

1. A league is a unit of length, equal to 3 miles. If a marathon is 26.2 miles, how many leagues is a marathon, to the nearest tenth?

A. 78.6
B. 45.9
C. 23.2
D. 13.1
E. 8.7

1 league = 3 miles
x leagues = 26.2 miles

$$\frac{1}{3} = \frac{x}{26.2}$$

$$3x = 26.2$$

$$x = \frac{26.2}{3}$$

2. Because of increased rents in the area, a pizzeria needs to raise the cost of its \$20.00 extra large pizza by 22%. What will the new cost be?

F. \$20.22
G. \$22.20
H. \$24.00
J. \$24.40
K. \$42.00

$$\$20 + \$20(.22)$$

$$\$20 + \$4.40$$

$$\$24.40$$

3. A group of friends were comparing the number of cards in their baseball card collection. The number of cards is indicated in the table below.

Friend	A	B	C	D	E
Number of Baseball Cards	30	110	70	200	70

What is the average number of baseball cards in the collection of the 5 friends?

A. 70
B. 82
C. 96
D. 102.5
E. 120

$$\frac{30 + 110 + 70 + 200 + 70}{5}$$

$$\frac{480}{5} = 96$$

4. Train A travels 50 miles per hour for 3 hours; Train B travels 70 miles per hour for $2\frac{1}{2}$ hours. What is the difference between the number of miles traveled by Train A and the number of miles traveled by Train B?

F. 0
G. 25
H. 150
J. 175
K. 325

$$D = 50(3) = 150$$

$$D = 70(2.5) = 175$$

$$175 - 150 = 25$$

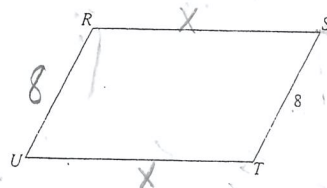
5. Which of the following is a value of b for which $(b - 3)(b + 4) = 0$?

A. 3
B. 4
C. 7
D. 10
E. 12

$$b - 3 = 0 \quad b + 4 = 0$$

$$b = 3 \text{ or } b = -4$$

6. In the parallelogram $RSTU$, \overline{ST} is 8 feet long. If the parallelogram's perimeter is 42 feet, how many feet long is \overline{UT} ?



F. 34
G. 26
H. 21
J. $15\frac{1}{4}$
K. 13

$$8 + 8 + x + x$$

$$16 + 2x = 42$$

$$2x = 26$$

$$x = 13$$

7. If the measure of each interior angle of a regular polygon is 60° , how many sides does the polygon have?

A. 3
B. 4
C. 6
D. 10
E. 12

$$180(n-2) = \text{total of degrees}$$

$$\frac{180(n-2)}{n} = 60$$

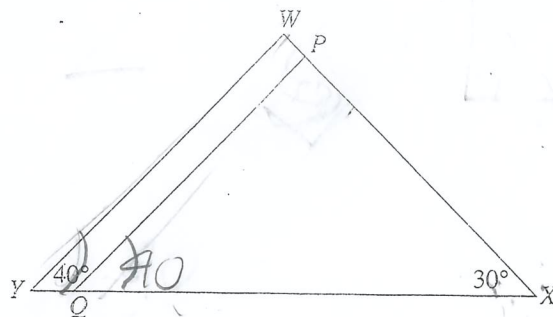
$$180n - 360 = 60n$$

$$120n = 360 \quad n = 3$$

8. For all nonzero a , b and c values, $\frac{12a^5bc^7}{-3ab^5c^2} = ?$

F. $\frac{-4c^5}{a^4b^4}$
G. $\frac{-4a^4c^5}{b^4}$
H. $\frac{-4ac}{b}$
J. $-4a^6b^6c^9$
K. $-4a^4b^4c^5$

9. In the figure below, P and Q lie on the sides of $\triangle WXY$, and \overline{PQ} is parallel to \overline{WY} . What is the measure of $\angle QPX$?



