Section 2.2

#3 – 22, 31 – 34, 38 – 42, 72, 73, 74

3.

$y = 3$

$y' = 0$

Derivative of all constants is 0

4.

$f(x) = -2$

$f'(x) = 0$

Derivative of all constants is 0

5.

$f(x) = x + 1$

$f'(x) = 1$

6.

$g(x) = 3x - 1$

$g'(x) = 3$

Derivative =slope and slope =3

7.

$g(x) = x^2 + 4$

$g'(x) = 2x^{2-1} + 0$

$= 2x^1$

$= 2x$

8.

$y = t^2 + 2t - 3$

$y' = 2t^{2-1} + 2(1)t^{1-1} - 0$

$= 2t + 2$

9.

$$f(t) = -2t^2 + 3t - 6$$

$$f'(t) = -2(2)t^{2-1} + 3(1)t^{1-1} - 6$$

$$= -4t + 3$$

10.

$$y = x^3 - 9$$

$$y' = 3x^{3-1} - 0$$

$$= 3x^2$$

11.

$$s(t) = t^3 - 2t + 4$$

$$s'(t) = 3t^{3-1} - 2(1)t^{1-1} + 0$$

$$= 3t^2 - 2$$

12.

$$f(x) = 2x^3 - x^2 + 3x$$

$$f'(x) = 2(3)x^{3-1} - (2)x^{2-1} + 3(1)x^{1-1}$$

$$= 6x^2 - 2x + 3$$

13.

$$y = x^2 - \frac{1}{2}\cos x$$

$$y' = 2x - \frac{1}{2}(-\sin x)$$

$$y' = 2x + \frac{1}{2}\sin x$$

14.

$$y = 5 + \sin x$$

$$y' = 0 + \cos x$$

$$y' = \cos x$$

15.

$$y = \frac{1}{x} - 3\sin x$$

$$y = x^{-1} - 3\sin x$$

$$y' = -1x^{-1-1} - 3(\cos x)$$

$$y' = -1x^{-2} - 3\cos x$$

$$y' = \frac{-1}{x^2} - 3\cos x$$

16.

$$g(t) = \pi\cos t$$

$$g'(t) = \pi(-\sin t)$$

$$g'(t) = -\pi\sin t$$

17.

$$y = \frac{1}{3x^3}$$

$$y = \frac{1}{3} \cdot \frac{1}{x^3}$$

$$y = \frac{1}{3}x^{-3}$$

$$y' = (-3)\frac{1}{3}x^{-3-1}$$

$$y' = -1x^{-4}$$

$$y' = \frac{-1}{x^4}$$

18.

$$y = \frac{2}{3x^2}$$

$$y = \frac{2}{3} \cdot \frac{1}{x^2}$$

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

$$y' = (-2) \frac{2}{3} x^{-2-1}$$

$$y' = \frac{-4}{3} x^{-3}$$

$$y' = \frac{-4}{3x^3}$$

19.

$$y = \frac{1}{(3x)^3}$$

$$y = \frac{1}{3^3 x^3}$$

$$y = \frac{1}{27x^3}$$

$$y = \frac{1}{27} \cdot \frac{1}{x^3}$$

$$y = \frac{1}{27} x^{-3}$$

$$y' = (-3) \frac{1}{27} x^{-3-1}$$

$$y' = \frac{-3}{27} x^{-4}$$

$$y' = \frac{-1}{9x^4}$$

20.

$$y = \frac{\pi}{(3x)^2}$$

$$y = \frac{\pi}{3^2 x^2}$$

$$y = \frac{\pi}{9x^2}$$

$$y = \frac{\pi}{9} \cdot \frac{1}{x^2}$$

$$y = \frac{\pi}{9} x^{-2}$$

$$y' = (-2) \frac{\pi}{9} x^{-2-1}$$

$$y' = \frac{-2\pi}{9} x^{-3}$$

$$y' = \frac{-2\pi}{9x^3}$$

21.

$$y = \frac{\sqrt{x}}{x}$$

$$y = \frac{x^{\frac{1}{2}}}{x} = \frac{x^{\frac{1}{2}}}{x^1}$$

$$y = x^{\frac{1}{2}-1} = x^{\frac{1}{2}-\frac{1}{1}} = x^{\frac{1}{2}-\frac{2}{2}} = x^{\frac{-1}{2}}$$

$$y' = \frac{-1}{2} x^{\frac{-1}{2}-1} = \frac{-1}{2} x^{\frac{1}{2}-\frac{1}{1}} = \frac{-1}{2} x^{\frac{1}{2}-\frac{2}{2}}$$

$$y' = \frac{-1}{2} x^{\frac{-3}{2}}$$

$$y' = \frac{-1}{2x^{\frac{3}{2}}}$$

$$y' = \frac{-1}{2\sqrt{x^3}}$$

22.

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

$$y = 4x^3$$

$$y' = 4(3)x^{3-1}$$

$$y' = 12x^2$$

31.

$$f(x) = x^3 - 3x - 2x^{-4}$$

$$f'(x) = 3x^{3-1} - 3x^{1-1} - 2(-4)x^{-4-1}$$

$$f'(x) = 3x^2 - 3 + 8x^{-5}$$

$$f'(x) = 3x^2 - 3 + \frac{8}{x^5}$$

32.

$$f(x) = x^2 - 3x - 3x^{-2}$$

$$f'(x) = 2x^{2-1} - 3x^{1-1} - 3(-2)x^{-2-1}$$

$$f'(x) = 2x - 3 + 6x^{-3}$$

$$f'(x) = 2x - 3 + \frac{6}{x^3}$$

33.

$$g(t) = t^2 - \frac{4}{t}$$

$$g(t) = t^2 - 4t^{-1}$$

$$g'(t) = 2t^{2-1} - 4(-1)t^{-1-1}$$

$$g'(t) = 2t + 4t^{-2}$$

$$g'(t) = 2t + \frac{4}{t^2}$$

34.

