Warm-Up

Grade 5 NS 1.2
What is 50% of 40?

A 2000
B 200
C 20
D 2

• Use three approaches to find the answer.

Grade 6 NS 1.4
What is 60% of 30?

A 1.8
B 18
C 180
D 1800

• How might a student obtain each of the answers?

Review: Grade 3 AF 1.1
Mark is buying a jacket that regularly costs $55. If he receives a $10 discount, what is the final sale price of the jacket?

• Explain the meaning of the word discount.

• What does sale price mean?

Other:
Fill in the missing percentages.

100%

? ?

? ?

? ?

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Using Bar Models to Solve Percent Word Problems

Bar models can be used to provide an alternative way to visualize percent problems that involve discount, sale price, and markup. Bar models help students build upon their prior understanding of percentages and apply that knowledge to solving word problems.

Today’s Objective: Using bar models to solve percent problems involving discount, sale price, and markup.

Standards: Grade 6 NS 1.4 and Grade 7 NS 1.7

Example 1: Problem involving discount

The price of a new pair of shoes is $40. If there is a 20% discount on all shoes, how much is deducted from the original price?

Bar Model

| $40 is 100% |
| --- | --- |
| $8 | $8 | $8 | $8 | $8 |

20% 20% 20% 20% 20%

discount (20% = $8)

\[ \therefore \text{ } 8 \text{ is deducted from } 40 \text{ (the discount)} \]

Method 2

(Proportions)

What is 20% of $40?

\[ \frac{x}{40} = \frac{20}{100} \]
\[ x = \frac{20}{10} \]
\[ x = 2 \times \frac{4}{4} \]
\[ x = \frac{8}{40} \]
\[ x = 8 \]

\[ \therefore \text{ } 8 \text{ is deducted from } 40 \text{ (the discount)} \]

Method 3

(Direct Translation)

What is 20% of $40?

\[ x = 20\% \times 40 \]
\[ x = 0.20 \times 40 \]
\[ x = 8 \]

\[ \therefore \text{ } 8 \text{ is deducted from } 40 \text{ (the discount)} \]
Your Turn 1: Problem involving discount

A jacket originally costs $70. Wilasha bought it yesterday at 30% off. How much was her discount?
Your Turn 1: Problem involving discount (solution)

A jacket originally costs $70. Wilasha bought it yesterday at 30% off. How much was her discount?

Bar Model

**Bar Model 1**

$70 is 100%

\[\begin{array}{cccccccc}
\$7 & \$7 & \$7 & \$7 & \$7 & \$7 & \$7 & \$7 \\
10\% & 10\% & 10\% & 10\% & 10\% & 10\% & 10\% & 10\% \\
\end{array}\]

discount (30% = $21)

**Bar Model 2**

$70 is 100%

\[\begin{array}{cccccccc}
7 & 14 & 21 & 28 & 35 & 42 & 49 & 56 \\
10\% & 20\% & 30\% & 40\% & 50\% & 60\% & 70\% & 80\% \\
\end{array}\]

discount (30% = $21)

Method 2

(Proportions)

What is 30% of $70?

\[
x = \frac{30}{100} \times 70
\]

\[
x = \frac{3}{70} \times 10
\]

\[
x = \frac{3 \times 7}{10} \times 10
\]

\[
x = \frac{21}{70} \times 10
\]

\[
x = 21
\]

$21 is 30% of $70

\[
\therefore \text{her discount was } \$21
\]

Method 3

(Direct Translation)

What is 30% of $70?

\[
x = 0.30 \times 70
\]

\[
x = 21
\]

$21 is 30% of $70

\[
\therefore \text{her discount was } \$21
\]
Example 2: Problem involving discount and sale price

The price of a new pair of shoes is $40. If there is a 20% discount on all shoes, what is the final sale price?

