ChE 310 – Computational Methods in Chemical Engineering

Fall 2019

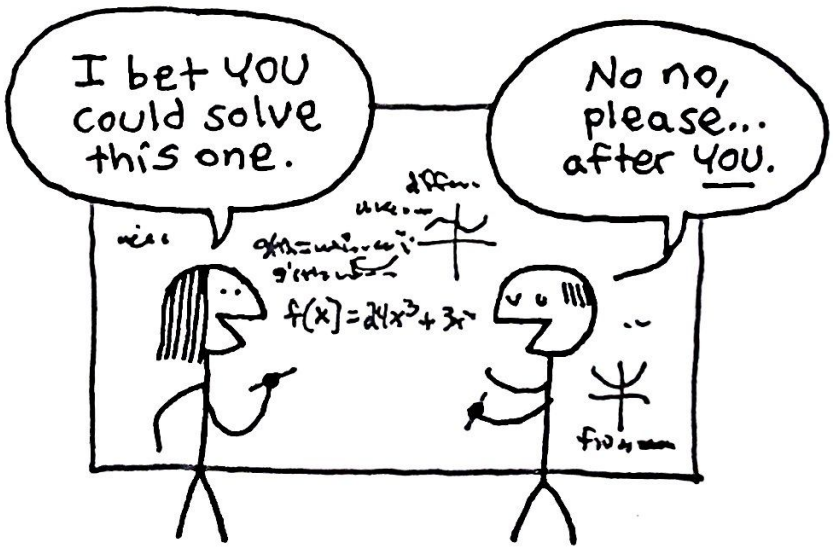
Midterm Exam #1

NAME: KEY

By writing my name, I certify that I have abided by all academic honesty policies.

- This portion of the exam is closed book, closed course notes. No additional resources may be consulted to complete this portion of the exam.
- This portion of the exam is worth 20 points (2 per problem).
- Write your answers to be graded in the space provided.
- You must turn in this portion of the exam before you will receive the free response portion, which is worth an additional 60 points.

DO NOT OPEN THIS EXAM UNTIL INSTRUCTED TO DO SO.



1. I enter the following expression into MATLAB, in which x and y are vectors of the same length. What ***specifically*** do the circled numbers represent?

```
my_interpolation = spline(x,[ 0.5 y -0.5 ],5)
```

+2 if they mention derivative of endpoints

+1 if they mention clamped spline

2. Using at least two elements of the following array A, which has been stored in MATLAB, write one line of code that results in `ans = 9` printed to the command window. (There are many possible solutions.)

```
A = [1 2 3 4; 5 6 7 8]
```

Many answers

+2 Correct

+1 use two elements but got it wrong

3. Consider the following script. In what order will the colors be printed to the command window?

```
y = [5 3 1 8];

for ii = 1:length(y)
    if y(ii) < 5
        fprintf('blue ')
    elseif y(ii) < 2
        fprintf('red ')
    else
        fprintf('yellow ')
    end
end
```

(a) blue blue red yellow

(b) yellow blue red yellow

+2 (c) yellow blue blue yellow

(d) yellow blue yellow blue red yellow yellow

4. I calculate a derivative using first order centered finite differences ($\mathcal{O}(h^2)$) and using second order centered finite differences ($\mathcal{O}(h^4)$) using a relatively small step size. Which estimate is more likely to be closer to the true derivative, and why? (The term *truncation error* should be discussed.)

+1 for which estimate is more likely closer

+1 truncation error is smaller for second order than first order $h^4 < h^2$ when $h<1$

5. **List the 2 errors** in the following code that will cause an incorrect evaluation of this series:

$$\frac{1}{(1-x)^2} = \sum_{n=0}^{\infty} nx^{n-1}$$

```
clear
x = 0.5;
newVal = 0;
realVal = 1/(1-x)^2;
tol = 10^-5;
err = 0;
n = 1;

while err > tol
    oldVal = newVal;
    newVal = n*x^(n-1)+oldVal;
    err = (oldVal-newVal)/newVal;
    n = n+1;
end
```

+1

+1

6. Suppose I've collected a set of 4 (x,y) data points. What is the difference between using cubic polynomial interpolation and cubic spline interpolation within this data set?

