}{3}\tan\left(\frac{\pi}{4}\right)+C$

$2=\frac{1}{3}\cdot 1+C$

$C=\frac{5}{3}$

$\boxed{y=\frac{1}{3}\tan(-3x)+\frac{5}{3}}$

3) Solve $\frac{dy}{dx} = -3\sec^2(3x)$

subject to the initial condition $y(\pi/12) = 0$.

$-3\int \sec^2(3x)dx$ $\quad u=3x \quad \frac{du}{dx}=3 \quad dx=\frac{du}{3}$

$-3\int \sec^2 u \cdot \frac{du}{3}$

$-\int \sec^2 u\, du$

$y=-\tan(3x)+C$

$0=-\tan\left(\frac{\pi}{4}\right)+C$

$0=-1+C \quad C=1$

$\boxed{y=-\tan(3x)+1}$

4) Solve $\frac{dy}{dx} = -5x^2 + x - 4$

subject to the initial condition $y(1) = -3$.

$\int -5x^2+x-4\, dx$

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

$-3=-\frac{5}{3}+\frac{1}{2}-4+C$

$C=\frac{13}{6}$

$\boxed{y=-\frac{5}{3}x^3+\frac{x^2}{2}-4x+\frac{13}{6}}$

5) Solve $\frac{dy}{dx} = 2\cos(x)$

subject to the initial condition $y(\pi/2) = 3$.

$2\int \cos x\, dx$

$y=2\sin x+C$

$3=2\sin\left(\frac{\pi}{2}\right)+C$

$3=2\cdot 1+C$

$C=1$

$\boxed{y=2\sin x+1}$

6) Solve $\frac{dy}{dx} = -4x^2 - 4x - 2$

subject to the initial condition $y(0) = 3$.

$\int -4x^2-4x-2\, dx$

$y=-\frac{4}{3}x^3-2x^2-2x+C$

$3=0+C$

$C=3$

$\boxed{y=-\frac{4}{3}x^3-2x^2-2x+3}$

7) The velocity of a particle moving along the x-axis is given by $v(t) = 2t^2 + 3$. Find its position as a function of t if $s(0) = -2$.

$s(t)=\int 2t^2+3\, dt = \frac{2}{3}t^3+3t+C$

$-2=0+C$

$C=-2$

$\boxed{s(t)=\frac{2}{3}t^3+3t-2}$

8) **A particle moving along a straight line has an acceleration *a = 4 t*. When *t = 0*, the velocity *v* of the particle and its position *s* are respectively equal to *3* and *4*. Find its position *s* as a function of time *t*.**

$v(t)=\int 4t\, dt = 2t^2+C \quad 3=0+C \quad C=3 \quad v(t)=2t^2+3$

$s(t)=\int 2t^2+3\, dt = \frac{2}{3}t^3+3t+C \quad 4=0+C \quad C=4 \quad \boxed{s(t)=\frac{2}{3}t^3+3t+4}$