K-12

CCHS-Number-Quantity

Common Core High School: Number and Quantity (Common Core State Standards Initiative)

Latest Version: 6.0

Question: 1

Simplify the expression: $\sqrt[5]{(4^3 \cdot 4^3)^2}$.

A. $4^{8/5}$

B. $4^{12/5}$

C. $4^{18/5}$

D. 4^{13}

Answer: B

Explanation:

First, simplify within the parentheses by adding the exponents since the bases are equal: 4^3 $4^3 = 4^{3+3} = 4^6$. Next convert the radical to a fractional exponent: $\sqrt[5]{(4^6)^2} = (4^6)^{2/5}$. Finally, multiply the exponents: $(4^6)^{2/5} = 4^{12/5}$.

Question: 2

Which of the following statements is false?

A. a. $\sqrt[5]{21}$ is both real and irrational.

B. The sum of $\sqrt[5]{21}$ and a non-zero real number will always be an irrational number.

C. The difference of $\sqrt[5]{21}$ and a non-zero real number not equal to $\sqrt[5]{21}$ will always be an irrational number.

D. The product of $\sqrt[5]{21}$ and a non-zero real number will always be an irrational number.

Answer: D

Explanation:

An irrational numbers is a number that cannot be written as a fraction. Some examples of irrational numbers are π, $\sqrt{3}$, and e. If an irrational number is added to or subtracted from, it will still not be a repeating decimal or expressible as a fraction. (The restriction in choice C prevents the subtraction from equaling zero, which would be a rational exception to the rule.) On the other hand, while most irrational products give irrational answers, there are counterexamples: $\sqrt[5]{21} \cdot \sqrt[5]{21^4} = 21^{1/5} \cdot 21^{4/5} = 21$. Since at least one example exists, D is false.

Question: 3

Write the below expression in simplest form using fractional exponents.

$$\frac{3 \cdot 3 \cdot \sqrt[3]{3 \cdot 3} \cdot 5 \cdot 5 \cdot \sqrt[3]{7 \cdot 7 \cdot 7 \cdot 7}}{3 \cdot \sqrt[3]{5 \cdot 5} \cdot 7\sqrt[3]{7 \cdot 7}}$$

A. $3^{2/3} \cdot 5^{-1/3} \cdot 7^{-1/3}$

B. $3^{4/3} \cdot 5^{2} \cdot 7^{2/3}$

C. $3^{5/3} \cdot 5^{4/3} \cdot 7^{-1/3}$

D. $3^{8/3} \cdot 5^{2} \cdot 7^{4/3}$

Answer: C

Explanation:

Start by rewriting the problem using fractional exponents. Remember that fractional exponential notation is $\sqrt[y]{b^x} = b^{x/y}$. Simplify when the bases are the same, the general rules for which are $b^x \cdot b^y = b^{x+y}$ and $\frac{b^x}{b^y} = b^{x-y}$:

$$\frac{3 \cdot 3 \cdot \sqrt[3]{3 \cdot 3} \cdot 5 \cdot 5 \cdot \sqrt[3]{7 \cdot 7 \cdot 7 \cdot 7}}{3 \cdot \sqrt[3]{5 \cdot 5} \cdot 7\sqrt[3]{7 \cdot 7}} = \frac{3^2 \cdot 3^{2/3} \cdot 5^2 \cdot 7^{4/3}}{3^1 \cdot 5^{2/3} \cdot 7^1 \cdot 7^{2/3}} = 3^{(2+2/3-1)} \cdot 5^{(2-2/3)} \cdot 7^{(4/3-1-2/3)}$$

$$= 3^{5/3} \cdot 5^{4/3} \cdot 7^{-1/3}$$

Question: 4

Simplify: $(7^{12} \cdot 7^{-5})^{2/3}$.

A. $7^{14/3}$

B. $7^{9/3}$

C. $7^{14/21}$

D. $7^{34/3}$

Answer: A

Explanation:

Since the bases are the same, start by combining the exponents in the parentheses using the rule $b^x \cdot b^y = b^{x+y}$. Then multiply the exponent outside the parentheses to the exponent inside the parentheses using the rule $(b^x)^y = b^{x \cdot y}$:

$$(7^{12} \cdot 7^{-5})^{2/3} = (7^{12-5})^{2/3} = (7^7)^{2/3} = 7^{7 \cdot 2/3} = 7^{14/3}$$

Question: 5

Which of the following is a rational number?

