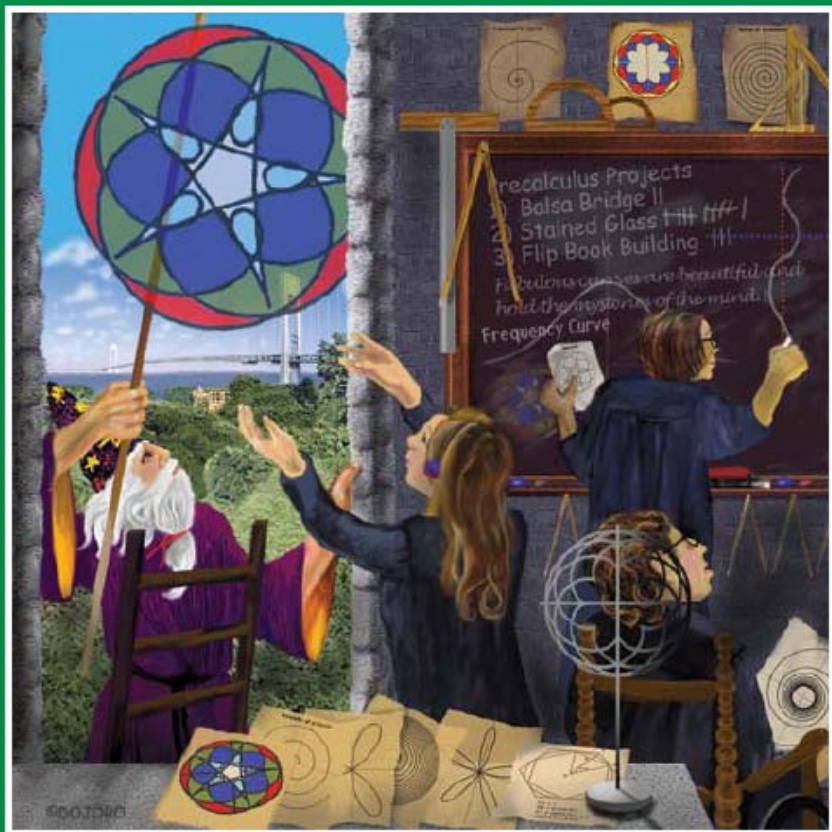


# PRE-CALCULUS



## QUESTION CATALOGUE

# Pre-Calculus

## Table of Contents

### I. REVIEW OF ALGEBRA

<b>1. The Real Number System</b>	
A. Subsets of the Reals	
i. Identifying and Defining Subsets of Real Numbers.....	1
B. The Real Number Line.....	2
C. Inequalities.....	3
D. Absolute Value.....	4
<b>2. Complex Numbers</b>	
A. Powers of $i$ .....	9
B. Addition and Subtraction of Complex Numbers.....	10
<b>C. Multiplication and Division of Complex Numbers.....</b>	<b>11</b>
D. Simplifying Complex Numbers.....	13
E. Multiplicative and Additive Inverses of Complex Numbers.....	14
F. The Complex Plane.....	15
<b>3. Exponents and Radicals</b>	
A. Positive and Negative Exponents.....	20
B. Fractional Exponents.....	22
C. Simplifying Radicals.....	23
D. Rationalizing Fractions.....	25
<b>4. Polynomials</b>	
A. Polynomial Addition, Subtraction, and Multiplication.....	28
B. Factoring Polynomials.....	29
<b>5. Rational Expressions</b>	
A. Finding the Domain of Rational Functions.....	31
B. Reducing and Combining Rational Expressions.....	32
C. Simplifying Compound Fractions.....	40
<b>6. Cartesian Plane</b>	
A. Distance Formula.....	45
B. Midpoint Formula.....	46
C. Graphical Representation of Data Using Cartesian Coordinates.....	47

### II. FUNCTIONS AND GRAPHS

<b>1. Functions</b>	
<b>A. Definition of A Function.....</b>	<b>49</b>
B. Determining Domain and Range.....	51
<b>2. Graphs of Functions</b>	
A. Vertical Line Test.....	55
B. Increasing and Decreasing Functions.....	57
C. Relative Minimum and Maximum Values.....	60
D. Even and Odd Functions.....	61
<b>E. Graphs of Common Functions.....</b>	<b>62</b>

<b>3. Graphing Lines In The Plane</b>	
A. Point Slope Form.....	69
B. Slope Intercept Form.....	72
C. Parallel And Perpendicular Lines.....	74
<b>4. Transformations Of Graphs</b>	
<b>A. Translations, Reflections, And Stretches.....</b>	<b>75</b>
B. Compositions of Transformations.....	81
<b>5. Function Algebra and Composition</b>	
A. General Function Algebra.....	83
B. Composition Of Functions.....	84
<b>6. Function Inverses</b>	
A. Definition Of Function Inverses.....	85
B. Derivation Of Inverses.....	87

### III. POLYNOMIAL AND RATIONAL FUNCTIONS

<b>1. Quadratic Functions</b>	
<b>A. Graphing the Quadratic Function.....</b>	<b>89</b>
B. Axis of Symmetry, Vertex.....	97
C. Quadratic Formula	
i. Discriminant.....	98
ii. Discriminants $< 0$ .....	101
iii. Principle Square Root.....	105
<b>2. Graphical Representation of Polynomial Functions</b>	
A. Leading Coefficient Test.....	106
B. Sketching Graphs: End Behavior, Zeros, Local Min and Max.....	107
C. Finding points of intersection.....	108
<b>3. Finding Zeros of Polynomial Functions</b>	
A. Long Division Algorithm.....	109
B. Synthetic Division.....	110
C. Remainder and Factor Theorem.....	111
D. Descarte's Rule of Sign.....	112
E. Rational Zero Test.....	114
<b>4. Complex Zeros of Polynomial Functions</b>	
A. Fundamental Theorem of Algebra: Linear Factorization Theorem.....	115
B. Conjugate Pairs.....	116
<b>5. Properties of Roots</b>	
A. Sum and Product.....	116
<b>6. Rational Functions</b>	
<b>A. Horizontal, Vertical, and Slant Asymptotes.....</b>	<b>117</b>
B. Partial Fractions.....	119

### IV. EXPONENTIAL AND LOGARITHMIC FUNCTIONS

<b>1. The Exponential Function</b>	
A. Definition.....	121
<b>B. Graphic Representation.....</b>	<b>122</b>
C. The Natural Base.....	126

<b>2. The Logarithmic Function</b>	
A. Definition: Relationship as Inverse to Exponential Function.....	127
B. Graphing Logarithmic Functions.....	128
C. Natural Logarithmic Function.....	129
D. Manipulating Logarithmic Expressions.....	130
<b>3. Solving Equations</b>	
A. Solving Exponential Equations.....	133
B. Solving Logarithmic Equations.....	135
<b>4. Applications of Functions</b>	
A. Compound Interest.....	136
B. Growth and Decay Models.....	137
<b>C. Intensity and Logistic Models.....</b>	<b>139</b>

## V. TRIGONOMETRY

<b>1. Degree and Radian Measure.....</b>	<b>141</b>
<b>2. Trigonometry of the Right Angle</b>	
<b>A. Sin, Cos, and Tan Functions.....</b>	<b>146</b>
<b>3. Trigonometric Functions</b>	
A. Quadrants.....	156
B. Express an Angle as a Positive Acute Angle.....	157
C. Inverse Trigonometric Functions.....	158
D. Reciprocal Trigonometric Functions.....	159
E. Evaluating Trigonometric Functions.....	160
F. Special Angles and Distinct Triangles.....	161
<b>4. Graphing Trigonometric Functions</b>	
<b>A. Amplitude, Frequency, and Period.....</b>	<b>162</b>
B. Sin, Cos, and Tan Graphs.....	164
C. The Graphs of Their Inverses.....	170
<b>5. Trigonometry of Acute and Obtuse Angles</b>	
A. Law of Sines.....	173
B. Law of Cosines.....	176
<b>C. Area of a Triangle Using Trig.....</b>	<b>180</b>
<b>6. Trigonometry of Equations and Identities</b>	
A. Solving Trigonometric Equations.....	182
B. Pythagorean, Quotient, and Reciprocal Identities.....	186
C. Functions of the Sum of Two Angles.....	188
D. Functions of the Difference of Two Angles.....	189
E. Functions of the Double Angle.....	190
F. Functions of the Half Angle.....	191
G. Proofs.....	192

## VI. SYSTEMS OF EQUATIONS AND MATRICES

<b>1. Methods of Solving Systems of Equations.....</b>	<b>193</b>
<b>2. Solving Systems of Inequalities.....</b>	<b>194</b>

<b>3. Matrices</b>	
<b>A. Matrix Algebra</b>	
i. Matrix Addition.....	199
ii. Scalar Multiplication.....	201
iii. Matrix Multiplication.....	202
iv. Matrix Inverses.....	203
v. Determinants of Square Matrices.....	205
<b>B. Elementary Row Operations and Solving Systems of Equations</b>	
i. Row Operations and Row Equivalence.....	207
ii. Using Matrices to Solve Systems	
a. Gaussian Elimination.....	209
b. Gauss Jordan Elimination.....	210
c. Cramer's Rule.....	211

## VII. SEQUENCES AND SERIES

<b>1. Sequences</b>	
<b>A. General Sequences</b>	
i. Finding the nth Term.....	213
<b>B. Arithmetic Sequences.....</b>	214
<b>C. Geometric Sequences.....</b>	215
<b>2. Series</b>	
A. Using Sigma Notation.....	216
B. Sums Of Common Series.....	219
<b>3. Mathematical Induction.....</b>	220

## VIII. PROBABILITY AND STATISTICS

<b>1. Binomial Theorem</b>	
A. Binomial Coefficients and Pascal's Triangle.....	221
B. Expanding Polynomials.....	221
<b>2. Combinatorics</b>	
A. Multiplication Principle.....	223
B. Permutations.....	223
C. Restricted Permutations.....	224
D. Combinations.....	225
<b>3. Probability Theory</b>	
<b>A. Probability of An Event.....</b>	226
<b>4. Mean, Median, Mode.....</b>	230
<b>5. Standard Deviation.....</b>	231
<b>6. Box and Whisker Plots.....</b>	238

## IX. CONICS, PARAMETRICS, AND POLAR COORDINATES

<b>1. Ellipses.....</b>	241
<b>2. Hyperbolas.....</b>	244
<b>3. Systems of Conic Equations.....</b>	245

<b>4. Parametric Equations</b>	
A. Plane Curves.....	247
B. Graphing Parametric Equations.....	251
<b>5. Polar Coordinates</b>	
A. Converting Cartesian Coordinated to Polar Form.....	254
<b>B. Graphing Polar Equations.....</b>	<b>255</b>
C. Common Polar Graphs.....	259

