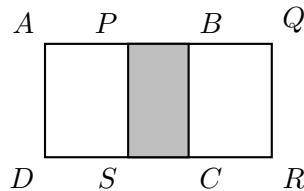


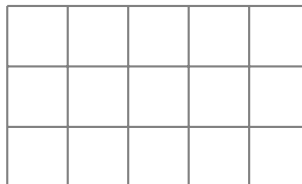
## NMC SAMPLE PROBLEMS: GRADE 8

1. A right triangle has side lengths of 4 and 8. What is the length of the hypotenuse (the longest side)?  
(a)  $4\sqrt{2}$             (b) 10            (c)  $4\sqrt{5}$             (d)  $4\sqrt{3}$             (e) 12
  
2. An isosceles triangle has a base length of 10 and a side length 13. What is the area of the triangle?  
(a)  $60^\circ$             (b)  $63^\circ$             (c)  $48^\circ$             (d)  $52^\circ$             (e)  $55^\circ$
  
3. A cone has a height of 6 and a base circle with a radius of 4. What is the volume of the cone?  
(a)  $16\pi$             (b)  $32\pi$             (c)  $16\pi^2$             (d)  $24\pi$             (e)  $12\pi$
  
4. John has two sisters, one 5 years younger than John and the other 5 years older than John. If the product of two sisters' ages is 75, how old is John?  
(a) 9            (b) 10            (c) 11            (d) 12            (e) 13
  
5. The boiling temperature of water is at 100 degrees Celsius. What is the boiling temperature in Fahrenheit? Note that the Fahrenheit( $F^\circ$ ) to Celsius( $C^\circ$ ) conversion formula is  $C^\circ = \frac{5}{9}(F^\circ - 32^\circ)$ .  
(a)  $200^\circ$             (b)  $50^\circ$             (c)  $212^\circ$             (d)  $32^\circ$             (e)  $235^\circ$
  
6. A line passes through two points  $(-1, -1)$  and  $(1, 3)$ . Which of the following equations represents the line?  
(a)  $y = x$             (b)  $y = x + 1$             (c)  $y = x - 1$             (d)  $y = 2x$             (e)  $y = 2x + 1$
  
7. If  $24^{13} = 2^x 3^y$ , what is  $x + y$ ?  
(a) 26            (b) 39            (c) 48            (d) 52            (e) 65
  
8. A convex hexagon has interior angles with measures  $x + 10$ ,  $2x + 10$ ,  $3x + 10$ ,  $4x + 20$ ,  $5x + 20$  and  $6x + 20$  degrees. What is the measure of smallest angle?  
(a)  $36^\circ$             (b)  $37^\circ$             (c)  $38^\circ$             (d)  $39^\circ$             (e)  $40^\circ$

9. Two different numbers are selected from  $\{2, 0, 1, 7\}$  and multiplied together. What is the probability that the product is nonzero?
- (a)  $\frac{1}{6}$                       (b)  $\frac{1}{3}$                       (c)  $\frac{1}{2}$                       (d)  $\frac{2}{3}$                       (e)  $\frac{5}{6}$
10. Amy's car can go 27 miles on a gallon of gas, and gas currently costs \$1.25 per gallon. How many miles can Amy drive on \$10 worth gas?
- (a) 180                      (b) 198                      (c) 216                      (d) 234                      (e) 252
11. Angie, Bob, Carlos, and Dan are randomly seated around a square table with one person to a side. What is the probability that Angie and Carlos are seated opposite each other ?
- (a)  $\frac{1}{4}$                       (b)  $\frac{1}{3}$                       (c)  $\frac{1}{2}$                       (d)  $\frac{2}{3}$                       (e)  $\frac{3}{4}$
12. Two congruent squares,  $ABCD$  and  $PQRS$ , have side length 20. They overlap to form the 20 by 37 rectangle  $AQRD$  as shown. What is the area of rectangle  $PBCS$  ? (*Figure not drawn to scale!*)



- (a) 30                      (b) 45                      (c) 60                      (d) 75                      (e) 90
13. At Liberty Park Middle School, 40% of the students in the Math Club are in the Science Club, and 80% of the students in the Science Club are in the Math Club. There are 20 students in the Science Club. How many students are in the Math Club?
- (a) 12                      (b) 15                      (c) 30                      (d) 36                      (e) 40
14. What is the smaller angle formed by the hour hand and the minute hand when the time is 10:18 ?
- (a)  $159^\circ$                       (b)  $160^\circ$                       (c)  $161^\circ$                       (d)  $162^\circ$                       (e)  $163^\circ$
15. How many rectangles are in the figure below?