A. 110°
B. 120°
C. 130°
D. 140°
E. 150°

10. $|-4| \cdot |2| = ?$

- F. -8
- G. -6
- H. -2
- J. 6
- ☒ K. 8

11. A class took a vote of their favorite type of music. Of the 32 students, 20 said they liked R&B, 8 said they liked Rock, and 4 students liked Top 40. What percent of the participants liked Rock?

- A. 8%
- B. 12%
- ☒ C. 25%
- D. 63%
- E. 80%

$$\frac{8}{32} = \frac{1}{4} = 25\%$$

12. Two whole numbers have a greatest common factor of 15 and a least common multiple of 225. Which of the following pairs of numbers will satisfy this condition?

- F. 9 and 25
- G. 15 and 27
- H. 25 and 45
- J. 30 and 45
- ☒ K. 45 and 75

GCF 15 - 15 goes into both
LCM 225 - 225 is the first # they both go into

13. If $x = 2$ and $y = -3$, then $x^5y + xy^5 = ?$

- A. -60
- B. -192
- C. -390
- ☒ D. -582
- E. -972

$$\begin{aligned} (2)^5(-3) + (2)(-3)^5 \\ 32(-3) + 2(-243) \\ -96 - 486 \\ -582 \end{aligned}$$

14. How many units long is one side of a square with perimeter $20 + 8j$ units?

- F. $20 + 8j$
- G. $20 + 2j$
- H. $4j$
- J. $5 + 8j$
- ☒ K. $5 + 2j$

$$\frac{20 + 8j}{4}$$

15. If $(x - k)^2 = x^2 - 26x + k^2$ for all real numbers x , then $k = ?$

- ☒ A. 13
- B. 26
- C. 52
- D. 104
- E. 208

$$\begin{aligned} (x-k)^2 &= (x-k)(x-k) \\ x^2 - 2xk + k^2 &= x^2 - 26x + k^2 \\ -2xk &= -26x \\ k &= 13 \end{aligned}$$

16. Helena bought her daughter a game system and two game cartridges for her birthday, all on sale. The game system, regularly \$180, was 10% off, and the game cartridges, regularly \$40 each, were 20% off. What was the total price of the 3 items Helena bought?

(Note: Assume there is no sales tax.)

- F. \$186
- G. \$194
- H. \$221
- ☒ J. \$226
- K. \$250

$$\begin{aligned} \$180(.10) &= \$18 \\ 180 - 18 &= \$162 \\ \$40(.20) &= \$8 \\ 40 - 8 &= 32 \\ \$162 + \$32 + \$32 &= \$226 \end{aligned}$$

17. Which of the following expressions gives the slope of the line connecting the points (5, 9) and (-3, -12)?

- A. $\frac{9 + (-12)}{-5 - (-3)}$
- B. $\frac{9 + (-12)}{-3 + 5}$
- ☒ C. $\frac{9 - (-12)}{5 - (-3)}$
- D. $\frac{9 - (-12)}{-3 - 5}$
- E. $\frac{9 - (-12)}{-5 + 3}$

18. In the standard (x, y) coordinate plane, how many times does the graph of $y = (x - 1)(x + 7)(x - 11)(x + 13)$ intersect the x-axis?

- F. 32
- G. 11
- H. 7
- ☒ J. 4
- K. 1

$$x = 1, -7, 11, -13 \quad \text{zeros}$$

19. Which of the following is an equivalent, simplified version of $\frac{4 + 8x}{12x}$?

- ☒ A. $\frac{2x + 1}{3x}$
- B. $\frac{1 + 8x}{3x}$
- C. 1
- D. $\frac{7}{3}$
- E. $\frac{8}{3}$

$$\frac{4(1+2x)}{3 \cdot 4x} = \frac{1+2x}{3x}$$

20. Four friends about to share an airport shuttle for \$21.50 per ticket discover that they can purchase a book of 5 tickets for \$95.00. How much would each of the 4 save if they can get a fifth person to join them and they divide the cost of the book of 5 tickets equally among all 5 people?

