

You may remove the formula sheet and multiplication table, but do not remove any other pages from the exam. You have two hours to do this exam. **No books, notes, or calculators may be used. Absolutely no cell phone use during the exam is allowed.**

The exam consists of 2 short answer questions and 18 multiple choice questions. Answer the short answer questions on the back of this page, and record your answers to the multiple choice questions on this page. For each multiple choice question, you will need to fill in the circle corresponding to the correct answer. For example, if (a) is correct, you must shade

☒ a ☐ b ☐ c ☐ d ☐ e

It is your responsibility to make it CLEAR which response has been chosen. **You will not get credit unless the correct answer has been clearly marked on this page.**

GOOD LUCK!

3. ☐ a ☐ b ☒ c ☐ d ☐ e

12. ☐ a ☐ b ☐ c ☐ d ☒ e

4. ☐ a ☒ b ☐ c ☐ d ☐ e

13. ☒ a ☐ b ☐ c ☐ d ☐ e

5. ☐ a ☐ b ☐ c ☒ d ☐ e

14. ☐ a ☐ b ☐ c ☐ d ☒ e

6. ☐ a ☐ b ☒ c ☐ d ☐ e

15. ☒ a ☐ b ☐ c ☐ d ☐ e

7. ☐ a ☐ b ☐ c ☒ d ☐ e

16. ☐ a ☒ b ☐ c ☐ d ☐ e

8. ☐ a ☒ b ☐ c ☐ d ☐ e

17. ☐ a ☐ b ☐ c ☐ d ☒ e

9. ☐ a ☐ b ☐ c ☐ d ☒ e

18. ☐ a ☐ b ☒ c ☐ d ☐ e

10. ☐ a ☐ b ☐ c ☒ d ☐ e

19. ☐ a ☐ b ☒ c ☐ d ☐ e

11. ☐ a ☐ b ☐ c ☒ d ☐ e

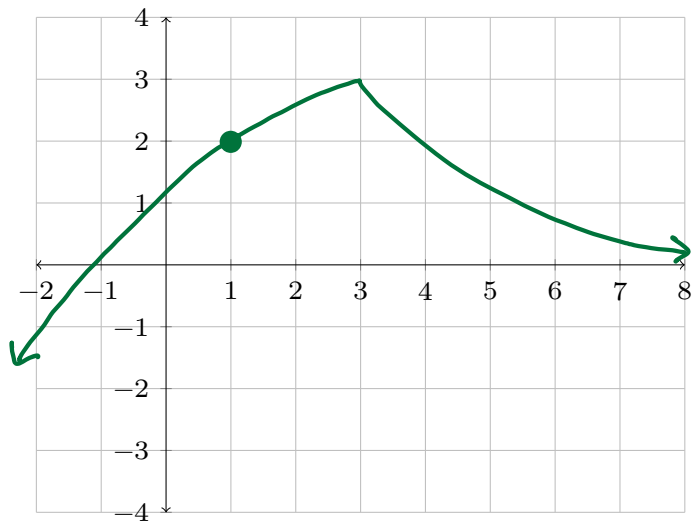
20. ☒ a ☐ b ☐ c ☐ d ☐ e

Short Answer Questions

Each question is an opportunity to earn 5 points. Points are earned on the clarity and correctness of your work, not merely on having a correct answer somewhere.

1. Sketch the graph of a continuous function $y = f(x)$ which satisfies the following properties:
 $f(1) = 2$, $f'(x) > 0$ on $(-\infty, 3)$, $f'(x) < 0$ on $(3, \infty)$, $f''(x) < 0$ on $(-\infty, 3)$ and $f''(x) > 0$ on $(3, \infty)$.

★ Note. There are many possible graphs.



2. Let x and y be two positive numbers such that $x \cdot y = 36$. Complete the parts below to determine the minimum possible sum of x and y .

- (a) Write the objective function.

$$S = x + y$$

- (b) Write the constraint.

$$x \cdot y = 36$$

- (c) Rewrite the objective function so that it is a function of a single variable.

$$S = \frac{36}{y} + y \quad \text{or} \quad S = x + \frac{36}{x}$$

- (d) Determine the critical values of the objective function and perform an appropriate number line test to determine the minimum possible sum of x and y .

critical value is $y = 6$ or $x = 6$

number line test: $\leftarrow \overset{-}{\underset{0}{\mid}} \overset{+}{\underset{10}{\mid}} \rightarrow$

minimum possible sum of x and y is 12