- (a) 30                      (b) 65                      (c) 90                      (d) 108                      (e) 144

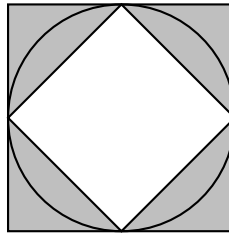
16. For any positive integer  $n$ , define  $\langle n \rangle$  to be the sum of all positive factors of  $n$ . For example,  $\langle 6 \rangle = 1 + 2 + 3 + 6 = 12$ . Find  $\langle \langle 11 \rangle \rangle$ .

- (a) 18                      (b) 20                      (c) 24                      (d) 26                      (e) 28

17. Jonny has a 4 by 4 by 4 uncolored Rubik’s cube that consists of 64 unit cubes. If he paints the outer layer of the six faces with six different colors, how many unit cubes will have at least one sidepainted?

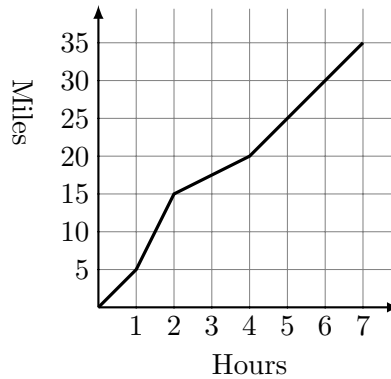
- (a) 60                      (b) 58                      (c) 56                      (d) 32                      (e) 27

18. A circle with radius 1 is inscribed in a square and circumscribed about another square as shown. Which of the following is closest to the ratio of the shaded area in the circle to the total shaded area?



- (a)  $\frac{1}{2}$                       (b) 1                      (c)  $\frac{3}{2}$                       (d) 2                      (e)  $\frac{5}{2}$

19. Ken takes a long bike ride on a hilly highway. The graph indicates the miles traveled during the time of his ride. What is Ken’s average speed for the entire ride in miles per hour?

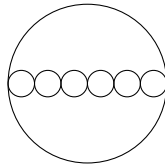


- (a) 2                      (b) 2.5                      (c) 4                      (d) 4.5                      (e) 5

20. What is the sum of the mean, median, and mode of the numbers 2,3,0,3,1,4,0,3?

- (a) 6.5                      (b) 7                      (c) 7.5                      (d) 8.5                      (e) 9

21. As Amy rides her bicycle on a long straight road, she spots Bob skating in the same direction half a mile in front of her. After she passes him, she can see him in her rear view mirror until he is half a mile behind her. Amy rides at a constant rate of 12 miles per hour, and Bob skates at a constant rate of 8 miles per hour. How many minutes passed between when Amy first spotted Bob and when she lost him in her rear view mirror?
- (a) 6                      (b) 8                      (c) 12                      (d) 15                      (e) 16
22. Three-digit integers are formed by arranging three different digits from  $\{3, 4, 5, 6, 7\}$ . How many of the three-digit numbers are multiples of 3?
- (a) 12                      (b) 18                      (c) 24                      (d) 48                      (e) 60
23. Amy's video game lets her design the appearance of her character. There are 4 different body types and 3 faces to choose from. How many different appearances can Amy design for her character?
- (a) 3                      (b) 4                      (c) 7                      (d) 12                      (e) 20
24. Six pepperoni circles will fit exactly across the diameter of a 12-inch pizza when placed as shown. If a total of 24 pepperoni circles are placed on this pizza without overlap each other, what fraction of the pizza is covered by pepperoni circles?



