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(a) $y = \frac{\cos x}{x}$ $u = \cos x$ $v = x$

$u' = -\sin x$ $v' = 1$

$$\frac{dy}{dx} = \frac{-x\sin x - \cos x}{x^2}$$

(b) $x^2 - x - 12 < 0$

$(x-4)(x+3) < 0$

$\therefore -3 < x < 4$

(c) $y = \ln(3x)$

$$\frac{dy}{dx} = \frac{3}{3x}$$

at $x = 2$, $m = \frac{1}{2}$

at $x = 2$, $y = \ln 6$

$\therefore y - \ln 6 = \frac{1}{2}(x-2)$

$2y - 2\ln 6 = x - 2$

$\therefore x - 2y - 2 + 2\ln 6 = 0$

(d) (i) $\int \sqrt{5x+1}\, dx$

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

$= \dfrac{(5x+1)^{\frac{3}{2}}}{3/2} + C$

$= \dfrac{2(5x+1)^{\frac{3}{2}}}{3} + C$

$= \dfrac{2\sqrt{(5x+1)^3}}{3} + C$

(ii) $\int \dfrac{x}{4+x^2}\, dx$

$= \dfrac{1}{2} \int \dfrac{2x}{4+x^2}$

$= \ln(4+x^2) + C$

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(e) $\int_0^6 (x+k)\,dx = 30$

$= \left[\frac{x^2}{2} + kx\right]_0^6 = 30$

$= \left(\frac{36}{2} + 6k\right) - (0) = 30$

$18 + 6k = 30$

$6k = 12$

$k = 2$