

ACT MATHEMATICS PRACTICE TEST
AUGUST 4

60 MINUTES – 60 QUESTIONS

DIRECTIONS: Solve each problem, choose the correct answer, and write the answer letter option clearly on your answer document. (In the actual ACT, you need to shade an oval. However, since we don't have the electronic technology used to read filled ovals, you're being asked to enter letter options).

Do not linger over problems that take too much time. Solve as many as you can; then return to the others in the time you have left for this test.

In the actual ACT, even numbered questions have options F, G, H, J, K while odd numbered questions have options A, B, C, D, E. This is to reduce the chance of marking an option for an incorrect question. Unfortunately, this proved hard to implement for the practice test, so all the questions in the practice test have options A, B, C, D, E.

Note: Unless otherwise stated, all of the following should be assumed:

- (1) Illustrative figures are NOT necessarily drawn to scale.
- (2) Geometric figures lie in a plane.
- (3) The word *line* indicates a straight line.
- (4) The word *average* indicates arithmetic mean.

DO YOUR FIGURING HERE.

- (1) 15 apples cost a total of \$ 12. What is the average cost of an apple?
- (A) \$ 0.40
 - (B) \$ 0.80
 - (C) \$ 1.20
 - (D) \$ 1.25
 - (E) \$ 1.80
- (2) Albert's average score across five tests is 65. His scores in the first four tests are 50, 60, 70, and 90. What is his score in the fifth test?
- (A) 55
 - (B) 65
 - (C) 70
 - (D) 75
 - (E) 85
- (3) A cellphone plan costs \$ 2 per month plus 10 cents per minute of talk time used. If the total talk time used in a month is m minutes, what is the total cost in dollars?
- (A) $10 + 2m$
 - (B) $2 + 10m$
 - (C) $0.1 + 2m$
 - (D) $2 + 0.1m$
 - (E) $12m$
- (4) What is the least common denominator when adding $a/2$, $b/3$, $c/4$, $d/5$, and $e/6$?
- (A) 30
 - (B) 60
 - (C) 120
 - (D) 240
 - (E) 720
- (5) Suppose $x + y = 17$. What is $(x + y)^2 - 3(x + y) + 12$?
- (A) 50
 - (B) 100
 - (C) 150
 - (D) 200
 - (E) 250

DO YOUR FIGURING HERE.

- (6) Consider the statements: (I) Anybody who likes dish A likes dish B , (II) Andrew likes dish A (III) Andrew likes dish B (IV) Bryan does not like dish A (V) Bryan does not like dish B

Which of the following is true?

- (A) (I) implies (II)
- (B) (I) and (III) together imply (II)
- (C) (I) and (II) together imply (IV)
- (D) (I) and (IV) together imply (V)
- (E) (I) and (V) together imply (IV)

- (7) What is $(2x - y)^2$?

- (A) $4x^2 - 2xy - y^2$
- (B) $4x^2 - 4xy - y^2$
- (C) $4x^2 + 2xy + y^2$
- (D) $4x^2 - 2xy + y^2$
- (E) $4x^2 - 4xy + y^2$

- (8) A jar with capacity 3 gallons is used to fill a tank with water. In each trip, the jar is partly or fully filled with water from a faucet and the jar is then taken to the tank where the water is emptied into the tank. If the tank's capacity is 91 gallons, what is the minimum number of trips needed to fill the tank?

- (A) 30
- (B) 31
- (C) 88
- (D) 94
- (E) 273

- (9) Cold drink cans be bought either individually for \$ 1.30 a can or in packs of 15 for \$ 18 a pack. What is the minimum amount of money needed to purchase a total of 40 cans? We are allowed to buy some packs and some individual cans.

- (A) \$ 36
- (B) \$ 49
- (C) \$ 52
- (D) \$ 54
- (E) \$ 60

DO YOUR FIGURING HERE.

