Session 1 (30 minutes; Calculators are permitted)

1. Each team has 30 minutes to answer two questions.
2. There are two questions in this section, each worth 9 points.
3. Write your answers neatly and clearly and label all problems and parts.
4. Each team submits **only one** set of answers at the end of the thirty minutes. You must cross out whatever you do not wish to be considered.
5. You must show steps and reasoning. Partial credit can be given.
6. Include units where appropriate.
7. Make sure the names of all members are written clearly.

You must show steps and reasoning. Partial credit can be given. Each team submits a single response to each question. You can cross out writing that you do not wish to submit. Make sure all answers are clear with units where applicable. Each question is worth 9 points for a total of 18 points for the non-graphing calculator section.

AP Precalculus, Session I, Calculators Allowed

School:

Team Members:

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1. A certain city's population is growing due to new housing developments. The population at the time of recording this data in 2010 was 120000 people. After ten years, the population had grown to 180000 people. The population (in thousands of people) t years after the housing developments began can be modeled by an exponential function of the form

$$P(t) = P_0 e^{kt}.$$

a) Approximate the values of P_0 and k to two decimal places.

b) Find the average rate of change of the population of this city between 2010 and 2020. Give units.

c) Use the average rate of change found in part b) to estimate the population of this city in 2017. Give units.

d) Another nearby town (Bigville) had a population had a population of 1,000,000 people in the year 2010 and it grew at a rate of 100,000 people per year. Would the population of Bigville ever be surpassed by the population of the city referenced in part a)? If so, when will that occur (Round to one decimal place.)? If not, state why Bigville would never be surpassed by the population of the city referenced in Part a.

2. The depth of water, D, (in meters) in a harbor on a particular day is modeled by the formula:

$$D(t) = 5 + 2\sin(30t)^{\circ} \text{ where } 0 \leq t < 24$$

where t is the number of hours after midnight.

A boat enters the harbor at 6:30a.m. and it takes 2 hours to load its cargo. The boat requires that the depth of water to be at least 3.8 meters before it can leave the harbor.

a) Find the depth of water in the harbor when the boat enters at 6:30a.m. Give units.

b) Find, to the nearest minute, the earliest time the boat can leave the harbor.

c) Draw a rough sketch of the graph of the depth of the water vs time after midnight for a one-day period. Label the axes with a proper scale.