Pre-Algebra Quizzes

krista king MATH

Topic: Number sets

Question: Which of the following is another name for the counting numbers?

Answer choices:

A Natural numbers

B Whole numbers

C Real numbers

D Integers

Solution: A

Counting numbers are also called natural numbers. They are the set of positive integers, or positive whole numbers,

$$\{1, 2, 3, 4, \ldots\}$$

All of the natural numbers are whole numbers, but unlike the set of whole numbers, the set of natural numbers doesn't include 0. Additionally, all natural numbers are real numbers, but real numbers includes things like fractions and decimals, which aren't included in natural numbers. Natural numbers are also integers, but integers includes negative numbers and 0, where natural numbers don't.

Topic: Number sets

Question: Which set could represent whole numbers?

Answer choices:

A $\{0,\ 1,\ 2,\ 3,\ \dots\}$

B $\{1,\ 2,\ 3,\ 4,\ \dots\}$

C $\{-1,\ 0,\ 1,\ 2,\ \dots\}$

D $\{-4,\ -3,\ -2,\ -1,\ \dots\}$

Solution: A

Whole numbers are made up of all positive integers, plus 0.

Topic: Number sets

Question: Which set makes sense?

Answer choices:

A Boys = {Tom, Joe, Eric}

B Girls = {1, 2, 3}

C Odd numbers = {2, 4, 6}

D Fruit = {Peas, Carrots}

Solution: A

Tom, Joe and Eric are all boys, so the set of “Boys” could be made up of those values. On the other hand, 1, 2 and 3 are not girls; 2, 4 and 6 are not odd numbers, they’re even numbers; and peas and carrots are not fruits, they’re vegetables.

Topic: Identity numbers

Question: Choose the identity number for addition.

Answer choices:

A 1

B 0

C -1

D 2

Solution: B

0 is the identity number for addition, because you can add 0 to anything without changing the identity. For example, $7 + 0 = 7$.

Topic: Identity numbers

Question: Find the sum.

$$25 + 0 =$$

Answer choices:

A $\quad 0$

B $\quad 25$

C $\quad -25$

D $\quad 1$

Solution: B

0 is the identity number for addition, which means that when you add 0 to something, you don't change the value of the original number. Therefore,

$$25 + 0 = 25$$

25 keeps its identity because 0 is the identity number of addition.

Topic: Identity numbers

Question: Find the product.

$$3 \cdot 1 =$$

Answer choices:

A 3

B 2

C 4

D $\frac{1}{3}$

Solution: A

1 is the identity number for multiplication, which means that when you multiply something by 1, you don't change the value of the original number. Therefore,

$$3 \cdot 1 = 3$$

3 keeps its identity because 1 is the identity number of multiplication.

Topic: Opposite of a number

Question: Which numbers are opposites?

Answer choices:

A 1 and 2

B -3 and 3

C 2 and $1/2$

D 0 and 1

Solution: B

-3 and 3 are opposite numbers because they're the same distance from the origin (three units). In other words, they're the same number but have opposite signs.

Topic: Opposite of a number

Question: What is the opposite of 45?

Answer choices:

A $\frac{1}{45}$

B $-\frac{1}{45}$

C -45

D 45

Solution: C

45 and -45 are opposite numbers because they're the same distance from the origin (45 units). In other words, they're the same number but have opposite signs.

Topic: Opposite of a number

Question: What is the opposite of -10?

Answer choices:

A 10

B $-\frac{1}{10}$

C -10

D $\frac{1}{10}$

Solution: A

-10 and 10 are opposite numbers because they're the same distance from the origin (10 units). In other words, they're the same number but have opposite signs.

Topic: Adding and subtracting signed numbers

Question: Simplify the expression.

$$-1+8$$

Answer choices:

A -7

B -9

C 7

D 9

Solution: C

We can rewrite the expression and solve it.

$$-1+8$$

$$8-1$$

$$7$$

We can also find the answer on the number line. Given $-1+8$, we'd start at -1 on the number line, which is one unit to the left of 0. Then, because we're asked to add 8 to -1, we'll move eight units to the right of -1, ending up at 7.

Topic: Adding and subtracting signed numbers

Question: Which equation is the same?

$$3 - 3 = 0$$

Answer choices:

A $3 + 3 = 0$

B $3 - (-3) = 0$

C $3 + (-3) = 0$

D $3 + \left[-(-3)\right] = 0$

Solution: C

Subtraction is the same as addition of a negative.

$$3 + (-3) = 0$$

$$3 - 3 = 0$$

$$0 = 0$$

Topic: Adding and subtracting signed numbers

Question: Which of these is true?

Answer choices:

A $3 + (+2) = -1$

B $3 + (-2) = 1$

C $3 - (-2) = 1$

D $3 - (+2) = -1$

Solution: B

Subtraction is the same as addition of a negative.

$$3+(-2)=1$$

$$3-2=1$$

$$1=1$$

Topic: Multiplying signed numbers

Question: Simplify the expression.

$$-3 \cdot 4$$

Answer choices:

A 12

B -12

C 7

D -1

Solution: B

Whenever we multiply two numbers where one number is positive and the other is negative, we'll get a negative answer. We know that $3 \cdot 4 = 12$, and since one of our numbers is negative and the other is positive, we know that $-3 \cdot 4 = -12$.

Topic: Multiplying signed numbers

Question: Which of these is true?

Answer choices:

A $5 \cdot 2 = 7$

B $-5 \cdot 2 = -10$

C $5 \cdot (-2) = 10$

D $-5 \cdot (-2) = -10$

Solution: B

Multiplying two numbers together that have the same sign will always result in a positive number. Multiplying two numbers together that have different signs will always result in a negative number.

$$-5 \cdot 2 = -10$$

$$-10 = -10$$

Topic: Multiplying signed numbers

Question: Simplify the expression.

$$-3 \cdot 2$$

Answer choices:

A 5

B -5

C 6

D -6

Solution: D

Whenever we multiply two numbers together where one number is positive and the other is negative, we'll get a negative answer. We know that $3 \cdot 2 = 6$, and since one of our numbers is negative and the other is positive, we know the answer is $-3 \cdot 2 = -6$.

Topic: Dividing signed numbers

Question: Which of these is true?

Answer choices:

A $\frac{-12}{4} = -3$

B $\frac{12}{-4} = 3$

C $\frac{-12}{-4} = -3$

D $\frac{12}{4} = -3$

Solution: A

Dividing a positive number by another positive number, or dividing a negative number by another negative number, will always result in a positive answer. In other words, if the signs are the same, the answer will be positive.

On the other hand, dividing a negative number by a positive number, or dividing a positive number by a negative number, will always result in a negative answer. In other words, if the signs are different, the answer will be negative.

$$\frac{-12}{4} = -3$$

Topic: Dividing signed numbers

Question: Simplify the expression.

$$\frac{-10}{5}$$

Answer choices:

A 2

B 1

C 5

D -2

Solution: D

Dividing a positive number by another positive number, or dividing a negative number by another negative number, will always result in a positive answer. In other words, if the signs are the same, the answer will be positive.

On the other hand, dividing a negative number by a positive number, or dividing a positive number by a negative number, will always result in a negative answer. In other words, if the signs are different, the answer will be negative.

$$\frac{-10}{5} = -2$$

Topic: Dividing signed numbers

Question: Simplify the expression.

$$\frac{-25}{-5}$$

Answer choices:

A 1

B 0

C -5

D 5

Solution: D

Dividing a positive number by another positive number, or dividing a negative number by another negative number, will always result in a positive answer. In other words, if the signs are the same, the answer will be positive.

On the other hand, dividing a negative number by a positive number, or dividing a positive number by a negative number, will always result in a negative answer. In other words, if the signs are different, the answer will be negative.

$$\frac{-25}{-5} = 5$$

Topic: Absolute value

Question: Simplify the expression.

$$-|-3|$$

Answer choices:

A 3

B 0

C -3

D 1

Solution: C

Order of operations tells us that we have to take the absolute value of -3 first, before we apply the minus sign that's outside the absolute value bars.

Absolute value is the same as "distance from the origin," and -3 is three units from the origin on the number line, so $|-3|=3$. But then we still have to apply the negative sign that's outside the absolute value bars, so we get

$$-|-3|=-3$$

Topic: Absolute value

Question: Simplify the expression.

$$|-3-2|$$

Answer choices:

A 1

B -5

C -1

D 5

Solution: D

Order of operations tells us that we have to do the computation inside the absolute value bars first. When we subtract 2 from -3, we get -5.

$$|-3-2|$$

$$|-3-2|=|-5|$$

Absolute value bars tell us that we need to find the distance from the origin of whatever's inside the absolute value bars. Since -5 is five units away from the origin on the number line, we get

$$|-3-2|=5$$

Topic: Absolute value

Question: Simplify the expression.

$$-|2-3-3|-|-2|$$

Answer choices:

A 6

B 2

C -6

D -4

Solution: C

Order of operations tells us that we have to do the computation inside the absolute value bars first.

$$-|2-3-3|-|-2|$$

$$-|-4|-|-2|$$

Absolute value bars tell us that we need to find the distance from the origin of whatever's inside the absolute value bars. Since the point -4 is 4 units from the origin on the number line, we get

$$-4-|-2|$$

Since the point -2 is 2 units from the origin on the number line, we get

$$-4-2$$

$$-6$$

Topic: Divisibility

Question: Which of the answer choices is divisible by this number?

3

Answer choices:

A 63

B 20

C 22

D 310

Solution: A

If the sum of the digits in a whole number is divisible by 3, then the number is divisible by 3 (and if the sum of the digits in a whole number isn't divisible by 3, then the number isn't divisible by 3). So let's find the sum of the digits in each of the answer choices and see which sum is divisible by 3.

Number	**Sum of digits**	**Sum divisible by 3?**
63	$6+3=9$	Yes, $9 \div 3 = 3$
20	$2+0=2$	No. When we divide 2 by 3, we get a remainder of 2.
22	$2+2=4$	No. When we divide 4 by 3, we get a remainder of 1.
310	$3+1+0=4$	No. When we divide 4 by 3, we get a remainder of 1.

Since 63 is the only answer choice whose digits sum to a number that's divisible by 3, we've found that 63 is the only answer choice that's divisible by 3.

If you didn't happen to know that "trick" about the sum of the digits being a multiple of 3, you could have just divided each of the answer choices by 3 directly.

$63 \div 3 = 21 +$ Remainder of 0

$20 \div 3 = 6 +$ Remainder of 2

$22 \div 3 = 7 +$ Remainder of 1

$310 \div 3 = 103 +$ Remainder of 1

Topic: Divisibility

Question: Which set of whole numbers divide evenly into both 25 and 100?

Answer choices:

A $1, 5, 25$

B $3, 10$

C $10, 2$

D $5, 2, 25$

Solution: A

Answer choice A is correct because both 25 and 100 are divisible by 1, 5, and 25.

From answer choice B, neither 25 nor 100 is divisible by 3, so this choice is incorrect.

From answer choice C, 25 is not divisible by 2, so this choice is incorrect.

From answer choice D, 25 is not divisible by 2, so this choice is incorrect.

Topic: Divisibility

Question: What is the divisibility rule for numbers that end in 0?

Answer choices:

A 10 will be a factor

B 0 will be a factor

C There will be exactly one factor

D All numbers are factors

Solution: A

All numbers that end in 0 will be divisible by 10. For example, 10, 20, 30, 40, 50, etc. are all evenly divisible by 10.

Topic: Multiples

Question: Which list contains only multiples of the number 7?

Answer choices:

A $3, 6, 9, 12$

B $7, 14, 21, 28$

C $36, 43, 50, 64$

D $78, 85, 92, 99$

Solution: B

We can see that all four of the numbers given in answer choice B are multiples of 7.

$$7 \cdot 1 = 7$$

$$7 \cdot 2 = 14$$

$$7 \cdot 3 = 21$$

$$7 \cdot 4 = 28$$

Topic: Multiples

Question: Choose the number that's a multiple of both 4 and 8.

Answer choices:

A 2

B 4

C 1

D 8

Solution: D

Notice that 8 is a multiple of 4, because $4 \cdot 2 = 8$, but 4 isn't a multiple of 8. Also, 8 is a multiple of 8, because $8 \cdot 1 = 8$. Furthermore, neither 1 nor 2 is a multiple of 4 or a multiple of 8. So D is the correct answer choice.

Topic: Multiples

Question: Choose the common multiple of 6 and 18.

Answer choices:

A 6

B 2

C 12

D 18

Solution: D

The first few multiples of 6 are

$$6 \cdot 1 = 6$$

$$6 \cdot 2 = 12$$

$$6 \cdot 3 = 18$$

$$6 \cdot 4 = 24$$

The first few multiples of 18 are

$$18 \cdot 1 = 18$$

$$18 \cdot 2 = 36$$

$$18 \cdot 3 = 54$$

$$18 \cdot 4 = 72$$

These lists have 18 in common, and 18 is one of the answer choices, so D is the correct answer choice.

Topic: Prime and composite

Question: Which number is prime?

Answer choices:

A 32

B 43

C 51

D 105

Solution: B

If a whole number greater than 1 is divisible by some number other than 1 and itself, then we know it's a composite number, not a prime number.

32 is divisible by 2: $32 \div 2 = 16$

51 is divisible by 3: $51 \div 3 = 17$

105 is divisible by 5: $105 \div 5 = 21$

The only answer choice that isn't divisible by any number other than 1 or itself is 43, so this is the only prime number, and the correct answer is 43.

Topic: Prime and composite

Question: Which number is prime?

Answer choices:

A 3

B 6

C 0

D 1

Solution: A

A prime number is a whole number greater than 1 which is divisible only by 1 and itself.

Because prime numbers are defined as greater than 1, that rules out 0 and 1 right away, leaving only 3 and 6 as possible correct answers. But 6 is divisible by 2 and 3 in addition to being divisible by 1 and itself.

3 is the only number which greater than 1 which is also only divisible by 1 and itself.

Topic: Prime and composite

Question: Which number is a composite?

