

## Age-related algebra Problem

Anne, Barbara, and Cindy are three sisters who were born in different years. Cindy is 5 years younger than Barbara, and Anne is 8 years older than Cindy. Anne is now  $a$  years old.

It is a wonderful age. . . .

Using  $a$  as a variable, write algebraic expressions describing each part of problems 1 and 2. Simplify if possible.

1. (a) Cindy's age now
- (b) Barbara's age now
- (c) The sum of Barbara's and Cindy's ages now
- (d) The sum of Barbara's and Cindy's ages in three years
- (e) The sum of Barbara's and Cindy's ages  $k$  years from now
- (f) The sum of Barbara's and Cindy's ages  $k$  years ago
2. (a) The difference between Barbara's and Cindy's ages now
- (b) The difference between Barbara's and Cindy's ages two years ago
- (c) The difference between Barbara and Cindy's ages two years from now
- (d) The difference between Barbara's and Cindy's ages  $k$  years from now
3. Write the verbal description (or several) for the algebraic expressions below. For instance:  $(a - 3)$  means "Alice's age three years ago" or "Cindy's age in five years."
  - (a)  $3a$
  - (b)  $3a - 11$
  - (c)  $2a - 9$
  - (d)  $a(a - 3) + (a + 3)$

Read each problem carefully: the words can be tricky!

Assume that both sisters had been born at the time.

Both had been born already!

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## Hints

There are no hints for this problem sequence.

## Answers

1. (a)  $a - 8$   
(b)  $a - 3$   
(c)  $2a - 11$   
(d)  $2a - 5$   
(e)  $2a + 9$   
(f)  $2a - 11 + 2k$   
(g)  $2a - 11 - 2k$
2. (a) 5  
(b) 5  
(c) 5  
(d) 5
3. See solutions.

## Solutions

1. (a) Since Cindy is 8 years younger than Anne (who is age  $a$ ), Cindy's age is  $a - 8$ .
- (b) Since Barbara is 5 years older than Cindy (who is age  $a - 8$ ), Barbara's age is  $(a - 8) + 5$ , or  $a - 3$ . Other way to think of this is to realize if Barbara is 5 years older than Cindy and Anne is 8 years older than Cindy, then Anne is 3 years older than Barbara.
- (c) Adding the results from parts (a) and (b) gives  $a - 8 + a - 3$ , which is  $2a - 11$ .
- (d) In three years, Cindy will be age  $a - 8 + 3$ , which is  $a - 5$ . Barbara will be age  $a - 3 + 3$ , which is  $a$ . The sum of their ages will be  $a - 5 + a$ , which is  $2a - 5$ .
- (e) In  $k$  years Barbara and Cindy will be  $a - 3 + k$  and  $a - 8 + k$ , so the sum of their ages is  $a - 3 + k + a - 8 + k$ , which is  $2a - 11 + 2k$ .
- (f) Barbara and Cindy were  $a - 3 - k$  and  $a - 8 - k$ ,  $k$  years ago. The sum of their ages then was  $a - 3 - k + a - 8 - k$ , which is  $2a - 11 - 2k$ .

2. Barbara's older, so subtract Cindy's age from Barbara's in each case. These could all be done by remembering that Barbara is 5 years older than Cindy. The difference between their ages will always be 5. This can also be found by subtracting algebraic expressions, as shown below.

- (a) The difference now is  $(a - 3) - (a - 8)$ . Simplify:

$$(a - 3) - (a - 8) = a - 3 - a + 8 = 5$$

- (b) The difference two years ago was  $(a - 3 - 2) - (a - 8 - 2)$ . Simplify:

$$(a - 3 - 2) - (a - 8 - 2) = a - 3 - 2 - a + 8 + 2 = 5$$

- (c) The difference two years from now will be  $(a - 3 - 2) - (a - 8 - 2)$ .

$$(a - 3 + 2) - (a - 8 + 2) = a - 3 + 2 - a + 8 - 2 = 5$$

- (d) The difference  $k$  years from now will be  $(a - 3 + k) - (a - 8 + k)$ .

$$(a - 3 + k) - (a - 8 + k) = a - 3 + k - a + 8 - k = 5$$

3. There are many possible answers; examples are given.

- (a) Anne's age tripled, Anne's age  $2a$  years from now, Barbara's age  $2a + 3$  years from now
- (b) The sum of the ages of all three sisters now
- (c) The sum of Barbara's and Cindy's ages a year from now
- (d) The product of Anne's and Barbara's ages now plus Anne's age three years from now