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

$$f(x) = x + 1x^{-2}$$

$$f'(x) = 1x^{1-1} + 1(-2)x^{-2-1}$$

$$f'(x) = 1 - 2x^{-3}$$

$$f'(x) = 1 - \frac{2}{x^3}$$

38.

$$f(x) = \sqrt[3]{x} + \sqrt[5]{x}$$

$$f(x) = x^{\frac{1}{3}} + x^{\frac{1}{5}}$$

$$f'(x) = \frac{1}{3}x^{\frac{1}{3}-1} + \frac{1}{5}x^{\frac{1}{5}-1}$$

$$f'(x) = \frac{1}{3}x^{\frac{-2}{3}} + \frac{1}{5}x^{\frac{-4}{5}}$$

$$f'(x) = \frac{1}{3x^{\frac{2}{3}}} + \frac{1}{5x^{\frac{4}{5}}}$$

$$f'(x) = \frac{1}{3\sqrt[3]{x^2}} + \frac{1}{5\sqrt[5]{x^4}}$$

39.

$$h(s) = s^{\frac{4}{5}}$$

$$h'(s) = \frac{4}{5}s^{\frac{4}{5}-1} = \frac{4}{5}s^{\frac{4}{5}-\frac{1}{1}} = \frac{4}{5}s^{\frac{4}{5}-\frac{5}{5}}$$

$$h'(s) = \frac{4}{5}s^{\frac{-1}{5}}$$

$$h'(s) = \frac{4}{5s^{\frac{1}{5}}}$$

$$h'(s) = \frac{4}{5\sqrt[5]{s}}$$

40.

$$f(t) = t^{\frac{1}{3}} - 1$$

$$f'(t) = \frac{1}{3}t^{\frac{1}{3}-1} - 0$$

$$f'(t) = \frac{1}{3}t^{\frac{-2}{3}}$$

$$f'(t) = \frac{1}{3t^{\frac{2}{3}}}$$

$$f'(t) = \frac{1}{3\sqrt[3]{t^2}}$$

41.

$$f(x) = 4\sqrt{x} + 3\cos x$$

$$f(x) = 4x^{\frac{1}{2}} + 3\cos x$$

$$f'(x) = 4\left(\frac{1}{2}\right)x^{\frac{1}{2}-1} + 3(-\sin x)$$

$$f'(x) = 2x^{\frac{-1}{2}} - 3\sin x$$

$$f'(x) = \frac{2}{x^{\frac{1}{2}}} - 3\sin x$$

$$f'(x) = \frac{2}{\sqrt{x}} - 3\sin x$$

42.

$$f(x) = 2\sin x + 3\cos x$$

$$f'(x) = 2(\cos x) + 3(-\sin x)$$

$$f'(x) = 2\cos x - 3\sin x$$

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72. 220-ft building = s_0

Initial velocity = v_0 = -22

What is velocity after 3 seconds = $v(3)$

$s(t) = -16t^2 + v_0 t + s_0$

$s(t) = -16t^2 - 22t + 220$

$v(t) = s'(t) = -32t - 22$

$v(3) = -32(3) - 22$

$v(3) = -96 - 22$

$v(3) = -118$

Velocity after 3seconds = -118 ft/sec

What is the velocity after falling 108 feet?

$s(t) = 108$

$s(t) = -16t^2 + v_0 t + s_0$

$s(t) = -16t^2 - 22t + 220$

$108 = -16t^2 - 22t + 220$

$0 = -16t^2 - 22t + 220 - 108$ //get everything on one side

$0 = -16t^2 - 22t + 112$

$t \approx -3.421$ or $t \approx 2.046$ // use calculator or quadratic formula

Can eliminate -3.421 since it is negative. To find velocity, plug in 2.046 into velocity formula:

$v(2.046) = -32(2.046) - 22$

$v(2.046) = -65.472 - 22$

$v(2.046) = -87.472$

The velocity after falling 108 feet is -87.472 ft/sec

73.

From the surface of the earth = $s_0 = 0$
Initial velocity = $v_0 = 120$
Velocity after 5 and 10 seconds = $v(5)$ and $v(10)$

$$s(t) = -4.9t^2 + v_0 t + s_0$$

$$s(t) = -4.9t^2 + 120t + 0$$

$$v(t) = s'(t) = -4.9(2)t + 120 = -9.8t + 120$$

$$v(5) = -9.8(5) + 120 = -49 + 120 = 71$$

$$v(10) = -9.8(10) + 120 = -98 + 120 = 22$$

Velocity after 5 seconds = 71 m/sec
Velocity after 10 seconds = 22 m/sec

74.

Dropped = $v_0 = 0$
$t = 6.8$
Pool of water at ground level = $s_0 = 0$

$$s(t) = -4.9t^2 + v_0 t + s_0$$

$$0 = -4.9(6.8)^2 + 0(6.8) + s_0$$

$$0 = -4.9(46.24) + 0 + s_0$$

$$0 = -226.576 + s_0$$

$$s_0 = 226.576$$

The height of the building is 226.576 m