Answer choices:

A 5

B 1

C 30

D 107

Solution: C

The numbers 1, 5, and 107 aren't divisible by anything other than 1 and themselves.

On the other hand, if we factor 30, we get

$$30$$

$$15 \cdot 2$$

$$5 \cdot 3 \cdot 2$$

30 is composed of the factors 2, 3, and 5, which makes it a composite number.

Topic: Prime factorization and product of primes

Question: What is the prime factorization of 120?

Answer choices:

A $2 \cdot 2 \cdot 5$

B $2 \cdot 2 \cdot 3 \cdot 5 \cdot 5$

C $2 \cdot 2 \cdot 2 \cdot 3 \cdot 5$

D $2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 \cdot 5$

Solution: C

We need to find the product of prime numbers that make up 120.

$$120$$

$$12 \cdot 10$$

$$6 \cdot 2 \cdot 5 \cdot 2$$

$$3 \cdot 2 \cdot 2 \cdot 5 \cdot 2$$

Now we'll collect the factors in ascending order.

$$2 \cdot 2 \cdot 2 \cdot 3 \cdot 5$$

We can also write it as

$$2^3 \cdot 3 \cdot 5$$

Topic: Prime factorization and product of primes

Question: What is the prime factorization of 300?

Answer choices:

A $2 \cdot 3 \cdot 3 \cdot 5$

B $2 \cdot 2 \cdot 3 \cdot 3 \cdot 5$

C $2 \cdot 2 \cdot 3 \cdot 5$

D $2 \cdot 2 \cdot 3 \cdot 5 \cdot 5$

Solution: D

We need to find the product of prime numbers that make up 300.

$$300$$

$$30 \cdot 10$$

$$6 \cdot 5 \cdot 5 \cdot 2$$

$$3 \cdot 2 \cdot 5 \cdot 5 \cdot 2$$

Now we'll collect the factors in ascending order.

$$2 \cdot 2 \cdot 3 \cdot 5 \cdot 5$$

We can also write it as

$$2^2 \cdot 3 \cdot 5^2$$

Topic: Prime factorization and product of primes

Question: Which factorization is complete?

Answer choices:

A $100 = 10^2$

B $100 = 4 \cdot 25$

C $100 = 10 \cdot 10$

D $100 = 2^2 \cdot 5^2$

Solution: D

If we want to completely factor 100, the factorization breaks down as

$$100$$

$$50 \cdot 2$$

$$25 \cdot 2 \cdot 2$$

$$5 \cdot 5 \cdot 2 \cdot 2$$

Now we'll collect the factors in ascending order.

$$2 \cdot 2 \cdot 5 \cdot 5$$

We can also write it as

$$2^2 \cdot 5^2$$

Topic: Least common multiple

Question: Find the least common multiple (LCM) of 4 and 6.

Answer choices:

A 10

B 12

C 24

D 30

Solution: B

The least common multiple of two positive whole numbers is the smallest number that's divisible by both of them. When the numbers are fairly small, one way to find the LCM is to list the first few positive multiples of each of them to see if we can find one that they have in common.

$$\begin{array}{llll} 4 \cdot 1 = & 4 & 6 \cdot 1 = & 6 \\ 4 \cdot 2 = & 8 & 6 \cdot 2 = & 12 \\ 4 \cdot 3 = & 12 & 6 \cdot 3 = & 18 \\ 4 \cdot 4 = & 16 & 6 \cdot 4 = & 24 \\ 4 \cdot 5 = & 20 & 6 \cdot 5 = & 30 \\ 4 \cdot 6 = & 24 & 6 \cdot 6 = & 36 \end{array}$$

The first time they overlap is when $4 \cdot 3 = 12$ and $6 \cdot 2 = 12$. Therefore, the least common multiple of 4 and 6 is 12.

Topic: Least common multiple

Question: Find the least common multiple (LCM) of 10 and 24.

Answer choices:

A 120

B 240

C 2

D 10

Solution: A

The least common multiple of two positive whole numbers is the smallest number that's divisible by both of them. When the numbers are a little larger, one way to find the LCM is to find their prime factorizations.

10	24
$5 \cdot 2$	$12 \cdot 2$
	$6 \cdot 2 \cdot 2$
	$3 \cdot 2 \cdot 2 \cdot 2$

The prime factorizations are

$2 \cdot 5$	$2^3 \cdot 3$

We get prime factors of 2, 3, and 5. We have one factor of 2 in 10 and three factors of it in 24, so we'll need three factors of 2 in the LCM. We have zero factors of 3 in 10 and one factor of it in 24, so we'll need one factor of 3 in the LCM. We have one factor of 5 in 10 and zero factors of it in 24, so we'll need one factor of it in the LCM. Therefore, our least common multiple is $2^3 \cdot 3 \cdot 5$. If we multiply this out to find one number, we get

$$2 \cdot 2 \cdot 2 \cdot 3 \cdot 5$$

$$4 \cdot 2 \cdot 3 \cdot 5$$

$$8 \cdot 3 \cdot 5$$

$$24 \cdot 5$$

120

Topic: Least common multiple

Question: Find the least common multiple (LCM) of the set.

$$\{15, 100\}$$

Answer choices:

A 300

B 100

C 15

D $1,500$

Solution: A

The least common multiple of two numbers is the smallest value that's evenly divisible by both numbers. When the numbers in our set are a little larger, the best way to find the LCM is to break down each number into its product of primes.

15	100
$5 \cdot 3$	$50 \cdot 2$
	$25 \cdot 2 \cdot 2$
	$5 \cdot 5 \cdot 2 \cdot 2$

The product of primes are

$5 \cdot 3$	$5^2 \cdot 2^2$

Across both product of primes, we have factors of 2, 3, and 5. We have to take the largest number of factors for each of those numbers. For example, there's only one factor of 5 in 15, but there are two factors of 5 in 100, which means we have to take two factors of 5 for our LCM. We also have to take one factor of 3 and two factors of 2.

Therefore, our least common multiple is

$$2^2 \cdot 3 \cdot 5^2$$

$$2 \cdot 2 \cdot 3 \cdot 5 \cdot 5$$

$$4 \cdot 3 \cdot 25$$

$12 \cdot 25$

300

Topic: Greatest common factor

Question: Find the greatest common factor (GCF) of 54 and 100.

Answer choices:

A 2

B 4

C 6

D 8

Solution: A

To find the greatest common factor of two positive whole numbers, we want to factor each one down to its product of primes.

54	100
$27 \cdot 2$	$50 \cdot 2$
$9 \cdot 3 \cdot 2$	$25 \cdot 2 \cdot 2$
$3 \cdot 3 \cdot 3 \cdot 2$	$5 \cdot 5 \cdot 2 \cdot 2$

To find the greatest common factor, we can only take factors that are common to each prime factorization. There is one factor of 2 in both, so we can take that. But once we take away one 2 from each factorization, we're left with

$3 \cdot 3 \cdot 3$	$5 \cdot 5 \cdot 2$

And now there are no remaining common factors. Therefore, the greatest common factor of 54 and 100 is

$$2$$

Topic: Greatest common factor

Question: Find the greatest common factor (GCF) of 120 and 288.

Answer choices:

A 6

B 12

C 24

D 48

Solution: C

To find the greatest common factor of two positive whole numbers, we want to factor each one down to its product of primes.

120	288
$60 \cdot 2$	$144 \cdot 2$
$30 \cdot 2 \cdot 2$	$72 \cdot 2 \cdot 2$
$15 \cdot 2 \cdot 2 \cdot 2$	$36 \cdot 2 \cdot 2 \cdot 2$
$5 \cdot 3 \cdot 2 \cdot 2 \cdot 2$	$18 \cdot 2 \cdot 2 \cdot 2 \cdot 2$
	$9 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$
	$3 \cdot 3 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

To find the greatest common factor, we can only take factors that are common to each prime factorization. There are three factors of 2 in both, so we can take those. But once we take away three 2s from each factorization, we're left with

$5 \cdot 3$	$3 \cdot 3 \cdot 2 \cdot 2$

We can also take one factor of 3 from both for our common factor, but once we take away one factor of 3, we're left with

5	$3 \cdot 2 \cdot 2$

And now there are no remaining common factors. Therefore, the greatest common factor of 120 and 288 is

$3 \cdot 2^3$

$3 \cdot 2 \cdot 2 \cdot 2$

$6 \cdot 2 \cdot 2$

$12 \cdot 2$

24

Topic: Greatest common factor

Question: Find the greatest common factor (GCF) of the set.

$$\{48, 128\}$$

Answer choices:

A 8

B 16

C 24

D 32

Solution: B

To find the greatest common factor of two numbers, we want to factor each one down to its product of primes.

48	128
$24 \cdot 2$	$64 \cdot 2$
$12 \cdot 2 \cdot 2$	$32 \cdot 2 \cdot 2$
$6 \cdot 2 \cdot 2 \cdot 2$	$16 \cdot 2 \cdot 2 \cdot 2$
$3 \cdot 2 \cdot 2 \cdot 2 \cdot 2$	$8 \cdot 2 \cdot 2 \cdot 2 \cdot 2$
	$4 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$
	$2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

In order to find the greatest common factor, we take all the common factors in these products of primes. The factors that are common to both numbers is four factors of 2. Therefore, the greatest common factor of 48 and 128 is

$$2 \cdot 2 \cdot 2 \cdot 2$$

$$4 \cdot 2 \cdot 2$$

$$8 \cdot 2$$

$$16$$

Topic: Fractions

Question: What is the numerator?

$$\frac{1}{4}$$

Answer choices:

A 1

B 4

C $\frac{1}{4}$

D None of these

Solution: A

In a fraction, the number on the top is the “numerator,” and the number on the bottom is the “denominator.” In the fraction

$$\frac{1}{4}$$

the number on the top is 1, so 1 is the numerator.

Topic: Fractions

Question: Write $27\,\%$ as a fraction.

Answer choices:

A $\frac{27}{1,000}$

B $\frac{27}{100}$

C $\frac{1}{27}$

D $\frac{100}{27}$

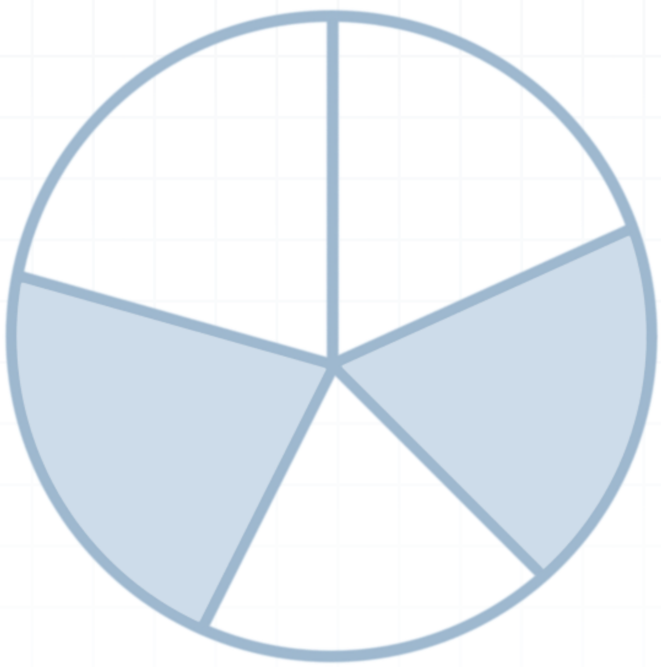
Solution: B

27% can be expressed as a fraction with 27 in the numerator and 100 in the denominator:

$$\frac{27}{100}$$

Topic: Fractions

Question: Which fraction represents the shaded area?



Answer choices:

A $\frac{2}{10}$

B $\frac{1}{5}$

C $\frac{2}{5}$

D $\frac{3}{5}$

Solution: C

The circle is divided into 5 sections, and two of them are shaded, so we can say that 2 of the 5 are shaded, and represent this as

$$\frac{2}{5}$$

Topic: Simplifying fractions and cancellation

Question: Simplify $50/85$ to lowest terms.

Answer choices:

A $\frac{10}{17}$

B $\frac{25}{42}$

C $\frac{3}{4}$

D $\frac{10}{15}$

Solution: A

Let's find the prime factorizations of the numerator and the denominator.

$$\frac{50}{85}$$

$$\frac{5 \cdot 5 \cdot 2}{17 \cdot 5}$$

The only factor that's common to the numerator and denominator is 5. Since 5 occurs twice as a factor in the numerator but only once in the denominator, we'll cancel one of the 5's in the numerator against the 5 in the denominator, leaving just

$$\frac{5 \cdot 2}{17}$$

$$\frac{10}{17}$$

Topic: Simplifying fractions and cancellation

Question: Simplify $6/30$ to lowest terms.

Answer choices:

A $\frac{1}{10}$

B $\frac{4}{7}$

C $\frac{2}{3}$

D $\frac{1}{5}$

Solution: D

We realize that 6 and 30 have a common factor of 6. Therefore, we'll divide both the numerator and denominator by 6.

$$\frac{6 \div 6}{30 \div 6}$$

$$\frac{1}{5}$$

The fraction can't be reduced any further.

Topic: Simplifying fractions and cancellation

Question: Simplify $14/21$ to lowest terms.

Answer choices:

A $\frac{1}{3}$

B $\frac{2}{3}$

C $\frac{7}{2}$

D $\frac{2}{7}$

Solution: B

We realize that 14 and 21 have a common factor of 7. Therefore, we'll divide both the numerator and denominator by 7.

$$\frac{14 \div 7}{21 \div 7}$$

$$\frac{2}{3}$$

The fraction can't be reduced any further.

Topic: Equivalent fractions

Question: Which fraction is equivalent to $3/7$?