- (10) The relationship between temperature in degrees Fahrenheit, F , and temperature in degrees Celsius, C , is expressed by the formula $F = \frac{9}{5}C + 32$. What is a temperature of $50^\circ F$ in $^\circ C$?
- (A) $10^\circ C$
 - (B) $32.4^\circ C$
 - (C) $58^\circ C$
 - (D) $122^\circ C$
 - (E) $147.6^\circ C$
- (11) Adrian and Sharon are both workers in a factory producing widgets. Adrian produces 50% more widgets than Sharon for the same amount of time worked. The percentage is measured using Sharon's production as the base. What can we say about the time taken by Adrian and Sharon to produce widgets?
- (A) Adrian takes about $1/2$ times as much time as Sharon per widget produced.
 - (B) Adrian takes about $2/3$ times as much time as Sharon per widget produced.
 - (C) Adrian takes about $3/2$ times as much time as Sharon per widget produced.
 - (D) Adrian takes about 2 times as much time as Sharon per widget produced.
 - (E) Adrian takes about 3 times as much time as Sharon per widget produced.
- (12) The total cost of a carpet broom and a trash can is \$ 45. The total cost of two carpet brooms and a trash can is \$ 70. What is the cost of a carpet broom?
- (A) \$ 20
 - (B) \$ 25
 - (C) \$ 30
 - (D) \$ 40
 - (E) \$ 45
- (13) Which of the following values of n satisfies $2^{3n} = 4 \cdot 2^7$?
- (A) $n = 1$
 - (B) $n = 3$
 - (C) $n = 6$
 - (D) $n = 9$
 - (E) $n = 18$

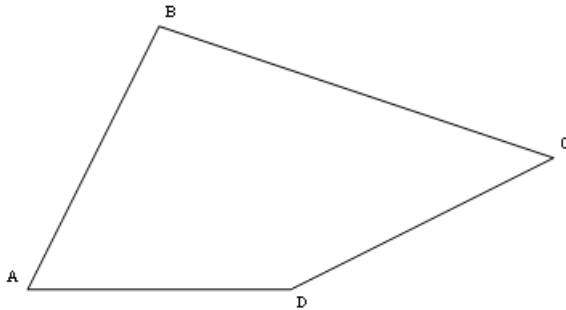
DO YOUR FIGURING HERE.

- (14) Triangles $\triangle ABC$ and $\triangle DEF$ are similar. The side lengths of $\triangle ABC$ are 4 inches, 5 inches, and 6 inches respectively. The middle side length (i.e., the side length that is neither the shortest nor the longest) of $\triangle DEF$ is 60 inches. What is the shortest side length of $\triangle DEF$?
- (A) 48 inches
 - (B) 50 inches
 - (C) 60 inches
 - (D) 72 inches
 - (E) 75 inches
- (15) Water container A has an initial temperature of $50^\circ F$ and container B has an initial temperature of $70^\circ F$. Container A is heated at a rate of $1^\circ F$ per minute and container B is heated at a rate of $0.5^\circ F$ per minute. After how many minutes will the two containers have equal temperatures?
- (A) 10 minutes
 - (B) 20 minutes
 - (C) 30 minutes
 - (D) 40 minutes
 - (E) 50 minutes
- (16) Consider the triangle $\triangle ABC$ with vertices $A = (3, 4)$, $B = (-4, 0)$, and $C = (-5, 5)$. Which of the following is true about the triangle?
- (A) It is a right isosceles triangle
 - (B) It is an equilateral triangle
 - (C) It is a right triangle that is not isosceles
 - (D) It is an isosceles triangle that is neither right angled nor equilateral
 - (E) It is neither a right triangle nor an isosceles triangle
- (17) For one of the following equations, the set of points in the plane satisfying the equation is a pair of intersecting lines. Identify that equation.
- (A) $x^2 + y^2 = 1$
 - (B) $x^2 + y^2 = 0$
 - (C) $x^2 = 1$
 - (D) $xy = 1$
 - (E) $xy = 0$

DO YOUR FIGURING HERE.

- (18) What is the area of the rectangle for which three of the vertices are $(0,0)$, $(3,3)$, and $(7,-1)$?
- (A) 5
(B) 12
(C) 24
(D) 25
(E) 48
- (19) Coffee cups are being sold in three sizes and with four different designs on them. Each size comes with each design. How many different size-design combinations are there?
- (A) 7
(B) 12
(C) 64
(D) 81
(E) 125

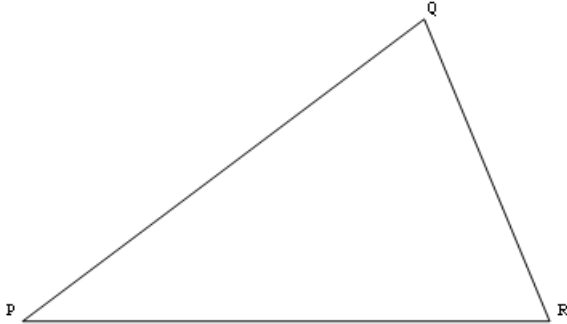
- (20) $ABCD$ is a quadrilateral, as shown in the figure. The sum of the angles B (i.e., $\angle ABC$) and D (i.e., $\angle ADC$) is 240° . What is the sum of the angles A and C ?