## X. VECTORS, ANALYTIC GEOMETRY

<b>1. Vector Algebra</b>	
A. Vector Addition.....	263
B. Scalar Multiplication.....	264
C. Magnitude Of A Vector.....	265
<b>2. Unit Vectors.....</b>	<b>266</b>
<b>3. Dot Product of Two Vectors</b>	
A. Finding The Dot Product Of Two Vectors.....	267
B. Finding the Angle Between Two Vectors.....	268
<b>4. Three Dimensional Coordinate System</b>	
A. Distance and Midpoint Formulas.....	268
B. Magnitude of a Three Dimensional Vector.....	269
<b>5. Vector Cross Products</b>	
A. Geometric Properties.....	270
B. Computing The Cross Product.....	271
C. Applications of The Cross Product.....	272
<b>6. Equations of Lines And Planes In Space</b>	
A. Finding Equations of Lines in Space.....	273
<b>B. Finding Equations Of Planes In Space.....</b>	<b>274</b>
C. Finding The Line Of Intersection Of Two Planes.....	275
D. Distance Between a Point and a Given Plane.....	276

## XI. INTRODUCTORY CALCULUS

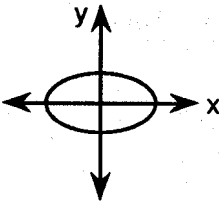
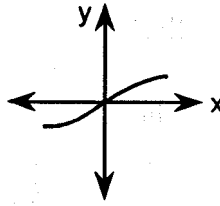
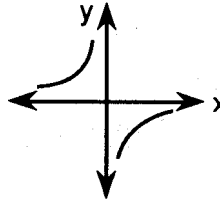
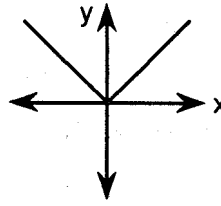
<b>1. Limits and Continuity</b>	
A. Definitions.....	277
B. Computing Limits.....	278
C. Infinite Limits.....	280
D. Continuous and Discontinuous Functions.....	281
<b>2. Derivatives</b>	
A. Definitions	
i. Geometric Definition.....	282
ii. Analytic Definition.....	283
B. Power Rule.....	284
C. Applications of Differentiation.....	287
<b>3. Basic Antiderivatives.....</b>	<b>288</b>



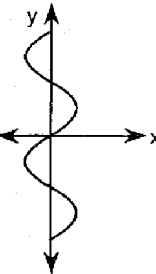
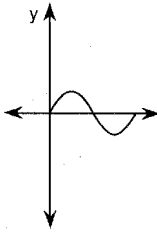
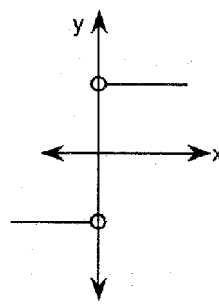
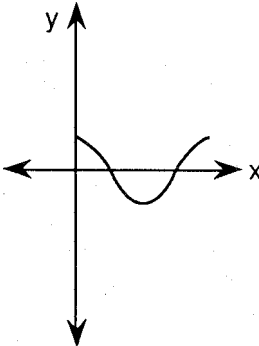
266. If  $f(x) = \sqrt{x^2 - 9}$ , then  $f(4)$  is

- (1) imaginary                      (3) **real and irrational**  
 (2) real and rational            (4) undefined

429. Which diagram is *not* the graph of a function?

- (1)                       (3)   
 (2)                       (4) 

435. Which diagram shows a relation that is *not* a function?

- (1)                       (3)   
 (2)                       (4) 

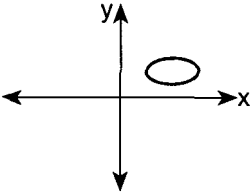
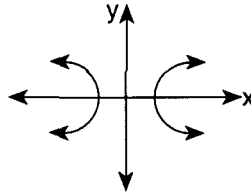
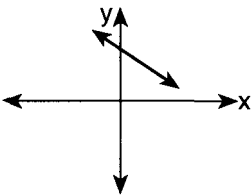
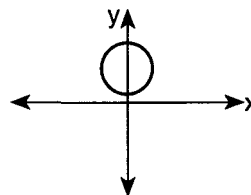
469. Which equation shows that  $p$  varies inversely as  $q$ ?

- (1)  $p = 10q$                       (3)  $p = 10 + q$   
 (2)  **$pq = 10$**                       (4)  $q = p^2 + 10$

800. Which relation is *not* a function?

- (1)  $y = 2x + 4$                       (3)  $x = 3y - 2$   
 (2)  $y = x^2 - 4x + 3$                       (4)  **$x = y^2 + 2x - 3$**

591. Which graph of a relation is also a function?

- (1)                       (3)   
 (2)                       (4) 

664. Which equation is *not* a function?

- (1)  **$3x^2 + 4y^2 = 12$**   
 (2)  $y = 2\cos x$   
 (3)  $y = 2^x$   
 (4)  $y = \log_2 x$

815. Which relation is a function?

- (1)  $x = 4$                       (3)  **$y = \sin x$**   
 (2)  $x = y^2 + 1$                       (4)  $x^2 + y^2 = 16$

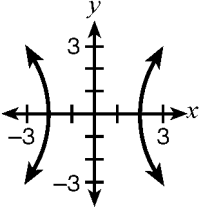
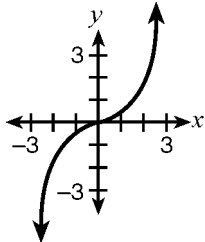
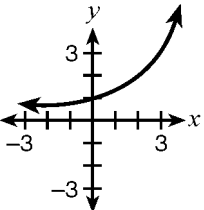
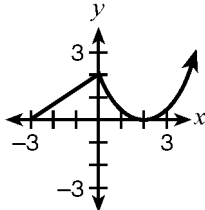
873. Which equation represents a function?

- (1)  $4y^2 = 36 - 9x^2$                       (3)  $x^2 + y^2 = 4$   
 (2)  **$y = x^2 - 3x - 4$**                       (4)  $x = y^2 - 6x + 8$

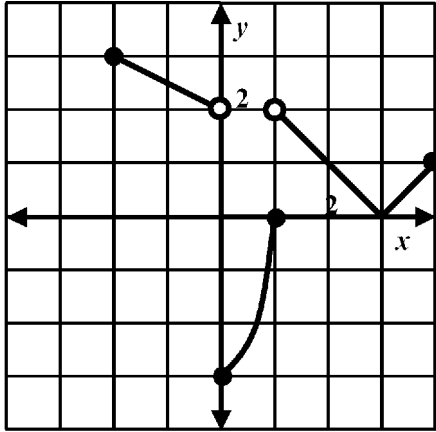
913. Which relation is *not* a function?

- (1)  $y = x^2 + 3x + 5$   
 (2)  $x = \frac{1}{2}y$   
 (3)  **$y^2 + x + 4y = x^2$**   
 (4)  $y = \sqrt[3]{x}$

994. Which graph is *not* a function?

- (1)                       (3)   
 (2)                       (4) 

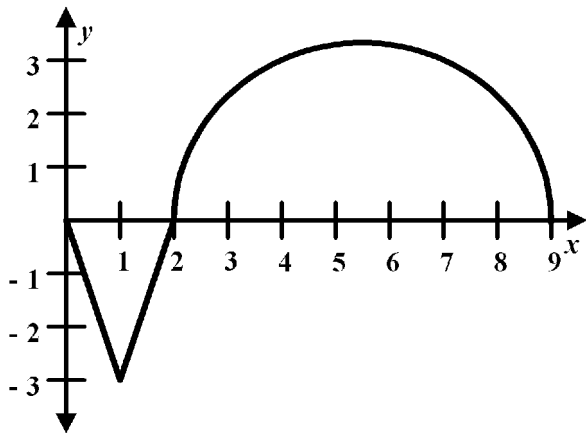
2438. Base your answer to the following question on the graph below.



What is the function's range?

$-3 \leq y < 2$  and  $2 < y \leq 3$

Base your answers to questions 2439 and 2440 on the graph below.



2439. What is the domain of the function?

$0 \leq x \leq 9$

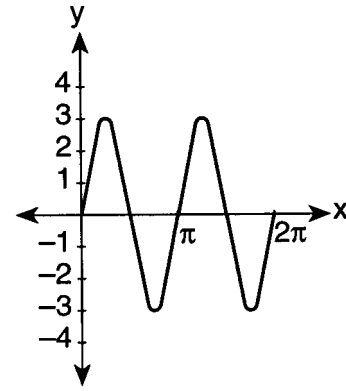
2440. What is the range of the function?

$-3 \leq y \leq 3$

2448. The distance between the two points (4, 6) and (3, 11) is

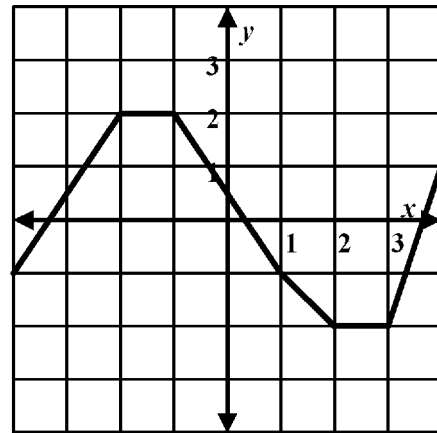
- (1) 5
- (2)  $\sqrt{26}$
- (3)  $2\sqrt{6}$
- (4)  $\sqrt{290}$

2441. What is the domain of the function in the graph below?



- (1)  $-3 \leq x \leq 3$
- (2)  $\pi \leq x \leq 2\pi$
- (3)  $0 \leq x \leq \pi$
- (4)  $0 \leq x \leq 2\pi$

Base your answers to questions 2443 and 2444 on the graph below.



2443. What is the function's domain?

- (1)  $-4 \leq x \leq 4$
- (2)  $-3 \leq x \leq 3$
- (3)  $0 \leq x \leq 2$
- (4)  $-2 \leq x \leq 2$

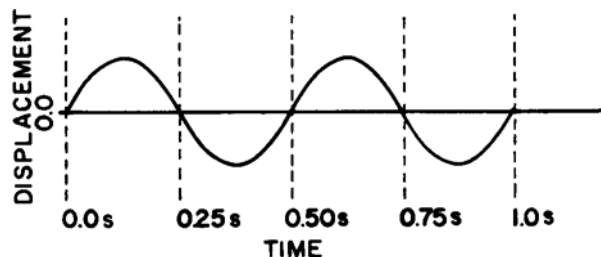
2444. What is the function's range?

- (1)  $-3 \leq y \leq 3$
- (2)  $-4 \leq y \leq 4$
- (3)  $-2 < y < 2$
- (4)  $-2 \leq y \leq 2$

312. The graph of which equation passes through point (0,1)?

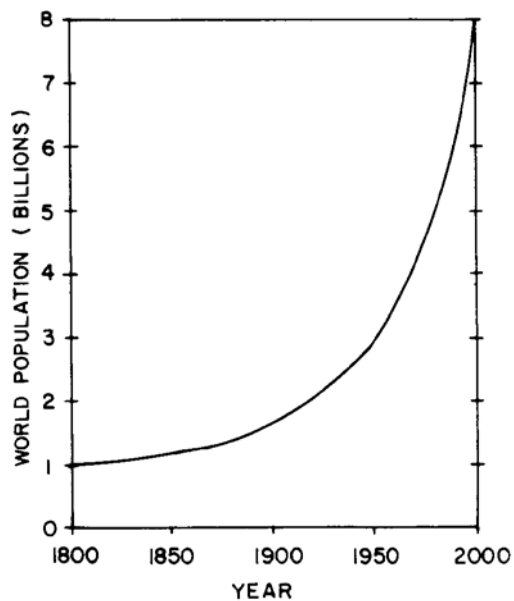
- (1)  $y = \sin x$
- (2)  $y = \tan x$
- (3)  $y = 2^x$
- (4)  $y = \log_2 x$

767. The graph below represents the displacement of a pendulum as a function of time. This graph best models what type of function?



