Computer Assignment #1

Due: Mar. 29, 2024, 23:59:59
Please show all work in order to get full credit.

Please determine **analytically** (i.e. handwritten proof) and by graphing in Matlab the convexity of the following sets:

1) $x, y \in \mathcal{S}, \mathcal{S} = \{x, y \in \mathbb{R}, x^2 + y^2 \le 4\}$
2) $x, y \in \mathcal{S}, \mathcal{S} = \{x, y, z \in \mathbb{R}, x^2 + y^2 + z^2 = 4\}$
3) $x, y \in \mathcal{S}, \mathcal{S} = \{x, y \in \mathbb{R}, x \ge 0, y \ge 0, 2x + 4y \le 12, x + y \le 4\}$
4) $x, y \in \mathcal{S}, \mathcal{S} = \{x, y \in \mathbb{R}, \sqrt{x} \ge y, y \le 2, 0 \le x \le 4\}$
5) $x, y \in \mathcal{S}, \mathcal{S} = \{x, y \in \mathbb{R}, x^2 \ge y, y \le 1\}$
6) $x, y \in \mathcal{S}, \mathcal{S} = \{x, y \in \mathbb{R}, x^2 \ge 1 - y^2\}$
7) $x, y \in \mathcal{S}, \mathcal{S} = \{x, y \in \mathbb{R}, \log_{10} x \ge y, x \ge 1, y \le 100, y \ge 0\}$
8) $x, y \in \mathcal{S}, \mathcal{S} = \{x, y \in \mathbb{R}, \sin(x) \le y, y \ge \sqrt{2}/2, -\pi/4 \le x \le \pi/4\}$
9) $x, y \in \mathcal{S}, \mathcal{S} = \{x, y \in \mathbb{R}, |x| \le y, -|x| + 5 \ge y\}$
10) $x, y, z \in \mathcal{S}, \mathcal{S} = \{x, y \in \mathbb{R}, x + y = 11 - z\}$

Below is the example of how to plot a given area in MATLAB.

```
clear all
x=linspace(0, 18);
y=x.^2;
y2=x.*(-1./4)+(9./2);
y3=x.*0;
plot(x,y, x,y2, x,y3); grid on;
axis([-1,20,-1,5]);
area(x, min([y; y2]), 'FaceColor','y');
```

This code produces following figure:
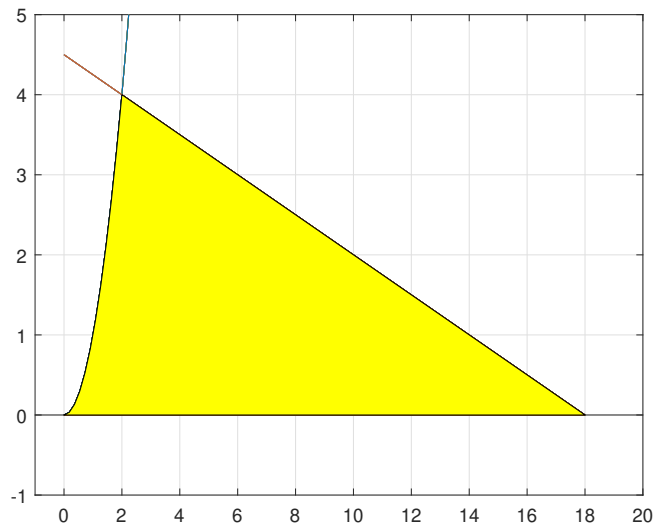
By looking at this figure, you should be able to tell if filled region convex.

Submission Policy

- In MATLAB, write scripts(can be single script) that plots all the sets given above.
- Place all your scripts inside a folder called "codes".
- Scan the handwritten proofs and place them inside a report file (see next bullet item).
- Place all your figures with answers (proofs and Matlab scripts) about convexity of the set inside a report file (pdf or word).
- Put "codes" and report inside zip file called `cal_xxxxxx.zip`, where `xxxxxx` is your student ID and submit it to E3.