

Math Superbowl XLVII
Level 4 Blitz: Secondary Math II – 2022

- Directions:** (1) Select the most correct answer for each question and mark it on your answer form.
(2) No calculators of any sort are allowed.
(3) Note that N.O.T. means “None of these.”

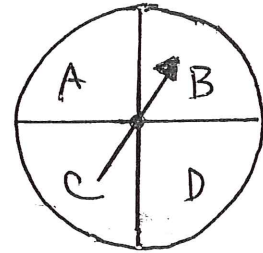
1. The y -intercept of $y = 3(x - 2)^2 + 7$ is
a) 7 b) 12 c) 19 d) 31 e) N.O.T.
2. If $i = \sqrt{-1}$, then $(2 + i)^2$ is
a) $3 + 4i$ b) $4 + 3i$ c) $2 + i$ d) $4 - 2i$ e) N.O.T.
3. If $x^2 + 14x + 49 = 0$, then x is
a) -7 b) 49 c) -49 d) 7 e) N.O.T.
4. The sum of the first 2022 natural numbers is
a) 2,041,210 b) 2,045,253 c) 2,043,231 d) 2,044,242 e) N.O.T.
5. What is the radius of the circle given by $x^2 - 8x + y^2 + 4y = 0$?
a) 2 b) 4 c) 6 d) 8 e) N.O.T.
6. A car can travel 60 miles in 60 minutes. How long would it take this car to travel 60 miles if it drove half as fast as before?
a) 30 minutes b) 60 minutes c) 90 minutes d) 120 minutes e) N.O.T.
7. Suppose $\triangle ABC$ is an isosceles triangle with $AC \cong AB$. If the measure of $\angle A$ is twice the measure of $\angle C$, then what is the measure of $\angle B$?
a) 30° b) 40° c) 45° d) 90° e) N.O.T.
8. Which of the following is a solution of the system $\begin{cases} y = 2x + 5 \\ y = x^2 + 2 \end{cases}$?
a) (2, 5) b) (0, 2) c) (3, 9) d) (3, 11) e) N.O.T.
9. Suppose $\angle DBA$ and $\angle DBC$ are adjacent angles. The measure of $\angle ABC$ is 148° , and the measure of $\angle DBA$ is 61° . Then the measure of $\angle DBC$ is
a) 209° b) 74° c) 87° d) 29° e) N.O.T.

10. A bag contains 3 red marbles, 1 blue marble, and 2 yellow marbles. A marble is selected from the bag at random, and it is not replaced. A second marble is then randomly selected. What is the probability that the first marble was red and the second marble was yellow?
- a) $\frac{1}{6}$ b) $\frac{1}{12}$ c) $\frac{5}{12}$ d) $\frac{1}{5}$ e) N.O.T.

11. Which of the following is the range of $f(x) = x^2 - 4x + 3$?
- a) $\{y \mid y > 1\}$ b) $\{y \mid y \geq 1\}$ c) $\{y \mid y > 3\}$ d) $\{y \mid y \geq 3\}$ e) N.O.T.

12. Which of the following must be true about an inscribed angle on a diameter of a circle?
- a) The angle must be an acute angle.
 b) The angle must be a right angle.
 c) The angle must be an obtuse angle.
 d) The angle measure cannot be calculated.
 e) N.O.T.

13. A six-sided fair die is rolled, and the spinner illustrated to the right is spun. The four areas on the spinner are equal sizes. What is the probability that the number rolled on the die is greater than 4 and the spinner points to B?

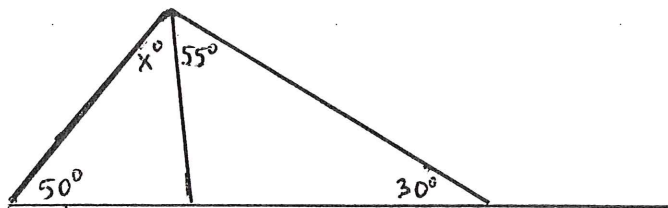


- a) $\frac{7}{12}$ b) $\frac{1}{12}$ c) $\frac{1}{8}$ d) $\frac{3}{4}$ e) N.O.T.

14. If $i = \sqrt{-1}$, then what is the value of i^{2022} ?
- a) -1 b) 1 c) i d) $-i$ e) N.O.T.

15. Simplify as much as possible: $(x - 4)(3x^2 + 4x - 7)$
- a) $3x^3 + 4x^2 - 7x + 28$ b) $3x^2 + 5x - 11$
 c) $3x^3 - 8x^2 - 23x + 28$ d) $-12x^2 - 17x + 28$ e) N.O.T.