- (1) logarithmic
- (2) **trigonometric**
- (3) linear
- (4) exponential

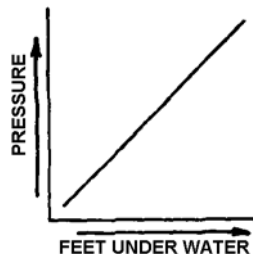
768. The graph below represents the relation between world population and year. This graph best models which type of function?



- (1) **exponential**
- (2) logarithmic
- (3) linear
- (4) quadratic

1233. *a* On graph paper, sketch and label the graph of the equation  $y = -2^x$ .  
*b* On the same set of axes, reflect the graph drawn in part *a* in the line  $y = -x$  and label it *b*.  
*c* Write an equation of the graph drawn in part *b*.  
 $c \ x = 2^{-y}$  or  $y = -\log_2 x$

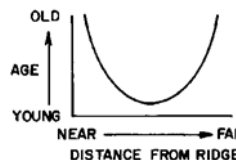
769. The graph below shows the relationship between pressure and the number of feet underwater.



What sort of function is best represented by this graph?

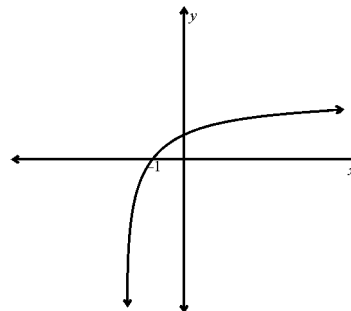
- (1) trigonometric
- (2) exponential
- (3) quadratic
- (4) **linear**

770. The graph below shows the relation between the age of the rock in a ridge and its distance from the ridges center. What sort of function best models this graph?



- (1) **quadratic**
- (2) linear
- (3) exponential
- (4) logarithmic

771. The graph below can be represented by which equation?



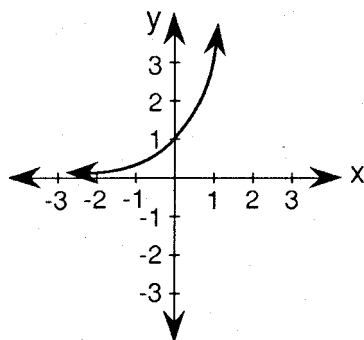
- (1)  $y = \log(x)$
- (2)  $y = \log(x) - 2$
- (3)  $y = 2^x - 2$
- (4)  **$y = \log(x + 2)$**

1265. A squirrel throws an acorn out of a tree so that its height is given by the equation  $h(t) = -5t^2 - 5t + 30$ , where  $h$  is the height in meters and  $t$  is the time in seconds. At what time to the nearest tenth of a second is the height equal to 15 meters?

1.3 s

1094. *a* Draw and label the graph of the equation  $xy = 6$  in the interval  $-6 \leq x \leq 6$ .  
*b* On the same set of axes, draw and label the graph of the image of  $xy = 6$  after a rotation of  $90^\circ$ .  
*c* Write the equation of the graph drawn in part *b*.  
*d* On the same set of axes, draw and label the graph of the image of  $xy = 6$  after a dilation of 2.  
*e* Write the equation of the graph drawn in part *d*.  
*c*  $xy = -6$   
*e*  $xy = 24$

1102. The accompanying diagram shows the graph of the equation  $y = 3^x$ .



What is the equation of the graph obtained by reflecting  $y = 3^x$  in the  $x$ -axis?

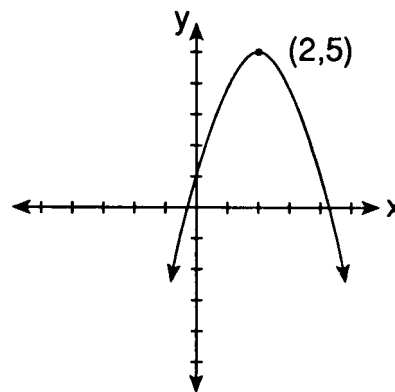
- (1)  $y = \log_3 x$   
 (2)  $y = (\frac{1}{3})^x$   
**(3)  $y = -3^x$**   
 (4)  $x = 3^y$
1108. Find the coordinates of the image of  $(-3, 4)$  under the transformation  $T_{-2, 3}$ .  
 **$(-5, 7)$**
1109. Find the coordinates of point  $N(-1, 3)$  under the composite  $r_{y\text{-axis}} \circ R_{90^\circ}$ .  
 **$(3, -1)$**
1110. If the translation  $T_{(x, y)}$  maps point  $A(1, -3)$  onto point  $A'(-4, 8)$ , what is the value of  $x$ ?  
 **$-5$**
1157. In which quadrant does the image of  $(-4, 1)$  lie after a reflection in the origin?  
 (1) I (3) III  
 (2) II **(4) IV**
1159. Using the translation that maps  $(3, -4)$  to its image  $(1, 0)$ , what is the image of any point  $(x, y)$ ?  
 (1)  $(x + 2, y + 4)$  (3)  $(x + 2, y - 4)$   
 (2)  $(x - 2, y - 4)$  **(4)  $(x - 2, y + 4)$**

1165. What is the image of the point  $(-3, -1)$  under the translation that shifts  $(x, y)$  to  $(x - 2, y + 4)$ ?  
 (1)  $(-1, 3)$  (3)  **$(-5, 3)$**   
 (2)  $(-1, -5)$  (4)  $(-5, -5)$

1170. *a* On graph paper, draw the graph of the equation  $y = x^2 - 4x + 4$ , including all values of  $x$  from  $x = -1$  to  $x = 5$ . Label the graph *a*.  
*b* On the same set of axes, draw the image of the graph drawn in part *a* after a translation that maps  $(x, y) \rightarrow (x - 2, y + 3)$ . Label the image *b*.  
*c* On the same set of axes, draw the image of the graph drawn in part *b* after a reflection in the  $x$ -axis. Label the image *c*.  
*d* Which equation could represent the graph drawn in part *c*?  
 (1)  $y = -x^2 + 4x - 4$   
 (2)  $y = x - 3$   
 (3)  $y = -x^2 - 3$   
 (4)  $y = -x^2 + 3$   
***d* 3**

1176. If a translation maps point  $A(-3, 1)$  to point  $A'(5, 5)$ , the translation can be represented by  
 (1)  **$(x + 8, y + 4)$**  (3)  $(x + 2, y + 6)$   
 (2)  $(x + 8, y + 6)$  (4)  $(x + 2, y + 4)$

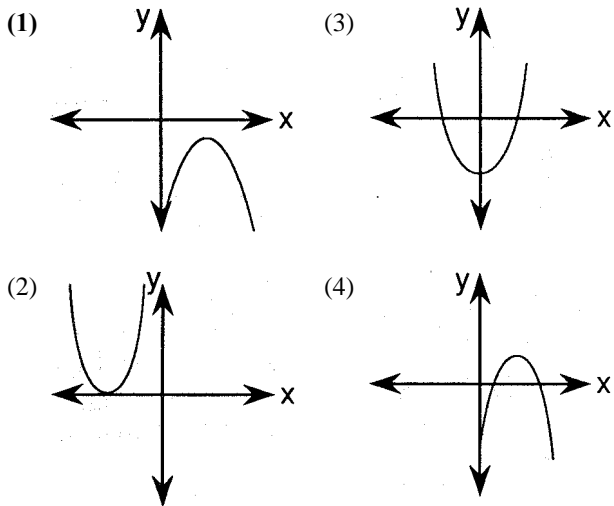
1178. The parabola shown in the diagram is reflected in the  $x$ -axis.



What is the image of the turning point after the reflection?  
 (1)  **$(2, -5)$**  (3)  $(-2, -5)$   
 (2)  $(-2, 5)$  (4)  $(5, 2)$

1180. *a* On graph paper, draw the graph of the equation  $y = x^2 - 6x + 8$  for all values of  $x$  in the interval  $0 \leq x \leq 6$ .  
*b* On the same set of axes, draw the image of the graph drawn in part *a* after a translation of  $(x - 3, y + 1)$  and label it *b*.  
*c* Write an equation of the graph drawn in part *b*.  
 **$y = x^2$**

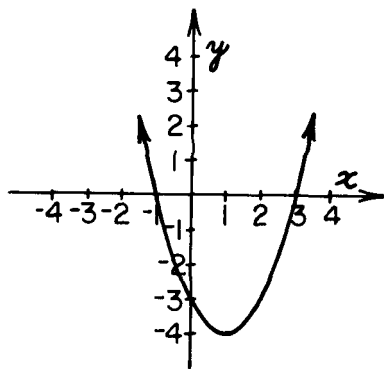
1101. Which graph represents a parabola whose corresponding quadratic equation has imaginary roots?



1136.a Draw the graph of the equation  $y = \frac{1}{2}x^2 - 4x + 4$  including all values of  $x$  such that  $0 \leq x \leq 8$ .  
b Write the coordinates of the turning point.  
c Between which pair of consecutive integers does one root of the equation  $\frac{1}{2}x^2 - 4x + 4 = 0$  lie?

b (4,-4)  
c 1 and 2

1142. In the accompanying diagram of the graph of the parabola  $y = ax^2 + bx + c$ , which must be one root of the equation  $ax^2 + bx + c = 0$ ?



- (1) 1 (3) 3  
(2) -3 (4) -4

1144.a Draw the graph of the equation  $y = x^2 - 4x$  for all values of  $x$  such that  $-1 \leq x \leq 5$ .  
b On the same set of axes used in part a, draw the graph of the equation  $y = -x + 4$ .  
c Using the graphs drawn in parts a and b, what is the positive value of  $x$  for which  $x^2 - 4x = -x + 4$ .  
c 4

1145. Which point is on the graph of the parabola whose equation is  $y = 2x^2 - 3x + 4$ ?

- (1) (0,3) (3) (4,0)  
(2) (3,0) (4) (0,4)

1147.a Draw the graph of the equation  $y = x^2 - 4x - 5$ , including all values of  $x$  such that  $-2 \leq x \leq 6$ .  
b On the same set of axes, draw the graph of the equation  $y = x - 5$ .  
c What are the coordinates of the points of intersection of the graphs drawn in parts a and b?  
c (0,-5) and (5,0)

1148. Which is true of the graph of the parabola whose equation is  $y = x^2 - 2x - 8$ ?

(1) The  $x$ -intercepts are at  $x = 2$  and  $x = -4$ .  
(2) The only  $x$ -intercept is at  $x = 4$ .  
(3) The  $x$ -intercepts are at  $x = 4$  and  $x = -2$ .  
(4) There are no  $x$ -intercepts.