+1 cubic polynomial interpolation ~ 1 cubic model for 4 points.

+1 cubic spline interpolation ~ 1 cubic model between each point.

7. Using MATLAB's `linspace` function, write an expression equivalent to the following:

```
x = [1:2:9]
```

+1 +1

X = linspace (1, 9, 5)

8. I enter two expressions into MATLAB. One will yield a new array, and the other results in an error. Circle the one that provides a new array, and write the resulting array.

```
A = [1 2 3] * [1 2 3]
```

+1

```
A = [1 2 3] .* [1 2 3]
```

Ans = [1 4 9] +1

9. What are the values of x, y, and z in the workspace (saved in MATLAB memory) after running the following code?

```
clear
y = 2;
f = @(x) 2*x + y;
y = 3;
z = f(3);
```

x = —

y = 3

z = 8

+2 if all correct

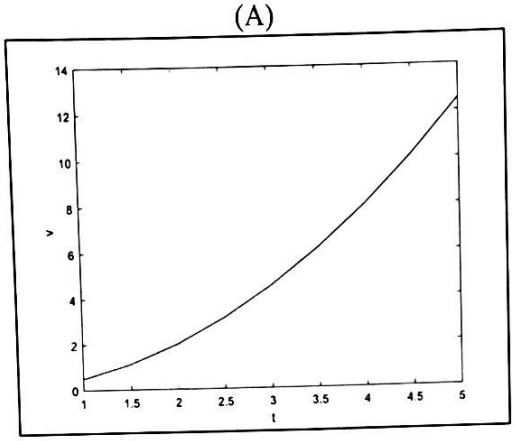
+1 if one correct

10. I want to plot velocity vs. time using the following code:

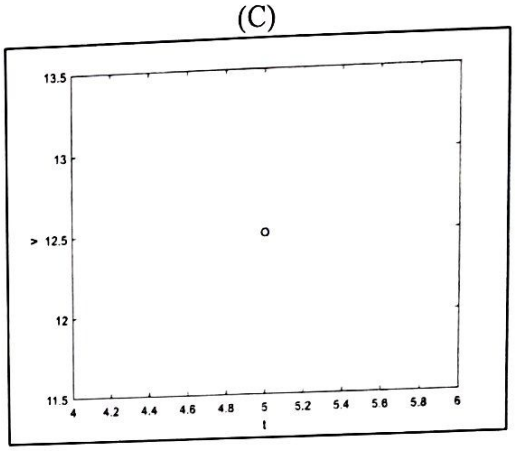
```
clear
v = zeros(1,9)
for t = 1:0.5:5
    v(1,t) = 0.5*t.^2;
end
plot(t,v)
xlabel('t')
ylabel('v')
```

Which of the following will result? Briefly (one sentence) **justify your answer in the section below.**

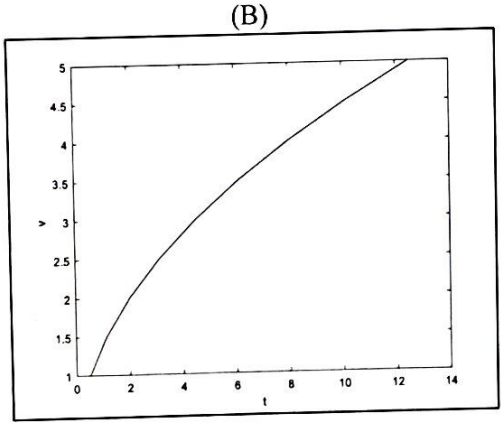
(A)



(C)



(B)



+1

(D) No plot will be made.

Justification:

Cannot index at non-integers

+1 or

t is not an array