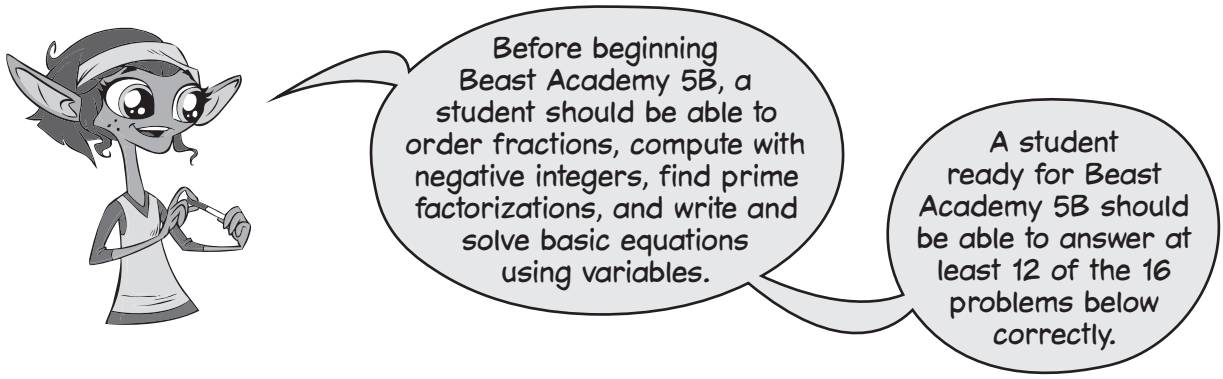
Are you ready for Beast Academy 5B?



Step 1. The student should try to answer every question without a calculator and without help.

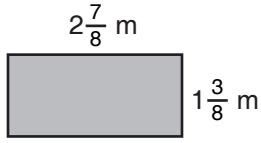
Step 2. Check the student's answers using the solutions at the end of this document.

Step 3. The student should be given a second chance on problems that he or she answered incorrectly.

1. Order the fractions below from least to greatest. **1.** _____

$$\frac{1}{5} \quad \frac{2}{11} \quad \frac{4}{3} \quad \frac{1}{4} \quad \frac{4}{7} \quad \frac{7}{6}$$

2. Compute the perimeter in meters of the rectangle below. **2.** _____



3. List all of the factors of 42 that are also multiples of 3. **3.** _____

4. What is the largest two-digit integer whose prime factorization includes exactly three 3's? **4.** _____

Evaluate each expression below.

5. $7+3(-6) =$ ____

6. $\dfrac{8-2}{-4+1} =$ ____

7. $-5+\dfrac{(-1)^{15}\cdot 3+15}{-2(-3)} =$ ____

8. Circle the expressions below that are equal to -25.

$$-5^2 \qquad (-5)^2 \qquad -(5^2) \qquad -(-5)^2 \qquad (-5^2) \qquad -(-5^2)$$

9. Evaluate $\dfrac{3ab-4}{-c}$ when $a = -4$, $b = 5$, and $c = -16$. **9.** _____

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Find the value of the variable in each equation below.

10. $\frac{3+n}{4}=9$

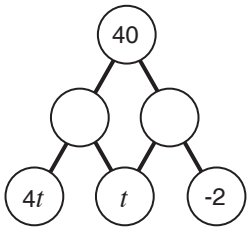
11. $47+36k=32k+95$

10. $n=$ _____

11. $k=$ _____

12. In the Circle Sum puzzle below, the number in each circle is the sum of the numbers in the connected circles below it. What is t?

12. $t=$ _____



13. The combined cost of a mop and a jumpsuit is 39 dollars. If the jumpsuit costs 3 dollars more than 5 times the cost of the mop, then how much does the jumpsuit cost?

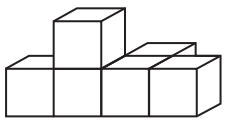
13. _____

14. A pyramid has exactly 12 edges. What is the shape of its base?

14. _____

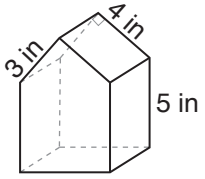
15. The solid below was created by attaching 6 unit cubes. What is the surface area of the solid?