1149. What are the coordinates of the turning point of the parabola whose equation is  $y = x^2 - 2x - 4$ ?

(1) (-2,4) (3) (-1,-1)  
(2) (1,-5) (4) (2,-4)

1150.a Draw a graph of the equation  $y = x^2 - 4x + 3$  for all values of  $x$  such that  $-1 \leq x \leq 5$ .  
b On the same set of axes, sketch the graph of the equation  $x^2 + (y - 3)^2 = 4$ .  
c Using the graphs drawn in parts a and b, determine the number of points these graphs have in common.  
c 2

1151. An equation of the axis of symmetry of the graph of  $y = x^2 + 6x + 9$  is  $x = -3$ . What is the  $y$ -coordinate of the turning point?  
0

1153.a Write an equation of the axis of symmetry of the graph of  $y = -x^2 + 8x - 7$ .  
b Draw the graph of the equation  $y = -x^2 + 8x - 7$ , including all integral values of  $x$  such that  $0 \leq x \leq 8$ .  
c From the graph drawn in part b, find the roots of  $-x^2 + 8x - 7 = 0$ .  
a  $x = 4$  c 1,7

1164. What is an equation of the axis of symmetry of the graph of the parabola  $y = 2x^2 + 3x + 5$ ?

(1)  $y = -\frac{3}{2}$  (3)  $x = -\frac{3}{2}$   
(2)  $y = -\frac{3}{4}$  (4)  $x = -\frac{3}{4}$

1185. The coordinates of the turning point of the graph of the equation  $y = x^2 - 2x - 8$  are  $(1, k)$ . What is the value of  $k$ ?  
-9

1199. *a* Draw the graph of the equation  $y = -x^2 + 4x - 3$  for all values of  $x$  in the interval  $-1 \leq x \leq 5$ .  
*b* Write the equation of the axis of symmetry for the graph drawn in part *a*.  
*c* Which values of  $x$  satisfy the equation:  
 $-x^2 + 4x - 3 = 0$   
 **$bx = 2 \quad c \ 1,3$**

1212. A quarterback throws a football to his receiver. The height of the football at all times,  $t$ , is given by the function  $h(t) = -32t^2 + 96t + 8$ . At what time does the football reach its maximum height?

- (1)  $t = .333$  (3)  $t = 3$   
 (2)  $t = 1.5$  (4)  $t = 6$

1213. An archer shoots an arrow into the air such that its height at any time,  $t$ , is given by the function  $h(t) = -16t^2 + kt + 3$ . If the maximum height of the arrow occurs at time  $t = 4$ , what is the value of  $k$ ?

- (1) **128** (3) 8  
 (2) 64 (4) 4

Base your answers to questions 1224 and 1225 on the information below.

A baseball is hit into the air, and its path is represented by the equation,  $y = -12t^2 + 72$ .

1224. The path of the baseball is represented by what type of function?

**parabola or quadratic**

1225. What is the maximum height of the baseball, in feet?  
**72 feet.**

1226. Roderick was making a rectangular deck. The length was 3 times the width. His neighbor wanted to make a deck 4 feet shorter and 4 feet thinner. If  $x$  represents the width of Roderick's deck, which expression would represent the difference between the area of Roderick's deck and the area of his neighbor's deck?

- (1)  $3x^2 - 16x + 16$  (3)  $6x^2 - 16x + 16$   
 (2)  $-16x - 16$  (4)  **$16x - 16$**

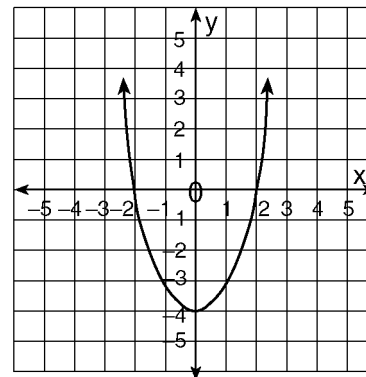
1234. The equation  $W = 120I - 12I^2$  represents the power ( $W$ ), in watts, of a 120-volt circuit having a resistance of 12 ohms when a current ( $I$ ) is flowing through the circuit. What is the maximum power, in watts, that can be delivered in this circuit?

**300**

1248. The height of an object,  $h(t)$ , is determined by the formula  $h(t) = -16t^2 + 256t$ , where  $t$  is time, in seconds. Will the object reach a maximum or a minimum?

**Maximum**

1229. The accompanying diagram shows the graph of the parabola  $y = ax^2 + bx + c$ .



What must be one root of the equation  $ax^2 + bx + c = 0$ ?

- (1) -4 (3) 0  
 (2) -2 (4) 4

1241. A rocket is fired from a cannon that is on the ground. The function  $c(t)$  below represents the distance, in feet, that the ball is from the ground at any time  $t$ . At what time, to the nearest hundredth of a second, is the rocket at its maximum height?

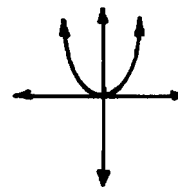
$$c(t) = -25t^2 + 12t + 3$$

- (1) 4.44 (3) .66  
 (2) **.24** (4) .18

1243. A ball is thrown vertically from the ground and it reaches a height of  $7t + t^2$  after  $t$  seconds. How many seconds after the ball is thrown will it reach maximum height, and what is the maximum height the ball will reach, in meters? How many seconds after the rock is thrown will it hit the ground? Round your answers to the nearest hundredth.

**The maximum height is at 3.50 seconds; the maximum height is 12.25 meter; The rock hits the ground in 7 seconds.**

1257.



Which of the following could be the equation of the graph above?

- (1)  $y^2 + x^2 = 8$  (3)  $y = x^3$   
 (2)  **$y = 8x^2$**  (4)  $y^2 - x^2 = 4$

29. The function  $f(x) = \frac{2x^2 + 2x + 3}{4x^2 - 4x}$  has
- (1) a horizontal asymptote at  $y = \frac{1}{2}$  and two vertical asymptotes at  $x = 0$  and  $x = 1$
  - (2) a horizontal asymptote at  $y = \frac{1}{2}$  but no vertical asymptotes
  - (3) no horizontal asymptotes but two vertical asymptotes at  $x = 0$  and  $x = 1$
  - (4) a horizontal asymptote at  $x = 2$  but no vertical asymptotes
  - (5) a horizontal asymptote at  $y = \frac{1}{2}$  and two vertical asymptotes at  $x = \pm 1$

31. The function  $f(x) = \frac{3}{x^2 - 1}$  has
- (1) a horizontal asymptote on the  $x$ -axis and vertical asymptotes at  $x = \pm 1$
  - (2) one vertical asymptote at  $x = 1$
  - (3) a vertical asymptote on the  $y$ -axis
  - (4) two vertical asymptotes at  $x = \pm 1$  but no horizontal asymptote
  - (5) no asymptote

37. The function  $y = \tan^{-1} x$  has
- (1) vertical asymptotes at  $x = \pm \frac{\pi}{2}$
  - (2) vertical asymptotes at  $x = 0$  and  $x = \pi$
  - (3) horizontal asymptotes at  $y = 0$  and  $y = \pi$
  - (4) horizontal asymptotes at  $y = \pm \frac{\pi}{2}$
  - (5) None of the above

40. Which of the following is true about the

$$\text{function } f(x) = \frac{2x^2 + 4}{2 + 7x - 4x^2} ?$$

- (1) It has a vertical asymptote at  $x = -\frac{1}{4}$
- (2) It has a vertical asymptote at  $x = 1$
- (3) It has a horizontal asymptote at  $y = -\frac{1}{4}$
- (4) It has a horizontal asymptote at  $y = 2$
- (5) It has no asymptotes

97. All of the following graphs are asymptotic to the  $x$ -axis except

(1)  $y = \frac{2x}{x^2 + 9}$                       (4)  $y = -\ln(x + 1)$

(2)  $y = \frac{1}{x^2 - 1}$                       (5)  $xy = 4$

(3)  $y = e^{(x-2)}$

80. Which of the following is true about the

$$\text{function } f(x) = \frac{1 - x^2}{3x^2 + 5x - 2} ?$$

- (1) It has vertical asymptotes at  $x = \frac{1}{3}$  and  $x = -2$  and a horizontal asymptote at  $y = -\frac{1}{3}$
- (2) It has vertical asymptotes at  $x = \frac{1}{3}$  and  $x = -2$  but no horizontal asymptotes
- (3) It has vertical asymptotes at  $x = -\frac{1}{3}$  and  $x = -2$  and a horizontal asymptote at  $y = \frac{1}{3}$
- (4) It has a horizontal asymptote at  $y = -\frac{1}{3}$  but no vertical asymptotes
- (5) It has horizontal asymptotes at  $y = \frac{1}{3}$  and  $y = -2$  and a vertical asymptote at  $x = -\frac{1}{3}$

121. The function  $f(x) = \frac{1}{x^3 + 2x^2 - 1}$  has a vertical asymptote at

- (1)  $x = 0$                                       (4)  $y = -2$
- (2)  $x = 1$                                     (5)  $y = 6$
- (3)  $x = -1$

2692. The function  $f(x) = \frac{12x^2 + 2}{12x^3}$  has a horizontal asymptote at

- (1)  $y = -1$                                     (3)  $y = 1$
- (2)  $y = 0$                                     (4)  $y = 12$

2693. The function  $f(x) = \frac{12x^{99} + 2}{12x^{100}}$  has a horizontal asymptote at

- (1)  $y = -1$                                     (3)  $y = 1$
- (2)  $y = 0$                                     (4)  $y = 12$

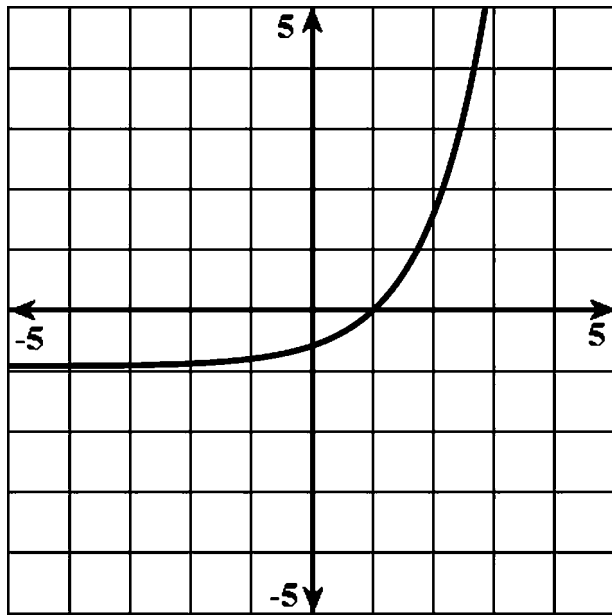
2694. The slant asymptote of  $x^2 - y^2 = 1$  is

- (1)  $y = 1$                                     (3)  $y = \pm 2x$
- (2)  $y = \pm x$                                 (4)  $y = \pm 3x$