- (a)  $\frac{1}{2}$                       (b)  $\frac{2}{3}$                       (c)  $\frac{3}{4}$                       (d)  $\frac{5}{6}$                       (e)  $\frac{7}{8}$
25. The top of one tree is 16 feet higher than the top of another tree. The ratio of the heights of the two trees is 3:4. In feet, how tall is the taller tree?
- (a) 48                      (b) 64                      (c) 80                      (d) 96                      (e) 112
26. Of the 500 balls in a large bag, 80% are red and the rest are blue. How many of the red balls must be removed from the bag so that 75% of the remaining balls are red?
- (a) 25                      (b) 50                      (c) 75                      (d) 100                      (e) 150
27. The lengths of the sides of a triangle are three consecutive integers. The length of the shortest side is 30% of the perimeter. What is the length of the longest side?
- (a) 7                      (b) 8                      (c) 9                      (d) 10                      (e) 11

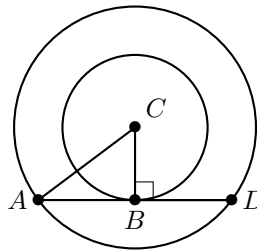
28. A square and a circle have the same area. What is the ratio of the side length of the square to the radius of the circle?

(a)  $\frac{\sqrt{\pi}}{2}$                       (b)  $\sqrt{\pi}$                       (c)  $\pi$                       (d)  $2\pi$                       (e)  $\pi^2$

29. Find the unit digits of  $3^{2017} + 7^{2017}$ .

(a) 3                      (b) 7                      (c) 0                      (d) 2                      (e) 1

30. The two circles in the picture below have the same center  $C$ . The line  $AD$  is tangent to the inner circle at  $B$ , and the line  $AD$  has length 16. What is the area between the two circles?



(a)  $49\pi$                       (b)  $64\pi$                       (c)  $81\pi$                       (d)  $100\pi$                       (e)  $121\pi$

31. Two fifth of all the people in a room are wearing gloves, and three quarters of all the people in the room are wearing hats. What is the minimum number of people in the room wearing both gloves and hats?

(a) 3                      (b) 5                      (c) 8                      (d) 15                      (e) 20

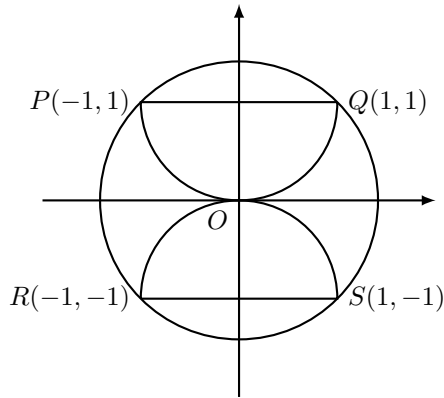
32. Nathan bought some lollipops costing more than a penny and paid \$2.53. Holly bought some of the same lollipops and paid \$1.98. How many more lollipops did Nathan buy more than Holly?

(a) 3                      (b) 4                      (c) 5                      (d) 6                      (e) 7

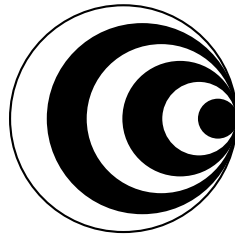
33. The hundreds digit of a three-digit number is 2 more than the units digit. The digits of the three-digit number are reversed, and the result is subtracted from the original three-digit number. What is the units digit of the result?

(a) 0                      (b) 2                      (c) 4                      (d) 6                      (e) 8

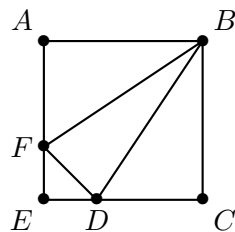
34. Semicircles  $POQ$  and  $ROS$  pass through the center  $O$  of a circle. What is the ratio of the sum of the areas of the two semicircles to the area of the larger circle?



- (a)  $\frac{\sqrt{2}}{4}$       (b)  $\frac{1}{2}$       (c)  $\frac{2}{\pi}$       (d)  $\frac{2}{3}$       (e)  $\frac{\sqrt{2}}{2}$
35. Given three numbers  $10^8$ ,  $5^{12}$ , and  $2^{24}$ , which of the expressions below is the correct ordering of the numbers?
- (a)  $2^{24} < 10^8 < 5^{12}$       (b)  $2^{24} < 5^{12} < 10^8$       (c)  $5^{12} < 2^{24} < 10^8$   
 (d)  $10^8 < 5^{12} < 2^{24}$       (e)  $10^8 < 2^{24} < 5^{12}$
36. In the design shown below, the smallest black circle has a radius 2 inches, with each successive circle's radius increasing by 2 inches. Approximately what percent of the design is black?