A. $5\sqrt[3]{49}+1$
B. $\sqrt{99}\cdot\sqrt{7}+3$
C. $3\pi - 4$
D. $2\sqrt{169}$

Answer: D

Explanation:

One way to answer this question is calculate the answers and look for the number that can be written as a fraction. $5\sqrt[3]{49}+1 = 19.2965$, and therefore $\sqrt[3]{49}$ is irrational. $\sqrt{99}\cdot\sqrt{7}+3 = 29.3248$, since both $\sqrt{99}$ and $\sqrt{7}$ are irrational. 3π-4=5.4247 since π is irrational. $2\sqrt{169}$=26 is, of course, rational.

Question: 6

Noelle is a 45-pound 5-year-old girl who has been prescribed amoxicillin for an acute ear infection. The amoxicillin dosage for children aged 4 to 6 years is 90 mg per kg of body weight per day for 10 days. Knowing that 1kg = 2.2 lb., how much of the antibiotic will be needed to fill the prescription?

A. 18.4 grams
B. 19.8 grams
C. 40.5 grams
D. 89.1 grams

Answer: A

Explanation:

Set this problem up using dimensional analysis. Convert the various statements into fractions that express equivalence; for example, write "90 mg per kg of body weight per day" as $\frac{90\frac{\text{mg}}{\text{kg}}}{\text{day}} = \frac{90mg}{kg}\cdot\frac{1}{day} = \frac{90mg}{kg\cdot day}$. Multiply the fractions and/or their reciprocals together so that unwanted units will cancel, leaving only the desired unit at the end:

$$45\ lbs\cdot\frac{1\text{ kg}}{2.2\text{ lbs}}\cdot\frac{90\text{ mg}}{\text{kg}\cdot\text{day}}\cdot 10\ days\cdot\frac{1\ gram}{1000\ mg} = 45\ \cancel{lbs}\cdot\frac{1\text{ kg}}{2.2\ \cancel{\text{lbs}}}\cdot\frac{90\text{ mg}}{1\ \cancel{\text{kg}}\cdot 1\ \cancel{\text{day}}}\cdot 10\ \cancel{days}\cdot\frac{1\ gram}{1000\ \cancel{mg}} = \frac{45\cdot 90\cdot 10}{2.2\cdot 1000}\ grams = 18.4\ grams.$$

Question: 7

Three friends are driving from WSU, in Pullman, WA, to Gonzaga, in Spokane, WA. The distance is 77 miles. The car gets 23 mpg and has a 15 gallon tank. Gas costs $3.89/gallon. What will each friend's share of the gas be round trip, assuming they split the costs evenly?

A. $4.34
B. $8.68
C. $13.02
D. $19.45

Answer: B

Explanation:

Set up conversion fractions to find the total cost of gas for the trip, and multiply the factors so unwanted units cancel (leaving dollars): $(77\ miles)(2\ ways) \cdot \frac{1\ gallon}{23\ miles} \cdot \frac{\$3.89}{gallon} = \$26.05$. If they split the cost evenly, each pays a third of \$26.05, or about \$8.68. (The size of the gas tank is irrelevant!)

Question: 8

Heidi owns a bakery and is converting her mother's soda bread recipe for commercial use. The recipe calls for 1 tablespoon of baking soda and makes 2 loaves of bread. She needs the recipe to make 350 loaves of bread. What is an appropriate unit of measure for baking soda in the converted recipe?