2695. The function  $f(x) = \frac{-x^3 + x^2 + 4}{x^2}$  has a vertical asymptote at  $x = 0$  and a slant asymptote at

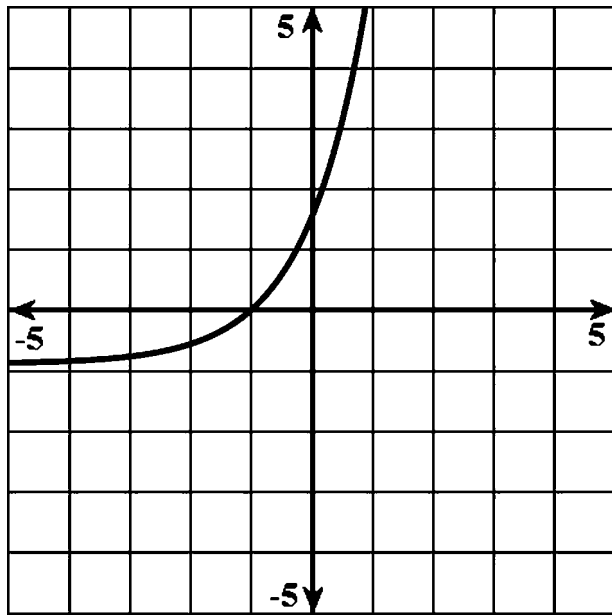
- (1)  $y = x$                                     (3)  $y = x + 1$
- (2)  $y = -x$                                 (4)  $y = -x + 1$

2662. Which function would produce the graph shown below?



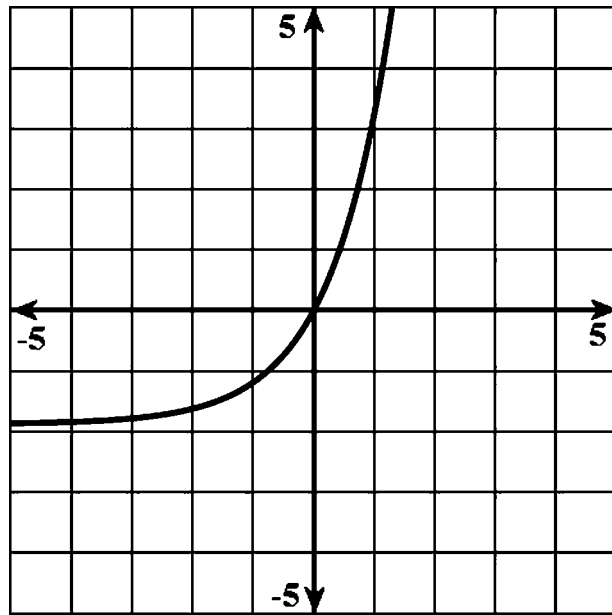
- (1)  $e^x - 1$
- (2)  $e^{(x-1)}$
- (3)  $e^{(x-1)} - 1$
- (4)  $e^{(x-1)} + 1$

2663. The function in the graph below is \_\_\_\_\_.



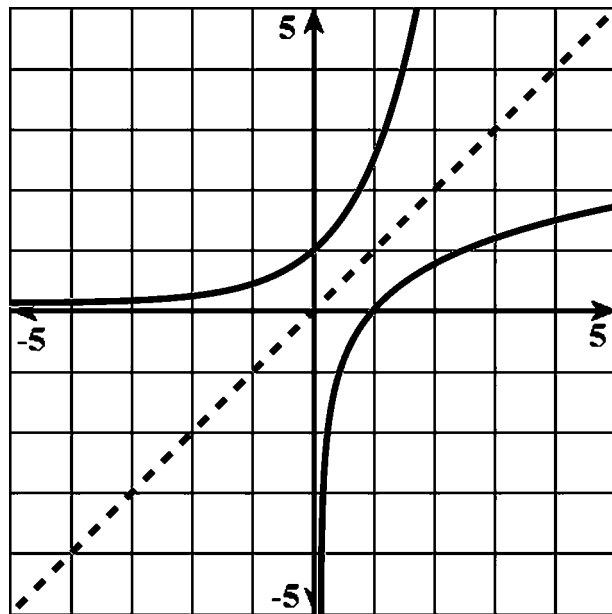
$-1 + e^{(x+1)}$

2664. The function  $f(x) = \underline{\hspace{2cm}}$  will produce the curve in the graph shown below.



- (1)  $2e^x - 1$
- (2)  $2(e^x - 1)$
- (3)  $e^{(x+1)}$
- (4)  $2e^{(x+1)}$

2665. The two curves below,  $\ln(x)$  and  $e^x$  are



inverses

797. The magnitude ( $R$ ) of an earthquake is related to its intensity ( $I$ ) by

$$R = \log\left(\frac{I}{T}\right),$$

where  $T$  is the threshold below which the earthquake is not noticed. If the intensity is doubled, its magnitude can be represented by

- (1)  $2(\log I - \log T)$                       (3)  $2 \log I - \log T$   
 (2)  $\log I - \log T$                         (4)  **$\log 2 + \log I - \log T$**

2161. The relationship between the number of decibels  $d\beta$  and the intensity of a sound  $I$  measured in watts per square meter is given by the relationship  $d\beta = 10 \log_{10}(I/(10^{-16}))$ .

Determine the number of decibels of a sound with an intensity of  $10^{-5}$  watts per square meter.

**110 dB**

2162. The magnitude of an earthquake on the Richter scale is related to the intensity of an earthquake by the relation;

$R = \log_{10}(I)$ , where  $I$  is the intensity of the earthquake in watts per square meter.

If an earthquake registers a 9.7 on the Richter scale what is the earthquake's intensity?

**5,011,872,336 watts per meter.**

2163. The relationship between the number of decibels  $d\beta$  and the intensity of a sound  $I$  measured in watts per square meter is given by the relationship  $d\beta = 10 \log_{10}(I/(10^{-16}))$ .

If a sound is recorded at 25 decibels, what is the intensity of the sound?

**$3.16 \times 10^{-14}$  watts per square meter.**

2164. The relationship between the number of decibels  $d\beta$  and the intensity of a sound  $I$  measured in watts per square meter is given by the relationship  $d\beta = 10 \log_{10}(I/(10^{-16}))$ .

If a sound's intensity is .1 watts per square meter, what is its magnitude in decibels?

**150 decibels**

2268. Explain briefly the reason that a logistic model is a more realistic long term model of population growth than an exponential model.

**The logistic model takes into account limiting conditions that inhibit the growth of any real population in the long term. The exponential model allows for unbounded population growth.**

2165. The relationship between the number of decibels  $d\beta$  and the intensity of a sound  $I$  measured in watts per square meter is given by the relationship  $d\beta = 10 \log_{10}(I/10^{-16})$ .

If the intensity of a sound is doubled, by how much is the magnitude in decibels increased?

- (1) Increased by a factor of 2  
 (2) Increased by a power of 2  
**(3) Increased by a factor of  $\log_{10}(2)$ .**  
 (4) Increased by 2

2265. The spread of a disease through a population of 3000 people can be modeled by the function,

$$P = \frac{3000}{1 + 2500e^{-9t}}$$

Where  $t$  is measured in years. How many years does it take for 1500 people to be infected?

**.87 years.**

2266. The population of a bacteria colony can be modeled by the equation

$$P = \frac{10^8}{1 + 10^7 e^{-.95t}}$$

where  $t$  is the time measured in hours.

At what time is the population equal to 1000 bacteria?

**$t = 4.85$**

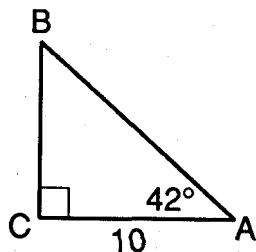
2267. The groundhog population in the city of Punxssetawney, PA during the spring months can be modeled by the function;

$$P = \frac{250}{1 + 50e^{-.15t}}$$

What is the maximum number of groundhogs present?

- (1) **250**    (3) 15  
 (2) 50    (4) 300

1565. In the diagram below,  $m\angle C = 90^\circ$ ,  $m\angle A$  and  $CA = 10$ .

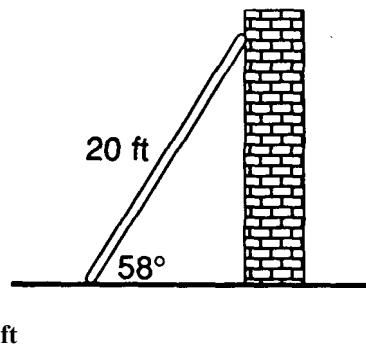


Which equation can be used to find  $AB$ ?

(1)  $\tan 42^\circ = \frac{10}{AB}$       (3)  $\cos 42^\circ = \frac{AB}{10}$

(2)  $\tan 42^\circ = \frac{AB}{10}$       (4)  $\cos 42^\circ = \frac{10}{AB}$

1567. A 20-foot ladder is leaning against a wall. The foot of the ladder makes an angle of  $58^\circ$  with the ground. Find, to the nearest foot, the vertical distance from the top of the ladder to the ground.



1569. If  $\tan A = 0.4548$ , find the measure of  $\angle A$  to the nearest degree.

24°

1570. The straight string of a kite makes an angle of elevation from the ground of  $60^\circ$ . The length of the string is 400 feet. What is the best approximation of the height of the kite?

- (1) 200 ft      (3) 300 ft  
(2) 250 ft      (4) 350 ft

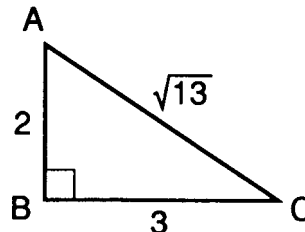
1573. If  $\tan A = 1.3400$ , find the measure of  $\angle A$  to the nearest degree.

53°

1575. If  $\tan A = 0.5400$ , find the measure of  $\angle A$  to the nearest degree.

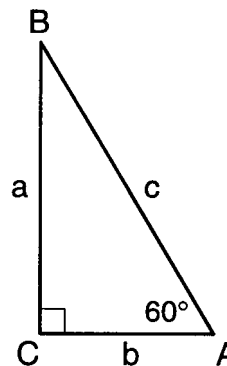
28°

1568. In the accompanying diagram of right triangle  $ABC$ , what is  $\tan C$ ?



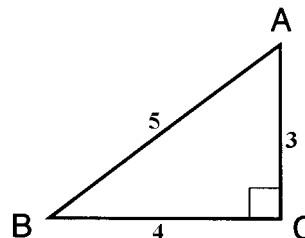
- (1)  $\frac{2}{3}$   
(2)  $\frac{\sqrt{13}}{3}$   
(3)  $\frac{3}{2}$   
(4)  $\frac{2}{\sqrt{13}}$

1571. In the accompanying diagram of right triangle  $ABC$ ,  $b = 40$  centimeters,  $m\angle A = 60^\circ$ , and  $m\angle C = 90^\circ$ . Find the number of centimeters in the length of side  $c$ .