Answer choices:

A $\frac{7}{14}$

B $\frac{24}{56}$

C $\frac{10}{21}$

D $\frac{7}{3}$

Solution: B

Of these answer choices, the fraction in answer choice B is the only fraction that's equivalent to $3/7$. To show this, we'll break the numerator and denominator of $24/56$ into their prime factors.

$$\frac{24}{56}$$

$$\frac{3\cdot 2\cdot 2\cdot 2}{7\cdot 2\cdot 2\cdot 2}$$

The prime factor 2 occurs three times in both the numerator and the denominator, so we can cancel all of those factors, and we'll be left with

$$\frac{3}{7}$$

There's another way to show that $24/56$ is equivalent to $3/7$: We'd have to multiply the numerator of $3/7$, 3, by 8 in order to get the numerator of $24/56$, 24. Therefore, we'd have to multiply the denominator of $3/7$, 7 by the same number (8) to get the denominator of the fraction that's equivalent to $3/7$ and has a numerator of 24:

$$\frac{3}{7}=\frac{3\cdot 8}{7\cdot 8}=\frac{24}{56}$$

Topic: Equivalent fractions

Question: Which fractions are equivalent?

Answer choices:

A $\frac{5}{7}$ and $\frac{13}{18}$

B $\frac{6}{8}$ and $\frac{30}{40}$

C $\frac{12}{16}$ and $\frac{3}{5}$

D $\frac{6}{11}$ and $\frac{12}{20}$

Solution: B

If you reduce equivalent fractions to lowest terms, you'll get the same result. For example, $6/8$ can be reduced as

$$\frac{6}{8}$$

$$\frac{6 \div 2}{8 \div 2}$$

$$\frac{3}{4}$$

And $30/40$ can be reduced as

$$\frac{30}{40}$$

$$\frac{30 \div 10}{40 \div 10}$$

$$\frac{3}{4}$$

Because we get the same result ($3/4$) when we reduce $6/8$ and $30/40$ to lowest terms, we know that they're equivalent.

Topic: Equivalent fractions

Question: Choose an equivalent fraction.

$$\frac{3}{4}$$

Answer choices:

A $\quad \dfrac{12}{16}$

B $\quad \dfrac{75}{80}$

C $\quad \dfrac{6}{10}$

D $\quad \dfrac{30}{36}$

Solution: A

Equivalent fractions, when you reduce them to their lowest terms, will always be equal to one another. For example, $12/16$ can be reduced as

$$\frac{12}{16}$$

$$\frac{12 \div 4}{16 \div 4}$$

$$\frac{3}{4}$$

Because we get $3/4$ when we reduce the fraction, we know that $12/16$ is equivalent to $3/4$.

Topic: Division of zero

Question: Which of these is false?

Answer choices:

A $1 \cdot 0 = 0$

B $\frac{1}{0} = 0$

C $\frac{0}{1} = 0$

D $0 \cdot 1 = 0$

Solution: B

A fraction is always undefined if the denominator is equal to 0, so the equation in answer choice B is false because it implies that we *can* divide 1 by 0 (and that the result of that division is 0).

Topic: Division of zero

Question: Which of these is true?

Answer choices:

A $\frac{0}{3}=0$

B $\frac{3}{0}=0$

C $\frac{2\cdot 3}{0}=0$

D $2\cdot\frac{1}{2}\cdot 3=0$

Solution: A

A fraction is always undefined if the denominator is equal to 0, so the equations in answer choices B and C are false.

The equation in answer choice D is not true because the left-hand side isn't 0.

The equation in answer choice A is the correct choice because 0 divided by any nonzero number (any number other than 0) is 0.

Topic: Division of zero

Question: Which answer choice is undefined?

Answer choices:

A $\frac{0}{5}$

B $\frac{0}{3}$

C $\frac{5}{0}$

D $\frac{3}{0.1}$

Solution: C

In math, dividing by 0 makes a fraction undefined, so the fraction in answer choice C is undefined. All of the other answer choices are defined, because having 0 in the numerator just results in the real number answer of 0.

Topic: Adding and subtracting fractions

Question: Simplify the expression.

$$\frac{1}{5}+\frac{3}{7}$$

Answer choices:

A $\frac{11}{35}$

B $\frac{4}{12}$

C $\frac{3}{35}$

D $\frac{22}{35}$

Solution: D

To add two fractions, they must have the same denominator. To find a common denominator, we look for the least common multiple of the denominators of the two fractions, so we'll look for the least common multiple of 5 and 7. The smallest number that's divisible by 5 and 7 is 35, so 35 is the least common multiple. Since $35 = 5 \cdot 7$, we have to multiply the numerator and denominator of the first fraction $(1/5)$ by 7, and we have to multiply the numerator and denominator of the second fraction $(3/7)$ by 5. Therefore, we get

$$\frac{1}{5} + \frac{3}{7}$$

$$\frac{1 \cdot 7}{5 \cdot 7} + \frac{3 \cdot 5}{7 \cdot 5}$$

$$\frac{7}{35} + \frac{15}{35}$$

$$\frac{7 + 15}{35}$$

$$\frac{22}{35}$$

Topic: Adding and subtracting fractions

Question: What is the least common denominator of the fractions in the expression?

$$\frac{1}{2}+\frac{1}{8}+\frac{1}{20}$$

Answer choices:

A 20

B 8

C 40

D 320

Solution: C

To find the least common denominator of two or more fractions, we need to find the least common multiple of their denominators. In other words, what's the smallest number that's divisible by 2, 8 and 20?

To figure this out, we'll use the largest denominator (20), and list its first few positive multiples.

$$20 \cdot 1 = 20$$

$$20 \cdot 2 = 40$$

$$20 \cdot 3 = 60$$

$$20 \cdot 4 = 80$$

$$20 \cdot 5 = 100$$

20 is divisible by both 2 and 20, but not by 8. However, 40 is divisible by 2, 8, and 20, so 40 is the least common multiple of these three numbers, and therefore it's the least common denominator of the three fractions in the given expression.

Topic: Adding and subtracting fractions

Question: Simplify the expression.

$$\frac{10}{7}-\frac{6}{15}$$

Answer choices:

A $\frac{3}{4}$

B $\frac{7}{15}$

C $\frac{4}{8}$

D $\frac{36}{35}$

Solution: D

To subtract one fraction from another, they have to have a common denominator.

$$\frac{10}{7}-\frac{6}{15}$$

$$\frac{10}{7}\left(\frac{15}{15}\right)-\frac{6}{15}\left(\frac{7}{7}\right)$$

$$\frac{150}{105}-\frac{42}{105}$$

$$\frac{150-42}{105}$$

$$\frac{108}{105}$$

Reduce the fraction to its lowest terms.

$$\frac{108\div 3}{105\div 3}$$

$$\frac{36}{35}$$

Topic: Multiplying and dividing fractions

Question: Simplify the expression.

$$\frac{2}{21}\cdot\frac{3}{5}$$

Answer choices:

A $\frac{2}{35}$

B $\frac{5}{26}$

C $\frac{6}{21}$

D $\frac{15}{42}$

Solution: A

To multiply two fractions, we multiply their numerators to get the new numerator, and we multiply their denominators to get the new denominator.

$$\frac{2}{21} \cdot \frac{3}{5}$$

$$\frac{2 \cdot 3}{21 \cdot 5}$$

$$\frac{6}{105}$$

We always need to make sure that the resulting fraction is reduced to lowest terms.

$$\frac{6 \div 3}{105 \div 3}$$

$$\frac{2}{35}$$

Topic: Multiplying and dividing fractions

Question: Multiply the fractions.

$$\frac{3}{5} \cdot \frac{1}{2} \cdot \frac{5}{6}$$

Answer choices:

A $\frac{3}{5}$

B $\frac{2}{3}$

C $\frac{1}{2}$

D $\frac{1}{4}$

Solution: D

When we multiply fractions, we multiply their numerators to get the new numerator, and we multiply their denominators to get the new denominator.

$$\frac{3}{5} \cdot \frac{1}{2} \cdot \frac{5}{6}$$

$$\frac{3 \cdot 1 \cdot 5}{5 \cdot 2 \cdot 6}$$

$$\frac{15}{60}$$

Now reduce the fraction to its lowest terms.

$$\frac{15 \div 15}{60 \div 15}$$

$$\frac{1}{4}$$

Topic: Multiplying and dividing fractions

Question: Divide the fractions.

$$\frac{1}{2} \div \frac{1}{7}$$

Answer choices:

A $\frac{1}{14}$

B 6

C $\frac{7}{2}$

D $\frac{2}{7}$

Solution: C

When we divide fractions, we flip the second fraction upside down to create its reciprocal, and change the division to multiplication.

$$\frac{1}{2} \div \frac{1}{7}$$

$$\frac{1}{2} \times \frac{7}{1}$$

To then do the fraction multiplication, we multiply all the numerators together to create the new numerator, and multiply all the denominators together to create the new denominator.

$$\frac{1 \cdot 7}{2 \cdot 1}$$

$$\frac{7}{2}$$

Topic: Signs of fractions

Question: Choose an equivalent fraction.

$$-\frac{2}{3}$$

Answer choices:

A $\quad \frac{-2}{3}$

B $\quad \frac{-2}{-3}$

C $\quad \frac{2}{3}$

D None of these

Solution: A

For every fraction, there are always three signs: the sign of the numerator, the sign of the denominator, and the fraction's own sign.

In the original fraction, the sign of the numerator is positive, the sign of the denominator is positive, and the fraction's own sign is negative. So of the three signs, one is negative.

To keep the value of the fraction the same, you must change any two signs of the fraction. In the fraction

$$\frac{-2}{3}$$

compared to the original fraction, the sign of the numerator has been changed from positive to negative, and the fraction's own sign has been changed from negative to positive.

Since exactly two signs have been changed, these fractions are equivalent.

Topic: Signs of fractions

Question: Multiply the fractions.

$$-\frac{6}{7}\cdot\frac{1}{2}$$

Answer choices:

A $-\frac{3}{7}$

B $-\frac{7}{3}$

C $\frac{3}{7}$

D $\frac{7}{3}$

Solution: A

When we multiply fractions, we multiply their numerators to get the new numerator, and we multiply their denominators to get the new denominator.

$$-\frac{6}{7} \cdot \frac{1}{2}$$

$$-\frac{6 \cdot 1}{7 \cdot 2}$$

$$-\frac{6}{14}$$

Now reduce the fraction to lowest terms.

$$-\frac{6 \div 2}{14 \div 2}$$

$$-\frac{3}{7}$$

Topic: Signs of fractions

Question: Divide the fractions.

$$-\frac{1}{2} \div -\frac{3}{4}$$

Answer choices:

A $-\frac{2}{3}$

B $\frac{3}{2}$

C $-\frac{3}{2}$

D $\frac{2}{3}$

Solution: D

When we divide fractions, we flip the second fraction upside down to create its reciprocal, and change the division to multiplication.

$$-\frac{1}{2} \div -\frac{3}{4}$$

$$-\frac{1}{2} \times -\frac{4}{3}$$

To then do the fraction multiplication, we multiply all the numerators together to create the new numerator, and multiply all the denominators together to create the new denominator.

Remember that every pair of two negative signs cancel to become a positive sign, so the result here will be positive.

$$\frac{1 \cdot 4}{2 \cdot 3}$$

$$\frac{4}{6}$$

Now reduce the fraction to its lowest terms.

$$\frac{4 \div 2}{6 \div 2}$$

$$\frac{2}{3}$$

Topic: Reciprocals

Question: Find the reciprocal.

$$\frac{1}{3}$$

Answer choices:

A $-\frac{1}{3}$

B -3

C $\frac{2}{3}$

D 3

Solution: D

The reciprocal of a fraction is what we get when we switch the fraction's numerator with its denominator. In the given fraction,

$$\frac{1}{3}$$

the numerator is 1 and the denominator is 3. When we switch them, we get

$$\frac{3}{1}$$

$$3$$

Topic: Reciprocals

Question: Find the reciprocal.

$$\frac{16}{21}$$

Answer choices:

A $\frac{7}{4}$

B $\frac{21}{7}$

C $\frac{21}{16}$

D $\frac{4}{7}$

Solution: C

The reciprocal of a fraction is what we get when we switch the fraction's numerator with its denominator. In the given fraction,

$$\frac{16}{21}$$

the numerator is 16 and the denominator is 21. When we switch them, we get

$$\frac{21}{16}$$

Topic: Reciprocals

Question: Find the negative reciprocal.

$$-\frac{1}{7}$$

Answer choices:

A -7

B 7

C $-\frac{7}{1}$

D -1

Solution: B

The reciprocal of a fraction is whatever we get when we replace the numerator with the denominator and the denominator with the numerator. In the given fraction,

$$-\frac{1}{7}$$

the numerator is 1 and the denominator is 7. When we switch them, we get

$$-\frac{7}{1}$$

$$-7$$

Since we're looking for the negative reciprocal, we have to take the reciprocal we just found and multiply it by -1.

$$-7(-1)$$

$$7$$

Topic: Mixed numbers and improper fractions

Question: Change the mixed number to an improper fraction.

$$15\frac{2}{5}$$

Answer choices:

A $\frac{77}{5}$

B $\frac{45}{5}$

C $\frac{27}{5}$

D $\frac{17}{5}$

Solution: A

To change a mixed number to an improper fraction, just multiply the denominator by the whole number, then add your result to the numerator, putting that final result over the original denominator.

$$15\frac{2}{5}$$

$$15+\frac{2}{5}$$

$$\frac{(5\times 15)+2}{5}$$

$$\frac{75+2}{5}$$

$$\frac{77}{5}$$

Topic: Mixed numbers and improper fractions

Question: Write the mixed number as an improper fraction.

$$7\frac{3}{5}$$

Answer choices:

A $\frac{21}{5}$

B $\frac{35}{3}$

C $\frac{38}{5}$

D $\frac{3}{35}$

Solution: C

To change a mixed number to an improper fraction, just multiply the denominator by the whole number, then add your result to the numerator, putting that final result over the original denominator.

$$7\frac{3}{5}$$

$$7+\frac{3}{5}$$

$$\frac{(5\times 7)+3}{5}$$

$$\frac{35+3}{5}$$

$$\frac{38}{5}$$

Topic: Mixed numbers and improper fractions

Question: Write the improper fraction as a mixed number.

$$\frac{42}{10}$$

Answer choices:

A $\frac{21}{5}$

B $4\frac{1}{5}$

C $5\frac{1}{4}$

D $8\frac{1}{2}$

Solution: B

To change an improper fraction to a mixed number, first figure out how many times the denominator can go into the numerator. For the fraction

$$\frac{42}{10}$$

10 can go into 42 four times, which means the whole number in our mixed number will be 4. That gets us up to 40, and from there we've only got 2 remaining to get up to 42. Which means the numerator of the fraction part of our mixed number will be 2, and the denominator will be the original denominator of 10. So the mixed number will be

$$4\frac{2}{10}$$

Lastly, we need to make sure we reduce our fraction to lowest terms.

$$4\frac{2 \div 2}{10 \div 2}$$

$$4\frac{1}{5}$$

Topic: Adding and subtracting mixed numbers

Question: Simplify the expression.

$$2\frac{1}{2}+5\frac{7}{8}$$

Answer choices:

A $\quad 7\frac{8}{9}$

B $\quad 7\frac{3}{8}$

C $\quad 8\frac{1}{8}$

D $\quad 8\frac{3}{8}$

Solution: D

We'll add the whole numbers and the fractions separately.

$$2\frac{1}{2}+5\frac{7}{8}$$

$$(2+5)+\left(\frac{1}{2}+\frac{7}{8}\right)$$

$$7+\left(\frac{1}{2}+\frac{7}{8}\right)$$

To add the fractions, we have to find a common denominator. We'll find the least common denominator (LCD), which is the least common multiple of the denominators. The least common multiple of 2 and 8 is 8.

$$7+\left[\frac{1}{2}\left(\frac{4}{4}\right)+\frac{7}{8}\right]$$

$$7+\left(\frac{4}{8}+\frac{7}{8}\right)$$

$$7+\frac{11}{8}$$

Since the remaining fraction $(11/8)$ is improper, we can express it as a sum of a whole number and a proper fraction, and then simplify.

$$7+\left(\frac{8}{8}+\frac{3}{8}\right)$$

$$7 + \left(1 + \frac{3}{8}\right)$$

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

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

Topic: Adding and subtracting mixed numbers

Question: Add the mixed numbers.

$$1\frac{3}{8}+1\frac{1}{8}$$

Answer choices:

A $\quad 1\frac{1}{2}$

B $\quad 2\frac{1}{2}$

C $\quad 2\frac{7}{16}$

D $\quad \frac{7}{8}$

Solution: B

We'll add the whole numbers and the fractions separately.

$$1\frac{3}{8}+1\frac{1}{8}$$

$$(1+1)+\left(\frac{3}{8}+\frac{1}{8}\right)$$

$$2+\left(\frac{3}{8}+\frac{1}{8}\right)$$

To add the fractions, we have to have a common denominator, and luckily we already do, so we can go ahead and add the numerators.

$$2+\frac{3+1}{8}$$

$$2+\frac{4}{8}$$

$$2\frac{4}{8}$$

Now we need to reduce the fraction to lowest terms.

$$2\frac{4\div 4}{8\div 4}$$

$$2\frac{1}{2}$$

Topic: Adding and subtracting mixed numbers

Question: Simplify the expression.

$$4\frac{1}{5} - 1\frac{1}{2}$$

Answer choices:

A $2\frac{7}{10}$

B $3\frac{1}{3}$

C $5\frac{1}{7}$

D $2\frac{1}{2}$

Solution: A

We'll subtract the whole numbers separately from the fractions.

$$4\frac{1}{5} - 1\frac{1}{2}$$

$$4 - 1 + \frac{1}{5} - \frac{1}{2}$$

$$3 + \frac{1}{5} - \frac{1}{2}$$

To subtract the fractions, we have to find the lowest common denominator (LCD), which is the least common multiple of the denominators.

$$3 + \frac{1}{5}\left(\frac{2}{2}\right) - \frac{1}{2}\left(\frac{5}{5}\right)$$

$$3 + \frac{2}{10} - \frac{5}{10}$$

$$3 - \frac{3}{10}$$

To change this to a mixed number, we need to change the expression so that it's addition instead of subtraction. We can change the 3 into the equivalent $2 + 1$.

$$2 + 1 - \frac{3}{10}$$

Make a common denominator with the 1 and the fraction.

$$2+1\left(\frac{10}{10}\right)-\frac{3}{10}$$

$$2+\frac{10}{10}-\frac{3}{10}$$

$$2+\frac{7}{10}$$

$$2\frac{7}{10}$$

Topic: Multiplying and dividing mixed numbers

Question: Simplify the expression.

$$2\frac{1}{2} \cdot \frac{7}{3}$$

Answer choices:

A $\frac{7}{3}$

B $\frac{6}{35}$

C $\frac{35}{6}$

D $6\frac{1}{5}$

Solution: C

First, we'll convert the mixed number to an improper fraction.

$$2\frac{1}{2} \cdot \frac{7}{3}$$

$$\left[\frac{(2 \cdot 2) + 1}{2}\right] \cdot \frac{7}{3}$$

$$\left(\frac{4 + 1}{2}\right) \cdot \frac{7}{3}$$

$$\frac{5}{2} \cdot \frac{7}{3}$$

To multiply the fractions, we multiply the numerators and the denominators separately.

$$\frac{5 \cdot 7}{2 \cdot 3}$$

$$\frac{35}{6}$$

Topic: Multiplying and dividing mixed numbers

Question: Simplify the expression.

$$2\frac{1}{2} \div \frac{7}{6}$$

Answer choices:

A $\frac{15}{7}$

B $\frac{14}{6}$

C $\frac{35}{12}$

D $\frac{35}{6}$

Solution: A

First, we'll convert the mixed number to an improper fraction.

$$2\frac{1}{2} \div \frac{7}{6}$$

$$\left[\frac{(2 \cdot 2) + 1}{2}\right] \div \frac{7}{6}$$

$$\left(\frac{4 + 1}{2}\right) \cdot \frac{7}{6}$$

$$\frac{5}{2} \div \frac{7}{6}$$

To divide by $7/6$, we multiply by its reciprocal.

$$\frac{5}{2} \times \frac{6}{7}$$

$$\frac{5 \cdot 6}{2 \cdot 7}$$

$$\frac{30}{14}$$

Now we'll reduce the fraction to its lowest terms by dividing the numerator and denominator by their greatest common factor, which is 2.

$$\frac{30 \div 2}{14 \div 2}$$

$$\frac{15}{7}$$

Topic: Multiplying and dividing mixed numbers

Question: Simplify the expression.

$$3\frac{1}{6} \div 1\frac{1}{8}$$

Answer choices:

A $\frac{27}{76}$

B $\frac{76}{27}$

C $4\frac{1}{2}$

D $\frac{9}{6}$

Solution: B

First, we'll convert the mixed numbers into improper fractions.

$$3\frac{1}{6} \div 1\frac{1}{8}$$

$$\frac{6 \cdot 3 + 1}{6} \div \frac{8 \cdot 1 + 1}{8}$$

$$\frac{19}{6} \div \frac{9}{8}$$

Instead of dividing by $9/8$, we'll multiply by its reciprocal.

$$\frac{19}{6} \times \frac{8}{9}$$

$$\frac{19 \cdot 8}{6 \cdot 9}$$

$$\frac{152}{54}$$

Now we'll reduce the fraction to its lowest terms by dividing the numerator and denominator by their greatest common factor.

$$\frac{152 \div 2}{54 \div 2}$$

$$\frac{76}{27}$$

Topic: Relationships of numbers

Question: Which fraction is greater?

$$\frac{4}{5} \text{ and } \frac{7}{10}$$

Answer choices:

A $\frac{4}{5}$

B $\frac{7}{10}$

C The fractions are equivalent

D Cannot be determined

Solution: A

To determine which fraction is greater, we want to find a common denominator for the two fractions. Since the least common multiple of their denominators (5 and 10) is 10, we'll change $4/5$ to an equivalent fraction that has a denominator of 10.

$$\frac{4}{5}$$

$$\frac{4}{5}\left(\frac{2}{2}\right)$$

$$\frac{8}{10}$$

Now that the denominators are equal, we can compare the fractions directly.

$$\frac{8}{10} \text{ and } \frac{7}{10}$$

Because the numerator of $8/10$ is greater than the numerator of $7/10$ (and their denominators are equal), we see that $8/10$ is greater than $7/10$, which means that the equivalent fraction $4/5$ is greater than $7/10$.

Topic: Relationships of numbers

Question: Which number is less than the other?

$$\frac{1}{2} \text{ and } \frac{3}{4}$$

Answer choices:

A $\frac{1}{2}$

B $\frac{3}{4}$

C The numbers are equivalent

D Cannot be determined

Solution: A

In order to compare $1/2$ to $3/4$, we need to find a common denominator for the two fractions. The least common multiple of their denominators (2 and 4) is 4, so we'll change $1/2$ to a denominator of 4.

$$\frac{1}{2}$$

$$\frac{1}{2}\left(\frac{2}{2}\right)$$

$$\frac{2}{4}$$

Now that the denominators are equal, we can compare the fractions directly.

$$\frac{2}{4} \text{ and } \frac{3}{4}$$

Because the numerator of $2/4$ is less than the numerator of $3/4$ (and their denominators are equal), we see that $2/4$ is less than $3/4$, which means that the equivalent fraction $1/2$ is less than $3/4$.

Topic: Relationships of numbers

Question: Pick an equivalent fraction.

$$4\frac{1}{8}$$

Answer choices:

A $\frac{32}{8}$

B $12\frac{1}{8}$

C $4\frac{2}{16}$

D $4\frac{1}{4}$

Solution: C

Equivalent fractions, when you reduce them to their lowest terms, will always be equal to one another. For example, $2/16$ can be reduced as

$$\frac{2}{16}$$

$$\frac{2 \div 2}{16 \div 2}$$

$$\frac{1}{8}$$

Which means that we can rewrite answer choice C as

$$4\frac{2}{16}$$

$$4\frac{1}{8}$$

Topic: Adding mixed measures

Question: Find the sum of the mixed measures.

$$(1 \text{ yd}, 2 \text{ ft}, 7 \text{ in}) + (2 \text{ yd}, 2 \text{ ft}, 8 \text{ in})$$

Answer choices:

A 3 yd, 2 ft, 15 in

B 3 yd, 2 ft, 3 in

C 3 yd, 1 ft, 11 in

D 4 yd, 2 ft, 3 in

Solution: D

To add these mixed measures, we first add the yards, the feet, and the inches separately.

$$(1 \text{ yd}, 2 \text{ ft}, 7 \text{ in}) + (2 \text{ yd}, 2 \text{ ft}, 8 \text{ in})$$

$$(1+2) \text{ yd}, (2+2) \text{ ft}, (7+8) \text{ in}$$

$$3 \text{ yd}, 4 \text{ ft}, 15 \text{ in}$$

Now we need to simplify this result, and we need to do this from right to left. Since there are 12 inches in a foot, we'll express 15 inches as the sum of 12 inches and 3 inches, then rewrite 12 inches as 1 foot, and add that 1 foot to the 4 feet we've already found:

$$3 \text{ yd}, 4 \text{ ft}, 12 \text{ in} + 3 \text{ in}$$

$$3 \text{ yd}, 4 \text{ ft}, 1 \text{ ft} + 3 \text{ in}$$

$$3 \text{ yd}, (4+1) \text{ ft}, 3 \text{ in}$$

$$3 \text{ yd}, 5 \text{ ft}, 3 \text{ in}$$

Next, we know that there are 3 feet in a yard, so we'll express 5 feet as the sum of 3 feet and 2 feet, then rewrite 3 feet as 1 yard, and add that 1 yard to the 3 yards we've already found:

$$3 \text{ yd}, 3 \text{ ft} + 2 \text{ ft}, 3 \text{ in}$$

$$3 \text{ yd}, 1 \text{ yd} + 2 \text{ ft}, 3 \text{ in}$$

$$(3+1) \text{ yd}, 2 \text{ ft}, 3 \text{ in}$$

4 yd, 2 ft, 3 in

Topic: Adding mixed measures

Question: Find the sum of the mixed measures.

$$(4 \text{ hr}, 40 \text{ min}, 35 \text{ sec}) + (1 \text{ hr}, 45 \text{ min}, 50 \text{ sec})$$

Answer choices:

A 5 hr, 5 min, 45 sec

B 5 hr, 26 min, 25 sec

C 6 hr, 5 min, 45 sec

D 6 hr, 26 min, 25 sec

Solution: D

To add these mixed measures, we first add the hours, the minutes, and the seconds separately.

$$(4 \text{ hr}, 40 \text{ min}, 35 \text{ sec}) + (1 \text{ hr}, 45 \text{ min}, 50 \text{ sec})$$

$$(4+1) \text{ hr}, (40+45) \text{ min}, (35+50) \text{ sec}$$

$$5 \text{ hr}, 85 \text{ min}, 85 \text{ sec}$$

Now we need to simplify this result, and we need to do this from right to left. There are 60 seconds in a minute, so we'll express 85 seconds as the sum of 60 seconds and 25 seconds, then rewrite 60 seconds as 1 minute, and add that 1 minute to the 85 minutes we've already found:

$$5 \text{ hr}, 85 \text{ min}, 60 \text{ sec} + 25 \text{ sec}$$

$$5 \text{ hr}, 85 \text{ min}, 1 \text{ min} + 25 \text{ sec}$$

$$5 \text{ hr}, (85+1) \text{ min}, 25 \text{ sec}$$

$$5 \text{ hr}, 86 \text{ min}, 25 \text{ sec}$$

Next, we know that there are 60 minutes in an hour, so we'll express 86 minutes as the sum of 60 minutes and 26 minutes, then rewrite 60 minutes as 1 hour, and add that 1 hour to the 5 hours we've already found:

$$5 \text{ hr}, 60 \text{ min} + 26 \text{ min}, 25 \text{ sec}$$

$$5 \text{ hr}, 1 \text{ hr} + 26 \text{ min}, 25 \text{ sec}$$

$$(5+1) \text{ hr}, 26 \text{ min}, 25 \text{ sec}$$

6 hr, 26 min, 25 sec

Topic: Adding mixed measures

Question: Find the sum of the mixed measures.