- F. \$2.25
- ☒ G. \$2.50
- H. \$3.13
- J. \$9.00
- K. \$12.50

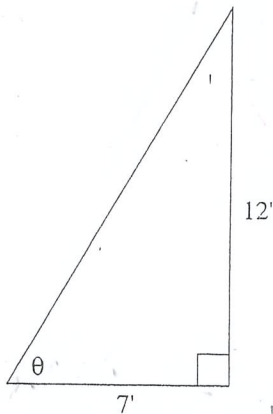
$$\begin{aligned} 95 \div 5 &= \$19 \text{ each} \\ \$21.50 - 19 &= \$2.50 \end{aligned}$$

21. What is the sum of the polynomials $-2x^2y^2 + x^2y$ and $3x^2y^2 + 2xy^2$?

- A. $-6x^4y^4 + 2x^3y^3$
 B. $-2x^2y^2 + x^2y + 2xy^2$
 C. $x^2y^2 + x^2y + 2xy^2$
 D. $x^2y^2 + x^2y$
 E. $x^2y^2 + 3x^2y$

$$1x^2y^2 + x^2y + 2xy^2$$

22. A 12-foot flagpole casts a 7-foot shadow when the angle of elevation of the sun is θ (see figure below). What is $\tan(\theta)$?



$$\tan \theta = \frac{\text{opp}}{\text{adj}}$$

$$\tan \theta = \frac{12}{7}$$

SOHCAHTOA

$$\sin = \frac{\text{opp}}{\text{hyp}} \quad \cos = \frac{\text{adj}}{\text{hyp}}$$

$$\tan = \frac{\text{opp}}{\text{adj}}$$

F. $\frac{7}{12}$

G. 1

H. $\frac{12}{7}$

J. 19

K. 84

23. Yousuf was x years old 15 years ago. How old will he be 7 years from now?

- A. $x + 7$
 B. $(x - 15) + 7$
 C. $(x + 15) - 7$
 D. $(x - 15) - 7$
 E. $(x + 15) + 7$

now $x + 15$
 in 7 years $(x + 15) + 7 =$

24. Which of the following is a factor of $x^2 - 4x - 12$?

- F. $(x + 1)$
 G. $(x - 2)$
 H. $(x + 2)$
 J. $(x - 3)$
 K. $(x - 4)$

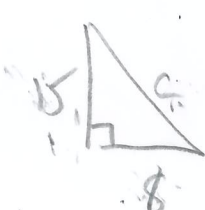
$$(x - 6)(x + 2)$$

$$\begin{array}{r} (x - 6)(x + 2) \\ \times 2 \\ - 12x \\ - 6x \\ \hline - 18x \\ - 12 \\ \hline - 18x - 12 \end{array}$$

FOIL

25. What is the length, in inches, of the hypotenuse of a right triangle with legs measuring 8 inches and 15 inches?

- A. 7
 B. 17
 C. 23
 D. $\sqrt{23}$
 E. $\sqrt{161}$



$$\begin{aligned} 8^2 + 15^2 &= c^2 \\ 64 + 225 &= c^2 \\ 289 &= c^2 \\ \sqrt{289} &= c \end{aligned}$$

