

## Sample Problems from the Morning Exam

As stated earlier, the morning exam is a 40 question multiple choice test. The topics covered in the exam are from the AP Calculus (AB) syllabus. The first ten questions are straightforward problems, the second ten more conceptual questions about these calculus ideas, the next ten questions have a “twist” requiring a deeper knowledge of calculus, and the last 10 questions are designed to make up the most challenging portion of the exam. Below we have listed one question from each category from a past exam.

### Questions 1-10:

An equation for a tangent line to the graph of  $\sin y = \frac{x}{2}$  at the origin is

- (A)  $x - 2y = 0$       (B)  $x - y = 0$       (C)  $x = 0$       (D)  $y = 0$       (E) none of the above

### Questions 11-20:

Suppose  $f$  is continuous and  $x^2 \leq f(x) \leq 6$  for all  $x$  in the interval  $[-1, 2]$ . Find values of  $A$  and  $B$  such that  $A \leq \int_{-1}^2 f(x) dx \leq B$ .

- (A)  $A = 3, B = 11$     (B)  $A = 4, B = 18$     (C)  $A = 3, B = 18$     (D)  $A = 4, B = 11$     (E) none of the above

### Questions 21-30:

$\int_0^1 \sqrt{x^2 - 2x + 1} dx =$

- (A)  $-1$       (B)  $-\frac{1}{2}$       (C)  $\frac{1}{2}$       (D)  $1$       (E) none of the above

### Questions 31-40:

Find the volume of the solid whose base is bounded by the circle  $x^2 + y^2 = 1$  and whose cross-section is a square (perpendicular to the base).

- (A)  $\frac{256}{3}$       (B)  $\frac{144}{3}$       (C)  $\frac{128}{3}$       (D)  $\frac{192}{3}$       (E) none of the above

The answers to the questions are (1) A; (2) C; (3) C; (4) E.

## Sample Question from the Afternoon Team Competition

The afternoon portion of the Clemson Calculus Challenge is a team competition consisting of eight rounds. At the start of each round a question is posed. The teams have up to 10 minutes to submit an answer to the question. To score any points for the round, the answer submitted by a team must be correct. Once the answer is deemed correct, the amount of points awarded for the correct answer is dependent on the time of submission. Specifically, a correct answer submitted  $x$  minutes into the round will receive a score of  $\lceil 10 - x \rceil$ , i.e., the least integer greater than  $10 - x$ . An example question is given below.

### Example Afternoon Question:

Let  $f(x) = \frac{1}{1+x^4} + A$ , where  $A$  is a constant, and let  $F(x)$  be an antiderivative of  $f$ . Find a value of  $A$  for which  $F$  has exactly one critical point.