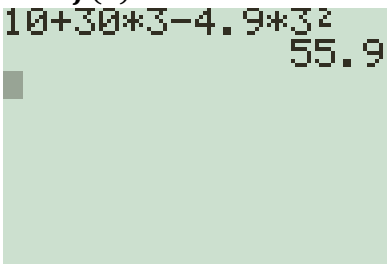
A ball is thrown upward from a height of 10 meters at a speed of 30 meters per second. The height of the ball after t seconds is given by $s(t) = 10 + 30t - 4.9t^2$.

1. What is the height of the ball at 3 seconds?

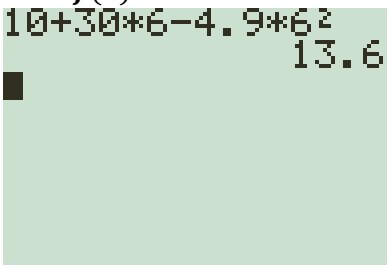
Find $f(3)$



… 55.9 meters

2. What is the height of the ball at 6 seconds?

Find $f(6)$

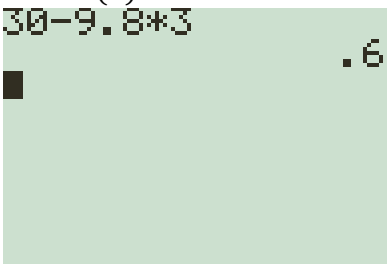


… 13.6 meters

3. What is the velocity of the ball at 3 seconds?

The derivative is $s'(t) = 30 - 9.8t$

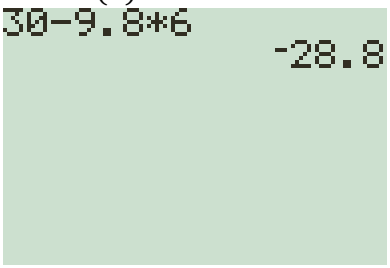
Find $s'(3)$



… .6 $^{m}/_{sec}$ (going up at .6 $^{m}/_{sec}$)

4. What is the velocity of the ball at 6 seconds?

Find $s'(6)$



… -28.8 $^{m}/_{sec}$ (going down at 28.8 $^{m}/_{sec}$)

5. What is the acceleration of the ball at 3 seconds?

Second derivative … $-32\ ^{m}/_{sec^2}$

6. What is the acceleration of the ball at 6 seconds?

Second derivative … $-32\ ^{m}/_{sec^2}$

7. When will the ball reach its highest point?

Derivative = 0 … $30 - 9.8t = 0$

```
30/9.8
      3.06122449
```

… **about 3.06 seconds**

8. How high is the highest point the ball will reach?

Find $f(3.06)$

```
30/9.8
      3.06122449
10+30Ans-4.9Ans²
     55.91836735
```

… **about 55.92 meters (just slightly higher than in Part a)**

9. When will the ball hit the ground?

Original = 0

$10 + 30t - 4.9t^2 = 0$ … Use Quadratic Formula

```
(-30+√(30²-4*-4.
9*10))/(2*-4.9)
     -.3169276239
(-30-√(30²-4*-4.
9*10))/(2*-4.9)
      6.439376604
```

… **about 6.4 seconds (only positive answer matters)**

How fast will the ball be moving when it hits the ground?

Find $s'(6.4)$

```
9*10))/(2*-4.9)
     -.3169276239
(-30-√(30²-4*-4.
9*10))/(2*-4.9)
      6.439376604
30-9.8Ans
     -33.10589071
```

… **-33.1 $^{ft}/_{sec}$ or 33.1 feet per second downward**

The height above ground of an object moving vertically is given by $s(t) = 112 + 96t - 16t^2$, with s in feet and t in seconds.

