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Question: 1

A game is played with an eight-component spinner labeled with the numbers 1 through 8. A player receives two marbles each time the arrow lands on a 2 or 3, four marbles each time the arrow lands on the 6, eight marbles each time the arrow lands on a 7 or 8, and no marbles when the arrow lands on any of the other options. What is the expected value for the number of marbles that a player will receive on one spin?

a. 3
b. 5
c. 15
d. 24

Answer: A

Explanation:

The expected value is equal to the sum of the products of the probability and marbles won for each value of the spinner.

$$E(X) = \left(2 \times \frac{1}{8}\right) + \left(2 \times \frac{1}{8}\right) + \left(4 \times \frac{1}{8}\right) + \left(8 \times \frac{1}{8}\right) + \left(8 \times \frac{1}{8}\right) + \left(0 \times \frac{1}{8}\right) + \left(0 \times \frac{1}{8}\right) + \left(0 \times \frac{1}{8}\right)$$

$$= \frac{2}{8} + \frac{2}{8} + \frac{4}{8} + \frac{8}{8} + \frac{8}{8} + 0 + 0 + 0 = \frac{24}{8} = 3$$

Question: 2

Which of the following is equivalent to $\left(\sqrt[3]{x^4}\right)^5$?

a. $x^{\frac{12}{5}}$
b. $x^{\frac{15}{4}}$
c. $x^{\frac{20}{3}}$
d. x^{60}

Answer: C

Explanation:

The nth root of x is equivalent to x to the power of $\frac{1}{n}$, i.e. $\sqrt[n]{x} = x^{\frac{1}{n}}$. This means in particular that $\sqrt[3]{x} = x^{\frac{1}{3}}$, and so $\left(\sqrt[3]{(x^4)}\right)^5 = \left((x^4)^{\frac{1}{3}}\right)^5$. Raising a power to another power is equivalent to multiplying the exponents together, so this equals $x^{4 \times \frac{1}{3} \times 5} = x^{\frac{20}{3}}$.

Question: 3

If $x > 2$, then $\left(\frac{x^2-5x+6}{x+1}\right) \times \left(\frac{x+1}{x-2}\right) =$

a. $x + 1$
b. $x - 3$
c. $\frac{x^2+2x+1}{x-2}$
d. $\frac{x^2-2x-3}{x+1}$

Answer: B

Explanation:

Before carrying out the multiplication of the polynomials, notice that there is a factor of $x + 1$ in both the right numerator and left denominator, so this term can be canceled out. The expression then multiplies to $\frac{x^2-5x+6}{x-2}$. We can simplify further by factoring the numerator.

One way to factor a quadratic expression with a leading coefficient of 1 is to look for two numbers that add up to the coefficient of x (in this case –5) and multiply to the constant term (in this case 6). Two such numbers are –2 and –3: $(-2) + (-3) = -5$ and $(-2) \times (-3) = 6$. So $x^2 - 5x + 6 = (x - 2)(x - 3)$. That means $\frac{x^2-5x+6}{x-2} = \frac{(x-2)(x-3)}{x-2}$. The $x - 2$ in the numerator and denominator can cancel, so we are left with just $x - 3$. (Note that if $x = -1$ or $x = 2$, the obtained simplified expression would not be true: either value of x would result in a denominator of zero in the original expression, so the whole expression would be undefined. Therefore, it is necessary to state that these values of x are excluded from the domain. For a domain of $x > 2$, both $x = -1$ and $x = 2$ would be excluded.)

Question: 4

Kyle bats third in the batting order for the Badgers baseball team. The table below shows the number of hits that Kyle had in each of 7 consecutive games played during one week in July.

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Hits	1	2	3	1	1	4	2

What is the mean of the numbers in the distribution shown in the table?

a. 1
b. 2
c. 3
d. 4

Answer: B

Explanation:

The mean, or average, is the sum of the numbers in a data set divided by the total number of items in the set. This data set has 7 items (one for each day of the week). The total number of hits that Kyle had during the week is the sum of the numbers in the right-hand column. The sum is 14, so the mean is 2 because $14 \div 7 = 2$.

Question: 5

$|x| > x$ for what values of x?

a. $x < 0$
b. $x > 0$
c. $|x| > x$ for all real values of x.
d. There is no real number x such that $|x| > x$.