3 days, 8 hours, 15 minutes $+$ 2 days, 15 hours, 45 minutes

Answer choices:

A 4 days, 15 hours, 15 minutes

B 5 days, 20 hours, 55 minutes

C 5 days, 23 hours, 60 minutes

D 6 days

Solution: D

To add these mixed measures, we want to add matching measures.

3 days, 8 hours, 15 minutes $+ 2$ days, 15 hours, 45 minutes

3 days $+ 2$ days, 8 hours $+ 15$ hours, 15 minutes $+ 45$ minutes

5 days, 23 hours, 60 minutes

Now we need to simplify this value as much as we can, and we want to do this from right to left. There are 60 minutes in an hour, which means we can rewrite the value for minutes, and then simplify.

5 days, 23 hours, 1 hour

5 days, 23 hours $+ 1$ hour

5 days, 24 hours

Next, we know that there are 24 hours in a day, which means we can rewrite the value for hours, and then simplify.

5 days, 1 day

5 days $+ 1$ day

6 days

Topic: Place value

Question: Identify the place value of the third 0 after the decimal point.

$$0.00\underline{0}4$$

Answer choices:

A Hundredths

B Thousandths

C Thousands

D Tenths

Solution: B

The third 0 after the decimal point is in the thousandths place.

$1{,}000.0000$	Thousands	place
100.0000	Hundreds	place
10.0000	Tens	place
1.0000	Ones (units)	place
0000.1	Tenths	place
0000.01	Hundredths	place
0000.001	**Thousandths**	**place**

Topic: Place value

Question: Identify the place value of the 3 that immediately follows the 4.

$4,\underline{3}65,831$

Answer choices:

A Ten thousands

B Hundred thousands

C Hundred-thousandths

D Millions

Solution: B

The 3 that immediately follows the 4 is in the hundred thousands place.

$1,000,000.0000$	Millions	place
$100,000.0000$	**Hundred thousands**	**place**
$10,000.0000$	Ten thousands	place
$1,000.0000$	Thousands	place
100.0000	Hundreds	place
10.0000	Tens	place
1.0000	Ones (units)	place
0000.1	Tenths	place
0000.01	Hundredths	place
0000.001	Thousandths	place
0000.0001	Ten-thousandths	place
0000.00001	Hundred-thousandths	place

Topic: Place value

Question: Identify the place value of the three.

$5.0\underline{3}45$

Answer choices:

A Hundredths

B Ones

C Tens

D Tenths

Solution: A

The indicated decimal place is the hundredths place.

$X00{,}000.0000$	Hundred thousands	place
$X0{,}000.0000$	Ten thousands	place
$X{,}000.0000$	Thousands	place
$X00.0000$	Hundreds	place
$X0.0000$	Tens	place
$X.0000$	Ones (units)	place
$0000.X$	Tenths	place
$0000.0X$	**Hundredths**	**place**
$0000.00X$	Thousandths	place
$0000.000X$	Ten thousandths	place
$0000.0000X$	Hundred thousandths	place

Topic: Decimal arithmetic

Question: Find the sum.

$$2.53 + 2.351$$

Answer choices:

A $\quad 4.88$

B $\quad 5.881$

C $\quad 4.881$

D $\quad 3.883$

Solution: C

Line up the decimal points and then add. There's no need to worry about the fact that one of the numbers has more digits to the right of the decimal point than the other number does.

We just pretend that there's a 0 after the 3 in 2.53 (we pretend that it's 2.530), so that the two decimal numbers we're adding have the same number of digits (in this case three digits) to the right of the decimal point.

$$\begin{array}{r} 2.530 \\ +\ 2.351 \\ \hline 4.881 \end{array}$$

Topic: Decimal arithmetic

Question: Find the difference.

$$10.84 - 7.635$$

Answer choices:

A 3.205

B 32.05

C 4.2

D 1.327

Solution: A

Line up the decimal points and then subtract, adding 0's to the end of one of the decimal numbers if necessary (to get the same number of digits to the right of the decimal point in both decimal numbers) before doing the subtraction.

$$\begin{array}{r} 10.840 \\ -\ 7.635 \\ \hline 3.205 \end{array}$$

Topic: Decimal arithmetic

Question: Find the product.

$$1.5 \times 2.35$$

Answer choices:

A 3.55

B 34.25

C 3.525

D 352.5

Solution: C

Multiply normally, ignoring the decimals.

$$\begin{array}{r} 2.35 \\ \times\ \ 1.5 \\ \hline 1175 \\ +2350 \\ \hline 3525 \end{array}$$

Between the two given numbers, there are three digits to the right of the decimal place, so we'll move the decimal three places to the left.

$$3525$$

$$3.525$$

Topic: Repeating decimals

Question: What's the next digit in 5.6321563215 if this number decimal can be rewritten as $5.\overline{63215}$?

Answer choices:

A 3

B 6

C 5

D 1

Solution: B

The bar over the 63215 indicates that this part of the number is repeating, which means the number could be written as

$$5.63215632156321563215...$$

Therefore, the next digit (the digit that comes immediately after 5.6321563215) is a 6.

Topic: Repeating decimals

Question: Rewrite the repeating decimal.

$$0.083333...$$

Answer choices:

A $0.08\overline{3}$

B $0.0\overline{83}$

C $0.083\overline{3}$

D 0.08

Solution: A

Once we get to the 3 immediately following the 8 in

$$0.083333...$$

the number 3 repeats forever, which means we can collapse all the 3's into a single 3 with a bar over it.

$$0.08\overline{3}$$

Topic: Repeating decimals

Question: Rewrite the repeating decimal.

$232.3232323...$

Answer choices:

A 232.33

B $232.\overline{32}$

C $232.3\overline{23}$

D $232.\overline{3}$

Solution: B

Considering all the numbers after the decimal point of

$$232.3232323...$$

we have an indefinitely repeating 32. Which means we need to collapse all the repeating 32s and put a line over the first 32.

$$232.\overline{32}$$

Topic: Rounding

Question: Round to the nearest hundredth.

0.73862

Answer choices:

A 0.75

B 0.72

C 0.74

D 0.73

Solution: C

The hundredths place in the given number is where the 3 is currently sitting.

$$0.73862$$

To round to this place, we'll look at the digit that comes right after the 3, which is the 8. If that digit is greater than or equal to 5, we'll round the 3 up to 4; it it's less than 5, we'll leave the 3 as a 3. Since 8 is greater than 5, we'll round up and get

$$0.74$$

Topic: Rounding

Question: Round to five decimal places.

$$5.41\overline{8}$$

Answer choices:

A 5.42

B 5.41888

C 5.41889

D 5.42000

Solution: C

The bar over the 8 in

$$5.41\overline{8}$$

indicates that the 8 repeats forever, which means we can express $5.41\overline{8}$ as

$$5.4188888888...$$

We've been asked to round this number to five decimal places, meaning that we want to round it to a number that has exactly five digits to the right of the decimal point. The 8 in the sixth decimal place (the fourth 8 to the right of the 1) will cause the 8 in the fifth decimal place to be rounded up to a 9. Therefore, this repeating decimal, rounded to five decimal places, is

$$5.41889$$

Topic: Rounding

Question: Round to the hundredths place.

$$0.1\overline{36}$$

Answer choices:

A 0.140

B 0.1367

C 0.136

D 0.14

Solution: D

The line over the 36 in

$$0.1\overline{36}$$

indicates that the 36 repeats indefinitely. Which means we can extend the 36 out a few decimal places.

$$0.136363636...$$

The hundredths place is

$$0.1\underline{3}6363636...$$

To round to this place, we look at the number to the right of it, which is a 6. Because 6 is greater than 5, that means we round the 3 up to the next number.

$$0.14$$

Topic: Ratio and proportion

Question: Solve for the variable.

$$\frac{3}{4}=\frac{x}{8}$$

Answer choices:

A $x=6$

B $x=4$

C $x=10$

D $x=2$

Solution: A

We'll first find the relationship between the denominators, and then we'll use that relationship to find the value of x.

The denominator on the right side is 8, and the denominator on the left side is 4. Since 8 is twice as big as 4, we know that x (the numerator on the right side) must be twice as big as 3 (the numerator on the left side).

$$x = 2(3)$$

$$x = 6$$

Alternatively, we can just cross multiply to get our answer.

$$\frac{3}{4} = \frac{x}{8}$$

$$8 \cdot 3 = 4 \cdot x$$

$$24 = 4x$$

$$\frac{24}{4} = \frac{4x}{4}$$

$$x = 6$$

Topic: Ratio and proportion

Question: Solve for the variable.

$$\frac{4}{m} = \frac{2}{7}$$

Answer choices:

A $m = 2$

B $m = 4$

C $m = 8$

D $m = 14$

Solution: D

We'll cross multiply.

$$\frac{4}{m} = \frac{2}{7}$$

$$7(4) = m(2)$$

$$28 = 2m$$

$$\frac{28}{2} = \frac{2m}{2}$$

$$m = 14$$

Topic: Ratio and proportion

Question: Solve for the variable.

$$\frac{x}{10} = \frac{3}{70}$$

Answer choices:

A $\quad x = \frac{1}{7}$

B $\quad x = \frac{10}{3}$

C $\quad x = 70$

D $\quad x = \frac{3}{7}$

Solution: D

We'll need to find the relationship between the constant denominators, so that we can use that relationship to find a value for x.

The denominator on the left is 10, and the denominator on the right is 70. Since 70 is seven times as big as 10, we know that 3 must be seven times as big as x.

$$7x = 3$$

$$x = \frac{3}{7}$$

Alternatively, we can just cross multiply to get our answer.

$$\frac{x}{10} = \frac{3}{70}$$

$$70 \cdot x = 3 \cdot 10$$

$$70x = 30$$

$$x = \frac{30}{70}$$

$$x = \frac{3}{7}$$

Topic: Unit price

Question: Given the cost of apples, how many can you buy?

If the price of apples is two for $\$0.50$, how many can you buy for $\$3.00$?

Answer choices:

A 8

B 6

C 4

D 12

Solution: D

If you can buy two apples for $\$0.50$, that means you can buy one apple for $\$0.25$

$$\frac{2 \text{ apples} \div 2}{\$0.50 \div 2} = \frac{1 \text{ apple}}{\$0.25}$$

Then, since you can buy one apple for $\$0.25$, the number of apples you can buy for $\$3.00$ can be found by dividing the total price ($\$3.00$) by the price per apple ($\$0.25$).

$$\$3.00 \div \$0.25$$

$$12$$

Topic: Unit price

Question: What's the price per ounce?

A box of cereal costs $\$4.80$, and there's 16 ounces in the box.

Answer choices:

A $\$0.50$

B $\$1.00$

C $\$0.40$

D $\$0.30$

Solution: D

Since 16 ounces costs $\$4.80$ and we want to find the price per ounce, we can set up a proportion and let the variable x be the price per ounce.

$$\frac{16\text{ ounces}}{\$4.80}=\frac{1\text{ ounce}}{x}$$

Now we'll cross multiply.

$$x(16\text{ ounces})=\$4.80(1\text{ ounce})$$

Next we'll divide both sides of this equation by 16 ounces, to get the x all by itself.

$$\frac{x(16\text{ ounces})}{16\text{ ounces}}=\frac{\$4.80(1\text{ ounce})}{16\text{ ounces}}$$

$$x=\frac{\$4.80(1\text{ ounce})}{16\text{ ounces}}$$

Canceling units, we get

$$x=\frac{\$4.80}{16}$$

$$x=\$0.30$$

Topic: Unit price

Question: Write the following statement as a ratio.

I can buy 3 pencils for $\$0.25$.

Answer choices:

A $\quad \dfrac{3}{\$0.25}$ pencils

B $\quad \dfrac{1}{\$0.15}$ pencils

C $\quad \dfrac{5}{\$0.50}$ pencils

D None of these

Solution: A

In the statement

"I can buy 3 pencils for $\$0.25$."

we're saying that we can get 3 pencils for every $\$0.25$. Or 3 pencils per each $\$0.25$. Therefore, we can write that ratio as

$$\frac{3}{\$0.25} \text{ pencils}$$

Topic: Unit multipliers

Question: Convert from feet to inches.

3 ft

Answer choices:

A 12 in

B 6 in

C 3 in

D 36 in

Solution: D

We put inches in the numerator and feet in the denominator, in order to end up with the units we want.

$$3 \text{ ft} \cdot \frac{12 \text{ in}}{1 \text{ ft}}$$

$$36 \text{ in}$$

Topic: Unit multipliers

Question: Convert from cubic centimeters to cubic meters.

$6{,}000 \text{ cm}^3$

Answer choices:

A 0.6 m^3

B 0.06 m^3

C 0.006 m^3

D 0.0006 m^3

Solution: C

We put meters in the numerator and centimeters in the denominator, in order to get to the units we want. Because we're dealing with cubic centimeters, we need three factors of each (when we were dealing with square units, we only needed two factors, and when we were dealing with linear units, we only needed one factor).

$$6{,}000 \text{ cm}^3 \cdot \frac{1 \text{ m}}{100 \text{ cm}} \cdot \frac{1 \text{ m}}{100 \text{ cm}} \cdot \frac{1 \text{ m}}{100 \text{ cm}}$$

The cm^3 in the numerator cancels out the $\text{cm} \cdot \text{cm} \cdot \text{cm}$ in the denominator, and the $\text{m} \cdot \text{m} \cdot \text{m}$ in the numerator can be written as m^3, so this becomes

$$\frac{6{,}000 \text{ m}^3}{(100)(100)(100)}$$

$$\frac{6{,}000}{1{,}000{,}000} \text{ m}^3$$

Now we'll reduce the fraction to lowest terms.

$$\frac{6{,}000 \div 1{,}000}{1{,}000{,}000 \div 1{,}000} \text{ m}^3$$

$$\frac{6}{1{,}000} \text{ m}^3$$

$$0.006 \text{ m}^3$$

Topic: Unit multipliers

Question: Convert from square yards to square centimeters.