A. teaspoons
B. tablespoons
C. quarts
D. gallons

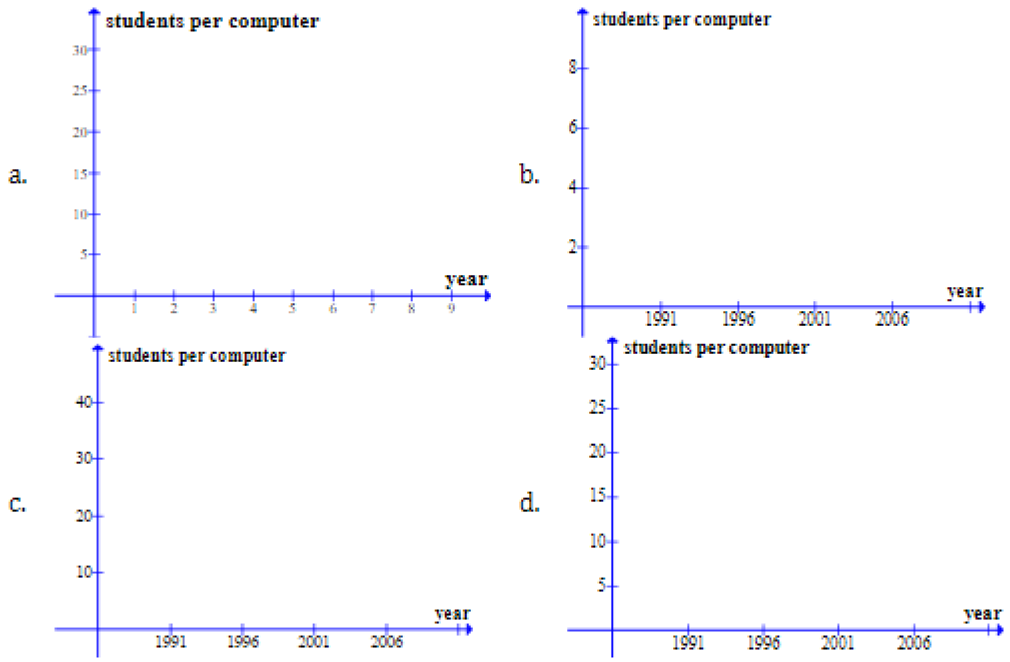
Answer: C

Explanation:

Heidi's recipe calls for 1 tablespoon for 2 loaves, so for 350 loaves she would need 175 tablespoons. There are 3 teaspoons in each tablespoon, though, so asking for 525 teaspoons seems silly. There are 16 tablespoons in a cup, so she would need $175\ tbs \cdot \left(\frac{1\ cup}{16\ tbs}\right) = 10.93$ cups. Similarly, there are 2 cups in a pint so she would need 5.46 pints, and there are 2 pints in a quart so she would need 2.73 quarts. There are 4 quarts in a gallon, though, so she would need 0.683 gallons, which feels a little awkward. Quarts is the best unit here.

Question: 9

The average number of students per computer in US public schools can be estimated by the sequence model $a_n = 35.8127(0.8646)^n$, for n=1,2,3,...25, with the 1987-1988 school year corresponding to n=1. Choose the most appropriate scale for a graph of this model from 1987 to 2012.



A. Option A
B. Option B
C. Option C
D. Option D

Answer: D

Explanation:

First, determine the range of values for each axis. Even though *n* represents the number of years since 1986-7, the time period starts in 1987 and runs until 2012, so the horizontal (time) axis should be labeled as in choices B, C, or D. To find the maximum and minimum number of students per computer, evaluate the model at *n* = 1 and 25: in 1987, $a_1 = 35.8127(0.8646)^1 = 30.96 \approx 31$ students per computer; in 2012, n=2012-1987=25, and $a_{25} = 35.8127(0.8646)^{25} = .9428 \approx 1$ student per computer. The y-axis, then, needs to show a range of students per computer [1, 31]. The range of the y-axis shown in choice C is larger than it needs to be, and while not technically incorrect, this makes choice D the *most* appropriate choice of scale.

Question: 10

The expression $[(3.35 \cdot 10^{18})t^2]^{1/3}$ gives the average radius, *r*, of a planet's path around the sun in meters, where *t* is the time in Earth-seconds that it takes the planet to go around the sun. Choose an appropriate unit for reporting the average radius of the earth's path around the sun.

A. meters
B. kilometers
C. mega meters

D. giga meters

Answer: D

Explanation:

The Earth revolves around the sun once every year, or 365 days. Converting this to seconds: $365\ days \cdot \left(\frac{24\ hours}{1\ day}\right) \cdot \left(\frac{60\ minutes}{1\ hour}\right) \cdot \left(\frac{60\ seconds}{1\ minute}\right) = 31{,}536{,}000\ seconds$. Evaluating the expression for this value of t: $[(3.35 \times 10^{18})(31{,}536{,}000)^2]^{\frac{1}{3}} = 1.49 \times 10^{11}$. This answer is in meters. Reporting this answer, one should use the largest possible unit; gigameters is the largest unit shown ($1\ Gm = 10^9\ m$).

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