- (A) 30°
(B) 120°
(C) 150°
(D) 210°
(E) 240°
- (21) l , m , and n are pairwise distinct lines in the plane. The acute angle between l and m at their point of intersection is 50° . The acute angle between m and n at their point of intersection is 60° . With this information, what can we say about the acute angle between l and n at their point of intersection?
- (A) It must be 10°
(B) It must be 20°
(C) It is either 10° or 20°
(D) It is either 20° or 70°
(E) It is either 10° or 70°

DO YOUR FIGURING HERE.

- (22) PQR is a triangle as shown in the figure. The side length PR is 21 units and the perpendicular distance from Q to PR is 12 units. If the side length PQ is 20 units, what is the perpendicular distance from R to PQ ?



- (A) It is somewhere between 6 and 9 units
(B) It is somewhere between 9 and 12 units
(C) It is somewhere between 12 and 18 units
(D) It is somewhere between 18 and 24 units
(E) It is greater than 24 units
- (23) Consider the functions $f(x) := x^3 - x + 1$. Consider the possibilities $a = -1$, $a = 0$ and $a = 1$. For which of these is it true that $f(f(a)) = f(a)$?
- (A) $a = -1$ only
(B) $a = 0$ only
(C) $a = 1$ only
(D) None of these values of a works
(E) All of these values of a work
- (24) Which of the following real numbers x does not satisfy the inequality $|x(x - 3)| \leq 13$?
- (A) $x = 1$
(B) $x = -1$
(C) $x = 2$
(D) $x = 3$
(E) $x = -3$

DO YOUR FIGURING HERE.

- (25) Emily observes that if she studies n hours for a test the night before the test, her score out of 100 on the test is $f(n) := 3n(10 - n)$. How many hours should Emily study the night before the test so as to maximize her test score?
- (A) 2 hours
 - (B) 3 hours
 - (C) 4 hours
 - (D) 5 hours
 - (E) 6 hours

- (26) Consider the following list of values of test scores out of 100 on a chemistry test for a class of 9 students:

81, 62, 83, 85, 85, 11, 80, 85, 87

Which of the following is true about this data set?

- (A) The mean is greater than the median, which is greater than the mode
 - (B) The mean is less than the median, which is less than the mode
 - (C) The mean and the median are equal, and the mode is greater than both
 - (D) The median and the mode are equal, and the mean is greater than both
 - (E) The median and the mode are equal, and the mean is smaller than both
- (27) n is a positive integer such that $2 < 2n - 1 < 5$. What is the set of all possible values of n ?
- (A) $n = 2$ only
 - (B) $n = 3$ only
 - (C) $n = 2$ and $n = 3$
 - (D) $n = 1$ and $n = 2$
 - (E) $n = 1, n = 2,$ and $n = 3$

DO YOUR FIGURING HERE.

- (28) The slope of the line in the coordinate plane joining the points $(t^2 + 1, t^2 + 2)$ and $(t^2 + 3, t^2 + 4)$ is:
- (A) independent of t
 - (B) dependent on t and is the square root of a linear function of t
 - (C) dependent on t and is a linear function of t
 - (D) dependent on t and is the square root of a quadratic function of t
 - (E) dependent on t and is a quadratic function of t
- (29) What is the area of the region $\{(x, y) : 1 \leq x^2 + y^2 \leq 2\}$ in the (x, y) coordinate plane? This region is a circular annulus, or is the region between two concentric circles both centered at the origin.
- (A) π
 - (B) 2π
 - (C) 3π
 - (D) 7π
 - (E) 8π
- (30) Two of the sides lengths of an isosceles triangle are 3 and 5. What are the possibilities for the third side length?
- (A) 4 only
 - (B) 3 only
 - (C) 5 only
 - (D) 3 or 4
 - (E) 3 or 5
- (31) The population of a town grows at a rate of 1% per year. If the initial population of the town is 300,000, what is the population after 1 year?
- (A) 3,000
 - (B) 30,000
 - (C) 300,000
 - (D) 303,000
 - (E) 330,000
- (32) Suppose $f(x) := x^m$ and $g(x) := x^n$, where m and n are positive integers. Which of the following is true for all real numbers x ?
- (A) $f(g(x)) = g(f(x))$
 - (B) $f(g(x)) = f(x)g(x)$
 - (C) $f(g(x)) = f(x) + g(x)$
 - (D) All of the above
 - (E) None of the above

