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MATH 4670
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1 Section 2.3, Problem 17

Using the Secant method, we will find the depth, h of water in a trough to within 0.01 ft using:

$$V = L[0.5\pi r^2 - r^2 \arcsin\frac{h}{r} - h(r^2 - h^2)^{\frac{1}{2}}]$$

with $V = 12.4$, $L = 10$, and $r = 1$.

2 Source Code

The following C code can be used to an accurate value:

```c
#include <stdlib.h>
#include <math.h>

#define PI 3.14159265359

double f(double x);
void secant_method(double a, double b);

int main()
{
   secant_method(-0.999999, .999999);
   return 0;
}

double f(double x)
{
   return -12.4 + 10 * ( 0.5 * PI - asin(x) - x * sqrt(1 - x * x));
}

void secant_method(double a, double b)
{
   double x[100];
   unsigned int k = 1;
   x[0] = a;
   x[1] = b;

   printf("%d \t %5.20f \t %5.20f \n", 0, x[0], f(x[0]) + 12.4);
   printf("%d \t %5.20f \t %5.20f \n", 1, x[1], f(x[1]) + 12.4);
```

```
    while( f(x[k]) != f(x[k-1]) )
    {
        x[k+1] = x[k] - ( f(x[k]) * (x[k] - x[k-1]) ) / ( f(x[k]) - f(x[k-1]) );
        printf("%d \t %5.20f \t %5.20f \n", k+1, x[k+1], f(x[k+1]) + 12.4 );
        k++;
    }
    printf("\n");
}
```

3 Results

```
             h                                V
--------------------------------------------------------------------
0        -0.99999899999999997124          31.41592651704278438274
1         0.99999899999999997124           0.00000001885721268025
2         0.21059127192558094177          11.52747976399420615223
3         0.15084063844519182696          12.70263007019520884455
4         0.16622789427873235768          12.39878001375298310904
5         0.16616611301492065222          12.39999845465657912769
6         0.16616603465800625083          12.40000000000817159673
7         0.16616603465842058607          12.40000000000000213163
8         0.16616603465842066933          12.39999999999999857891
9         0.16616603465842061382          12.40000000000000035527
10        0.16616603465842061382          12.40000000000000035527
```

4 Summary

It is clearly shown that h converges to approximately 0.16616603465842061382.