- (a) 42      (b) 44      (c) 45      (d) 46      (e) 48
37. In square  $ABCE$ ,  $AF = 2FE$  and  $CD = 2DE$ . What is the ratio of the area of triangle  $BFD$  to the area of square  $ABCE$ ?



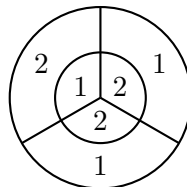
- (a)  $\frac{1}{6}$       (b)  $\frac{2}{9}$       (c)  $\frac{5}{18}$       (d)  $\frac{1}{3}$       (e)  $\frac{7}{20}$

38. Ten tiles have numbers 1 through 10 painted on them and are placed face down. You randomly pick a tile and throw a fair die, and multiply the two numbers from the tile and the die. What is the probability that the product is a square number?
- (a)  $\frac{1}{10}$                       (b)  $\frac{1}{6}$                       (c)  $\frac{11}{60}$                       (d)  $\frac{1}{5}$                       (e)  $\frac{7}{30}$
39. How many positive integer values of  $n$  can have both  $n/3$  and  $3n$  be three-digit whole numbers?
- (a) 12                      (b) 21                      (c) 27                      (d) 33                      (e) 34
40. Evaluate the following sum:
- $$1 - 2 - 3 + 4 + 5 - 6 - 7 + 8 + \cdots + 2016 + 2017$$
- (a) 0                      (b) 1008                      (c) 2017                      (d)  $-2017$                       (e)  $-1008$
41. How many numbers between 1 and 105 are relatively prime to 105? Two integers are said to be relatively prime if their greatest common divisor is 1.
- (a) 24                      (b) 36                      (c) 48                      (d) 52                      (e) 64
42. Given three boxes, there are three possible ways to choose a pair. If each pair weights either 122, 125 or 127 pounds, what is the sum of the weights of all three boxes?
- (a) 160                      (b) 170                      (c) 187                      (d) 195                      (e) 354
43. A ball is dropped from a height of 3 meters. On its first bounce, it rises to a height of 2 meters. It continues to fall and bounce back up to  $\frac{2}{3}$  of the height it reached on the previous bounce. On which bounce will it first not rise to a height at or above 0.5 meters?
- (a) 3                      (b) 4                      (c) 5                      (d) 6                      (e) 7
44. The average age of the 6 people in room  $A$  is 40. The average age of the 4 people in room  $B$  is 25. If the people in the two rooms gather together, what is the average age of the 10 people?
- (a) 32.5                      (b) 33                      (c) 33.5                      (d) 34                      (e) 35
45. An investment of \$100 suffered a 15% loss in the first year. In the second year, however, the remaining investment showed a 20% gain. Over the two-year period, what is the change in the investment?
- (a) 5% loss                      (b) 2% loss                      (c) 1% gain                      (d) 2% gain                      (e) 5% gain

46. In how many ways can 2017 be written as the sum of two primes?

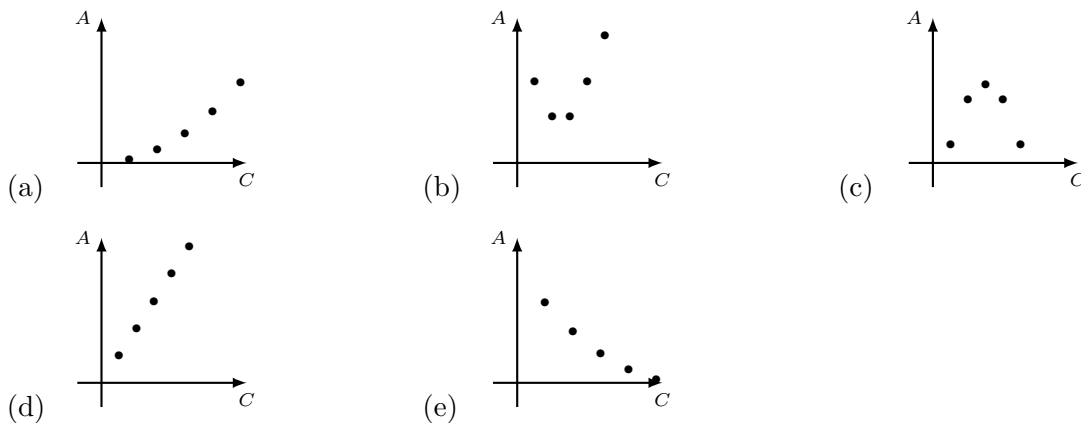
- (a) 0                      (b) 1                      (c) 2                      (d) 3                      (e) 4