**Bar Model**

<table>
<thead>
<tr>
<th>$40 is 100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>$8</td>
</tr>
<tr>
<td>$8</td>
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<tr>
<td>$8</td>
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<td>$8</td>
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<tr>
<td>$8</td>
</tr>
</tbody>
</table>

20% 20% 20% 20% 20%

discount
(20% = $8)

sale price
(80% = $32)

20% of $40 is $8 (discount)
80% of $40 is $32 (sale price)

\[ \therefore \text{the final price is }$32 \]

<table>
<thead>
<tr>
<th>Method 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method 3</td>
</tr>
</tbody>
</table>

**Method 2** (Proportions)

What is 20% of $40?

\[
\begin{align*}
0% & \quad \text{0}\% \\
20% & \quad \text{x} \\
\hline
100% & \quad \text{$40} \\
\end{align*}
\]

\[
x = \frac{20}{100} \\
x = \frac{2}{10} \\
x = \frac{2 \cdot 4}{10 \cdot 4} \\
x = \frac{8}{40} \\
x = \frac{1}{5} \\
\]

20% of $40 is $8 (discount)

original price  discount

$40 \quad \text{–} \quad $8 = $32

sale price

\[ \therefore \text{the final price is }$32 \]

**Method 3** (Direct Translation)

What is 20% of $40?

\[
\begin{align*}
0% & \quad \text{0}\% \\
20% & \quad \text{x} \\
\hline
100% & \quad \text{$40} \\
\end{align*}
\]

\[
x = \frac{20 \cdot 40}{100} \\
x = \frac{2}{10} \cdot 40 \\
x = \frac{5 \cdot 8}{5} \\
x = 8 \\
\]

20% of $40 is $8

\[ \therefore \text{the final price is }$32 \]

\[ \therefore \text{the final price is }$32 \]
Your Turn 2a: Problem involving discount and sale price

An e-book reader regularly sells for $220. It is on sale for 75% off. What is the sale price of the reader?
Your Turn 2a: Problem involving discount and sale price (solution)

An e-book reader regularly sells for $220. It is on sale for 75% off. What is the sale price of the reader?

**Bar Model**

$220 is 100%  
25%  25%  25%  25%  
$55  $55  $55  $55  
discount (75% = $165) sale price (25% = $55)

What is 75% of $220?

\[
x = \frac{75}{100} \times 220 = 165
\]

\[
x = 0.75 \times 220 = 165
\]

\[
220 - 165 = 55
\]

∴ the sale price is $55

**Method 2** (Proportions)

What is 75% of $220?

\[
x = \frac{75}{100} \times 220 = 165
\]

\[
x = 0.75 \times 220 = 165
\]

\[
220 - 165 = 55
\]

∴ the sale price is $55

**Method 3** (Direct Translation)

What is 75% of $220?

\[
x = 75\% \times 220
\]

\[
x = 0.75 \times 220
\]

\[
x = 165
\]

75% of $220 is $165

\[
220 - 165 = 55
\]

∴ the sale price is $55

75% of $220 is $165 (discount)

25% of $220 is $55 (sale price)

∴ the sale price is $55
Your Turn 2b: Problem involving discount and sale price

A pair of noise-canceling headphones regularly sells for $116. They are on sale for 75% off. What is the sale price of the headphones?

Bar Model

Method 2
(Proportions)

Method 3
(Direct Translation)
Your Turn 2b: Problem involving discount and sale price (solution)

A pair of noise-canceling headphones regularly sells for $116. They are on sale for 75% off. What is the sale price of the headphones?

**Method 2**

(Proportions)

What is 75% of $116?

\[
\frac{x}{116} = \frac{75}{100}
\]

\[
x = \frac{3}{4} 
\]

\[
4 \cdot x = 3 \cdot 116
\]

\[
x = 87
\]

75% of $116 is $87 (discount)

25% of $116 is $29 (sale price)

\[
\therefore \text{the sale price is}\$29
\]

**Method 3**

(Direct Translation)

What is 75% of $116?

\[
x = 0.75 \cdot 116
\]

\[
x = 87
\]

75% of $116 is $87

\[
$116 - $87 = $29
\]

\[
\therefore \text{the sale price is}\$29
\]
Example 3a: Problem involving multiple discounts

Jorge bought a watch on sale for 50% off the original price and another 50% off the discounted price. If the watch originally costs $70, what was the final sale price that Jorge paid for the watch?

