Lesson 5

Strategy Focus
Work Backward

MATH FOCUS: Operations with Positive and Negative Numbers

Learn

Read the Problem

Dr. Winn is using a remotely operated underwater vehicle (ROV) to explore a shipwreck. The ROV begins the day at a certain depth below sea level. It moves up 800 meters and then down 1,200 meters. Finally it moves up 200 meters. The ROV stops 2,000 meters below sea level. How far below sea level was the ROV when the day began?

Reread Ask yourself questions as you read the problem.

- What is the problem about?

_____

- What kind of information is given?

_____

- What does the problem ask you to find?

_____

Mark the Text

Search for Information

Read the problem again. Circle the distances the ROV moves and underline the directions in which it travels.

Record Use the information you marked to fill in the blanks. Use + and − to show the direction of each ROV move.

First move: + _____ meters

Second move: − _____ meters

Third move: + _____ meters

The ROV stops at − _____ meters.

The problem tells you about the end and asks you about the beginning. You can use this information to choose a problem-solving strategy.

Decide What to Do

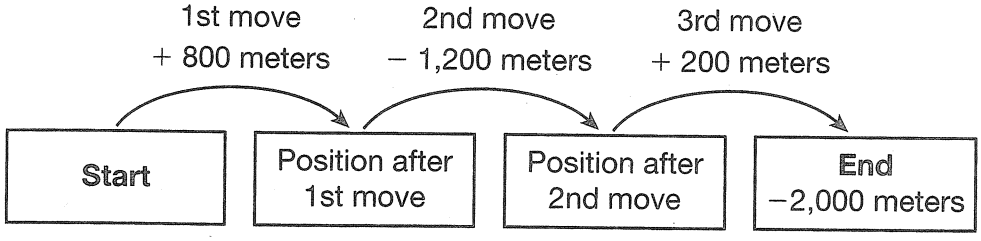
You know that the ROV starts somewhere below the surface. You know the directions and distances it moves. You also know the depth at which it stops.

Ask How can I find how far below sea level the ROV is when the day begins?

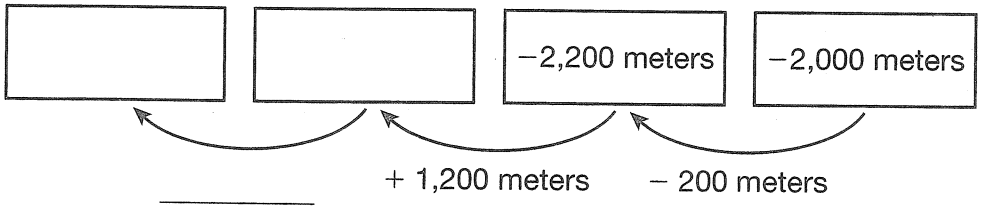
- I can use the strategy *Work Backward.*
- I can begin with the depth at which the ROV stops, then reverse the steps to find the depth at which it starts.

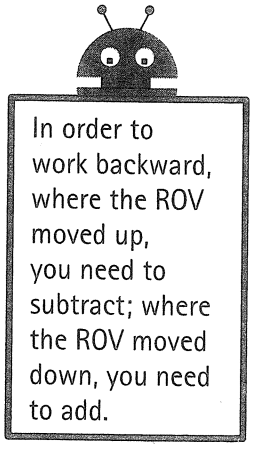
Use Your Ideas

Step 1 Draw a diagram that shows each move the ROV makes. Include a start and an end.



Step 2 Begin at the ending depth and work backward to find the missing information. Use 0 to represent sea level. Then use negative numbers to represent distances below sea level.





So the ROV started the day at _____ meters below sea level.

Review Your Work

Work the problem forward to check your answer.

Describe How did working backward help you solve the problem?

_____

_____

Try

Solve the problem.

1 The city of Tower holds the record for lowest recorded temperature in Minnesota. It was −60°F on February 2, 1996. The table shows the daily low temperatures for some days in February in a different year. The mean daily low temperature for those 5 days was −8°F. What was the low temperature on Tuesday?

Monday	Tuesday	Wednesday	Thursday	Friday
−20°F		−18°F	−7°F	15°F

Read the Problem and Search for Information

Restate what the table shows in your own words.

Decide What to Do and Use Your Ideas

You can use the strategy *Work Backward* to find Tuesday's temperature.

Ask Yourself

How can I use the mean to find the unknown temperature?

Step 1 $\text{mean} = \dfrac{\text{sum of low temperatures}}{\text{number of low temperatures}}$

Work backward to find Tuesday's low temperature. You know the mean is −8°F.

$$-8 = \frac{\text{sum of low temperatures}}{5}$$

$5 \times -8 =$ sum of low temperatures

_____ = sum of low temperatures

Step 2 Add the temperatures you know.

$(-20) + (-18) + (-7) + 15 =$ _____

$-40 =$ _____ + Tuesday's temperature

$-40 + 30 =$ Tuesday's temperature

$-10 =$ Tuesday's temperature

So the low temperature on Tuesday was _____ °F.

Review Your Work

To check your work, find the mean of the 5 temperatures.

Identify What information is given that is not needed?

