Calculus Field Day

AP Precalculus – Session 1 **April 14, 2026**

Session 1 (30 minutes; Calculators are permitted)

1. Each team has 30 minutes to answer three questions.
2. There are three 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. Cross out any work 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 may 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 27 points in this calculator-permitted section.

AP Precalculus, Session I, Calculators Allowed

School: _____

Team Members: _____

Score: _____ /27

1. At a certain latitude, the number of daylight hours per day can be modeled by

$$D(t) = A + B\sin(kt),$$

where $D(t)$ is the number of daylight hours per day, t is the number of days after the Spring Equinox, and A, B, and k are constants.

(a) Assuming the number of hours of daylight follows an annual cycle of 365 days, find the exact value of k. **[1 pt]**

(b) Given that the longest and shortest days have 18 hours and 6 hours of daylight, respectively, find the values of A and B. Give exact values. **[2 pts]**

(c) Use a calculator to find, in hours, minutes, and seconds, the amount of daylight on New Year's Day, which is 80 days before the Spring Equinox. *(Note: 60 minutes = 1 hour and 60 seconds = 1 minute.)* **[3 pts]**

(d) This town has a fair on the two days per year when daylight is exactly 10 hours. Determine, in relation to the Spring Equinox, when those two days occur. **[3 pts]**

Score: _____ /9

2. The concentration of a certain drug in a patient's bloodstream after being administered is modeled by

$$C(t) = \frac{10t}{t^2 + 4},$$

where $C(t)$ is the concentration in mg/L (milligrams per liter) and t is the time in hours since administration, with $t \geq 0$.

(a) Write the equation of the horizontal asymptote of $C(t)$, or indicate that there is no horizontal asymptote. You may explain using limits or general reasoning about the behavior of the function. Use function notation and include units. Explain the meaning of any horizontal asymptote in the context of drug concentration, or explain why there is none. **[3 pts]**

(b) Determine the maximum concentration of the drug in the bloodstream. Show work using calculator procedures, the behavior of the function, or algebraic methods. Give your answer to one decimal place and include units. **[3 pts]**

(c) At what time or times is the concentration $C(t)$ equal to 1 mg/L? Write down any calculator procedures or algebra used. Round answers to two decimal places where appropriate, and include units. **[3 pts]**

Score: _____ /9

3. The function f is increasing and is defined for all real numbers. The table below gives values of $f(x)$ at selected values of x:

x	-2	-1	0	1	2
$f(x)$	1	3	5	7	9

The function g is given by

$$g(x) = -0.4x^3 + 1.2x^2 + 2.1x - 3.$$

(a) **(i)** Based on the table, which of the following function types best models function f: linear, quadratic, exponential, or logarithmic? **[2 pts]**

(ii) Give a reason for your answer to part (a)(i) based on the relationship between the change in the output values of f and the change in the input values of f. Refer to the values in the table in your reasoning. **[1 pt]**

(iii) Determine the end behavior of $g(x)$, as x decreases without bound. Express your answer using limit notation. **[1 pt]**

(b) **(i)** The function h is defined by $h(x) = g(f(x))$. Find the value of $h(-1)$ as a decimal approximation, rounded to two decimal places, or indicate that it is not defined. Show the work that leads to your answer. **[1 pt]**

(ii) Find the value of $f^{-1}(7)$, rounded to two decimal places, or indicate that it is not defined. **[1 pt]**

(iii) Find all values of x, as decimal approximations, rounded to two decimal places, for which $g(x) = 0$, or indicate that there are no such values. **[3 pts]**

Score: _____ /9