1. $$\frac{d}{dx}\int_0^x \sqrt{4+t^6}\,\mathrm{d}t = \left(\sqrt{4+x^6}\right)(1) - \sqrt{4}(0) = \sqrt{4+x^6}$$

2. $$\frac{d}{dx}\int_2^x \frac{1}{t^4+4}\,\mathrm{d}t = \frac{1}{x^4+4}(1) - \frac{1}{2^4+4}(0) = \frac{1}{x^4+4}$$

3. $$\frac{d}{dx}\int_x^3 \sqrt{\sin t}\,\mathrm{d}t = \frac{d}{dx}\left[-\int_3^x \sqrt{\sin t}\,\mathrm{d}t\right] = -\sqrt{\sin x}\,(1) - \sqrt{\sin 3}\,(0) = -\sqrt{\sin x}$$

4. $$\frac{d}{dx}\int_{-x}^x \frac{1}{3+t^2}\,\mathrm{d}t = \frac{1}{3+x^2}(1) - \frac{1}{3+(-x)^2}(-1) = \frac{2}{3+x^2}$$

5. $$\frac{d}{dx}\int_1^{x^3} \sqrt[3]{t^2+1}\,\mathrm{d}t = \sqrt[3]{x^6+1}\,(3x^2) - \sqrt[3]{1+1}\,(0) = 3x^2\sqrt[3]{x^6+1}$$

6. $$\frac{d}{dx}\int_2^{\tan x} \frac{1}{1+t^2}\,\mathrm{d}t = \frac{1}{1+\tan^2 x}(\sec^2 x) - \frac{1}{1+2^2}\,(0) = \frac{\sec^2 x}{1+\tan^2 x} = \frac{\sec^2 x}{\sec^2 x} = 1$$

7. $F(2) = \int_2^2 \sqrt{3t^2+1}\,\mathrm{d}t = 0$

   $F'(x) = \sqrt{3x^2+1} \longrightarrow F'(2) = \sqrt{13}$

   $F''(x) = \dfrac{3x}{\sqrt{3x^2+1}} \longrightarrow F''(2) = \dfrac{6}{\sqrt{13}}$

8. $F(0) = \int_0^0 \dfrac{\cos t}{t^2+3}\,\mathrm{d}t = 0$

   $F'(x) = \dfrac{\cos x}{x^2+3} \longrightarrow F'(0) = \dfrac{1}{3}$

   $F''(x) = \dfrac{(x^2+3)(-\sin x) - (\cos x)(2x)}{(x^2+3)^2} \longrightarrow F''(0) = 0$

9. $\dfrac{d}{dx}\displaystyle\int_{2x}^{3x} \frac{u-1}{u+1}\,\mathrm{d}u = \frac{3x-1}{3x+1}\ (3) - \frac{2x-1}{2x+1}\ (2)$

10. $\dfrac{d}{dx}\displaystyle\int_{\tan x}^{x^2} \frac{1}{\sqrt{2+t^4}}\,\mathrm{d}t = \frac{1}{\sqrt{2+x^8}}\ (2x) - \frac{1}{\sqrt{2+\tan^4 x}}\ (\sec^2 x)$

11. $\dfrac{d}{dx}\displaystyle\int_{\sqrt{x}}^{x^3} \sqrt{t}\,\mathrm{d}t = 3x^2\sqrt{x^3} - \frac{\sqrt[4]{x}}{2\sqrt{x}}$

12. $\dfrac{d}{dx}\displaystyle\int_{\cos x}^{5x} \cos u^2\,\mathrm{d}u = 5\cos 25x^2 - [\cos(\cos^2 x)](-\sin x)$

13. $F(x) = -3 + \displaystyle\int_5^x (t-3)^3\,\mathrm{d}t$

    $F(5) = -3 + 0 = -3$

    $F'(x) = 0 + (x-3)^3 \longrightarrow F'(5) = 8$

    $F''(x) = 3(x-3)^2 \longrightarrow F''(5) = 12$

14. $G(3) = 0$

    $G'(x) = \ln x$

    $G'(3) = \ln 3$

    $\therefore G(3) - G'(3) = -\ln 3$

15. $F(x) = -7 + \displaystyle\int_8^x \sqrt{2t^2-5}\,\mathrm{d}t$

    $F(8) = -7 + 0 = -7$

    $F'(x) = \sqrt{2x^2-5} \longrightarrow F'(8) = \sqrt{123}$

    $F''(x) = \dfrac{2x}{\sqrt{2x^2-5}} \longrightarrow F''(8) = \dfrac{16}{\sqrt{123}}$