26. Which of the following expressions is a simplified form of $(-2x^5)^3$?

- F. $-6x^8$
 G. $8x^8$
 H. $-2x^{15}$
 J. $-6x^{15}$
 K. $-8x^{15}$

$$-8x^{15}$$

27. If 1 mile is approximately equal to 1.609 kilometers, how many miles are in 80 kilometers?

- A. 49.7
 B. 78.4
 C. 80
 D. 81.6
 E. 128.7

$$1 \text{ mile} = 1.609 \text{ km}$$

$$x \text{ miles} = 80 \text{ km}$$

$$\frac{1}{1.609} = \frac{x}{80}$$

$$1.609x = 80$$

$$x = \frac{80}{1.609} = 49.72$$

28. If $2x + 3 = -5$, what is the value of $x^2 - 7x$?

- F. -44
 G. -12
 H. -4
 J. 12
 K. 44

$$2x + 3 = -5$$

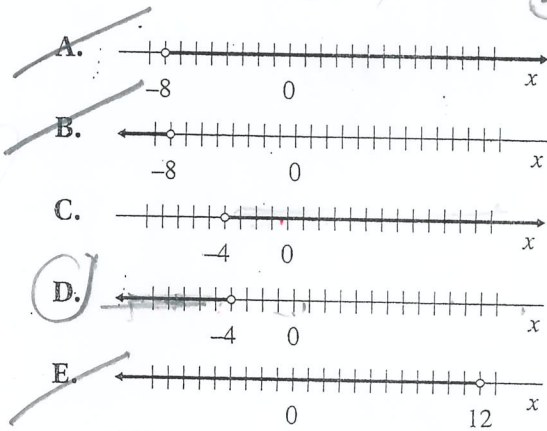
$$2x = -8$$

$$x = -4$$

$$(-4)^2 - 7(-4)$$

$$16 + 28 = 44$$

29. Which of the following is a graph of the solution set for $2(5 + x) < 2$?



30. Which of the following equations has m varying directly as the cube of b and inversely as the square of c ?

- F. $\frac{m^3}{c^2} = b$
 G. $\frac{b^3}{c^2} = m$
 H. $\frac{c^3}{b^2} = m$
 J. $\frac{\sqrt[3]{b}}{c} = m$
 K. $\frac{b^3}{m^2} = c$

$$\text{directly } y = kx$$

$$\text{inversely } y = \frac{k}{x}$$

$$m = \frac{b^3}{c^2} \text{ directly}$$

$$m c^2 = b^3$$

944

31. Points $V(-2, -7)$ and $W(4, 5)$ determine line segment \overline{VW} in the standard (x, y) coordinate plane. If the midpoint of \overline{VW} is $(1, p)$, what is the value of p ?

A. -2
B. -1
C. 1
D. 2
E. 6

$$x = \frac{-2+4}{2} = 1$$

$$y = \frac{-7+5}{2} = p$$

$$\frac{-2}{2} = p$$

32. If the graphs of $y = 3x$ and $y = mx + 6$ are parallel in the standard (x, y) coordinate plane, then what is the value of m ?

F. -6
G. $\frac{1}{3}$
H. 2
J. 3
K. 6

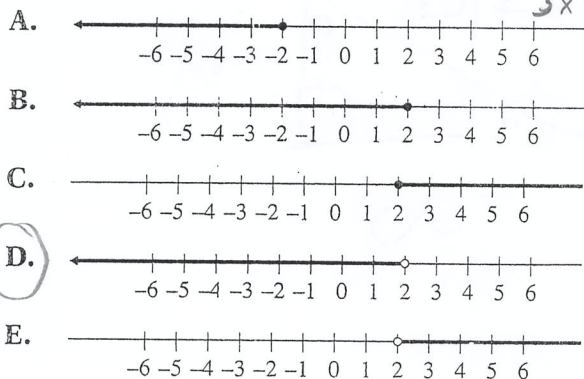
Slopes =
 $3 = m$

33. When 3 times x is increased by 5, the result is less than 11. Which of the following is a graph of the real numbers x for which the previous statement is true?

$$3x + 5 < 11$$

$$3x < 6$$

$$x < 2$$



34. It costs 54 cents to buy x pencils and 92 cents to buy y erasers. Which of the following is an expression for the cost, in cents, of 7 pencils and 3 erasers?

F. $\frac{54}{7+x} + \frac{92}{3+y}$
G. $3\left(\frac{54}{x}\right) + 7\left(\frac{92}{y}\right)$
H. $7\left(\frac{x}{54}\right) + 3\left(\frac{y}{92}\right)$
J. $7\left(\frac{54}{x}\right) + 3\left(\frac{92}{y}\right)$
K. $7\left(\frac{92}{x}\right) + 3\left(\frac{54}{y}\right)$

$$\frac{54}{x} = \text{cost of each pencil}$$

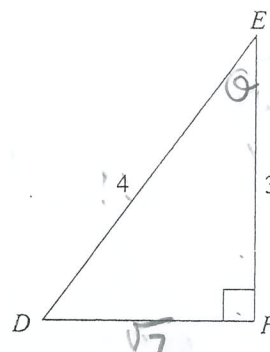
$$\frac{92}{y} = \text{cost of each eraser}$$

35. When graphed in the standard (x, y) coordinate plane, 3 points from among $(-9, -7)$, $(-5, -3)$, $(-2, -1)$, $(1, -1)$ and $(10, -8)$ lie on the same side of the line $y - x = 0$. Which of the three points are they?