16. In the figure below, the value of x is



- a) 35° b) 45° c) 55° d) 65° e) N.O.T.

17. Factor $x^2 + 36$.

a) $(x + 6i)(x - 6i)$

b) $(x + 36)(x - 36)$

c) $(x - 6)(x + 6)$

d) $(x + 36i)(x - 36i)$

e) N.O.T.

18. Which of the following would be the coefficient of the monomial $16x^3y^5z^{12}$?

a) 16

b) 3

c) 5

d) 11

e) N.O.T.

19. Which of the following would be the degree of the monomial $16x^3y^5z^{12}$?

a) 16

b) 3

c) 5

d) 12

e) N.O.T.

20. Which statement about parallelograms is false?

a) Opposite sides are always congruent.

b) The diagonals of a parallelogram are always congruent.

c) Opposite angles are always congruent.

d) The diagonals of a parallelogram always bisect each other.

e) N.O.T.

21. For $x, y > 0$, simplify $\left(\frac{9x^2y^{1/3}}{x^{1/3}y}\right)^{1/2}$ so that only positive exponents occur.

a) $\frac{3x^{5/3}}{y^{2/3}}$

b) $\frac{9x^{5/6}}{y^{1/3}}$

c) $\frac{9x^{5/3}}{y^{2/3}}$

d) $\frac{3x^{5/6}}{y^{1/3}}$

e) N.O.T.

22. If the side length of a cube is doubled, by what factor does the volume of the cube increase?

a) 1

b) 2

c) 4

d) 8

e) N.O.T.

23. What is the solution set of the equation $3x^2 - 5x + 1 = 0$?

a) $\left\{\frac{5 + \sqrt{22}}{6}, \frac{5 - \sqrt{22}}{6}\right\}$

b) $\left\{\frac{5 + \sqrt{13}}{6}, \frac{5 - \sqrt{13}}{6}\right\}$

c) $\left\{\frac{5 + \sqrt{22}}{2}, \frac{5 - \sqrt{22}}{2}\right\}$

d) $\left\{\frac{5 + \sqrt{13}}{2}, \frac{5 - \sqrt{13}}{2}\right\}$

e) N.O.T.

24. What is the midpoint of the line segment whose endpoints are $(-2, 6)$ and $(8, -4)$?

a) $(3, -1)$

b) $(-5, 2)$

c) $(3, 1)$

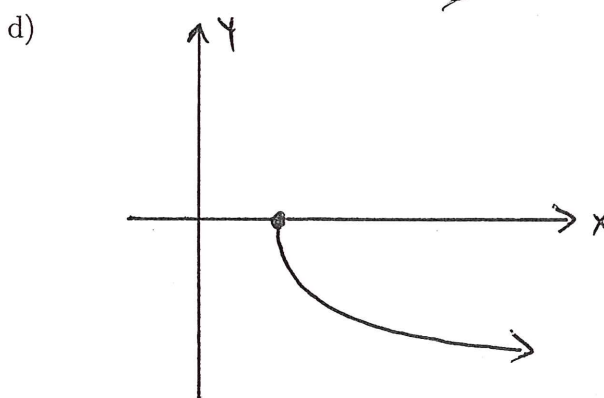
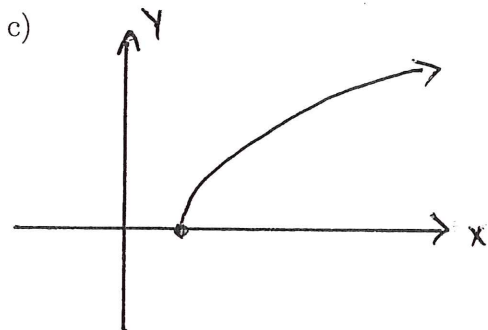
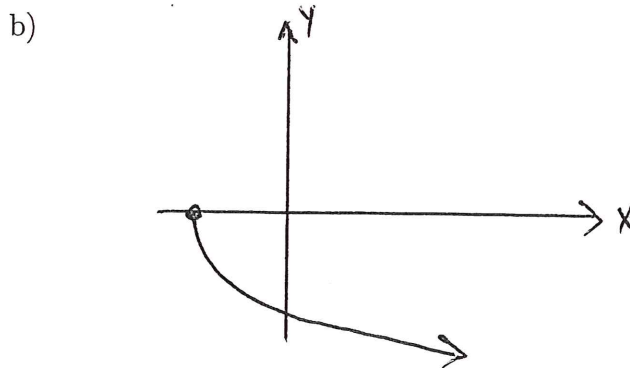
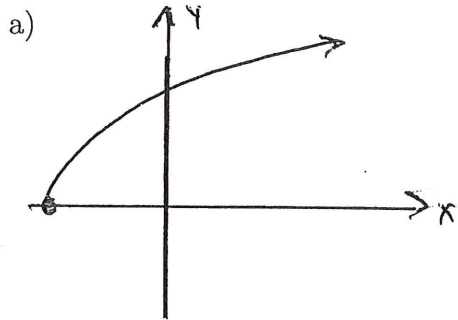
d) $(5, -5)$

