#1 $$f(x) = (x^2+3x+1)^{-5/2}$$

$$f'(x) = -\tfrac{5}{2}(x^2+3x+1)^{-7/2}(2x+3)$$

#2 $$f(x) = (x+x^{-1})\sqrt{x^2+1}$$
$$= (x+x^{-1})(x^2+1)^{1/2}$$

$$f'(x) = (x+x^{-1})\left[(x^2+1)^{1/2}\right]' + (x^2+1)^{1/2}(x+x^{-1})'$$

$$= (x+x^{-1})\tfrac{1}{2}(x^2+1)^{-1/2}2x +$$
$$(x^2+1)^{1/2}(1-x^{-2})$$

#3 $$f(x) = \frac{1}{\sqrt{\cos(x^2)+1}} = (\cos(x^2)+1)^{-1/2}$$

$$f'(x) = -\tfrac{1}{2}(\cos(x^2)+1)^{-3/2}(-\sin(x^2))2x$$

#4 $$f(x) = \tan(\sin x\cos x)$$

$$f'(x) = \sec^2(\sin x\cos x)(\sin x(-\sin x)$$
$$+ \cos x\cos x)$$

#5 $(x+2)^2 - 6(2y+3)^2 = 3$

$2(x+2)(1) - 12(2y+3)2y' = 0$

$2x + 4 - 48yy' - 72y' = 0$

$2x + 4 - (48y + 72)y' = 0$

$(48y+72)y' = 2x+4$

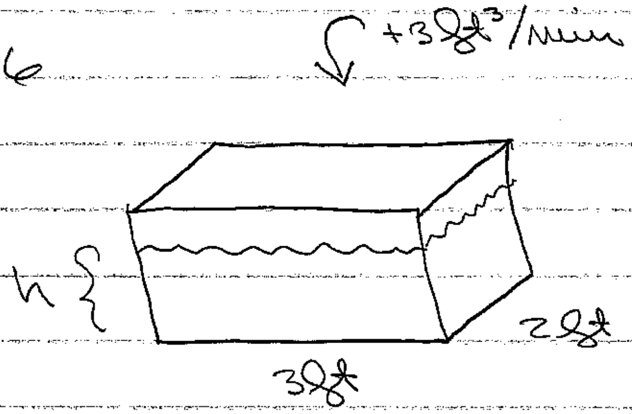
$y' = \dfrac{2x+4}{48y+72}$

at $(1,-1)$ $\quad y' = \dfrac{2+4}{-48+72} = \dfrac{6}{24}$

$= 1/4$

$y+1 = 1/4(x-1)$

#6



$V_{water} = 2ft * 3ft * h = 6ft^2 h$

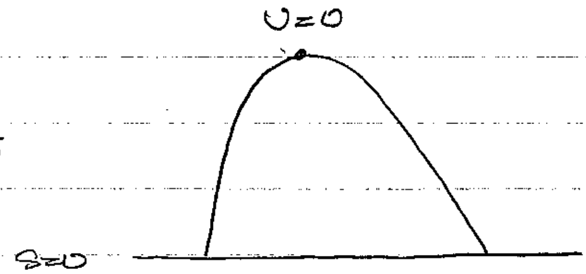
$\dfrac{dV}{dt} = 6ft^2 \dfrac{dh}{dt}$

$3\,ft^3/min = 6ft^2 \dfrac{dh}{dt}$

$1/2 = \dfrac{dh}{dt}$

h increases at the rate of 1/2 ft/min

#7



$$s = 80t - 16t^2$$

Maximum height $v = 80 - 32t$

when $v=0$ $\quad 0 = 80 - 32t$

$$t = \frac{80}{32} = 5/2 \text{ s.}$$

$$s(5/2) = 80(5/2) - 16(5/2)^2$$
$$= 200 - 100$$
$$= 100 \text{ ft.}$$

#8

$$f(x) = \frac{1}{\sqrt{x}+1} = (x^{1/2}+1)^{-1}$$

$$f'(x) = -(x^{1/2}+1)^{-2}\, \tfrac{1}{2} x^{-1/2}$$

$$f''(x) = -(x^{1/2}+1)^{-2}\left(-\tfrac{1}{4}x^{-3/2}\right) +$$
$$-\tfrac{1}{2}x^{-1/2}\,(-2)(x^{1/2}+1)^{-3}\,\tfrac{1}{2}x^{-1/2}$$