A. $(-9, -7)$, $(-2, -1)$, $(-5, -3)$
B. $(-9, -7)$, $(-2, -1)$, $(1, -1)$
C. $(-9, -7)$, $(-5, -3)$, $(10, -8)$
D. $(-9, -7)$, $(1, -1)$, $(10, -8)$
E. $(-5, -3)$, $(1, -1)$, $(10, -8)$



36. What is the sine of angle E in right triangle $\triangle DEF$ below?



$$3^2 + y^2 = 4^2$$

$$9 + y^2 = 16$$

$$y^2 = 7$$

$$y = \sqrt{7}$$

F. $\frac{\sqrt{7}}{3}$
G. $\frac{3}{4}$
H. $\frac{\sqrt{7}}{4}$
J. $\frac{3}{\sqrt{7}}$
K. $\frac{4}{\sqrt{7}}$

$$\sin \theta = \frac{\text{opp}}{\text{hyp}}$$

$$\sin \theta = \frac{\text{opp}}{4}$$

$$\sin \theta = \frac{\sqrt{7}}{4}$$

37. The graph of the solution set for the system of linear equations below is a single line in the (x, y) coordinate plane.

$$12x - 20y = 108$$

$$3x + ky = 27 \quad (-4)$$

What is the value of k ?

A. -5
B. -3
C. $\frac{1}{4}$
D. $\frac{3}{5}$
E. 4

$$12x - 20y = 108$$

$$-12x + 4ky = -108$$

$$-20y + 4ky = 0$$

$$k = 5$$

38. A common rule of thumb is that each additional inch of height (H) will add 10 pounds to a person's weight (W). Doctors recommend finding your Body Mass Index (BMI) as a measure of health. BMI is computed as follows (H is in inches, and W is in pounds):

$$BMI = \frac{703W}{H^2}$$

If a 68-inch-tall person typically weighs 150 pounds, which of the following is closest to the expected BMI of a 72-inch-tall person?

F. 1
G. 2
H. 20
J. 26
K. 42

$$190 \text{ lbs}$$

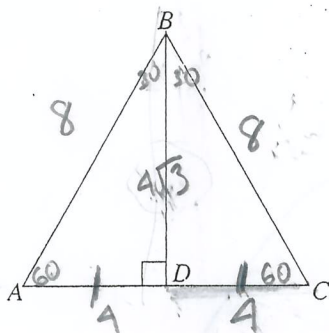
$$BMI = \frac{703(150)}{68^2} = \frac{105450}{4624} \approx 22.8$$

$$BMI = \frac{703(190)}{72^2} = \frac{133570}{5184} \approx 25.766$$

39. Dave's math tutor reminded him not to calculate $\left(\frac{x}{y}\right)^2$ as $\frac{x^2}{y}$. Dave thinks there are some numbers for which that calculation works. Eventually, he was able to show that $\left(\frac{x}{y}\right)^2$ equals $\frac{x^2}{y}$ if and only if:
- (Note: Assume that $y \neq 0$.)

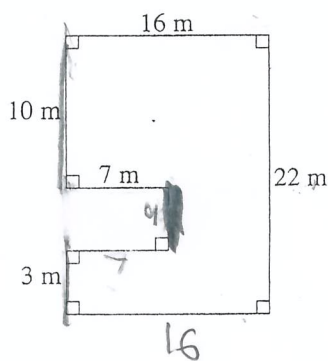
- A. $x = 0$
- B. $x = 1$
- C. $y = 1$
- D. $x = 0$ and $y = 1$
- ☒ E. $x = 0$ or $y = 1$

40. In the figure below, \overline{BD} is a perpendicular bisector of \overline{AC} in equilateral triangle $\triangle ABC$. If \overline{BD} is $4\sqrt{3}$ units long, how many units long is \overline{BC} ?