80 cm

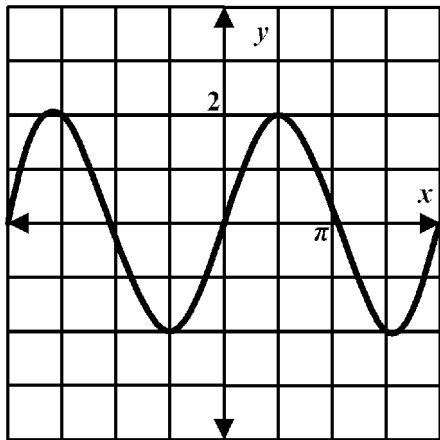
1572. In the accompanying diagram of right triangle  $ABC$ , the hypotenuse is  $\overline{AB}$ ,  $AC = 3$ ,  $BC = 4$ , and  $AB = 5$ .



Sin  $B$  is equal to

- (1)  $\sin A$       (3)  $\tan A$   
(2)  $\cos A$       (4)  $\cos B$

113.



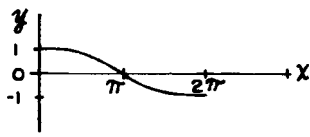
Which of the following functions is represented by the graph above?

- (1)  $f(x) = \sin 2x$                       (4)  $f(x) = \cos 2x$   
 (2)  $f(x) = 2 \sin x$                       (5)  $f(x) = 2 \cos 2x$   
 (3)  $f(x) = 2 \cos x$

1296. The maximum value of the function  $y = 3 \sin 2x$  is

- (1)  $\pi$     (3) **3**  
 (2) 2    (4)  $2\pi$

1304. Which is the equation of the graph shown below?



- (1)  $y = \sin \frac{1}{2}x$                       (3)  $y = \frac{1}{2} \sin x$   
 (2)  $y = \cos \frac{1}{2}x$                       (4)  $y = \frac{1}{2} \cos x$

1361. What is the amplitude of the graph of the equation  $y = 2 \cos 3x$ ?

- (1)  $\frac{2\pi}{3}$   
 (2) **2**  
 (3) 3  
 (4)  $6\pi$

1367. What is the period of the graph for the equation  $y = 3 \cos 2x$ ?

- (1)  $\pi$     (3) 3  
 (2) 2    (4)  $4\pi$

1393. What is the maximum value of  $y$  for the equation  $y = 1 + 3 \sin x$ ?

- (1) 1    (3) 3  
 (2) 2    (4) **4**

1446. What is the period of the graph of the equation  $y = 2 \sin 4x$ ?

- (1)  $\frac{\pi}{2}$   
 (2)  $\pi$   
 (3)  $4\pi$   
 (4)  $8\pi$

1460. What is the amplitude of the graph of the equation  $y = 3 \sin 2x$ ?

- (1)  $\frac{1}{2}$     (3) **3**  
 (2) 2    (4)  $\frac{1}{3}$

1622. The brightness of the star MIRA over time is

given by  $y = 2 \sin\left(\frac{\pi x}{4}\right) + 6$  where  $x$  measures

years and  $y$  is the brightness factor. A new star has a brightness factor determined by

$$y = 4 \sin\left(\frac{\pi x}{16}\right) + 4.$$

- a. Do the two stars have the same maximum brightness factor?  
 b. Do the two stars have the same minimum brightness factor?  
 c. How does the period of the brightness factor of the new star compare to the period of MIRA?  
 d. Is it possible for the two stars to be equally bright at the same time?

- a. **yes**   b. **no**   c. **it is longer by a factor of 4**  
 d. **yes**

1665. What is the period of the function  $y = 7 \cos (3x)$ ?

- (1) 3  
 (2) 7  
 (3)  $\frac{2}{3}\pi$   
 (4)  $\frac{2}{7}\pi$

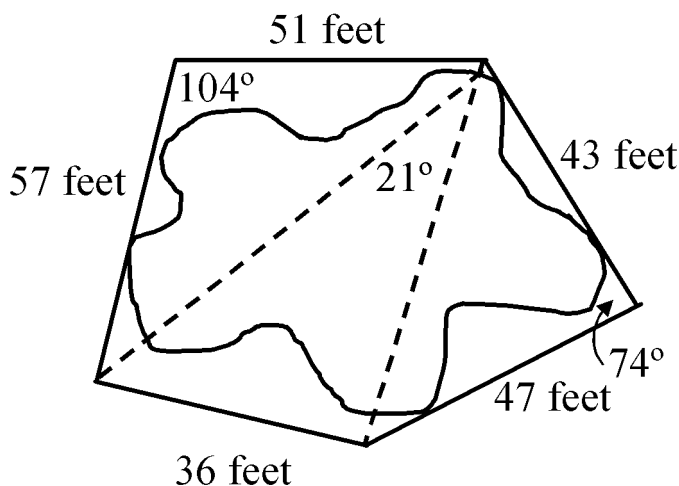
1672. The current,  $I$ , in amperes, flowing through an alternating current circuit at time  $t$  is  $I = 150 \sin (14\pi t + \frac{3}{4}\pi)$ ,  $t \geq 0$ . What is the period of the current?

- (1)  $14\pi$   
 (2)  $\frac{1}{7}$   
 (3)  $\frac{1}{7}\pi$   
 (4)  $\frac{3}{4}\pi$

1687. What is the period of motion of a mass on a spring that moves according to the equation  $x(t) = 4 + 6 \cos (5 + 4t)$ ?

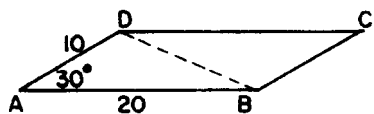
- (1) 10    (3)  $5/\pi$   
 (2) 9    (4)  **$\pi/2$**

1671. To approximate the area of an irregularly shaped area of land, a map maker drew three adjacent triangles around the figure. Using the measurements obtained by the map maker, estimate the area of the plot of land based on the areas of the triangles, to the nearest foot.



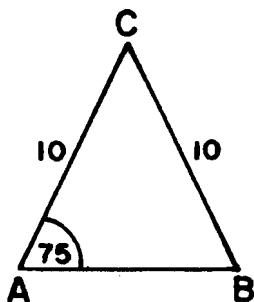
3211

1287. In the accompanying diagram,  $ABCD$  is a parallelogram with  $AB = 20$ ,  $AD = 10$ , and  $m\angle A = 30$ . Find the area of parallelogram  $ABCD$ .



100

1291. In the accompanying figure of  $\triangle ABC$ ,  $a = 10$ ,  $b = 10$ , and  $m\angle A = 75$ . Find the area of  $\triangle ABC$ .



25

1343. In triangle  $ABC$ ,  $a = 6$ ,  $b = 8$ , and  $\sin C = \frac{1}{4}$ . Find the area of triangle  $ABC$ .

6

1329. In triangle  $ABC$ ,  $a = 20$ , and  $m\angle C = 30$ . For which value of  $b$  is the area of triangle  $ABC$  equal to 100 square units?

- (1) 10
- (2) 20
- (3)  $\frac{20\sqrt{3}}{3}$
- (4) 25

1347. Find the area of triangle  $ABC$  if  $a = 12$ ,  $b = 15$ , and  $m\angle C = 30$ .

45

1373. Find the area of  $\triangle ABC$  if  $m\angle A = 30$ ,  $b = 10$ , and  $c = 5$ .

$12\frac{1}{2}$

1379. The area of  $\triangle ABC$  is 100 square centimeters. If  $c = 20$  centimeters and  $m\angle A = 30$ , then  $b$  is equal to

- (1) 20 cm
- (2) 500 cm
- (3)  $20\sqrt{3}$  cm
- (4)  $10\sqrt{2}$  cm

1382. In  $\triangle ABC$ ,  $a = 6$ ,  $b = 8$ , and  $\sin C = \frac{1}{4}$ . Find the area of  $\triangle ABC$ .

6

1388. Find, to the nearest tenth, the area of  $\triangle ABC$  if  $a = 6$ ,  $b = 10$ , and  $m\angle C = 18$ .

9.3

1451. In  $\triangle NEW$ ,  $m\angle N = 60$ ,  $NE = 8$ , and  $NW = 6$ . Find the area of  $\triangle NEW$ .

$12\sqrt{3}$

2394. Use Gauss Jordan elimination to solve for  $x$ ,  $y$ , and  $z$ .

$$2x + 2y + z = 14$$

$$x - y - z = -5$$

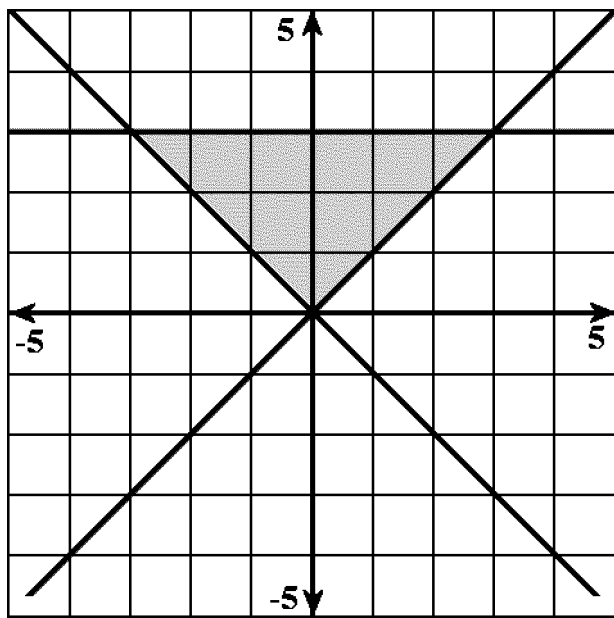
$$3x + y + z = 13$$

What is the final step in the reduction?

$$(1) \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 3 \\ 3 \\ 4 \end{bmatrix} \quad (3) \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 3 \\ 2 \\ 4 \end{bmatrix}$$

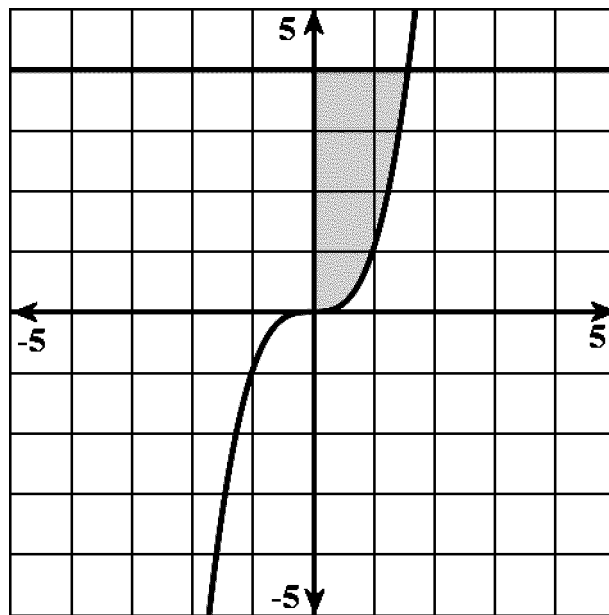
$$(2) \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 2 \\ 3 \\ -4 \end{bmatrix} \quad (4) \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix}$$