Bar Model

<table>
<thead>
<tr>
<th>$70 is 100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
</tr>
<tr>
<td>50%</td>
</tr>
<tr>
<td>$35</td>
</tr>
<tr>
<td>1st discount (50% = $35)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1st discounted price</th>
</tr>
</thead>
<tbody>
<tr>
<td>(50% = $35)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$35</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1st discounted price)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
</tr>
<tr>
<td>$17.50</td>
</tr>
<tr>
<td>2nd discount (50% = $17.50)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$17.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>(50% = $17.50)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Final price</th>
</tr>
</thead>
<tbody>
<tr>
<td>(50% = $17.50)</td>
</tr>
</tbody>
</table>

∴ the final sale price is $17.50

Method 2

(Direct Translation)

What is 50% of $70?

\[ x = \frac{50}{100} \cdot 70 \]

\[ x = \frac{1}{2} \cdot 70 \]

\[ x = \frac{2 \cdot 35}{2} \]

\[ x = 35 \]

50% of $70 is $35 (1st discount)

$70 – $35 = $35 (1st discounted price)

What is 50% of $35?

\[ x = \frac{50}{100} \cdot 35 \]

\[ x = \frac{1}{2} \cdot 35 \]

\[ x = \frac{35}{2} \]

\[ x = 17.5 \]

50% of $35 is $17.50 (2nd discount)

$35 – $17.50 = $17.50

(final sale price)

∴ the final sale price is $17.50
Example 3b: Problem involving multiple discounts

Jorge bought a watch on sale for 25% off the original price and another 75% off the discounted price. If the watch originally costs $64, what was the final sale price that Jorge paid for the watch?

**Bar Model**

<table>
<thead>
<tr>
<th>25%</th>
<th>25%</th>
<th>25%</th>
<th>25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>$16</td>
<td>$16</td>
<td>$16</td>
<td>$16</td>
</tr>
</tbody>
</table>

1st discount (25% = $16)  1st discounted price (75% = $48)

$64 is 100%

1st discounted price (75% = $48)

<table>
<thead>
<tr>
<th>25%</th>
<th>25%</th>
<th>25%</th>
<th>25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>$12</td>
<td>$12</td>
<td>$12</td>
<td>$12</td>
</tr>
</tbody>
</table>

2nd discount (75% = $36)  final price (25% = $12)

∴ the final sale price is $12

**Method 2**

(Direct Translation)

What is 25% of $64?

\[ x = \frac{25}{100} \cdot 64 \]

\[ x = \frac{1}{4} \cdot 64 \]

\[ x = \frac{4 \cdot 16}{4} \]

\[ x = 16 \]

25% of $64 is $16 (1st discount)

$64 – $16 = $48 (1st discounted price)

What is 75% of $48?

\[ x = \frac{75}{100} \cdot 48 \]

\[ x = \frac{3}{4} \cdot 48 \]

\[ x = \frac{3 \cdot 4 \cdot 12}{4} \]

\[ x = 36 \]

75% of $48 is $36 (2nd discount)

$48 – $36 = $12 (final sale price)

∴ the final sale price is $12
Your Turn 3: Problem involving multiple discounts

Antonia is buying a space heater that regularly costs $90. It is on sale for 40% off with an additional 25% off the discounted price. What is the final sale price of the heater?
Your Turn 3: Problem involving multiple discounts (solution)

Antonia is buying a space heater that regularly costs $90. It is on sale for 40% off with an additional 25% off the discounted price. What is the final sale price of the heater?