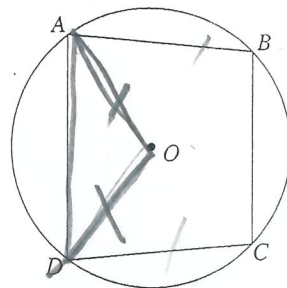
- F. $2\sqrt{3}$
- G. 4
- ☒ H. 8
- J. $8\sqrt{3}$
- K. 16

41. What is the perimeter, in meters (m), of the figure below?



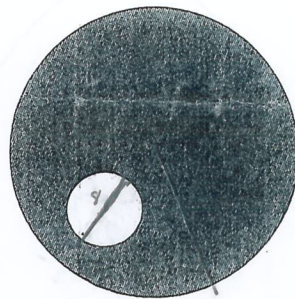
- A. 58
- ☒ B. 83
- C. 90
- D. 208
- E. 352

42. Isosceles trapezoid $ABCD$ is inscribed in a circle with center O , as shown below. Which of the following is the most direct explanation of why $\triangle AOD$ is isosceles?



- F. If two angles in a triangle are congruent, the sides opposite them are congruent.
- ☒ G. 2 sides are radii of the circle.
- H. Side-angle-side congruence
- J. Angle-side-angle congruence
- K. Angle-angle-angle similarity

43. A circle with radius 4 meters is cut out of a circle with radius 12 meters, as shown in the figure below. Which of the following gives the area of the shaded figure, in square meters?



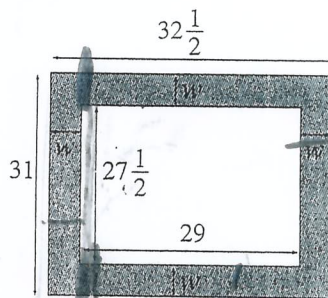
- A. $\pi(12-2)^2$
- B. $\pi 12^2 - 2^2$
- C. $\pi 12^2 - 4^2$
- D. $\pi(12-4)^2$
- ☒ E. $\pi(12^2 - 4^2)$

$$A = \pi 12^2 = 144\pi$$

$$A = \pi 4^2 = 16\pi$$

$$144\pi - 16\pi$$

44. A walkway, 31 by $32\frac{1}{2}$ feet, surrounds a pool that is $27\frac{1}{2}$ by 29 feet, as shown below.



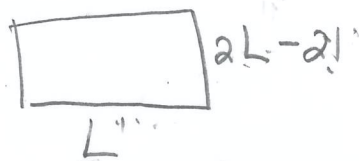
What is the width, w , in feet, of the walkway?

- F. $1\frac{1}{4}$
- G. 1
- H. $1\frac{1}{2}$
- ☒ J. $1\frac{3}{4}$
- K. $3\frac{1}{2}$

$$31 - 27.5 = \frac{3.5}{2} = 1.75$$

5. The area of a rectangular floor is 323 square feet. The width of the floor is 21 feet less than twice the length. How many feet long is the floor?

A. 8.5
B. 11
C. 13.5
D. 17
E. 19



$$A = L(2L-21) = 323$$

$$2L^2 - 21L - 323 = 0$$

$$(2L+17)(L-19) = 0$$

16. For the area of a circle to double, the new radius must be the old radius multiplied by:

F. $\frac{1}{2}$
G. $\sqrt{2}$
H. 2
J. π
K. 4

Let $r = 1$ πr^2

$A = \pi$ new circle (double)

$$A = 2\pi$$

$$2\pi = \pi r^2$$

$$2 = r^2$$

$$\sqrt{2} = r$$

47. If $\log_x 64 = 3$, then $x = ?$

A. 4
B. 8
C. $\frac{64}{3}$
D. $\frac{64}{\log 3}$
E. 64^3

$$x^3 = 64$$

$$x = 4$$

48. If $A = \begin{bmatrix} 3 & -6 \\ 0 & 9 \end{bmatrix}$ and $B = \begin{bmatrix} -3 & 6 \\ 0 & -9 \end{bmatrix}$ then $A - B = ?$

