Rules for this exam:

a) You can use anything you want for the exam other than a smart phone, email or another student.

b) Remember to follow the programming conventions that have been established in class.

c) If the instructions indicate that you should write a function/script/etc. this means that your answer should run and execute correctly.

d) You must hand in this exam copy along with printouts of any scripts/functions/program output that you create.

e) Make sure anything written by hand is legible.

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1) (1 pt) Which of these variables is not a built-in variable in MATLAB: `i`, `j`, `e`, `pi`, `Inf`, `NaN`?

e

2) (3 pts) Given 4 resistors R_1, R_2, R_3, R_4 connected in parallel, the equivalent resistance of the parallel connection is defined as

$$R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}}$$

Write a MATLAB script that will ask the user to input resistances R_1, R_2, R_3, R_4 and compute their equivalent resistance. Test your script using $R_1 = 2.1, R_2 = 3.7, R_3 = 4.2, R_4 = 1.3$.

```
r1 = input('input r1');
r2 = input('input r2');
r3 = input('input r3');
r4 = input('input r4');
req = 1/(1/r1 + 1/r2 + 1/r3 + 1/r4);
```

3) (4 pts) Using any methods you wish, give 3 different ways to compute the 2-norm of a vector with only a single statement.

```
norm(x)
norm(x,2)
sqrt(x' * x)
sqrt(sum(x.*x))
sqrt(trace(x*x'))
```

4) (4 pts) Supppose A is $n \times m$, B is $n \times k$ and C is $m \times k$. Which of the calculations below can be performed?

a) `A*B`

b) `A*C`

c) `A*B'`

d) `B*C'`

5) (5 pts) Write a MATLAB function that will take in 4 scalars `a`, `b`, `c`, `d` and return the matrix

$$A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}.$$

```
function A = mymat(a,b,c,d)
A = [a b; c d];
```

6) (2 pts) Explain why it is not safe to test two numbers that have digits after the decimal point for equality.

round off errors create deviations from true values. $a+b \neq$ (a+b stored on computer) for example. Even a single bit of error will result in lack of equality.

7) (3 pts) Explain what physical quantity will be contained in the vector d when the code section below is run.

```
x,z,y = some vectors of equal length that have been defined
n = length(x);
for i = 1:n
    d(i) = (x(i)-2)^2 + (y(i)+3)^2 + (z(i)-1)^2;
    d(i) = sqrt(d(i));
end
```

d_i = radius of sphere w center (2, -3, 1)

or

distance from (x_i, y_i, z_i) to (2, -3, 1)

8) (2 pt) True or False: The code segment in Question 7 can be accomplished by doing

```
d = sqrt((x-2)^2 + (y+3)^2 + (z-1)^2);
```

False. Need .^2

9) (5 pts) The function below is supposed to compute the 1-norm of a vector. Explain all the reasons that this code is incorrect.

```
function total = sum(x)
n = lenght(x);
for i = 1,n
    total = total + x(i);
end
```

1) can't use sum as function name
2) length misspelled
3) need total = 0 before loop
4) i = 1:n
5) need abs(x(i))

10) For the 2 problems below, you should not need more than 8-10 total lines of code.

a) (2 pts) Suppose that MATLAB did not have an abs function already built-in. Write a segment of code that will compute the absolute value of a scalar x.

b) (4 pts) Write a segment of code that will evaluate the function below for the scalars x and y

$$z = \begin{cases} e^{x^2+y^2} & \text{if } x^2+y^2 < 2 \\ \sin(x)+\cos(y) & \text{if } 2 \le x^2+y^2 < 5 \\ e^{-(x^2+y^2)} & \text{if } x^2+y^2 \ge 5 \end{cases}$$

a)
```
if (x < 0)
    y = -x;
else
    y = x;
end
```

```
c = x^2+y^2
if (c >= 5)
    z = exp(-c);
elseif (c >= 2)
    z = sin(x)+cos(y);
else
    z = exp(c);
end
```