3 yd^2, assuming 2.54 cm in 1 in

Answer choices:

A 300 cm^2

B $3{,}888$ cm^2

C 274.32 cm^2

D $25{,}083.82$ cm^2

Solution: D

Since we know there are 3 ft in 1 yd, we put feet in the numerator and yards in the denominator in order to convert from yards to feet. Because we're dealing with square yards, we need two factors of each.

$$3 \text{ yd}^2 \cdot \frac{3 \text{ ft}}{1 \text{ yd}} \cdot \frac{3 \text{ ft}}{1 \text{ yd}}$$

$$3 \text{ yd}^2 \cdot \frac{9 \text{ ft}^2}{1 \text{ yd}^2}$$

The yd units will all cancel.

$$27 \text{ ft}^2$$

Since we know there are 12 in in 1 ft, we put inches in the numerator and feet in the denominator in order to convert from feet to inches. Because we're dealing with square feet, we need two factors of each.

$$27 \text{ ft}^2 \cdot \frac{12 \text{ in}}{1 \text{ ft}} \cdot \frac{12 \text{ in}}{1 \text{ ft}}$$

$$27 \text{ ft}^2 \cdot \frac{144 \text{ in}^2}{1 \text{ ft}^2}$$

The ft units will all cancel.

$$3{,}888 \text{ in}^2$$

Since we know there are 2.54 cm in 1 in, we put centimeters in the numerator and inches in the denominator in order to convert from inches to centimeters. Because we're dealing with square inches, we need two factors of each.

$$3{,}888 \text{ in}^2 \cdot \frac{2.54 \text{ cm}}{1 \text{ in}} \cdot \frac{2.54 \text{ cm}}{1 \text{ in}}$$

$$3{,}888 \text{ in}^2 \cdot \frac{6.4516 \text{ cm}^2}{1 \text{ in}^2}$$

The in units will all cancel.

$$25{,}083.82 \text{ cm}^2$$

If we wanted to do the conversion in one step, we could have written the conversion as

$$3 \text{ yd}^2 \cdot \frac{3 \text{ ft}}{1 \text{ yd}} \cdot \frac{3 \text{ ft}}{1 \text{ yd}} \cdot \frac{12 \text{ in}}{1 \text{ ft}} \cdot \frac{12 \text{ in}}{1 \text{ ft}} \cdot \frac{2.54 \text{ cm}}{1 \text{ in}} \cdot \frac{2.54 \text{ cm}}{1 \text{ in}}$$

The only units that remain after cancellation are cm.

$$3 \cdot 3 \cdot 3 \cdot 12 \cdot 12 \cdot 2.54 \text{ cm} \cdot 2.54 \text{ cm}$$

$$25{,}083.82 \text{ cm}^2$$

Topic: Exponents

Question: Find the value of the expression.

$$3^4$$

Answer choices:

A 12

B 81

C 27

D 243

Solution: B

The expression 3^4 means that the base 3 needs to be multiplied by itself 4 times.

$$(3)(3)(3)(3)$$

$$(9)(3)(3)$$

$$(27)(3)$$

$$81$$

Topic: Exponents

Question: Simplify by using exponents.

$$2 \cdot 2 \cdot 2 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7$$

Answer choices:

A $2^3 \cdot 7^5$

B $14^3 \cdot 7^5$

C $4^2 \cdot 7^5$

D $14^4 \cdot 7$

Solution: A

In the given expression,

$$2 \cdot 2 \cdot 2 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7$$

we see that 2 appears as a factor 3 times, so we can write that part in exponential form as 2^3. Also, 7 appears as a factor 5 times, which we can write as 7^5. Combining these results, we get

$$2^3 \cdot 7^5$$

Topic: Exponents

Question: Find the difference.

$$8^2 - 3^3$$

Answer choices:

A 5

B 37

C 4

D 11

Solution: B

In order to find the difference, we need to simplify each term separately.

$$8^2 - 3^3$$

$$64 - 27$$

$$37$$

Topic: Rules of exponents

Question: Simplify the expression.

$$x \cdot x$$

Answer choices:

A x^2

B $2x$

C x

D $3x$

Solution: A

We can rewrite the given expression.

$$x \cdot x$$

$$x^1 \cdot x^1$$

Then using the fact that

$$x^a x^b = x^{a+b}$$

and noticing that here we have $a = 1$ and $b = 1$, we get

$$x^{1+1}$$

$$x^2$$

Topic: Rules of exponents

Question: Simplify the expression.

$$x^2 \cdot x^2 \cdot x^5$$

Answer choices:

A x^{20}

B x^4

C x^9

D x^7

Solution: C

We'll use the fact that

$$x^a x^b = x^{a+b}$$

or, in this particular case,

$$x^a x^b x^c = x^{a+b+c}$$

Here we have $a = 2$, $b = 2$, and $c = 5$, so we get

$$x^{2+2+5}$$

$$x^9$$

Topic: Rules of exponents

Question: Simplify the expression.

$$x^m \cdot x^n$$

Answer choices:

A x^{m+n}

B x^{m-n}

C x^{mn}

D x^{2m+n}

Solution: A

When you multiply exponential expressions with like bases, you add the exponents. The product

$$x^m \cdot x^n$$

has like bases, since both bases are x. So we'll add the exponents, keeping the same base, and the result will be

$$x^{m+n}$$

Topic: Power rule for exponents

Question: Which of the equations are true?

Answer choices:

A $x^a x^b = x^{a+b}$

B $\frac{x^a}{x^b} = x^{a-b}$

C $\left(x^a\right)^b = x^{a \cdot b}$

D All of these

Solution: D

All of these are true rules of exponents.

Topic: Power rule for exponents

Question: Simplify the expression.

$$\left(x^a\right)^b$$

Answer choices:

A x^{a^2}

B x^{2ab}

C x^{2a2b}

D x^{ab}

Solution: D

When you raise an exponential expression to a power, you can apply the power rule for exponents, by multiplying the exponents and keeping the base the same. Given

$$\left(x^a\right)^b$$

the base x stays the same and the exponents a and b get multiplied. The result is

$$x^{ab}$$

Topic: Power rule for exponents

Question: Simplify the expression.

$$\left(x^a\right)^{a^2}$$

Answer choices:

A $\quad x^{a+a^2}$

B $\quad x^{2a^2}$

C $\quad x^{a^3}$

D $\quad x^a$

Solution: C

When you raise an exponent to another exponent, you apply the power rule for exponents, and you multiply the exponents together, keeping the base the same. Given

$$\left(x^a\right)^{a^2}$$

the base x stays the same and the exponents a and a^2 get multiplied together. The result is

$$x^{a\cdot a^2}$$

$$x^{a^3}$$

Topic: Quotient rule for exponents

Question: Simplify the expression.

$$\frac{x^9}{x^7}$$

Answer choices:

A x^{16}

B x^{63}

C x^3

D x^2

Solution: D

The quotient rule for exponents tells us that

$$\frac{x^a}{x^b} = x^{a-b}$$

In other words, because the numerator and denominator have the same base x, we can subtract the exponent in the denominator from the exponent in the numerator.

$$\frac{x^9}{x^7}$$

$$x^{9-7}$$

$$x^2$$

Topic: Quotient rule for exponents

Question: Simplify the expression.

$$\frac{\left(x^{a+3}\right)^2}{x^{3-a}}$$

Answer choices:

A x^{a+3}

B x^{3a+3}

C x^{3a+1}

D x^{a+1}

Solution: B

The power rule for exponents tells us that

$$\left(x^a\right)^b = x^{ab}$$

We'll apply this rule to the expression in the numerator of the fraction, and then we'll simplify the numerator before dividing it by the denominator.

$$\frac{\left(x^{a+3}\right)^2}{x^{3-a}}$$

$$\frac{x^{(a+3)(2)}}{x^{3-a}}$$

$$\frac{x^{2a+6}}{x^{3-a}}$$

The quotient rule for exponents tells us that

$$\frac{x^a}{x^b} = x^{a-b}$$

Applying this to our fraction, we get

$$x^{(2a+6)-(3-a)}$$

$$x^{2a+6-3+a}$$

$$x^{3a+3}$$

Topic: Quotient rule for exponents

Question: Simplify the expression.

$$\frac{x^m}{x^n}$$

Answer choices:

A x^{mn}

B x^{nm}

C x^{2m2n}

D x^{m-n}

Solution: D

To use the quotient rule for exponents, we need to make sure we have like bases between our terms in both the numerator and denominator. In the fraction

$$\frac{x^m}{x^n}$$

the base of the term in the numerator is x, and the base of the term in the denominator is x, so we have like bases. Which means we can apply quotient rule, and subtract the exponents. The exponent in the denominator gets subtracted from the exponent in the numerator.

$$x^{m-n}$$

Topic: Radicals

Question: Simplify the radical expression.

$$\sqrt{100}$$

Answer choices:

A 10

B 20

C -10

D 25

Solution: A

We know that

$$(10)(10) = 100 = (-10)(-10)$$

Remember that $\sqrt{100}$ means the positive number that when multiplied by itself gives 100, so

$$\sqrt{100} = 10$$

Topic: Radicals

Question: Simplify the radical expression.

$$\sqrt[3]{-64}$$

Answer choices:

A -8

B 4

C -4

D 6

Solution: C

We know that

$$(-4)(-4)(-4) = (16)(-4) = -64$$

Because this is a cube root, there's only one number that, when multiplied by itself 3 times, gives -64. This tells us that

$$\sqrt[3]{-64} = -4$$

Topic: Radicals

Question: Simplify the radical expression.

$$\sqrt{225}$$

Answer choices:

A 15

B 20

C 22

D 25

Solution: A

We know that

$$(15)(15) = 225 = (-15)(-15)$$

Remember that $\sqrt{225}$ means the positive number that when multiplied by itself gives 225, so

$$\sqrt{225} = 15$$

Topic: Adding and subtracting radicals

Question: Simplify the expression.

$$\sqrt{3}+\sqrt{5}+\sqrt{3}+\sqrt{2}$$

Answer choices:

A $\sqrt{13}$

B $\sqrt{90}$

C $2\sqrt{3}+\sqrt{5}+\sqrt{2}$

D $\sqrt{9}$

Solution: C

When we're adding or subtracting two terms and each of them contains a square root, we can combine them only if the radicands are the same, because those are the only like terms.

Here we have two terms consisting of $\sqrt{3}$, so those terms can be combined.

$$\sqrt{3}+\sqrt{5}+\sqrt{3}+\sqrt{2}$$

$$2\sqrt{3}+\sqrt{5}+\sqrt{2}$$

Now we have one term that contains $\sqrt{3}$, one term that contains $\sqrt{5}$, and one term that contains $\sqrt{2}$. Since all three terms have different radicands (and none of the radicands can be factored, because 3, 5, and 2 are all prime numbers), there's no way to combine any of the terms, so we can't do any further simplification.

Topic: Adding and subtracting radicals

Question: Simplify the expression.

$$2\sqrt{2}+3\sqrt{2}$$

Answer choices:

A $5\sqrt{2}$

B $6\sqrt{2}$

C 12

D 13

Solution: A

When we're adding or subtracting, we can combine square roots only when the radicands are the same, because those are the only like terms.

Since in

$$2\sqrt{2} + 3\sqrt{2}$$

both terms contain $\sqrt{2}$, we can combine them and we get

$$(2 + 3)\sqrt{2}$$

$$5\sqrt{2}$$

Topic: Adding and subtracting radicals

Question: Simplify the expression.

$$10\sqrt{3} - 6\sqrt{3}$$

Answer choices:

A 12

B $4\sqrt{3}$

C $3\sqrt{3}$

D 6

Solution: B

When we're adding or subtracting, we can only combine square roots when the value inside the radical is the same, because those are the only like terms.

Since in

$$10\sqrt{3} - 6\sqrt{3}$$

both terms contain $\sqrt{3}$, we can combine them and we get

$$(10 - 6)\sqrt{3}$$

$$4\sqrt{3}$$

Topic: Multiplying radicals

Question: Simplify the expression.

$$\sqrt{3} \cdot \sqrt{2}$$

Answer choices:

A $\sqrt{5}$

B $\sqrt{6}$

C $\sqrt{10}$

D $\sqrt{1}$

Solution: B

We need to use the rule that tells us that

$$\sqrt{m} \cdot \sqrt{n} = \sqrt{mn}$$

Applying this to our problem, we can rewrite it.

$$\sqrt{3} \cdot \sqrt{2}$$

$$\sqrt{3 \cdot 2}$$

$$\sqrt{6}$$

Topic: Multiplying radicals

Question: Simplify the expression.

$$\sqrt{2} \cdot \sqrt{8}$$

Answer choices:

A $\sqrt{4}$

B 2

C 4

D 16

Solution: C

We need to use the rule that tells us that

$$\sqrt{m} \cdot \sqrt{n} = \sqrt{mn}$$

Applying this to our problem, we can rewrite it.

$$\sqrt{2} \cdot \sqrt{8}$$

$$\sqrt{2 \cdot 8}$$

$$\sqrt{16}$$

$$4$$

Topic: Multiplying radicals

Question: Simplify the expression.

$$\sqrt{25} \cdot \sqrt{2}$$

Answer choices:

A $\sqrt{5}$

B $5\sqrt{2}$

C 100

D 50

Solution: B

Normally we would use the rule that tells us that

$$\sqrt{m} \cdot \sqrt{n} = \sqrt{mn}$$

and we'd get

$$\sqrt{25} \cdot \sqrt{2}$$

$$\sqrt{25 \cdot 2}$$

$$\sqrt{50}$$

but then we'd need to work on simplifying $\sqrt{50}$. It would be easier to realize that 25 is the perfect square of 5, and simplify the original problem to

$$\sqrt{25} \cdot \sqrt{2}$$

$$5 \cdot \sqrt{2}$$

$$5\sqrt{2}$$

Topic: Dividing radicals

Question: Simplify the expression.

