Here are some sample questions, mostly from old tests. Most of the test will be quite similar to these, but other topics that we covered are still fair game.

1. Your friend has a data set represented by vectors **x** and **y** and is considering using a polynomial interpolation, a spline interpolation, or a least squares approximation.

   (a) For polynomial interpolation, explain to them:
   - what it is,
   - how you get it in MATLAB, and
   - in what situations it is better than the other methods.

   (b) Do the same for spline interpolation.

   (c) Do the same for least squares approximation.

2. Estimate the integral $\int_{-1}^{3} x^2\,dx$ using L_4, R_4, T_4 and S_4. Calculate the exact value and the errors of each of the approximations.

3. Approximate the integral $\int_0^{\pi} \sin x\,dx$ using M_4 and S_4. Which do you expect to be more accurate?

4. Write a MATLAB **function** program to do the Trapezoid Rule for integration of a function given by data. Let the inputs be vectors `x` and `y`, representing a list of points $(x_i, y_i) = (x_i, f(x_i))$. Assume $x_i < x_{i+1}$ but do not assume the x values are evenly spaced. Include comments.

5. Write a MATLAB **function** program to do the midpoint method for integration. Let the inputs be the function f, the endpoints a, b and the number of subintervals n. Include comments.

6. Write a MATLAB **function** program to do the trapezoid method for integration. Let the inputs be the function f, the endpoints a, b and the number of subintervals n. Include comments.

7. Write a MATLAB **function** program to do the four-corners method for integration of a function $f(x, y)$ on a rectangle $a \le x \le b$, $c \le y \le d$ using m subintervals in x and n subintervals in y. Let the inputs be `(f,a,b,c,d,m,n)`. Include comments.

8. Describe and give formulas for 2 methods to approximate double integrals based on triangles.

9. For the function $f(x) = x^2$ you need to find $f'(5)$, but you can't remember whether $f'(x) = 2x$ or $f'(x) = x^3/3$. You remember that

$$f'(5) = \lim_{h \to 0} \frac{f(5+h) - f(5)}{h},$$

so you try:

```
> h=10^(-50)
> ((5+h)^2-5^2)/h
```

which gives the result: `ans = 0`. Is this the correct answer? Explain what happened and why.

10. Write a MATLAB **function** program to do the center-point method for integration of a function $f(x, y)$ on a rectangle $a \le x \le b$, $c \le y \le d$ using m subintervals in x and n subintervals in y. Let the inputs be `(f,a,b,c,d,m,n)`. Include comments.

11. Explain what would happen if you ran the following MATLAB commands:

```
> format long
> for i=1:30
>    x=10^i+pi
>    mypi=x-10^i
>    error=(pi-mypi)/pi
> end
```