2396. Which set of inequalities is depicted by the shaded area in the picture below?



- (1)  $y \leq -x$   
 $y \geq x$   
 $y \leq 3$
- (2)  $y \geq -x$   
 $y \leq x$   
 $y \geq 3$
- (3)  $y \geq -x$   
 $y \geq x$   
 $y \leq 3$
- (4)  $y \geq -x$   
 $y \geq x$   
 $y \geq 3$

2397. Which set of inequalities is depicted by the shaded area in the picture below?



- (1)  $y \leq x^3$   
 $y \leq 4$   
 $x \geq 0$
- (2)  $y \geq x^3$   
 $y \leq 4$   
 $x \geq 0$
- (3)  $y \geq x^3$   
 $y \geq 4$   
 $x \geq 0$
- (4)  $y \geq x^3$   
 $y \leq 4$   
 $x \leq 0$

2405. Use row operations to reduce the following matrix to reduced row echelon form.

$$x + y + z = 6$$

$$2x - y - 2z = -5$$

$$x - y + z = 0$$

$$(1) \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 3 \\ 2 \end{bmatrix} \quad (3) \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$$

$$(2) \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ 2 \end{bmatrix} \quad (4) \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 3 \\ 2 \\ 1 \end{bmatrix}$$

2093. What is the multiplying factor of the the following geometric sequence?

$$a_n = \left\{2, 1, \frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \dots\right\}$$

- (1) 2 (3) -1  
(2) 1 (4) **0.5**

2094. What is the multiplying factor of the the following geometric sequence?

$$a_n = \left\{\pi, \frac{\pi\sqrt{2}}{2}, \frac{\pi}{2}, \frac{\pi\sqrt{2}}{4}, \frac{\pi}{4}, \dots\right\}$$

$2^{-0.5}$

2095. The sequence  $a_n = \{2, 4, 8, 16, 32, 64, \dots\}$  is geometric. What is the ratio between any two consecutive terms?

**1 : 2**

2096. Determine if the sequence

$$a_n = \{2, 4, 6, 8, 10, \dots\}$$

is geometric.

**It is not geometric.**

2097. Determine if the given sequence is geometric.

$$a_n = \{3, 12, 21, 30, \dots\}$$

**It is not geometric.**

2098. Write the first five terms of the geometric sequence;

$$a_1 = 4$$

$$r = \frac{1}{4}$$

$$4, 1, \frac{1}{4}, \frac{1}{16}, \frac{1}{112}$$

2099. Given that the 3<sup>rd</sup> term of a geometric sequence is 343 and the fourth is 2401, what is the common ratio?

- (1) 6 (3) 8  
(2) **7** (4) 9

2100. Given that the fourth term of a geometric sequence is 12 and the third is 48, find the common ratio.

- (1) 1 (3) 3  
(2) 2 (4) **4**

2101. Find the first five terms of the geometric sequence with;

$$r = 4$$

$$a_1 = 12$$

**12, 48, 192, 768, 3072**

2102. Find the 17<sup>th</sup> term of the geometric sequence with starting term 2 and common ratio 2.

- (1) 65536 (3) 443298  
(2) **131072** (4) 143202

2103. Find the 12<sup>th</sup> term of the geometric sequence with starting term 5 and common ratio 3.

- (1) 2958629 (3) **885735**  
(2) 586903 (4) 2657205

2104. Find the formula for the  $n^{\text{th}}$  term of the geometric sequence with

$$a_1 = \frac{1}{4}$$

$$r = \frac{1}{2}$$

$$(1) a_n = \frac{1}{2} \cdot \frac{1}{4}^n$$

$$(2) a_n = \frac{1}{4} \cdot \frac{1}{2}^n$$

$$(3) a_n = \frac{1}{8}^n$$

$$(4) a_n = \frac{1}{8}$$

2105. Write the  $n^{\text{th}}$  term of the geometric sequence with starting term 3 and common ratio  $\frac{1}{5}$ .

$$a_n = 3 \left(\frac{1}{5}\right)^n$$

2106. A principal of \$2000 is invested at 10% interest. Find the amount after 10 years if the interest is compounded

- a) annually  
b) biannually  
c) quarterly  
d) monthly  
e) daily

**a) \$5187.48**

**b) \$5306.60**

**c) \$5370.13**

**d) \$5414.08**

**e) \$5435.82**

2107. A principal of \$2500 is invested at 12%. Find the amount in the account after 20 years if the interest is compounded

- a) annually  
b) semiannually  
c) quarterly  
d) monthly

**a) \$24115.73**

**b) \$25714.29**

**c) \$26602.23**

**d) \$27231.38**

1744. If a fair coin is tossed four times, what is the probability of obtaining *at most* one head?

- (1)  $\frac{1}{16}$   
 (2)  $\frac{4}{16}$   
**(3)  $\frac{5}{16}$**   
 (4)  $\frac{11}{16}$

1758. If the probability that an event will occur is  $\frac{x}{y}$ , then the probability that the event will *not* occur is

- (1)  $\frac{-x}{y}$   
 (2)  $\frac{-y}{x}$   
 (3)  $\frac{1-x}{y}$   
**(4)  $\frac{y-x}{y}$**

1786. When Nick plays cards with Lisa, the probability that Nick will win is  $\frac{6}{10}$ . If they play three games of cards and there are no ties, what is the probability that Lisa will win all three games?

$$\frac{64}{1000}$$

1788. If the probability of hitting a target is  $\frac{3}{4}$ , then the probability of hitting the target *exactly* once in four tries is

- (1)  $\frac{3}{256}$   
**(2)  $\frac{12}{256}$**   
 (3)  $\frac{27}{256}$   
 (4)  $\frac{36}{256}$

1789. In a family of six children, what is the probability that *exactly* one child is female?

- (1)  $\frac{6}{64}$   
**(2)  $\frac{7}{64}$**   
 (3)  $\frac{32}{64}$   
 (4)  $\frac{58}{64}$

1803. If a fair coin is flipped three times, what is the probability of obtaining *exactly* two heads?

$$\frac{3}{8}$$

1800. *a* If a letter is selected at random from the name MARILYN in five separate trials, what is the probability that the M is chosen *exactly* three times?

*b* If a letter is selected at random from the name DAPHNE in seven separate trials, what is the probability that a vowel is chosen *at least* six times?

*c* If a letter is selected at random from the name NORMA in six separate trials, what is the probability that a consonant is chosen *at most* once?

$$a \frac{360}{16807} \quad b \frac{15}{2187} \quad c \frac{640}{15625}$$

1806. If a fair die is tossed five times, what is the probability of getting *exactly* three 6's?

- (1)  $\frac{125}{7776}$  (3)  ${}_5C_3 \left(\frac{1}{6}\right)^2 \left(\frac{5}{6}\right)^3$   
 (2)  ${}_5C_3 \left(\frac{1}{6}\right)^3 \left(\frac{5}{6}\right)^2$  (4)  $\frac{25}{7776}$

1810. A fair die is tossed five times. What is the probability of obtaining *exactly* three 4's?

- (1)  $\frac{250}{7776}$   
 (2)  $\frac{10}{7776}$   
 (3)  $\frac{1250}{7776}$   
 (4)  $\frac{90}{1024}$

1811. A mathematics quiz has five multiple-choice questions. There are four possible responses for each question. Jennifer selects her responses at random on every question.

(1) What is the probability she will select the correct response for *at most* one question?

(2) What is the probability she will select the correct response to *at least* three questions?

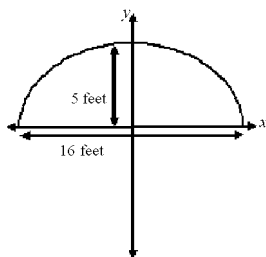
$$(1) \frac{648}{1024} \quad (2) \frac{106}{1024}$$

1828. At a certain intersection, the light for eastbound traffic is red for 15 seconds, yellow for 5 seconds, and green for 30 seconds. Find, to the *nearest tenth*, the probability that out of the next eight eastbound cars that arrive randomly at the light, exactly three will be stopped by a red light.

$$0.3$$



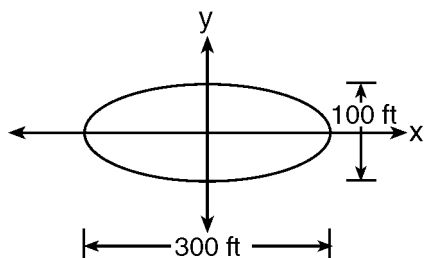
1242. The opening of a cave that is in the shape of a semi-ellipse (half an ellipse), such that the width of the arch is 16 feet and the height of the arch is 5 feet, as shown in the accompanying diagram.



Which equation models this arch?

- (1)  $\frac{x^2}{64} + \frac{y^2}{25} = 1$       (3)  $\frac{x^2}{25} + \frac{y^2}{64} = 1$   
 (2)  $\frac{x^2}{256} + \frac{y^2}{25} = 1$       (4)  $\frac{x^2}{25} + \frac{y^2}{64} = 1$

1251. The accompanying diagram represents the elliptical path of a ride at an amusement park.



Which equation represents this path?

- (1)  $x^2 + y^2 = 300$       (3)  $\frac{x^2}{150^2} + \frac{y^2}{50^2} = 1$   
 (2)  $y = x^2 + 100x + 300$       (4)  $\frac{x^2}{150^2} - \frac{y^2}{50^2} = 1$

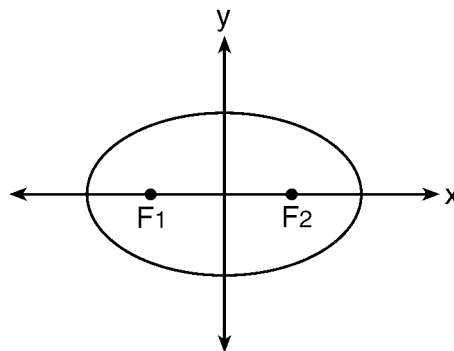
1271. A circle has the equation  $(x + 1)^2 + (y - 3)^2 = 16$ . What are the coordinates of its center and the length of its radius?

- (1) **(-1, 3) and 4**      (3) (-1, 3) and 16  
 (2) (1, -3) and 4      (4) (1, -3) and 16

1274. What is the equation of a circle with center  $(-3, 1)$  and radius 7?

- (1)  $(x - 3)^2 + (y + 1)^2 = 7$       (3)  $(x + 3)^2 + (y - 1)^2 = 7$   
 (2)  $(x - 3)^2 + (y + 1)^2 = 49$       (4)  **$(x + 3)^2 + (y - 1)^2 = 49$**

1267. The accompanying diagram shows the elliptical orbit of a planet. The foci of the elliptical orbit are  $F_1$  and  $F_2$ .



If  $a$ ,  $b$ , and  $c$  are all positive and  $a \neq b \neq c$ , which equation could represent the path of the planet?