15. _____



16. A triangular prism is attached to the top face of a cube as shown. What is the volume in cubic inches of the new solid?

16. _____



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Solutions

1. There are three fractions in the list that are less than $\frac{1}{2}$: $\frac{1}{5}$, $\frac{2}{11}$, and $\frac{1}{4}$. Since fifths are smaller than fourths, $\frac{1}{5}$ is less than $\frac{1}{4}$. Then, $\frac{2}{11}$ is less than $\frac{2}{10}=\frac{1}{5}$. So, $\frac{2}{11}$ is the smallest fraction in the list, followed by $\frac{1}{5}$, then by $\frac{1}{4}$.

Of the remaining fractions, $\frac{4}{7}$ is greater than $\frac{1}{2}$ but less than 1, while $\frac{4}{3}$ and $\frac{7}{6}$ are greater than 1. So, $\frac{4}{7}$ is the next fraction in the list.

We write the remaining two fractions as mixed numbers: $\frac{4}{3}=1\frac{1}{3}$ and $\frac{7}{6}=1\frac{1}{6}$. Since $\frac{1}{3}=\frac{2}{6}$ is greater than $\frac{1}{6}$, we see that $\frac{4}{3}$ is greater than $\frac{7}{6}$.

So, the list of fractions in order from least to greatest is $\mathbf{\frac{2}{11}, \frac{1}{5}, \frac{1}{4}, \frac{4}{7}, \frac{7}{6}, \frac{4}{3}}$.

2. The perimter of the rectangle is

$$\begin{aligned} 2\tfrac{7}{8}+1\tfrac{3}{8}+2\tfrac{7}{8}+1\tfrac{3}{8} &= (2+1+2+1)+\left(\tfrac{7}{8}+\tfrac{3}{8}+\tfrac{7}{8}+\tfrac{3}{8}\right) \\ &= 6+\tfrac{20}{8} \\ &= 6+2\tfrac{4}{8} \\ &= 8\tfrac{4}{8} \\ &= \mathbf{8\tfrac{1}{2}} \text{ meters.} \end{aligned}$$

3. The factors of 42 are 1, 2, 3, 6, 7, 14, 21, and 42. Of these factors, only **3, 6, 21, and 42** are also multiples of 3.

4. A number that has exactly three 3's in its prime factorization must be a multiple of $3^3=27$. The two-digit multiples of 27 are 27, 54, and 81 (the next multiple is 108, which has three digits).

Of these numbers, 81 is the largest. However, the prime factorization of 81 is 3^4, and we are told that the prime factorization of the number has *exactly* three 3's.

The next-largest number is 54, which has prime factorization $2 \cdot 3^3$. Therefore, the largest two-digit number with exactly three 3's in its prime factorization is **54**.

5. Following the order of operations, we compute the product 3(-6), then add 7 to the result:

$$\begin{aligned} 7+3(-6) &= 7+(-18) \\ &= \mathbf{-11}. \end{aligned}$$

6. Following the order of operations, we evaluate the numerator and denominator first, then divide:

$$\frac{8-2}{-4+1}=\frac{6}{-3}=\mathbf{-2}.$$

7. We first simplify the numerator and denominator of the fraction, then divide, then add.

In the numerator, $(-1)^{15}$ is the product of an odd number of -1's, so its result is negative: $(-1)^{15}=-1$. So, we have

$$\begin{aligned} -5+\frac{(-1)^{15}\cdot 3+15}{-2(-3)} &= -5+\frac{-1\cdot 3+15}{-2(-3)} \\ &= -5+\frac{-3+15}{6} \\ &= -5+\frac{12}{6} \\ &= -5+2 \\ &= \mathbf{-3}. \end{aligned}$$

8. We evaluate each expression:

$-5^2=-(5\cdot 5)=-25$.
$(-5)^2=(-5)\cdot(-5)=25$.
$-(5^2)=-(5\cdot 5)=-25$.
$-(-5)^2=-((-5)\cdot(-5))=-(25)=-25$.
$(-5^2)=(-(5\cdot 5))=-25$.
$-(-5^2)=-(-(5\cdot 5))=-(-25)=25$.

So, the four circled expressions are equal to -25.