DO YOUR FIGURING HERE.

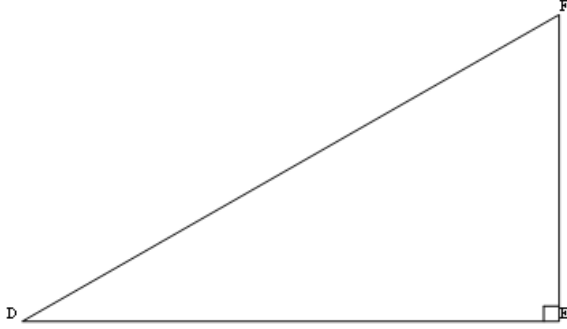
- (33) Which of the following is $x^4 + y^4$ identically equal to?
- (A) $(x^2 + y^2)(x + y)(x - y)$
 - (B) $(x^2 + xy + y^2)(x^2 - xy + y^2)$
 - (C) $(x^2 + \sqrt{2}xy + y^2)(x^2 - \sqrt{2}xy + y^2)$
 - (D) $(x^2 + \sqrt{3}xy + y^2)(x^2 - \sqrt{3}xy + y^2)$
 - (E) $(x + y)^2(x - y)^2$
- (34) What is the last digit of $124^3 + 143^4 + 7^{43}$?
- (A) 0
 - (B) 2
 - (C) 4
 - (D) 6
 - (E) 8
- (35) In which of the following intervals does $\cos 12^\circ$ lie?
- (A) Between -1 and 0
 - (B) Between 0 and $1/2$
 - (C) Between $1/2$ and $1/\sqrt{2}$
 - (D) Between $1/\sqrt{2}$ and $\sqrt{3}/2$
 - (E) Between $\sqrt{3}/2$ and 1
- (36) One of the following equations has no solutions for real x . Identify the equation.
- (A) $x^3 + x^2 = 1$
 - (B) $x^3 + x^2 = -1$
 - (C) $x^4 + x^2 = 1$
 - (D) $x^4 + x^2 = -1$
 - (E) $x^4 + x^3 + x^2 = 1$
- (37) A typist makes approximately 1 spelling error for each 2000 words that she types. Approximately how many spelling errors will she make if she types 1 million words?
- (A) 200
 - (B) 500
 - (C) 2000
 - (D) 5000
 - (E) 20000
- (38) Consider the sequence 17, 43, ____, ____, 121. If the sequence is an arithmetic progression, i.e., the differences of adjacent terms is constant, what are the two middle terms?
- (A) 69 and 95
 - (B) 79 and 95
 - (C) 69 and 85
 - (D) 79 and 85
 - (E) 79 and 105

DO YOUR FIGURING HERE.

- (39) What values of x satisfies $x + 2\frac{1}{3} = 1\frac{3}{4}$?
- (A) $7/6$
 - (B) $-7/6$
 - (C) $7/12$
 - (D) $-7/12$
 - (E) $7/18$
- (40) Suppose i is an imaginary square root of -1 .
What is $i^3 + i + 1$?
- (A) 1
 - (B) $i + 1$
 - (C) $2i + 1$
 - (D) $i + 2$
 - (E) $3i$
- (41) Which of the following, if any, are equal for all real numbers x and y ?
- I.:** $\sqrt{x^2 + y^2}$
 - II.:** $\sqrt{x^2} + \sqrt{y^2}$
 - III.:** $|x| + |y|$
- (A) I and II only
 - (B) I and III only
 - (C) II and III only
 - (D) I, II, and III
 - (E) None of the expressions are equivalent.
- (42) The GDP of a country grows by 10% from 2007 to 2008 (with 2007 GDP as the base for calculating percentages) and 25% from 2008 to 2009 (with 2008 GDP as the base for calculating percentages). What is the GDP growth from 2007 to 2009 with the 2007 GDP taken as the base?
- (A) 35%
 - (B) 37.5%
 - (C) 40%
 - (D) 45%
 - (E) 50%

- (43) In the figure shown here, the angle $\angle E$ is a right angle. Which of the following is true?

