SAT Math Level 1
Percent Increase and Decrease

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Choose correct answer(s) from the given choices

(1) If a rhombus is re-shaped such that one of its diagonal increases by 4%, while other diagonal decreases by 4%. Find the percentage change in the area of rhombus.

a. 1.6% increase | **b.** 0.16% increase
c. 16% decrease | **d.** 0.16% decrease

(2) The salary of a doctor is increased by 25%. By what percent should the new salary be reduced to restore the original salary?

a. 20% | **b.** 25%
c. 30% | **d.** 17%

(3) If the price of cooking gas increases by 24%, by what percent should a family decrease its consumption of cooking gas, so that their expenditure on cooking gas remains same as earlier.

a. $17\frac{11}{31}\%$ | **b.** $18\frac{11}{31}\%$
c. $20\frac{11}{31}\%$ | **d.** $19\frac{11}{31}\%$

(4) Find the percentage increase in the area of a triangle if each side is increased by x times.

a. $100x^2\%$ | **b.** $200x^2\%$
c. $100(x^2+1)\%$ | **d.** $100(x^2-1)\%$

(5) Find the percentage increase in the area of a triangle if each side is increased to 4 times.

a. 1600% | **b.** 1500%
c. 1300% | **d.** 1400%

(6) The salary of a worker is increased by 30%. By what percent should the new salary be reduced to restore the original salary?

a. 20.08% | **b.** 33.08%
c. 23.08% | **d.** 28.08%

(7) If the price of milk increases by 20%, by what percent should a family decrease its consumption of milk, so that their expenditure on milk remains same as earlier.

a. $14\frac{2}{3}\%$ | **b.** $17\frac{2}{3}\%$
c. $16\frac{2}{3}\%$ | **d.** $15\frac{2}{3}\%$

Fill in the blanks

(8) If the length of a rectangle is increased by 10% and the width is decreased by 30%, its area decreases by

_____ %.

(9) If the length of a rectangle is increased by 20% and the width is decreased by 40%, its area decreases by

_____ %.

(10) If the length of a rectangle is increased by 10% and the width is decreased by 10%, its area decreases by

_____ %.

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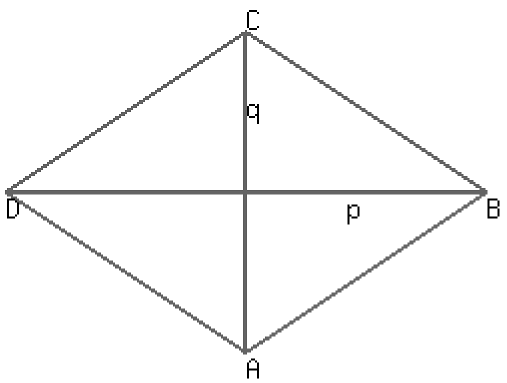
(1) **d.** 0.16% decrease

Step 1



Let's assume the length of the diagonals BD and AC of the rhombus ABCD are **p** and **q** respectively.

Step 2

The area of the rhombus = $\frac{pq}{2}$

Step 3

According to the question, one of its diagonal increases by 4%, while other diagonal decreases by 4%.

The new length of the diagonal BD = $p + p \times \frac{4}{100} = p + 0.04p = (1 + 0.04)p$

Step 4

The new length of the diagonal AC = $q - q \times \frac{4}{100} = q - 0.04q = (1 - 0.04)q$

Step 5

Now, the area of the rhombus = $\dfrac{(1 + 0.04)p \times (1 - 0.04)q}{2}$

= $\dfrac{(1^2 - 0.04^2)pq}{2}$ **...[Since, $(a + b)(a - b) = a^2 - b^2$]**

= $\dfrac{pq - 0.0016pq}{2}$

Step 6

Change in area = New area of the rhombus - The area of the rhombus

= $\dfrac{pq - 0.0016pq}{2} - \dfrac{pq}{2}$

= $\dfrac{pq - 0.0016pq - pq}{2}$

= $\dfrac{-0.0016pq}{2}$

Step 7

% Change in area = $\dfrac{\text{Change in area}}{\text{The area of the rhombus}} \times 100$

= $\dfrac{\frac{-0.0016pq}{2}}{\frac{pq}{2}} \times 100$

= -0.16%

Step 8

Thus, the area of the rhombus is decreased by 0.16%.