(-5²) (-5)² (-(5²)) (-(-5)²) (-5²) -(-5²)

9. When $a=-4$, $b=5$, and $c=-16$, we have

$$\begin{aligned} \frac{3ab-4}{-c} &= \frac{3(-4)(5)-4}{-(-16)} \\ &= \frac{(-12)(5)-4}{16} \\ &= \frac{-60-4}{16} \\ &= \frac{-64}{16} \\ &= \mathbf{-4}. \end{aligned}$$

10. In this equation, we add 3 to n, then divide the result by 4 to get 9. To isolate n, we undo these steps in reverse order.

To undo dividing by 4, we multiply both sides of the equation by 4. Since $\frac{3+n}{4}\cdot 4$ simplifies to $3+n$, we have

$$\frac{3+n}{4}\cdot 4 = 9\cdot 4$$

$$3+n=36$$

Then, to undo adding 3, we subtract 3 from both sides of $3+n=36$, giving $n=\mathbf{33}$.

11. We first get all terms with k on one side of the equation. We can eliminate $32k$ from the right side of the equation by subtracting $32k$ from both sides.

$$\begin{array}{rcl} 47+36k & = & 32k+95 \\ -32k & & -32k \\ \hline 47+4k & = & 95 \end{array}$$

Then, subtracting 47 from both sides of $47+4k=95$ gives $4k=48$. Dividing both sides by 4, we have $k=\mathbf{12}$.

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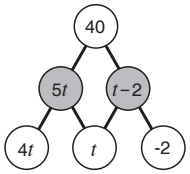
12. Each circle is labeled with the sum of the numbers below it. So, we label the left blank circle $4t+t=5t$ and the right blank circle $t+(-2)=t-2$.



Then, we use the top three circles to write an equation:

$$5t+(t-2)=40.$$

Combining like terms, the equation simplifies to

$$6t-2=40.$$

Adding 2 to both sides gives $6t=42$. Dividing both sides by 6, we have $t=$ **7**.

13. We let m represent the cost of a mop in dollars. Since a jumpsuit costs 3 dollars more than 5 times the cost of a mop, the jumpsuit costs $5m+3$ dollars.

The combined cost of a mop and a jumpsuit is 39 dollars. So, we can write an equation:

$$m+(5m+3)=39.$$

Combining like terms, the equation simplifies to

$$6m+3=39.$$

Subtracting 3 from both sides gives $6m=36$. Dividing both sides by 6, we have $m=6$.

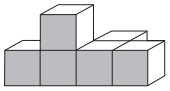
Since m represents the cost of a mop, the mop costs 6 dollars. Since 39 dollars is the cost of the mop and the jumpsuit, the jumpsuit costs $39-6=$ **33** dollars.

14. If there are n edges on the base of the pyramid, then there are n edges that connect the base to the apex, which give us a total of $n+n=2n$ edges.

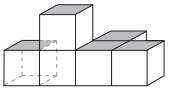
The number of edges is two times the number of sides on its base, so a pyramid with exactly 12 edges has a base with $12\div2=6$ sides. A 6-sided polygon is a **hexagon**.

15. We can count the number of visible faces on the outside of the solid from each of the six views.

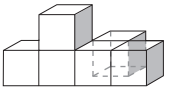
Front: 5 faces



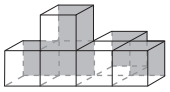
Top: 5 faces



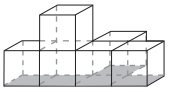
Right: 3 faces



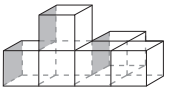
Back: 5 faces



Bottom: 5 faces



Left: 3 faces

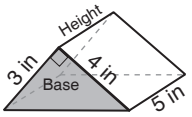


Each face on each small cube is a unit square with area 1. So, the total surface area of the solid is $5+5+3+5+5+3=$ **26 square units**.

16. The volume of the new solid is the sum of the volumes of the cube and the triangular prism.

A cube with side length 5 in has volume $5\cdot5\cdot5=125$ cubic inches.

To compute the volume of the triangular prism, we multiply the area of its base by its height. The area of the base is $\frac{3\cdot4}{2}=6$ square inches. The height of the prism is 5 inches. So, the volume of the triangular prism is $6\cdot5=30$ cubic inches.



Therefore, the total volume of the solid is $125+30=$ **155 cubic inches**.