10. When does the maximum height occur?

Derivative = 0 … $96 - 32t = 0$

```
96/32
                3
```

… **3 seconds**

11. What is the maximum height?

Find $s(3)$

```
112+96*3-16*3²
              256
```

… **256 feet**

12. When is the position s = 0.38?

Set $s(t) = 0.38$ **…** $112 + 96t - 16t^2 = .38$ … $0 = 16t^2 - 96t - 111.62$

Use Quadratic Formula

```
(96+√((-96)²-4*1
6*(-111.62)))/(2
*16)
     6.997030147
```

… **about 7 seconds**

13. What is the velocity when s = 0.38?

Find $s'(7)$

```
(96+√((-96)²-4*1
6*(-111.62)))/(2
*16)
     6.997030147
96-32Ans
    -127.9049647
```

… **-127.9 (or -128) $^{ft}/_{sec}$**

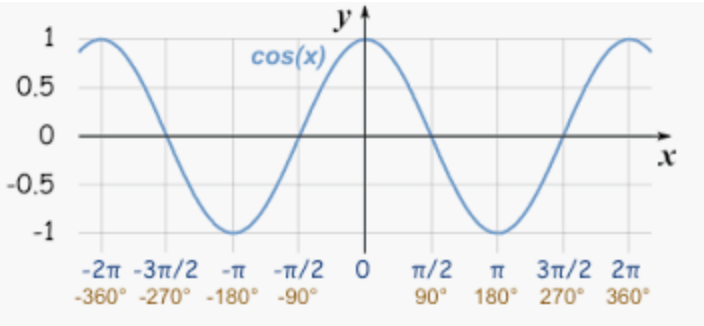
14. What is the constant acceleration?

Second derivative **…** **-32** $\frac{ft}{sec^2}$

The motion of an oscillating object is given by the formula $s(t) = 40 - sint$.

15. The object will reach its maximum height at many different times. Find one of these times.

Derivative = 0, so $-cost = 0$



$\pi/2$ (or any odd multiple of $\pi/2$) … 90° would also be correct.

16. Find a general expression for all the times the object is at its maximum height.

$\frac{\pi}{2} + k\pi$ (This is NOT something you'll be asked to find later.)

17. What is the maximum height the object reaches?

Plug $\pi/2$ into the original function

$\mathbf{40 - sin\left(\frac{\pi}{2}\right) = 40 - 1 = 39}$

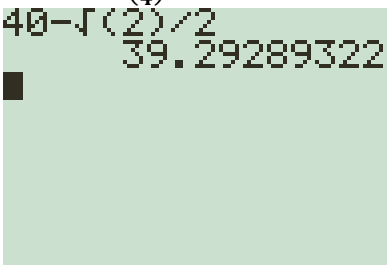
18. What expression gives the acceleration of the object?

Second derivative

$\boldsymbol{s''(t) = sint}$

19. What is the height of the object at time $t = {}^{\pi}/_{4}$?

$\mathbf{40 - sin\left(\frac{\pi}{4}\right)}$

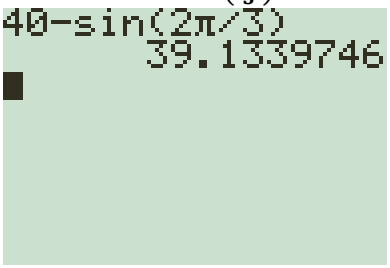


20. What is the velocity of the object at time $t = {}^{\pi}/_{4}$?

$\boldsymbol{-cos\left(\frac{\pi}{4}\right) = {}^{-\sqrt{2}}/_{2}}$

21. What is the height of the object at time $t = {}^{2\pi}/_{3}$?

22. $\mathbf{40 - sin\left(\frac{2\pi}{3}\right)}$



This is the same as $\mathbf{40 - {}^{\sqrt{3}}/_{2}}$**. (The decimal answer is fine.)**

23. What is the velocity of the object at time $t = {}^{2\pi}/_{3}$?

$\boldsymbol{-cos\left(\frac{2\pi}{3}\right) = \frac{1}{2}}$