DO YOUR FIGURING HERE.



- (A) $\sin \angle F = DE/DF$
 (B) $\sin \angle D = DE/DF$
 (C) $\sin \angle F = EF/DF$
 (D) $\cos \angle F = DE/DF$
 (E) $\tan \angle F = EF/DE$
- (44) Consider a triangle with vertices A , B , and C and the sides opposite those vertices having lengths a , b , and c respectively. Then, the cosine law says that:

$$c^2 = a^2 + b^2 - 2ab \cos C$$

where C is the angle $\angle ACB$. If $a = 3$, $b = 2$, and the angle C is 60° , what is c ?

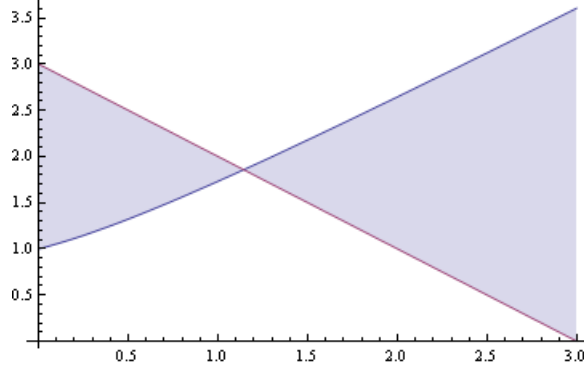
- (A) 1
 (B) $\sqrt{7}$
 (C) $\sqrt{13}$
 (D) $\sqrt{19}$
 (E) 5
- (45) Determine the matrix product:

$$[1 \ 0 \ 0 \ 1] \begin{bmatrix} 0 \\ 1 \\ 0 \\ 1 \end{bmatrix}$$

- (A) $[0]$
 (B) $[1]$
 (C) $[0 \ 0 \ 0 \ 1]$
 (D) $\begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \end{bmatrix}$
 (E) $\begin{bmatrix} 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 \end{bmatrix}$

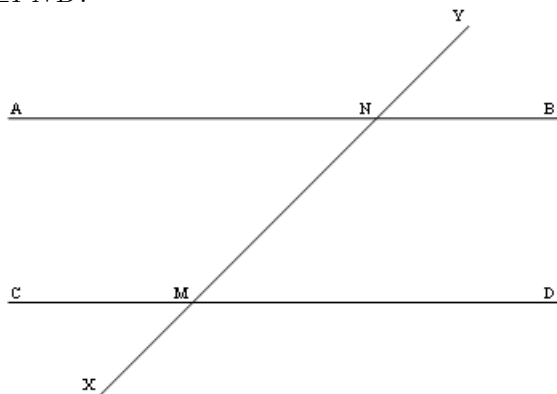
DO YOUR FIGURING HERE.

In the diagram below, the rising curve is the graph of the function $f(x) := \sqrt{x^2 + x + 1}$ and the falling curve is $g(x) := 3 - x$, both for $0 \leq x \leq 3$.

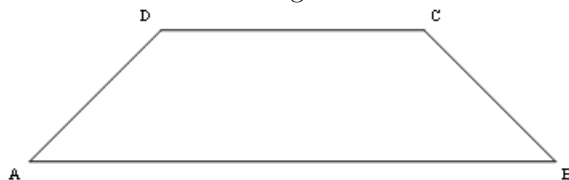


- (46) Let a be the unique value between 0 and 3 such that $f(a) = g(a)$. What is a ?
- (A) $a = (2 + \sqrt{6})/4$
(B) $a = \sqrt{11}/3$
(C) $a = \sqrt{5}/2$
(D) $a = 9/8$
(E) $a = 8/7$
- (47) With the value of a as in the previous question, what is the value of $f(a)$?
- (A) $7/4$
(B) $9/5$
(C) $11/6$
(D) $13/7$
(E) $15/8$
- (48) What is the approximate area of the shaded region?
- (A) 4.5 square units
(B) 7.5 square units
(C) 9 square units
(D) 10.5 square units
(E) 12 square units

- (49) In the figure below, $\angle NMD = \frac{1}{3}\angle ANY$. What is $\angle YNB$?