$$\sqrt{\frac{6}{23}} \cdot \frac{\sqrt{23}}{\sqrt{23}}$$

Answer choices:

A $\frac{\sqrt{111}}{2}$

B $\frac{\sqrt{23}}{118}$

C $\frac{\sqrt{138}}{23}$

D $\frac{23}{6}$

Solution: C

When we have the square root of a fraction, we want to rewrite it as the quotient of the square roots of the numbers in the numerator and denominator.

$$\sqrt{\frac{6}{23}} \cdot \frac{\sqrt{23}}{\sqrt{23}}$$

$$\frac{\sqrt{6}}{\sqrt{23}} \cdot \frac{\sqrt{23}}{\sqrt{23}}$$

Then, as usual, we multiply the two fractions by multiplying the numerators separately from the denominators.

$$\frac{\sqrt{6}\sqrt{23}}{\sqrt{23}\sqrt{23}}$$

$\sqrt{23}$ multiplied by itself will give us just 23 in the denominator.

$$\frac{\sqrt{6}\sqrt{23}}{23}$$

To get the product of square roots in the numerator, $\sqrt{6}\sqrt{23}$, we can rewrite it as the square root of the product of the radicands (as $\sqrt{6 \cdot 23}$).

$$\frac{\sqrt{6 \cdot 23}}{23}$$

$$\frac{\sqrt{138}}{23}$$

Topic: Dividing radicals

Question: Rationalize the denominator.

$$\frac{4+\sqrt{5}}{\sqrt{3}}$$

Answer choices:

A $\quad \dfrac{\sqrt{3}+\sqrt{5}}{3}$

B $\quad 4\sqrt{3}+3\sqrt{5}$

C $\quad \dfrac{\sqrt{3}}{4+\sqrt{5}}$

D $\quad \dfrac{4\sqrt{3}+\sqrt{15}}{3}$

Solution: D

To rationalize the denominator, we'll multiply both the numerator and denominator by $\sqrt{3}$.

$$\frac{4+\sqrt{5}}{\sqrt{3}}$$

$$\frac{\left(4+\sqrt{5}\right)\sqrt{3}}{\sqrt{3}\sqrt{3}}$$

$$\frac{4\sqrt{3}+\sqrt{5}\sqrt{3}}{\sqrt{3}\sqrt{3}}$$

$\sqrt{3}$ multiplied by itself will give us just 3 in the denominator.

$$\frac{4\sqrt{3}+\sqrt{5}\sqrt{3}}{3}$$

We can rewrite the product of square roots in the second term in the numerator, $\sqrt{5}\sqrt{3}$, as the square root of the product of the radicands (as $\sqrt{5}\sqrt{3}$), which can be simplified to $\sqrt{15}$.

$$\frac{4\sqrt{3}+\sqrt{15}}{3}$$

Topic: Dividing radicals

Question: Simplify the expression.

$$\frac{\sqrt{27}}{\sqrt{3}}$$

Answer choices:

A 3

B 9

C $\sqrt{9}$

D 27

Solution: A

When you have a fraction in which the numerator is a root and the denominator is a root, you can put the fraction under one root instead.

$$\frac{\sqrt{27}}{\sqrt{3}}$$

$$\sqrt{\frac{27}{3}}$$

Then, since $27/3 = 9$, we get

$$\sqrt{9}$$

$$3$$

Topic: Radical expressions

Question: Simplify the expression.

$$\sqrt{50}$$

Answer choices:

A $5\sqrt{2}$

B $2\sqrt{5}$

C 10

D 50

Solution: A

We know that 25 is a factor of 50, and also a perfect square, so we'll factor 50 as $25 \cdot 2$ and then write the square root of the product (of 25 and 2) as the product of the square roots.

$$\sqrt{50}$$

$$\sqrt{25 \cdot 2}$$

$$\sqrt{25}\sqrt{2}$$

Taking the square root of 25, we get

$$5\sqrt{2}$$

Topic: Radical expressions

Question: Simplify the expression.

$$14 + \sqrt{16}$$

Answer choices:

A 17

B 18

C 19

D 20

Solution: B

We know that 16 is a perfect square, so we'll take its square root.

$$14+\sqrt{16}$$

$$14+4$$

$$18$$

Topic: Radical expressions

Question: Simplify the expression.

$$\sqrt{200}$$

Answer choices:

A $\sqrt{300}$

B $2\sqrt{3}$

C $10\sqrt{2}$

D $8\sqrt{2}$

Solution: C

We know that 100 is a factor of 200, and also a perfect square, so we'll pull that out.

$$\sqrt{200}$$

$$\sqrt{100 \cdot 2}$$

$$\sqrt{100}\sqrt{2}$$

Take the square root of 100.

$$10\sqrt{2}$$

Topic: Powers of 10

Question: Simplify the expression.

$$350 \times 10^3$$

Answer choices:

A $350{,}000$

B 35

C 0.0035

D $3{,}500$

Solution: A

When we multiply by a power of 10, we move the decimal point to the right (by the number of places equal to the exponent if we write the power of 10 in exponential form). Since the exponent in 10^3 is 3, we move the decimal point three places to the right.

$$350 \times 10^3$$

$$350{,}000$$

Topic: Powers of 10

Question: Simplify the expression.

$$2.7 \times 10^5$$

Answer choices:

A $\quad 270{,}000$

B $\quad 27$

C $\quad 27{,}000$

D $\quad 2{,}700$

Solution: A

When we multiply by a power of 10, we move the decimal point to the right (by the number of places equal to the exponent if we write the power of 10 in exponential form). Since the exponent in 10^5 is 5, we move the decimal point five places to the right.

$$2.7 \times 10^5$$

$$270{,}000$$

Topic: Powers of 10

Question: Simplify the expression.

$$7.25 \times 10^{-3}$$

Answer choices:

A 0.00725

B 0.0725

C 725

D 0.00000725

Solution: A

When the power of 10 is negative, we move the decimal point to the left the number of places indicated by the exponent. Since the exponent is negative 3, we move the decimal point to the left three places, and we get

$$7.25 \times 10^{-3}$$

$$0.00725$$

Topic: Scientific notation

Question: Write the number in scientific notation.

$$523{,}000{,}000$$

Answer choices:

A 523×10^6

B 5.23×10^8

C 52.3×10^7

D 0.523×10^9

Solution: B

To put the number in proper scientific notation, we need to make sure we have only one digit to the left of the decimal point. In order to do that, we have to move the decimal point 8 places to the left, which means that the exponent (in the power of 10 written in exponential form) will be 8.

$$523{,}000{,}000$$

$$5.23 \times 10^8$$

Topic: Scientific notation

Question: Write the number in scientific notation.

$$0.000569$$

Answer choices:

A 56.9×10^{-5}

B 5.69×10^{4}

C 0.569×10^{-3}

D 5.69×10^{-4}

Solution: D

To put the number in proper scientific notation, we need to make sure we have only one digit to the left of the decimal point. In order to do that, we have to move the decimal point 4 places to the right, which means the exponent (in the power of 10 written in exponential form) will be -4.

$$0.000569$$

$$5.69 \times 10^{-4}$$

Topic: Scientific notation

Question: Write the number in scientific notation.

$$2{,}000$$

Answer choices:

A 3×10^2

B 3×10^4

C 2×10^3

D 2×10^4

Solution: C

To put the number in proper scientific notation, we need to make sure we have only one digit to the left of the decimal point. In order to do that, we have to move the decimal point 3 places to the left, which means that we get

$$2{,}000$$

$$2 \times 10^3$$

Topic: Multiplying scientific notation

Question: Rewrite the expression in scientific notation.

$$\left(2 \times 10^{8}\right)\left(3.4 \times 10^{-2}\right)$$

Answer choices:

A 0.068×10^{7}

B 6.8×10^{6}

C 0.68×10^{5}

D 68×10^{6}

Solution: B

We'll multiply the decimal numbers and the powers of 10 separately, remembering that we have to add the exponents in the latter multiplication.

$$\left(2 \times 10^8\right)\left(3.4 \times 10^{-2}\right)$$

$$(2 \times 3.4)\left(10^8 \times 10^{-2}\right)$$

$$6.8 \times 10^{8+(-2)}$$

$$6.8 \times 10^{8-2}$$

$$6.8 \times 10^6$$

Topic: Multiplying scientific notation

Question: Rewrite the expression in scientific notation.

$$(2{,}000)(40)\left(1.2\times10^{7}\right)$$

Answer choices:

A 10×10^{6}

B 9.2×10^{5}

C 9.6×10^{11}

D 80×10^{2}

Solution: C

Only the third number in this multiplication includes a power of 10 (the 10^7 in 1.2×10^7), so for the time being we'll leave that 10^7 alone and multiply everything else.

$$(2{,}000)(40)\left(1.2 \times 10^7\right)$$

$$80{,}000\left(1.2 \times 10^7\right)$$

$$(80{,}000 \times 1.2) \times 10^7$$

$$96{,}000 \times 10^7$$

In order to write this in scientific notation, we have to express $96{,}000$ as only one digit in the ones (units) place, and one digit in the tenths place. We need to think of $96{,}000$ as $96{,}000.0$ in order to realize that we need to move the decimal four places to the left in order to get 9.6. So we'll change the expression to

$$9.6 \times 10^4 \times 10^7$$

$$9.6 \times 10^{4+7}$$

$$9.6 \times 10^{11}$$

Topic: Multiplying scientific notation

Question: Rewrite the expression in scientific notation.

$$\left(26 \times 10^{2}\right)\left(200 \times 10^{-8}\right)$$

Answer choices:

A 52×10^{2}

B 5.2×10^{-3}

C 5.2×10^{-4}

D 260×10^{-2}

Solution: B

We'll multiply the whole numbers together, and then separately multiply the powers of 10, remembering that we have to add the exponents.

$$\left(26 \times 10^2\right)\left(200 \times 10^{-8}\right)$$

$$\left(26 \times 200\right)\left(10^2 \times 10^{-8}\right)$$

$$5{,}200 \times 10^{2+(-8)}$$

$$5{,}200 \times 10^{2-8}$$

$$5{,}200 \times 10^{-6}$$

In proper scientific notation, we only leave one digit to the left of the decimal point in the first number, so $5{,}200$ needs to become 5.2. In order to do that, we have to move the decimal point three places to the left, which means we'll also have to multiply by 10^3.

$$5.2 \times 10^3 \times 10^{-6}$$

$$5.2 \times 10^{3+(-6)}$$

$$5.2 \times 10^{3-6}$$

$$5.2 \times 10^{-3}$$

Topic: Dividing scientific notation

Question: Rewrite the expression in scientific notation.

$$\left(9.88 \times 10^{12}\right) \div \left(2.6 \times 10^{-3}\right)$$

Answer choices:

A 3.8×10^{15}

B 2.6×10^{-15}

C 3.8×10^{-15}

D 4.7×10^{14}

Solution: A

The given expression is

$$\left(9.88 \times 10^{12}\right) \div \left(2.6 \times 10^{-3}\right)$$

First, we divide the decimal numbers and the powers of 10 separately, remembering to subtract the exponents in the latter division.

For the division of the decimal numbers, we get

$$9.88 \div 2.6 = 3.8$$

Dividing the powers of 10:

$$10^{12} \div 10^{-3} = 10^{12-(-3)} = 10^{12+3} = 10^{15}$$

Next, we multiply the results of those two divisions.

$$3.8 \times 10^{15}$$

Topic: Dividing scientific notation

Question: Rewrite the expression in scientific notation.

$$\left(1.554 \times 10^{-6}\right) \div \left(2.1 \times 10^{5}\right)$$

Answer choices:

A 3.3×10^{-11}

B 0.74×10^{-12}

C 3.3×10^{11}

D 7.4×10^{-12}

Solution: D

The given expression is

$$(1.554 \times 10^{-6}) \div (2.1 \times 10^{5})$$

First, we divide the decimal numbers and the powers of 10 separately, remembering to subtract the exponents.

For the division of the decimal numbers, we get

$$1.554 \div 21 = 0.74$$

Dividing the powers of 10:

$$10^{-6} \div 10^{5} = 10^{-6-5} = 10^{-11}$$

Next, we multiply the results of those two divisions.

$$0.74 \times 10^{-11}$$

The number we just found (0.74×10^{-11}) isn't in proper scientific notation, because in 0.74 the digit to the left of the decimal point is 0.