47. On a dart board, the outer circle has radius 6 and the inner circle has radius 3. Three radii divide each circle into three congruent regions, with point values shown in the figure. The probability that a dart hits a given region is proportional to the area of the region. When two darts hit this board, the score is the sum of the point values in the two regions. What is the probability that the score is odd?



- (a)  $\frac{17}{36}$                       (b)  $\frac{35}{72}$                       (c)  $\frac{1}{2}$                       (d)  $\frac{37}{72}$                       (e)  $\frac{19}{36}$

48. Suppose you have five circles with radii 1,2,3,4, and 5. Which of the graphs plots the point  $(C, A)$ , where  $C$  is the circumference and  $A$  is the area of the five circles.



49. How many positive integers are there less than 1000 with an odd number of positive divisors?

- (a) 22                      (b) 25                      (c) 28                      (d) 31                      (e) 42

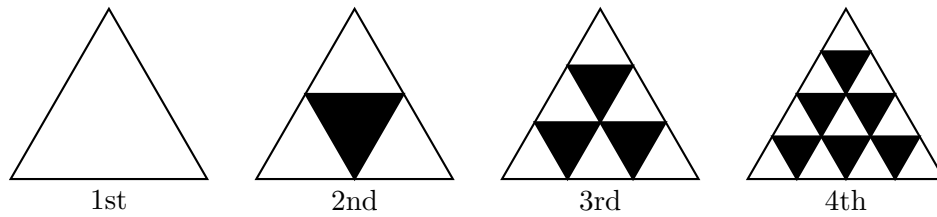
50. A grid must have each of the digits 1 through 4 once in each row and once in each column. What number occupies the lower right-hand square in the grid?

1		2	
2	3		
			4

- (a) 1                      (b) 2                      (c) 3                      (d) 4  
 (e) Cannot be determined



51. There are four consecutive integers such that the sum of the cubes of the first three numbers equals the cube of the fourth number. Find the sum of the four numbers.
52. A point  $(x, y)$  is randomly chosen such that  $0 \leq x \leq 1$  and  $0 \leq y \leq 1$ . What is the probability that  $y \leq 2x$ ?
53. Find the smallest three-digit number whose remainders are 2, 3, 4 and 5 when it is divided by 3, 4, 5 and 6, respectively.
54. If a square and a circle have the same perimeter, what is the ratio of the area of the square to the area of the circle?
55. If the pattern in the diagram continues, what fraction of the interior of the eighth triangle is shaded?



▷ KEYS ◁

[1] (c)	[15] (c)	[29] (c)	[43] (c)
[2] (a)	[16] (e)	[30] (b)	[44] (d)
[3] (b)	[17] (c)	[31] (a)	[45] (d)
[4] (b)	[18] (a)	[32] (c)	[46] (a)
[5] (c)	[19] (e)	[33] (e)	[47] (b)
[6] (e)	[20] (c)	[34] (b)	[48] (a)
[7] (d)	[21] (d)	[35] (a)	[49] (d)
[8] (e)	[22] (c)	[36] (a)	[50] (b)
[9] (c)	[23] (d)	[37] (c)	[51] 18
[10] (c)	[24] (b)	[38] (c)	[52] $\frac{3}{4}$
[11] (b)	[25] (b)	[39] (a)	[53] 119
[12] (c)	[26] (d)	[40] (c)	[54] $\frac{\pi}{4}$
[13] (e)	[27] (e)	[41] (c)	[55] $\frac{7}{16}$
[14] (a)	[28] (b)	[42] (c)	