F. $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$
G. $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$
H. $\begin{bmatrix} 0 & -12 \\ 0 & 18 \end{bmatrix}$
J. $\begin{bmatrix} -6 & 0 \\ 0 & 0 \end{bmatrix}$
K. $\begin{bmatrix} 6 & -12 \\ 0 & 18 \end{bmatrix}$

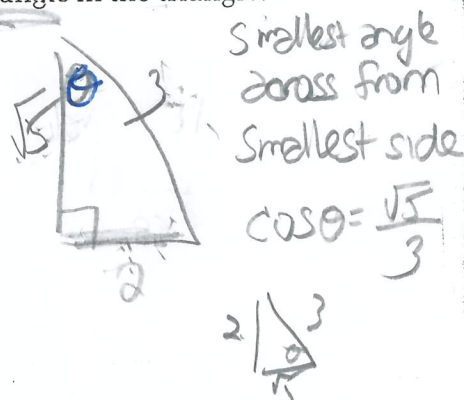
49. If a and b are real numbers, and $a > 0$, and $b < a$, then which of the following inequalities must be true?

A. $b \leq 0$
B. $b \geq 0$
C. $b^2 \geq 0$
D. $b^2 \geq a^2$
E. $b^2 \leq a^2$

$a = 4$
 $b = 3$
 b is positive
 b is smaller than a , but not necessarily positive

50. The ratio of the lengths of the sides of a right triangle is $2 : \sqrt{5} : 3$. What is the cosine of the smallest angle in the triangle?

F. $\frac{2}{3}$
G. $\frac{\sqrt{5}}{3}$
H. $\frac{2\sqrt{5}}{5}$
J. $\frac{9}{10}$
K. 2



Smallest angle across from Smallest side
 $\cos \theta = \frac{\sqrt{5}}{3}$

51. What is the amplitude of the graph of the equation $y + 3 = 4 \sin(5\theta)$?

(Note: the amplitude is $\frac{1}{2}$ the difference between the maximum and the minimum values of y .)

A. 3
B. 4
C. 5
D. 7
E. 10

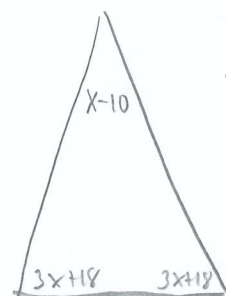
amplitude $|4|$
max 4
min -4
 $\frac{1}{2}(4 - (-4)) = 4$

52. Each of the following determines a unique plane in 3-dimensional Euclidian space EXCEPT:

F. 1 line and 1 point NOT on the line.
G. 3 distinct points NOT on the same line.
H. 2 lines that intersect in exactly 1 point.
J. 2 distinct parallel lines.
K. 2 lines that are NOT parallel and do NOT intersect.

53. The measure of the vertex angle of an isosceles triangle is $(x - 10)^\circ$. The base angles each measure $(3x + 18)^\circ$. What is the measure in degrees of one of the base angles?

A. 12
B. 22
C. $37\frac{1}{2}$
D. $43\frac{1}{2}$
E. 84



$$7x + 26 = 180$$

$$7x = 154$$

$$x = 22$$

base angle = $3(22) + 18 = 84$

54. To make a set of potholders of various sizes to give as a gift, Margot needs the following amounts of fabric for each set:

pieces of fabric	length (inches)	
6	8	48
5	12	60
2	18	36
		144 inches

If the fabric costs \$1.95 per yard, which of the following would be the approximate cost of fabric for 5 sets of potholders?

