Midterm practice question

1. Consider the problem of finding where is the minimum of

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

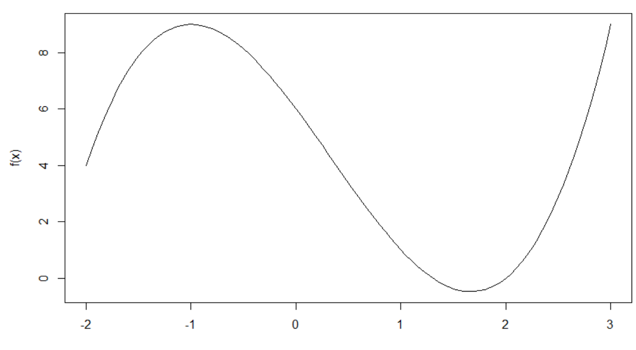
in the interval [-2, 3]. Use the following R code to answer the questions below.

```
f = function(x) return(x^3 - x^2 -5*x + 6)
curve(f, from = -2, to = 3)
golden <- function(f, int, precision = 1e-6)
{
  rho <- (3-sqrt(5))/2 # ::: Golden ratio
  f_a <- f(int[1] + rho*(diff(int)))
  f_b <- f(int[2] - rho*(diff(int)))
  N <- ceiling(log(precision/(diff(int)))/log(1-rho))
  for (i in 1:N)                    # index the number of
iterations
  {
    f_a <- f(int[1] + rho*(diff(int)))
    f_b <- f(int[2] - rho*(diff(int)))
    if (f_a < f_b)
    {
      int[2] = int[2] - rho*(diff(int))

    } else{
      if (f_a >= f_b) int[1] = int[1] + rho*(diff(int))
       }
  }
  int
}

golden(f, c(-1.8, 1.5))
[1] 1.499999 1.500000

golden(f, c(0.5, 2))
[1] 1.666666 1.666667
```



a) Calculate the exact value of where the min is using derivatives.

b) Calculate the approximate value of where the min is using the R output.

c) Why are the two R output answers different?

d) In general, any numerical optimization method is characterized by the following *except*:

   i. Easily computed by hand
   ii. Answer is approximate
   iii. Uses iterations
   iv. Designed only for problems that can't be solved analytically