_____

_____

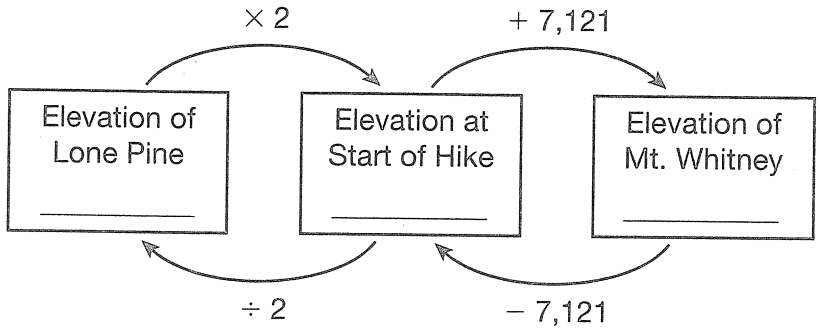
Apply

Solve the problems.

2 The Chungi family wants to hike to the peak of Mt. Whitney, which is 14,505 feet above sea level. They leave the city of Lone Pine and drive to a point which is at twice the elevation of Lone Pine. Then they hike a vertical distance of 7,121 feet to the top of Mt. Whitney. What is the elevation of Lone Pine?

Ask Yourself

What does *twice the elevation* mean?



Hint Remember when you work backward, start at the end and use the inverse of each operation.

Answer _____

Generalize When working backward, why do you use inverse operations?

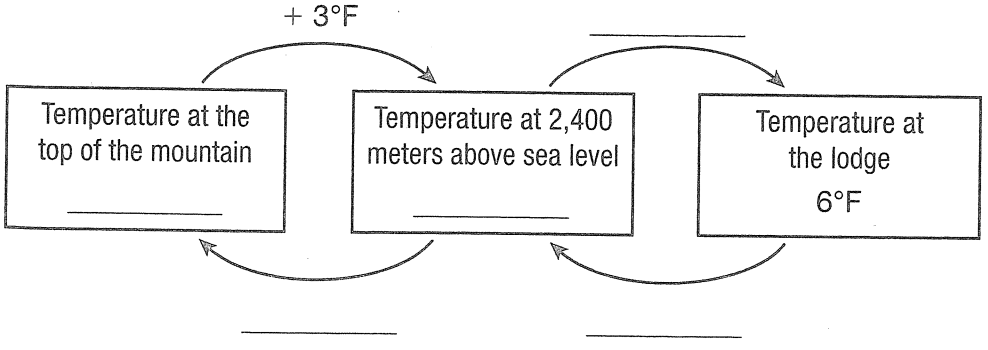
_____

_____

Ask Yourself

Are there numbers in the problem that I do *not* need to use?

3 The top of a mountain is 2,700 meters above sea level. At 2,400 meters above sea level, it is 3°F warmer than at the top of the mountain. It is another 5°F warmer at a ski lodge's elevation. If it is 6°F at the ski lodge, how warm is it at the top of the mountain?



Hint Start with the temperature you know.

Answer _____

Explain How did you use the diagram to solve the problem?

_____

_____

Ask Yourself

If I know the mean and 5 out of the 6 temperatures, how can I find the missing temperature?

4 In Prospect Creek, Alaska, the average low temperature for 6 months in 2007 was 17.5°F. The table shows the monthly average low temperatures for 5 of those 6 months. What was the average low temperature for July?

July	Aug.	Sep.	Oct.	Nov.	Dec.
	45°F	34°F	−13°F	−2°F	−9°F

(sum of temperatures) ÷ (number of temperatures) = mean temperature

Hint Undo the division first.

_____ × 17.5 = _____

Answer _____

Compare How is this problem like Problem 1? How is it different?

_____

_____

5 The Ramirez family visited Lima, Peru, which is about 430 meters above sea level. Then they went to Machu Picchu, Peru, which is about 2,430 meters above sea level. It was 55°F at Machu Picchu. If the temperature decreases 1°F for every 100-meter increase in elevation, what was the temperature in Lima?

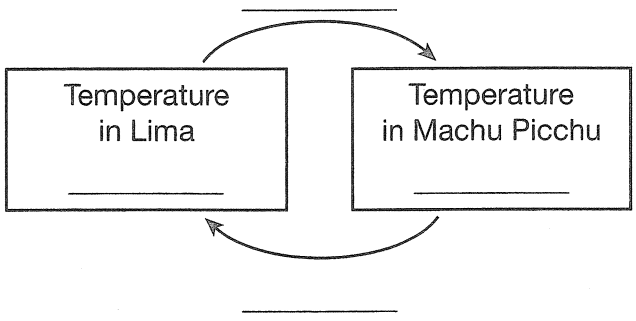
The difference in elevation between Lima and Machu Picchu is _____ meters.

Hint Find the number of 100-meter intervals in 2,000 meters.

Over a 2,000 meter increase in elevation, the temperature will decrease _____ °F.

Ask Yourself

Will the temperature be higher in Machu Picchu than in Lima, or lower?



Answer _____

Analyze Nolan says that the temperature in Lima was 35°F. What mistake could Nolan have made?

_____

_____

Practice

Solve the problems. Show your work.

6 Amarillo, Texas can have extreme changes in temperature over the course of a day. On March 8, 2002, the average (mean) of the high and low temperatures was 52°F. The high temperature was 77°F. What was the low temperature?

Answer _____

Extend What is another question you could ask about the problem?

_____

_____

7 An operator on board a ship uses a joystick to control a remotely operated underwater vehicle (ROV). The ROV begins the day at a certain depth below sea level. The operator moves the ROV up 200 yards and then down 1,000 yards. She then moves it up 400 yards. The operator stops the ROV at 2,500 yards below sea level. How far below sea level was it when the day began?

Answer _____

Design How can you use a drawing to model the problem? Show with a drawing.

Create

Look back at the Learn problem. Change two or more distances or directions of the movements of the ROV. Write and solve a new problem that can be solved by working backward.