$\boxed{8.1}$ - 2, 4, 8, 12, 30, 38, 40, 44, 50, 54, 58, 64

(2) $\int \frac{3\cos x \, dx}{\sqrt{1+3\sin x}}$

Let $u = 1+3\sin x \Rightarrow du = 3\cos x \, dx$.

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

$= \boxed{2\sqrt{1+3\sin x} + C}$

(4) $\int \cot^3 y \csc^2 y \, dy$

Let $u = \cot y \Rightarrow du = -\csc^2 y \, dy$.

$\int -u^3\,du = -\frac{1}{4}u^4 + C$

$= \boxed{-\frac{1}{4}\cot^4 y + C}$

(8) $\int \frac{dx}{x-\sqrt{x}} = \int \frac{dx}{\sqrt{x}(\sqrt{x}-1)}$

Let $u = \sqrt{x}-1 \Rightarrow du = \frac{1}{2\sqrt{x}}\,dx$

$\int 2\cdot\frac{1}{u}\,du = 2\ln|u| + C$

$= \boxed{2\ln|\sqrt{x}-1| + C}$

(12) $\int \frac{\cot(3+\ln x)}{x}\,dx$

Let $u = \ln x \Rightarrow du = \frac{1}{x}\,dx$

$\int \cot(3+u)\,du = \ln|\sin(3+u)| + C$

$= \boxed{\ln|\sin(3+\ln x)| + C}$

(30) $\int \frac{2\,dx}{x\sqrt{1-4\ln^2 x}}$

Let $u = 2\ln x \Rightarrow du = \frac{2}{x}\,dx$

$\int \frac{1}{\sqrt{1-u^2}}\,du = \sin^{-1}\left(\frac{u}{1}\right) + C$

$= \boxed{\sin^{-1}(2\ln x) + C}$

(38) $\int_2^4 \frac{2\,dx}{x^2-6x+10}$

CTS: $x^2-6x+10 = (x^2-6x+9)+1 = (x-3)^2+1$

$\int_2^4 \frac{2\,dx}{(x-3)^2+1}$

Let $u = x-3 \Rightarrow du = dx$

$\int_2^4 \frac{2}{u^2+1}\,du = 2\cdot\frac{1}{1}\tan^{-1}\left(\frac{u}{1}\right)\Big|_2^4$

$= 2\tan^{-1}(x-3)\Big|_2^4 = 2\left[\tan^{-1}(1) - \tan^{-1}(-1)\right]$

$= 2\left(\frac{\pi}{4} - \left(-\frac{\pi}{4}\right)\right) = 2\left(\frac{\pi}{2}\right) = \boxed{\pi}$

(40) $\int \frac{d\theta}{\sqrt{2\theta-\theta^2}}$

CTS: $2\theta-\theta^2 = -(\theta^2-2\theta+1)+1 = 1-(\theta-1)^2$

$\int \frac{d\theta}{\sqrt{1-(\theta-1)^2}}$

Let $u = \theta-1 \Rightarrow du = d\theta$

$\int \frac{du}{\sqrt{1-u^2}} = \sin^{-1}\left(\frac{u}{1}\right)+C = \boxed{\sin^{-1}(\theta-1)+C}$

(44) $\int (\csc x - \tan x)^2\,dx$

$(\csc x - \tan x)^2 = \csc^2 x - 2\csc x\tan x + \tan^2 x$

$= \csc^2 x - 2\left(\frac{1}{\sin x}\right)\left(\frac{\sin x}{\cos x}\right) + (\sec^2 x - 1)$

$= \csc^2 x - 2\sec x + (\sec^2 x - 1)$

$\int \csc^2 x\,dx - 2\int \sec x + \int (\sec^2 x - 1)\,dx$

$= \boxed{-\cot x - 2\ln|\sec x + \tan x| + \tan x - x + C}$

(50) $\int_{-1}^3 \frac{4x^2-7}{2x+3}\,dx$

Division: $2x+3 \,\overline{)\,4x^2-7}$ quotient $2x-3$; $-(4x^2+6x)$; $-6x-7$; $-(-6x-9)$; 2

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

$x^2-3x\Big|_{-1}^3 + \int_{-1}^3 \frac{1}{u}\,du \quad \begin{pmatrix} u = 2x+3 \\ du = 2\,dx \end{pmatrix}$

$(9-9)-(1+3) + \ln|2x+3|\Big|_{-1}^3$

$-4 + \ln(9) - \ln(1)$

$-4 + \ln(9) - 0 = -4 + \ln 3^2 = \boxed{-4+2\ln 3}$

(54) $\int \frac{x+2\sqrt{x-1}}{2x\sqrt{x-1}}\,dx = \int \frac{x}{2x\sqrt{x-1}}\,dx + \int \frac{2\sqrt{x-1}}{2x\sqrt{x-1}}$

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

$\begin{pmatrix} u = x-1 \\ du = dx \end{pmatrix} \quad = \int \frac{1}{2\sqrt{u}}\,du + \ln|x| + C$

$= \sqrt{u} + \ln|x| + C$

$= \boxed{\sqrt{x-1} + \ln|x| + C}$

(58) $\int \frac{1}{1+\cos x}\,dx$

Note: $1+\cos x = 1+\cos\left(2\cdot\frac{x}{2}\right) = 2\cos^2\left(\frac{x}{2}\right)$, so

$\int \frac{1}{1+\cos x}\,dx = \int \frac{1}{2\cos^2\left(\frac{x}{2}\right)}\,dx$

$= \frac{1}{2}\int \sec^2\left(\frac{x}{2}\right)dx$

$= \boxed{\frac{1}{2}\tan\left(\frac{x}{2}\right) + C}$

(64) $\int_0^{\pi} \sqrt{1-\cos 2x}\,dx$

Recall: $1+\cos 2x = 2\cos^2 x$

$\Rightarrow \quad -\cos 2x = 1 - 2\cos^2 x$

$\int_0^{\pi} \sqrt{1+1-2\cos^2 x}\,dx = \int_0^{\pi} \sqrt{2-2\cos^2 x}\,dx$

$= \int_0^{\pi} \sqrt{2}\cdot\sqrt{1-\cos^2 x}\,dx = \int_0^{\pi} \sqrt{2}\sqrt{\sin^2 x}\,dx$

$= \sqrt{2}\int_0^{\pi} |\sin x|\,dx = \sqrt{2}\int_0^{\pi} \sin x\,dx$ (b/c $\sin x \geq 0$ for $0 \leq x \leq \pi$)

$= \sqrt{2}\left(-\cos x \Big|_0^{\pi}\right) = \sqrt{2}\left[1-(-1)\right] = \boxed{2\sqrt{2}}$