To take care of that, we'll express 0.74 in proper scientific notation. To get just one nonzero digit to the left of the decimal point, we have to move the decimal point one place to the right, so the exponent will be -1.

$$0.74 = 7.4 \times 10^{-1}$$

Finally, we'll multiply 7.4×10^{-1} by the result of the division of the powers of 10 (by 10^{-11}), so we need to add the exponents.

$$(7.4 \times 10^{-1}) \times 10^{-11}$$

$$7.4 \times (10^{-1} \times 10^{-11})$$

$$7.4 \times 10^{-1+(-11)}$$

$$7.4 \times 10^{-1-11}$$

$$7.4 \times 10^{-12}$$

Topic: Dividing scientific notation

Question: Rewrite the expression in scientific notation.

$$\frac{\left(0.04 \times 10^{-9}\right)\left(50 \times 10^{10}\right)}{(0.000004)(50{,}000)}$$

Answer choices:

A $\quad 1 \times 10^2$

B $\quad 10^8$

C $\quad 2 \times 10^8$

D $\quad 100$

Solution: A

If we start with the given expression

$$\frac{\left(0.04 \times 10^{-9}\right)\left(50 \times 10^{10}\right)}{(0.000004)(50{,}000)}$$

we'll first work on the numerator separately from the denominator. And when we're working inside the numerator or inside the denominator, when we multiply numbers in scientific notation, we multiply the decimal terms together.

$$\frac{0.04 \cdot 50 \times 10^{-9} \cdot 10^{10}}{0.000004 \cdot 50{,}000}$$

$$\frac{2 \times 10^{-9} \cdot 10^{10}}{0.2}$$

Then we'll multiply the powers of 10 together, adding the exponents when we do that.

$$\frac{2 \times 10^{1}}{0.2}$$

Now that we've somewhat simplified the numerator and denominator, we'll divide the decimal terms, and then separately divide the powers of 10.

$$\frac{2}{0.2} \times 10^{1}$$

$$10 \times 10^{1}$$

Now we have to put this answer into proper scientific notation. To change the 10 decimal term into proper scientific notation, we need to move the decimal point one place to the left.

$$1.0 \times 10^1$$

But because we made the decimal term smaller, we have to make the 10 term larger. We moved the decimal point one place, so we need to increase the exponent by 1.

$$1.0 \times 10^2$$

Drop the 0 from the decimal term since it's not a significant figure.

$$1 \times 10^2$$

Topic: Multiplying and dividing scientific notation

Question: Rewrite the expression in scientific notation.

$$\frac{\left(60 \times 10^{7}\right)\left(200 \times 10^{-2}\right)}{\left(1{,}000 \times 10^{-5}\right)}$$

Answer choices:

A 12×10^{11}

B 1.2×10^{-10}

C 1.2×10^{11}

D 1.2×10^{10}

Solution: C

We'll begin by doing the multiplication in the numerator, so we'll multiply the decimal numbers and the powers of 10 separately, remembering that we have to add the exponents.

$$\frac{\left(60 \times 10^7\right)\left(200 \times 10^{-2}\right)}{\left(1{,}000 \times 10^{-5}\right)}$$

$$\frac{\left(60 \times 200\right)\left(10^7 \times 10^{-2}\right)}{\left(1{,}000 \times 10^{-5}\right)}$$

$$\frac{12{,}000 \times 10^{7+(-2)}}{\left(1{,}000 \times 10^{-5}\right)}$$

$$\frac{12{,}000 \times 10^{7-2}}{\left(1{,}000 \times 10^{-5}\right)}$$

$$\frac{12{,}000 \times 10^{5}}{1{,}000 \times 10^{-5}}$$

The result we got for that multiplication $(12{,}000 \times 10^5)$ isn't in proper scientific notation, but we'll go ahead and do the division, and then at the end we'll make any adjustments that are needed to express the answer in proper scientific notation.

Dividing the decimal numbers, we get

$$12{,}000 \div 1{,}000 = 12$$

Dividing the powers of 10, remembering to subtract the exponents:

$$10^5 \div 10^{-5} = 10^{5-(-5)} = 10^{5+5} = 10^10$$

Multiplying the results of those two divisions, we get

$$12 \times 10^{10}$$

This still isn't in proper scientific notation, because there are two digits to the left of the place where the decimal point would be in 12. We first put a decimal point after the 12 (giving $12.$), and then we move the decimal point one place to the left, so the exponent will be 1.

$$12 = 1.2 \times 10^1$$

Now we'll multiply 1.2×10^1 by 10^{10}, adding the exponents.

$$(1.2 \times 10^1) \times 10^{10}$$

$$1.2 \times (10^1 \times 10^{10})$$

$$1.2 \times 10^{1+10}$$

$$1.2 \times 10^{11}$$

Topic: Multiplying and dividing scientific notation

Question: Rewrite the expression in scientific notation.

$$\frac{\left(2.7 \times 10^3\right)\left(3 \times 10^{-5}\right)}{\left(60 \times 10^{-2}\right)\left(20 \times 10^5\right)}$$

Answer choices:

A 10×5.2

B 8.1×10^{-2}

C 5.75×10^{-7}

D 6.75×10^{-8}

Solution: D

We'll first do the multiplication in the numerator and the multiplication in the denominator. In each of those multiplications, we'll multiply the decimal numbers and the powers of 10 separately, remembering that we have to add the exponents when we multiply powers of 10.

$$\frac{\left(2.7 \times 10^3\right)\left(3 \times 10^{-5}\right)}{\left(60 \times 10^{-2}\right)\left(20 \times 10^5\right)}$$

$$\frac{(2.7 \times 3)\left(10^3 \times 10^{-5}\right)}{\left(60 \times 20\right)\left(10^{-2} \times 10^5\right)}$$

$$\frac{8.1 \times 10^{3+(-5)}}{1{,}200 \times 10^{-2+5}}$$

$$\frac{8.1 \times 10^{3-5}}{1{,}200 \times 10^{-2+5}}$$

$$\frac{8.1 \times 10^{-2}}{1{,}200 \times 10^3}$$

The denominator isn't in proper scientific notation, because there are four digits to the left of the place where the decimal point would be in $1{,}200$. However, we'll go ahead and do the division, and wait until the end to make any adjustments that are needed to get the answer in proper scientific notation.

Our next step will be to divide the decimal numbers and the powers of 10 separately, remembering to subtract the exponents.

$$8.1 \div 1{,}200 = 0.00675$$

$$10^{-2} \div 10^{3} = 10^{-2-3} = 10^{-5}$$

Multiplying the results of those two divisions, we get

$$0.00675 \times 10^{-5}$$

This isn't in proper scientific notation, because the digit to the left of the decimal point in 0.00675 is 0, so now we'll convert 0.00675 to proper scientific notation.

In order to get exactly one nonzero digit to the left of the decimal point, we need to move the decimal point 3 places to the right, so the exponent will be -3.

$$0.00675 = 6.75 \times 10^{-3}$$

Finally, we'll multiply 6.75×10^{-3} by 10^{-5}, adding the exponents.

$$(6.75 \times 10^{-3}) \times 10^{-5}$$

$$6.75 \times (10^{-3} \times 10^{-5})$$

$$6.75 \times 10^{-3+(-5)}$$

$$6.75 \times 10^{-3-5}$$

$$6.75 \times 10^{-8}$$

Topic: Multiplying and dividing scientific notation

Question: Rewrite the expression in scientific notation.

$$\frac{\left(40{,}000 \times 10^{5}\right)\left(120 \times 10^{-20}\right)}{\left(0.003 \times 10^{-8}\right)(2{,}000)}$$

Answer choices:

A 80×10^{2}

B $(40 \times 20)\left(10^{2}\right)$

C 0.8×10^{-2}

D 8.0×10^{-2}

Solution: D

In the numerator and denominator, we'll multiply the decimal numbers together, and then separately multiply the powers of 10, remembering that we have to add the exponents.

$$\frac{(40{,}000 \times 10^5)(120 \times 10^{-20})}{(0.003 \times 10^{-8})(2{,}000)}$$

$$\frac{(40{,}000 \times 120)(10^5 \times 10^{-20})}{(0.003 \times 2{,}000)(10^{-8})}$$

$$\frac{4{,}800{,}000 \times 10^{5+(-20)}}{6 \times 10^{-8}}$$

$$\frac{4{,}800{,}000 \times 10^{5-20}}{6 \times 10^{-8}}$$

$$\frac{4{,}800{,}000 \times 10^{-15}}{6 \times 10^{-8}}$$

$$\frac{4{,}800{,}000}{6} \times \frac{10^{-15}}{10^{-8}}$$

$$800{,}000 \times 10^{-15-(-8)}$$

$$800{,}000 \times 10^{-15+8}$$

$$800{,}000 \times 10^{-7}$$

In order to write this in scientific notation, we have to express $800{,}000$ as only one digit in the ones (units) place, and one digit in the tenths place. We need to think of $800{,}000$ as $800{,}000.0$ in order to realize that we need to move the decimal five places to the left in order to get 8.0. So we'll change the expression to

$$8.0 \times 10^5 \times 10^{-7}$$

$$8.0 \times 10^{5+(-7)}$$

$$8.0 \times 10^{5-7}$$

$$8.0 \times 10^{-2}$$

Topic: Estimating with scientific notation

Question: Use scientific notation to estimate the value of the expression.

$$\frac{\left(51{,}685 \times 10^{4}\right)\left(3{,}295 \times 10^{-16}\right)}{519{,}000}$$

Answer choices:

A $\approx 3 \times 10^{10}$

B $\approx 3 \times 10^{-10}$

C ≈ 5

D $\approx 6 \times 10^{2}$

Solution: B

Since we're estimating, we'll begin by rounding each of the whole numbers to one significant figure.

$$\frac{\left(51{,}685 \times 10^4\right)\left(3{,}295 \times 10^{-16}\right)}{519{,}000}$$

$$\frac{\left(50{,}000 \times 10^4\right)\left(3{,}000 \times 10^{-16}\right)}{500{,}000}$$

Next, we'll express each of the whole numbers in proper scientific notation.

$$\frac{\left((5 \times 10^4) \times 10^4\right)\left((3 \times 10^3) \times 10^{-16}\right)}{5 \times 10^5}$$

Combine powers of 10 in the numerator.

$$\frac{\left(5 \times (10^4 \times 10^4)\right)\left(3 \times (10^3 \times 10^{-16})\right)}{5 \times 10^5}$$

$$\frac{\left(5 \times 10^{4+4}\right)\left(3 \times 10^{3+(-16)}\right)}{5 \times 10^5}$$

$$\frac{\left(5 \times 10^8\right)\left(3 \times 10^{3-16}\right)}{5 \times 10^5}$$

$$\frac{\left(5 \times 10^8\right)\left(3 \times 10^{-13}\right)}{5 \times 10^5}$$

If we separate the whole numbers from the powers of 10, we get

$$\frac{5 \times 3}{5} \times \frac{10^8 \times 10^{-13}}{10^5}$$

$$3 \times \frac{10^{8+(-13)}}{10^5}$$

$$3 \times \frac{10^{8-13}}{10^5}$$

$$3 \times \frac{10^{-5}}{10^5}$$

Applying the quotient rule for exponents to the powers of 10, we get

$$3 \times 10^{-5-5}$$

$$3 \times 10^{-10}$$

Topic: Estimating with scientific notation

Question: Use scientific notation to estimate the value of the expression.

$$\frac{0.00247 \times 10^{-14}}{421{,}091 \times 10^{6}}$$

Answer choices:

A $\approx 5 \times 10^{-29}$

B $\approx 5 \times 10^{30}$

C $\approx 4 \times 10^{-20}$

D $\approx 6 \times 10^{20}$

Solution: A

First, we'll express each of the decimal numbers in proper scientific notation.

$$\frac{0.00247 \times 10^{-14}}{421{,}091 \times 10^{6}}$$

$$\frac{(2.47 \times 10^{-3}) \times 10^{-14}}{(4.21091 \times 10^{5}) \times 10^{6}}$$

Next, we'll combine the powers of 10 in the numerator and denominator separately:

$$\frac{2.47 \times (10^{-3} \times 10^{-14})}{4.21091 \times (10^{5} \times 10^{6})}$$

$$\frac{2.47 \times 10^{-3+(-14)}}{4.21091 \times 10^{5+6}}$$

$$\frac{2.47 \times 10^{-3-14}}{4.21091 \times 10^{5+6}}$$

$$\frac{2.47 \times 10^{-17}}{4.21091 \times 10^{11}}$$

Now we'll round each of the decimal numbers to the nearest whole number.

$$\frac{2 \times 10^{-17}}{4 \times 10^{11}}$$

If we separate the whole numbers from the powers of 10, and apply the quotient rule for exponents to the powers of 10, we get

$$\frac{2}{4} \times \frac{10^{-17}}{10^{11}}$$

$$0.5 \times 10^{-17-11}$$

$$0.5 \times 10^{-28}$$

We still need to express this in proper scientific notation. To get just one digit to the left of the decimal point in 0.5, we need to move the decimal point one place to the right, so the exponent will be -1.

$$0.5 = 5 \times 10^{-1}$$

Now we'll multiply that by 10^{-28}.

$$(5 \times 10^{-1}) \times 10^{-28}$$

$$5 \times (10^{-1} \times 10^{-28})$$

$$5 \times 10^{-1+(-28)}$$

$$5 \times 10^{-1-28}$$

$$5 \times 10^{-29}$$

Topic: Estimating with scientific notation

Question: Use scientific notation to estimate the value of the expression.

$$\frac{\left(62{,}314 \times 10^{-20}\right)\left(0.000356 \times 10^{7}\right)}{\left(400{,}000 \times 10^{6}\right)\left(.000000821 \times 10^{-18}\right)}$$

Answer choices:

A 7.5

B 7.5×10^{2}

C 7.5×10^{20}

D 7.5×10^{200}

Solution: A

First, we'll put each of the decimal numbers in scientific notation.

$$\frac{\left(62{,}314 \times 10^{-20}\right)\left(0.000356 \times 10^{7}\right)}{\left(400{,}000 \times 10^{6}\right)\left(.000000821 \times 10^{-18}\right)}$$

$$\frac{\left(6.2314 \times 10^{4} \times 10^{-20}\right)\left(3.56 \times 10^{-4} \times 10^{7}\right)}{\left(4 \times 10^{5} \times 10^{6}\right)\left(8.21 \times 10^{-7} \times 10^{-18}\right)}$$

Since we're estimating, we'll round the decimals to the nearest whole number and combine the powers of 10.

$$\frac{\left(6 \times 10^{4+(-20)}\right)\left(4 \times 10^{-4+7}\right)}{\left(4 \times 10^{5+6}\right)\left(8 \times 10^{-7+(-18)}\right)}$$

$$\frac{\left(6 \times 10^{-16}\right)\left(4 \times 10^{3}\right)}{\left(4 \times 10^{11}\right)\left(8 \times 10^{-25}\right)}$$

If we separate the whole numbers from the powers of 10, and apply quotient rule for exponents to the powers of 10, we get

$$\frac{6 \cdot 4}{4 \cdot 8} \times \frac{10^{-16} \cdot 10^{3}}{10^{11} \cdot 10^{-25}}$$

$$\frac{24}{32} \times \frac{10^{-16+3}}{10^{11+(-25)}}$$

$$0.75 \times \frac{10^{-13}}{10^{-14}}$$

$$0.75 \times 10^{-13-(-14)}$$

$$0.75 \times 10^{-13+14}$$

$$0.75 \times 10^{1}$$

Change this answer into proper scientific notation, by moving the decimal point to the right one place, and decreasing the exponent by 1 in return.

$$7.5 \times 10^{0}$$

$$7.5 \times 1$$

$$7.5$$