- (1)  $ax^2 - by^2 = c^2$       (3)  $y = ax^2 + c^2$   
 (2)  **$ax^2 + by^2 = c^2$**       (4)  $x^2 + y^2 = c^2$

1275. What are the coordinates of the center of the circle represented by the equation  $(x + 3)^2 + (y - 4)^2 = 25$ ?

- (1) (3, 4)      (3) **(-3, 4)**  
 (2) (3, -4)      (4) (-3, -4)

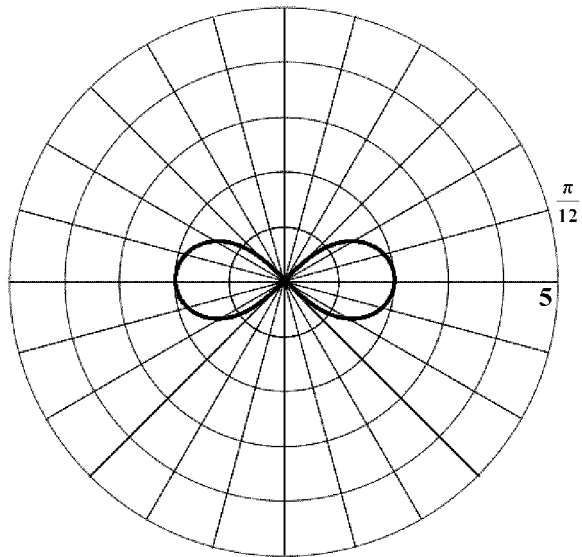
1276. Which equation, when graphed on a Cartesian coordinate plane, would best represent an elliptical racetrack?

- (1)  **$3x^2 + 10y^2 = 288,000$**       (3)  $3x + 10y = 288,000$   
 (2)  $3x^2 - 10y^2 = 288,000$       (4)  $30xy = 288,000$

1281. An object orbiting a planet travels in a path represented by the equation  $3(y + 1)^2 + 5(x + 4)^2 = 15$ . In which type of pattern does the object travel?

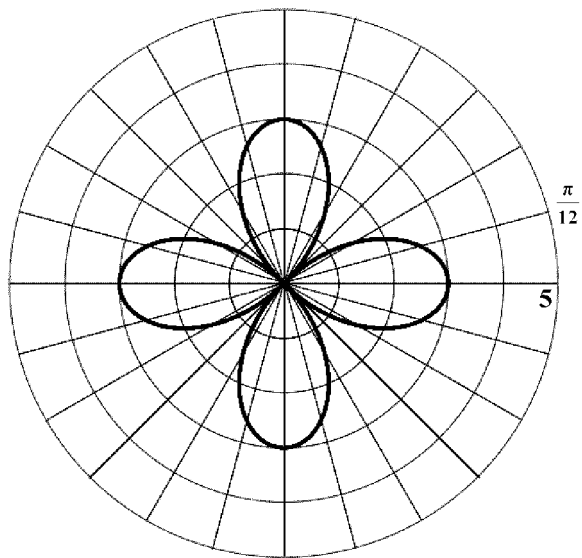
- (1) hyperbola      (3) circle  
 (2) **ellipse**      (4) parabola

2490. Which polar equation correctly identifies the curve on the polar axis below?



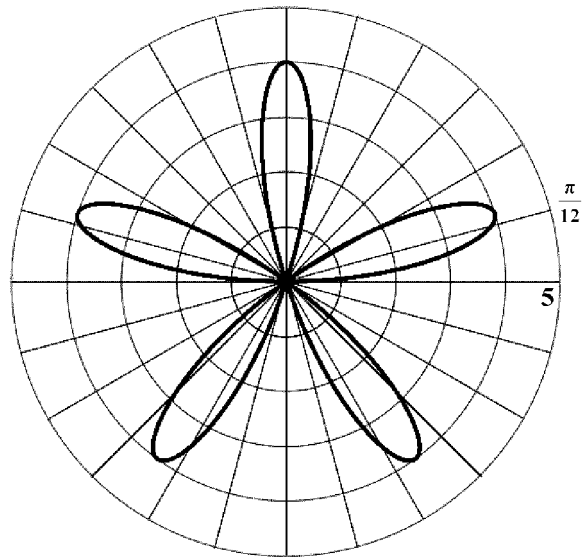
- (1)  $r^2 = 4\cos(2t)$       (3)  $r^2 = 2\cos(4t)$   
 (2)  $r^2 = 2\cos(2t)$       (4)  $r^2 = 4\cos(4t)$

2491. Which polar equation correctly identifies the curve on the polar axis below?



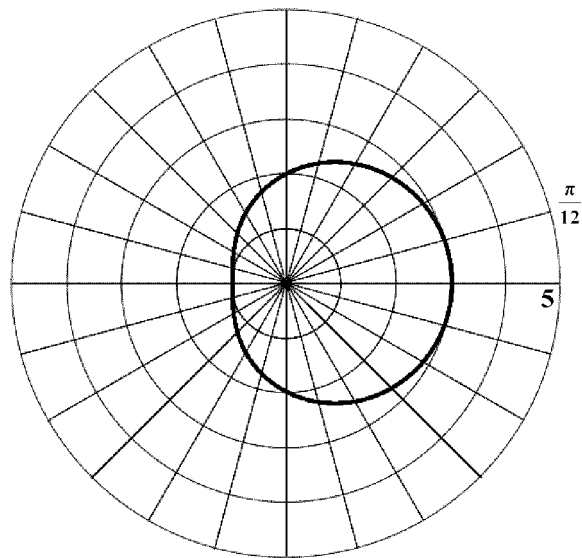
- (1)  $r = 3\cos(t)$       (3)  $r = 3\cos(4t)$   
 (2)  $r = 3\cos(2t)$       (4)  $r = 3\sin(4t)$

2492. Which polar equation correctly identifies the curve on the polar axis below?



- (1)  $r = 4\sin(5t)$       (3)  $r = 4\cos(5t)$   
 (2)  $r = 5\sin(4t)$       (4)  $r = 5\cos(4t)$

2493. Which polar equation correctly identifies the curve on the polar axis below?



- (1)  $r = 2 - \cos(t)$       (3)  $r = 1 + \cos(t)$   
 (2)  $r = 2 + \cos(t)$       (4)  $r = 1 + 2\cos(t)$

2039. Find the equation of the plane that contains the points (7, 2, 8), (1, 1, 2), (2, 5, 3).

**$23(x - 1) - 23(z - 2) = 0$**

2040. Which of the following is the equation of the plane that passes through the points (0, 0, 0), (1, 1, 0), (0, 3, 3)?

- (1)  $x + y = 0$                       (3)  **$3x - 3y + 3z = 0$**   
 (2)  $3x + 3z = 0$                   (4)  $3y + 3z = 0$

2041. Which of the following is the equation of the plane that passes through the point (2, -3, 5) and is normal to the vector  $\langle 4, 5, 11 \rangle$  written in general form?

- (1)  $4x + 5y + 11z + 48 = 0$     (3)  $4x + 5y + 11z + 62 = 0$   
 (2)  $2x - 3y + 5z - 48 = 0$     (4)  **$4x + 5y + 11z - 48 = 0$**

2042. Write the equation of the plane that contains the lines:

$x = 6 + t$   
 $y = -5 - 2t$   
 $z = 1 + 3t$   
 and  
 $x = 7 + 5s$   
 $y = 5 + 2s$   
 $z = -8 + 3s$

You can assume the fact that the lines are coplanar.

**$-12(x - 6) + 12(y + 5) + 12(z - 1) = 0$**

2043. Which of the following is the equation of the plane that contains the points: (2, -6, 3), (3, 5, 8), (1, 13, 4)?

- (1)  $106x - 4y - 260 = 0$     (3)  $106x - 4y + 8z + 260 = 0$   
 (2)  $14x + y - 5z + 7 = 0$     (4)  **$14x + y - 5z - 7 = 0$**

2044. Which of the following is the equation of the plane that passes through the point (-7, 0, -2) and is parallel to the yz-plane.

- (1)  **$x + 7 = 0$**                       (3)  $y + 7 = 0$   
 (2)  $x - 7 = 0$                       (4)  $z + 7 = 0$

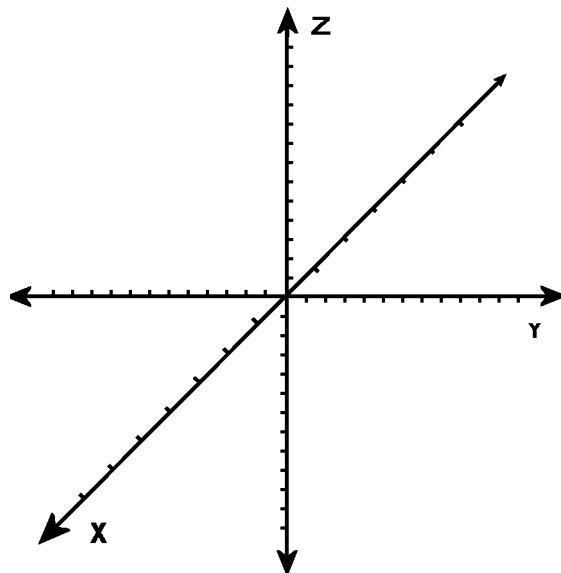
2045. Which of the following is the equation of the plane that passes through the point (10, 38, 25) and is parallel to the xy-plane?

- (1)  $z + 25 = 0$                       (3)  $10x + 38y + 25z = 0$   
 (2)  **$z - 25 = 0$**                       (4)  $-10x - 38y - 25z = 0$

2048. Which of the following is the general equation of the plane that contains the point (-3, -5, -8) and is normal to the vector  $\langle 2, 4, 7 \rangle$ ?

- (1)  $2x + 4y + 7z - 82 = 0$     (3)  $3x + 5y + 8z + 82 = 0$   
 (2)  **$2x + 4y + 7z + 82 = 0$**     (4)  $3x + 5y + 8z - 82 = 0$

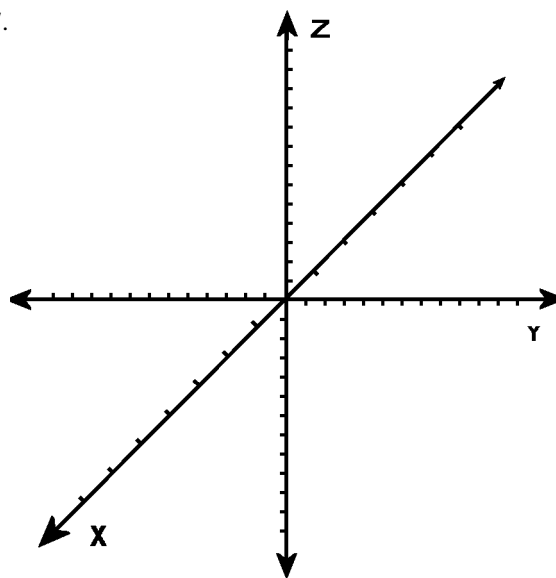
2046. Given the equation of the plane:  $4x + 3y + 4z = 12$



On the paper provided, mark the x, y, and z-intercepts and sketch the plane.

**Sketch**

2047.



Given the equation of the plane:  $5x - 3y + 3z = 15$ , mark the x, y, and z-intercepts and sketch a graph of the plane.

**Graph**