**Method 2**
(Direct Translation)

What is 40% of $90?

\[ x = 40\% \cdot 90 \]

\[ x = 0.40 \cdot 90 \]

\[ x = 36 \]

40% of $90 is $36 (1st discount)

\[ $90 - $36 = $54 \] (1st discounted price)

What is 25% of $54?

\[ x = 25\% \cdot 54 \]

\[ x = 0.25 \cdot 54 \]

\[ x = 13.50 \]

25% of $54 is $13.50 (2nd discount)

\[ $54 - $13.50 = $40.50 \] (final sale price)

\[ \therefore \] the final sale price is $40.50
Example 4: Problem involving markup

A few years ago, a skate shop originally sold a skateboard for $96. Today the same skateboard is sold with a markup of 25%. How much does the skateboard cost today?

### Bar Model

<table>
<thead>
<tr>
<th>$96 is 100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>25% 25% 25% 25%</td>
</tr>
<tr>
<td>$24 $24 $24 $24</td>
</tr>
</tbody>
</table>

**markup (25% = $24)**

### Method 2 (Proportions)

What is 25% of $96?

```
0 0%

x 25%

$96 100%
```

\[
x \cdot \frac{25}{100} = 24
\]

\[
x = \frac{24 \cdot 1}{4}
\]

\[
x = 6 \times 4 = 24
\]

$24 is 25% of $96 (markup)

\[
$96 + $24 = $120
\]

\[
\therefore \text{the cost is $120}
\]
Your Turn 4: Problem involving markup

An amusement park recently increased its family season pass by 22%. If the original price of the pass was $150, what is the cost of the pass after markup?

Bar Model

Method 2
Your Turn 4: Problem involving markup (solution)

An amusement park recently increased its family season pass by 22%. If the original price of the pass was $150, what is the cost of the season pass after markup?

**Method 2**
(Direct Translation)

What is 22% of $150?

\[ x = 22\% \cdot $150 \]
\[ x = 0.22 \cdot 150 \]
\[ x = 33 \]

\$33 is 22% of $150 (markup)

\$150 + $33 = $183

∴ the cost is $183

---

**Bar Model**

- $150 is 100%
- $30 is 20%
- Markup: $33 (22% of $150)
- Selling price: $183

$33 is 22% of $150 (markup)

original price  markup  selling price

\$150 + $33 = $183

∴ the cost is $183
Extension 1: Problem involving discount and tax

Saydi is buying a pair of jeans that regularly cost $60. They are on sale for 40% off. If the tax rate is 9%, what is the sale price of the jeans including tax?

**Bar Model**

**Method 2**
(Direct Translation)
Extension 1: Problem involving discount and tax (solution)

Saydi is buying a pair of jeans that regularly cost $60. They are on sale for 40% off. If the tax rate is 9%, what is the sale price of the jeans including tax?

**Bar Model**

```
<table>
<thead>
<tr>
<th></th>
<th>$60 is 100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>$12</td>
</tr>
<tr>
<td>discount</td>
<td>40% = $24</td>
</tr>
<tr>
<td>$60 - $24</td>
<td>$36</td>
</tr>
<tr>
<td>sale price</td>
<td>60% = $36</td>
</tr>
</tbody>
</table>

$36 is (sale price)
```

```
<table>
<thead>
<tr>
<th>$36</th>
</tr>
</thead>
<tbody>
<tr>
<td>9%</td>
</tr>
<tr>
<td>$3.24</td>
</tr>
</tbody>
</table>
``` 

```
<table>
<thead>
<tr>
<th>$36</th>
</tr>
</thead>
<tbody>
<tr>
<td>$36 + $3.24 = $39.24 (sale price including tax)</td>
</tr>
</tbody>
</table>
``` 

**Method 2**
(Direct Translation)

What is 40% of $60?

\[
x = 40\% \cdot 60\]

\[
x = 0.40 \cdot 60\]

\[
x = 24\]

40% of $60 is $24 (discount)

\[
$60 - $24 = $36 \text{ (sale price)}
\]

What is 9% of $36?

\[
x = 9\% \cdot 36\]

\[
x = 0.09 \cdot 36\]

\[
x = 3.24\]

9% of 36 is 3.24 (tax)

\[
$36 + $3.24 = $39.24 \text{ (sale price including tax)}
\]

∴ the sale price including tax is $39.24