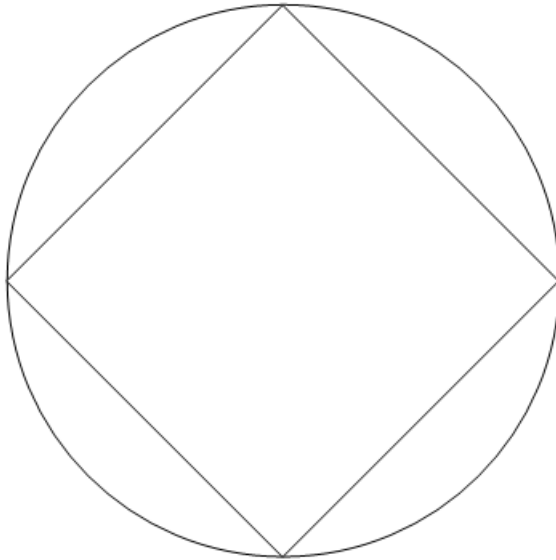
- (A) 45°
 (B) 60°
 (C) 90°
 (D) 120°
 (E) 135°
- (50) In the figure below, $ABCD$ is an isosceles trapezium, i.e., the sides AB and CD are parallel and the sides BC and AD . If AB is 6 units, CD is 4 units, and BC and AD are 2 units. What is the angle $\angle ABC$?



- (A) 15°
 (B) 30°
 (C) 45°
 (D) 60°
 (E) 75°

DO YOUR FIGURING HERE.

- (51) The figure below shows a square inscribed in a circle. What fraction of the circle's area is inside the square?

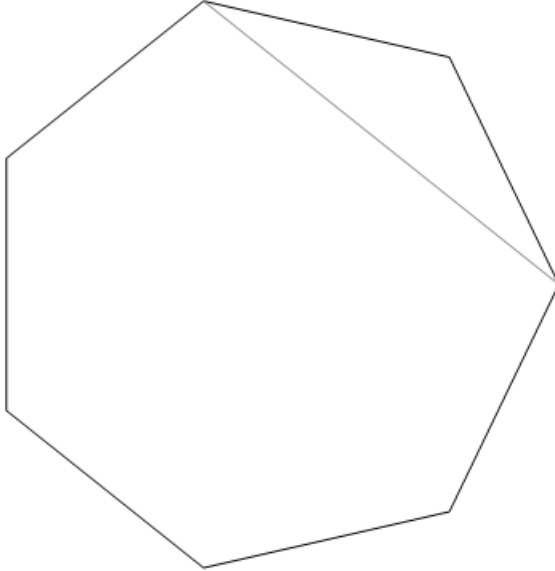


- (A) $1/2$
(B) $1/(2\pi)$
(C) $1/\pi$
(D) $2/\pi$
(E) $\pi/4$
- (52) A bag has 30 balls. Every ball is either red, green, or blue. There are twice as many red balls as green balls. The probability of a randomly picked ball being blue is 30% (in other words, 30% of the balls are blue). How many green balls are there?
- (A) 3
(B) 7
(C) 9
(D) 14
(E) 18

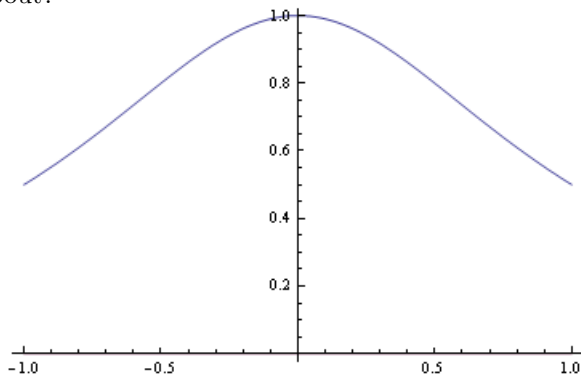
DO YOUR FIGURING HERE.