(Note: 1 yard = 36 inches)

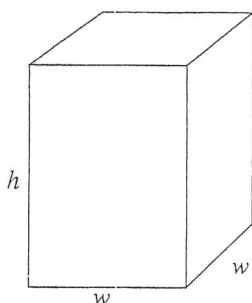
F. \$ 8
G. \$ 24
H. \$ 39
J. \$ 58
K. \$ 117

$$144 \times 5 = 720 \text{ in}$$

$$\frac{720}{36} = 20 \text{ yards}$$

$$\$1.95 \times 20 = \$39$$

55. The formula for the surface area (S) of a rectangular solid with square bases (shown below) is $S = 4wh + 2w^2$, where w is the side length of the bases, and h is the height of the solid. Doubling each of the dimensions (w and h) will increase the surface area to how many times its original size?



try $w=2$ $h=3$
then $w=4$ $h=6$

$$S = 4(2)(3) + 2(2)^2 = 24 + 8 = 32$$

$$S = 4(4)(6) + 2(4)^2 = 96 + 32 = 128$$

$$128 \div 32 = 4$$

- A. 2
B. 4
C. 6
D. 8
E. 24

56. The average of a set of four integers is 14. When a fifth number is included in the set, the average of the set increases to 16. What is the fifth number?

- F. 16
G. 18
H. 21
J. 24
K. 26

$$\frac{\text{sum}}{4} = 14 \quad \text{sum} = 56$$

$$\frac{56 + x}{5} = 16$$

$$56 + x = 80$$

$$x = 24$$

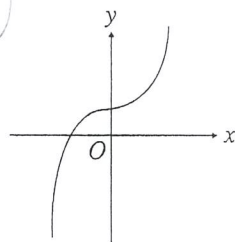
57. Which of the following is the equation of the largest circle that can be inscribed in the ellipse with equation $\frac{(x-4)^2}{16} + \frac{y^2}{4} = 1$?

- A. $(x-4)^2 + y^2 = 64$ radius 8
B. $(x-4)^2 + y^2 = 16$ radius 4
C. $(x-4)^2 + y^2 = 4$ radius 2
D. $x^2 + y^2 = 16$ radius 4
E. $x^2 + y^2 = 4$ radius 2

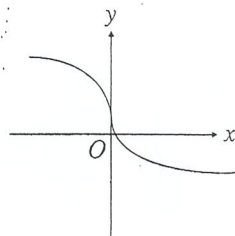


58. One of the graphs below is that of $y = x^3 + C$, where C is a constant. Which one?

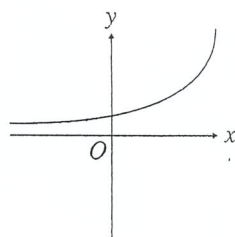
F.



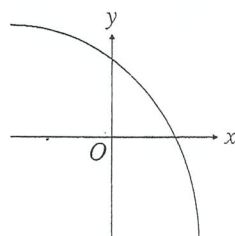
G.



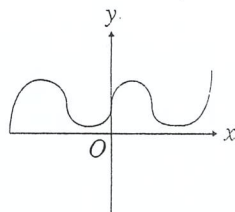
H.



J.



K.



$$y = x^3$$

move graph up or down

59. How many points do the graphs of all three equations below have in common?

$$x = y + 8$$

$$-x = y - 8$$

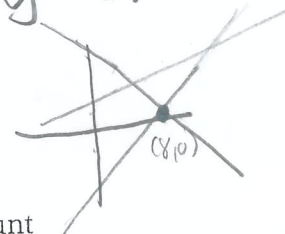
$$6x = 2y + 4$$

- A. 0
B. 1
C. 2
D. 3
E. An infinite amount

$$y = x - 8$$

$$y = -x + 8$$

$$y = 3x - 2$$



60. In 4 fair coin tosses, what is the probability of obtaining exactly 3 heads?

(Note: In a fair coin toss, the two outcomes, heads and tails, are equally likely.)

H H H T
H H T H
H T H H
T H H H

4 of 16 combinations will have 3 H

- F. $\frac{1}{16}$
G. $\frac{1}{8}$
H. $\frac{3}{16}$
J. $\frac{1}{4}$
K. $\frac{1}{2}$

T T T T
T T T H
T T H T etc

$$2^4 = 16 \text{ possibilities}$$