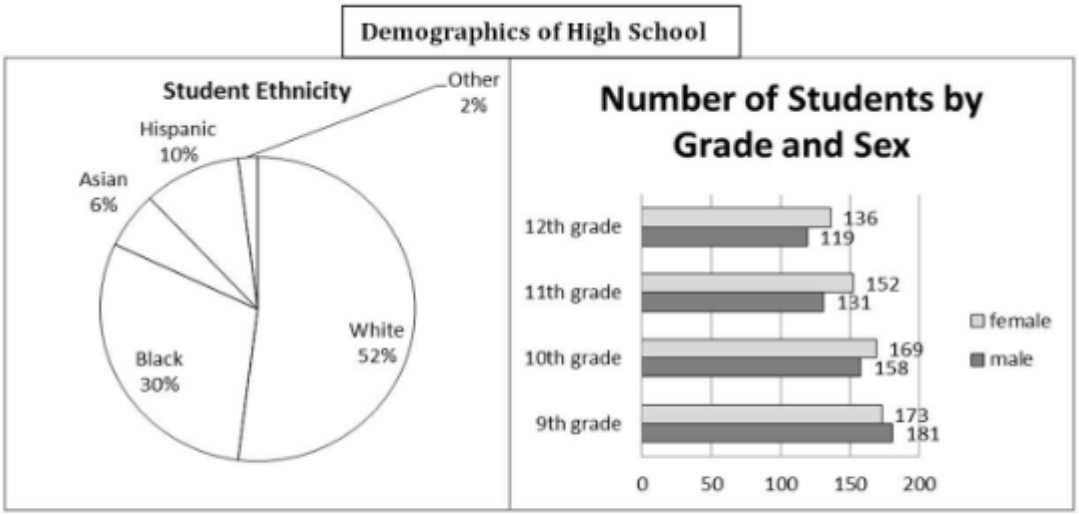
Answer: A

Explanation:

When $x \geq 0$, $|x| = x$, so it is not true that $|x| > x$. However, when $x < 0$, $|x| = -x$. This means x is negative and $|x|$ is positive, and since any positive number is greater than any negative number, $|x| > x$ when $x < 0$.

Question: 6

Consider the following graphic showing demographics of a high school with 1219 total students:



Which of these is the least quantity?

a. The average number of Black students in the 9th and 10th grades
b. The number of Asian female students at the school
c. The difference in the number of male and female students at the school
d. The difference in the number of 10th and 12th grade students at the school

Answer: B

Explanation:

The difference in the number of male and female students at the school is $630 - 589 = 41$, and the difference in the number of 9th and 12th grade students at the school is $327 - 255 = 72$. There are approximately 38 Asian females at the school (0.06×630). The average number of black students is more than 90 (30% of 300) because there are more than 90 in the 10th grade and the class is smaller than the 9th grade group.

Question: 7

$(\sqrt{2} + \sqrt{3}) \times (2 + \sqrt{6}) =?$

a. $2\sqrt{6} + 4$
b. $3\sqrt{2} + 2\sqrt{3}$
c. $5\sqrt{2} + 4\sqrt{3}$
d. $2\sqrt{5} + \sqrt{30}$

Answer: C

Explanation:

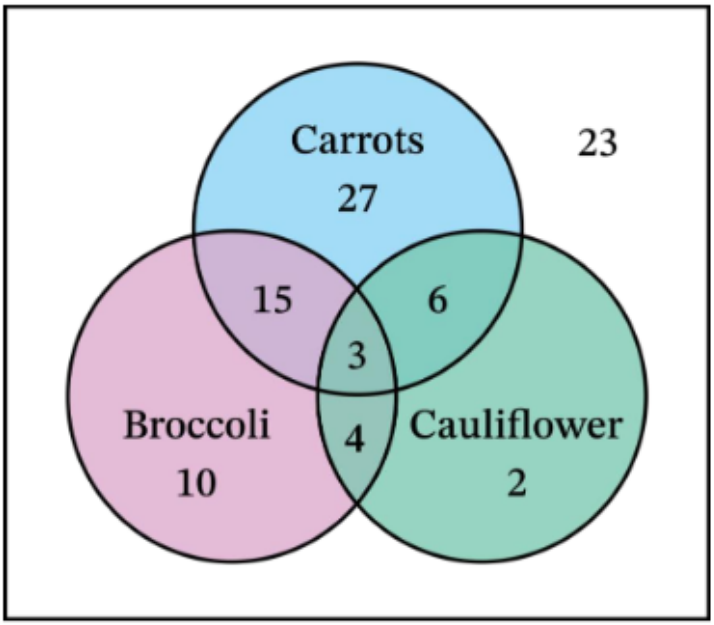
A method commonly taught to multiply two binomials is the "FOIL" method, an acronym for First, Outer, Inner, Last: multiply the first terms of each factor, then the outer terms, and so forth. Applied to $(\sqrt{2}+\sqrt{3}) \times (2+\sqrt{6})$, this yields $(\sqrt{2})(2) + (\sqrt{2})(\sqrt{6}) + (\sqrt{3})(2) + (\sqrt{3})(\sqrt{6}) = 2\sqrt{2} + \sqrt{12} + 2\sqrt{3} + \sqrt{18}$. Two of these terms can be simplified: $12 = 4 \times 3$, so $\sqrt{12} = \sqrt{4} \times \sqrt{3} = 2\sqrt{3}$, and $18 = 9 \times 2$, so $\sqrt{18} = \sqrt{9} \times \sqrt{2} = 3\sqrt{2}$. Therefore, the product can be written as $2\sqrt{2} + 2\sqrt{3} + 2\sqrt{3} + 3\sqrt{2}$, which simplifies to $5\sqrt{2} + 4\sqrt{3}$ after like terms are combined.

Question: 8

A random sample of 90 students at an elementary school were asked these three questions:

Do you like carrots?
Do you like broccoli?
Do you like cauliflower?

The results of the survey are shown below. If these data are representative of the population of students at the school, which of these is most probable?



a. A student chosen at random likes broccoli.
b. If a student chosen at random likes carrots, they will also like at least one other vegetable.
c. If a student chosen at random likes cauliflower and broccoli, they will also like carrots.
d. A student chosen at random does not like carrots, broccoli, or cauliflower.

Answer: B

Explanation:

The results are displayed in a Venn diagram, so to get the number of students who like any particular vegetable, sum all of the numbers that appear within the circle for that vegetable. 32 of the 90 students like broccoli, so the probability of A is $\frac{32}{90} \approx 0.356$. There are 51 students who like carrots, and of those 51, 24 also like another vegetable, so the probability of B is $\frac{24}{51} \approx 0.471$. There are 7 students who like broccoli and cauliflower, and of those 7, 3 also like carrots, so the probability of C is $\frac{3}{7} \approx 0.429$. 23 of the 90 students did not like any of the vegetables, so the probability of D is $\frac{23}{90} \approx 0.256$. B has the highest probability of these choices.

Question: 9

The formula for the volume of a pyramid is $\frac{1}{3}Bh$, where B is the area of the base and h is the height. The Pyramid of Khafre in Giza has a square base about 700 feet on a side and is about 450 feet high. Which of the following is closest to its volume?

a. 18 million cubic feet
b. 55 million cubic feet
c. 75 million cubic feet
d. 220 million cubic feet

Answer: C

Explanation:

The area of the square base is just the square of the side length: $(700 \text{ ft})^2 = 490{,}000 \text{ ft}^2$. Since we only need an approximation, we can round that to $500{,}000 \text{ ft}^2$, or half a million square feet. The volume is therefore $\frac{1}{3}Bh \approx \frac{1}{3}\left(\frac{1}{2} \text{ million ft}^2\right)(450 \text{ ft}) = \frac{450}{6} \text{million ft}^3 = 75 \text{ million ft}^3$.

Question: 10

In an election in Kimball County, Candidate A obtained 36,800 votes. His opponent, Candidate B, obtained 32,100 votes. 2,100 votes went to write-in candidates. What percentage of the vote went to Candidate A?

a. 45.2%
b. 46.8%
c. 51.8%
d. 53.4%

Answer: C

Explanation:

Candidate A's vote percentage is determined by the number of votes that he obtained, divided by the total number of votes cast, and then multiplied by 100 to convert the decimal into a percentage.

$$\text{Candidate A's vote percentage } = \frac{36{,}800}{36{,}800 + 32{,}100 + 2{,}100} \times 100 = 51.8\%$$

Therefore, 51.8% of the vote went to Candidate A.

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