- (53) The figure below is a regular 7-gon. A diagonal of the figure is any line segment joining two non-adjacent vertices of the regular 7-gon. The gray line shown in the figure is one of the diagonals. What is the total number of diagonals?

DO YOUR FIGURING HERE.



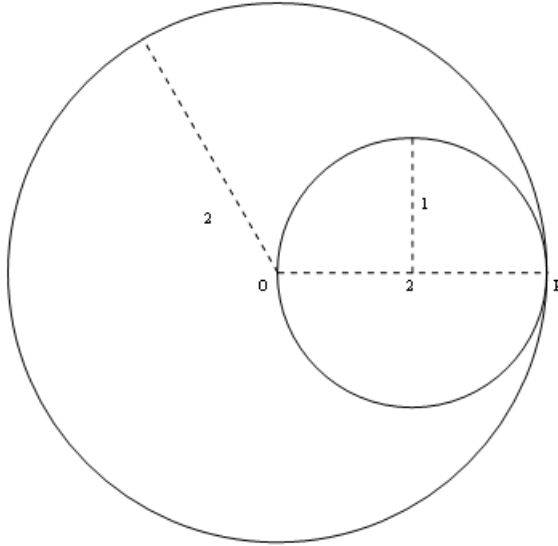
- (A) 14
 (B) 21
 (C) 28
 (D) 42
 (E) 49
- (54) Shown below is a part of the graph of a function $f(x) := \frac{1}{x^2+1}$ for $-1 \leq x \leq 1$. Which of the following lines is the graph symmetric about?



- (A) The y -axis, i.e., the line $x = 0$
 (B) The x -axis, i.e., the line $y = 0$
 (C) The line $y = x$
 (D) The line $y = -x$
 (E) None of the above

DO YOUR FIGURING HERE.

- (55) In the figure below, the big circle has center O and radius 2. The small circle is tangent to the big circle at point P and OP is a diameter of the small circle. Hence the small circle has radius 1. What is the quotient of the circumference of the small circle to the circumference of the big circle?



- (A) $1/4$
(B) $1/3$
(C) $1/2$
(D) $2/3$
(E) $3/4$
- (56) The base area of a cylindrical jar is 20 square feet. Suppose water is poured into the jar at the rate of 10 cubic feet per minute. What is the rate at which the height of water in the jar increases?
- (A) 0.5 feet per minute
(B) 2 feet per minute
(C) 200 feet per minute
(D) $1/(2\pi)$ feet per minute
(E) $1/\pi$ feet per minute

DO YOUR FIGURING HERE.

- (57) For a sphere of radius r , the volume is $4\pi r^3/3$ and the surface area is $4\pi r^2$. If S is the surface area, what is the expression for the volume in terms of S ?
- (A) $S^{3/2}/3$
 - (B) $S^{3/2}/(2\sqrt{\pi})$
 - (C) $S^{3/2}/(3\sqrt{\pi})$
 - (D) $S^{3/2}/(4\sqrt{\pi})$
 - (E) $S^{3/2}/(6\sqrt{\pi})$
- (58) For a region Ω of finite area in a plane, we call a point O a *center of bisection* if every line through O divides Ω into two regions of equal area. Which of the following types of regions does *not* have a center of bisection?
- (A) The interior region of a square
 - (B) The interior region of a circle
 - (C) The interior region of a rectangle
 - (D) The interior region of an equilateral triangle
 - (E) None of the above, i.e., they all have centers of bisection.
- (59) Suppose a and b are the side lengths of a rectangle. What is the length of the diagonal of the rectangle?
- (A) $a + b$
 - (B) $a^2 + b^2$
 - (C) $\sqrt{a + b}$
 - (D) $\sqrt{a^2 + b^2}$
 - (E) None of the above
- (60) Suppose two lines in the coordinate plane, neither of them vertical, have slopes m_1 and m_2 respectively. m_1 and m_2 are both finite since neither line is vertical. Which of the following is a necessary and sufficient condition for the two lines to be perpendicular?
- (A) $m_1 + m_2 = 0$
 - (B) $m_1 m_2 = 0$
 - (C) $m_1 + m_2 = -1$
 - (D) $m_1 m_2 = -1$
 - (E) $m_1^2 + m_2^2 = 1$