e) N.O.T.

25. A circle has diameter 8π . What is the circumference of this circle?

- a) 8π b) $16\pi^2$ c) $4\pi^2$ d) 16π e) N.O.T.

26. Which of the following graphs could represent the function $f(x) = \sqrt{x+8}$?



e) N.O.T.

27. If $\triangle ABC$ is similar to $\triangle EFG$, the length of AB is 16 units, and the length of EF is 24 units, then what is the ratio of the measures of side BC to side FG ?

- a) 1 : 2 b) 2 : 4 c) 1 : 3 d) 3 : 4 e) N.O.T.

28. What is the rate of change of $f(x) = 2x^2 + 4x - 1$ over the x -interval $[1, 4]$?

- a) 42 b) $\frac{28}{3}$ c) 14 d) $\frac{47}{4}$ e) N.O.T.

29. Determine the equation of the parabola with focus at $(0, 4)$ and directrix the line $y = -4$.

- a) $y = 16x^2$ b) $y = \frac{1}{4}x^2$ c) $y = \frac{1}{16}x^2$ d) $y = 4x^2$ e) N.O.T.

30. The solution to the inequality $\frac{x}{x-1} \leq 2$ is

- a) $(-\infty, 1) \cup [2, \infty)$ b) $(-\infty, 1] \cup [2, \infty)$
c) $(1, 2]$ d) $[1, 2]$ e) N.O.T.

31. Two tangent circles each with a diameter of 10 units are in the interior of a larger circle with a diameter of 20 units. What is the area of the region inside the larger circle but outside of the inner circles?
- a) 200π units² b) 100π units² c) 75π units² d) 50π units² e) N.O.T.
32. When two parallel lines are cut by a transversal, what must be true about a pair of alternate interior angles?
- a) The angles must be obtuse.
 b) The angles must be acute.
 c) The angles must be congruent.
 d) The angles must be supplementary.
 e) N.O.T.
33. In an experiment, two crayons are simultaneously selected from a box of four distinct crayons. If S is the sample space for this experiment, how many different outcomes are in S ?
- a) 8 b) 6 c) 4 d) 2 e) N.O.T.
34. The diameter of a circle is also
- a) a radius b) an arc c) a chord d) a line e) N.O.T.
35. Write $\frac{2-3i}{4-3i}$ in standard form, where $i = \sqrt{-1}$.
- a) $\frac{1}{2} + i$ b) $-\frac{1}{7} - \frac{6}{7}i$ c) $\frac{17}{25} - \frac{6}{25}i$ d) $\frac{17}{7} - \frac{6}{7}i$ e) N.O.T.
36. Which of the following functions is the inverse of $f(x) = 3x^5$?
- a) $g(x) = \frac{1}{3}x^{-5}$ b) $g(x) = 3x^{-5}$ c) $g(x) = \frac{1}{3}\sqrt[5]{x}$ d) $g(x) = 3\sqrt[5]{x}$ e) N.O.T.
37. Suppose $\angle A$ and $\angle B$ are vertical angles, and $\angle A$ has a measure of 42° . What is the measure of $\angle B$?
- a) 48° b) 42° c) 138° d) 84° e) N.O.T.
38. A box contains five green balls and four white balls. A sample of two balls is selected at random. What is the probability that exactly one of the two balls selected is green?
- a) $\frac{5}{6}$ b) $\frac{1}{20}$ c) $\frac{2}{9}$ d) $\frac{5}{9}$ e) N.O.T.