(2) **a.** 20%

Step 1

Let the original salary be $\$100$.

Increase in salary = 25%

Salary after increase = $\$(100 + 25)$= $\$125$

Step 2

Now, to restore the original salary, reduction = $\$(125 - 100) = \$25$

Reduction$\%$ = $\left(\frac{25}{125} \times 100\right)\%$ = 20%

Hence, the required reduction on new salary is 20%.

(3) **d.** $19\frac{11}{31}\%$

Step 1

Let us assume that the price of cooking gas is *x* and the consumption of cooking gas by the family is *y*.
So, the expenditure on cooking gas = xy -----(1)

Step 2

According to the question, the price of cooking gas increases by 24%.

The new price of cooking gas = x + (x × $\frac{24}{100}$)

= x + $\frac{6x}{25}$

= $\frac{31x}{25}$

Step 3

Let us assume that the new consumption of cooking gas is *z*.

Step 4

The expenditure on cooking gas = $\frac{31x}{25}$ × z = $\frac{31xz}{25}$

⇒ $\frac{31xz}{25}$ = xy ...(Since, the expenditure on cooking gas remains the same)

⇒ $\frac{31z}{25}$ = y

$\Rightarrow z = \dfrac{25y}{31}$

Step 5

Decrease in the consumption of cooking gas by the family = y - z

$= y - \dfrac{25y}{31}$

$= \dfrac{6y}{31}$

Step 6

% decrease in consumption = $\dfrac{6y/31}{y} \times 100$

$= \dfrac{600}{31}$

$= 19\dfrac{11}{31}$ %

Step 7

Thus, option **d** is the correct answer.

(4) **d.** $100(x^2-1)\%$

Step 1

Consider a $\triangle QRS$ with sides a, b and c. Let $S = \dfrac{a+b+c}{2}$.
Area of $\triangle QRS, A_1 = \sqrt{S(S-a)(S-b)(S-c)}$

Step 2

Increasing the side of each side by x times, we get a new $\triangle XYZ$.
$\triangle XYZ$ has sides xa, xb and xc.

Step 3

By Heron's formula:
Area of new triangle $= \sqrt{S_1(S_1-xa)(S_1-xb)(S_1-xc)}$
Where, $S_1 = \dfrac{xa+xb+xc}{2} = x \times \dfrac{a+b+c}{2}$

$$\begin{aligned} \text{Area of } \triangle XYZ &= \sqrt{xS(xS-xa)(xS-xb)(xS-xc)} \\ &= \sqrt{x^4 S(S-a)(S-b)(S-c))} \\ &= x^2 \times A_1 \end{aligned}$$

Step 4

Increase in area $= x^2 A_1 - A_1$

$\%$ Increase in area $= \dfrac{A_1(x^2-1)}{\dfrac{A_1}{100}} = 100(x^2-1)\%$.

(5) **b.** 1500%

Step 1

Consider a triangle QRS with sides a, b and c.
Let $S = \dfrac{a+b+c}{2}$
Area of triangle $QRS, A_1 = \sqrt{S(S-a)(S-b)(S-c)}$

Step 2

Increasing the side of each side by 4 times, we get a new triangle XYZ.
XYZ has sides $4a, 4b$ and $4c$.
By Heron's formula,
Area of new triangle $= \sqrt{S_1(S_1-4a)(S_1-4b)(S_1-4c)}$
Where $S_1 = \dfrac{4a+4b+4c}{2} = 4 \times \dfrac{a+b+c}{2}$
Area of $XYZ = \sqrt{4S(4S-4a)(4S-4b)(4S-4c)}$

$$= \sqrt{4^4 S(S-a)(S-b)(S-c)}$$
$$= 4^2 \times A_1$$
$$= 16A_1$$

Step 3

Percentage increase in the area of the triangle,

$$= \frac{\text{Area of Triangle XYZ } - \text{ Area of Triangle QRS}}{\text{Area of Triangle QRS}} \times 100$$
$$= \frac{16A_1 - A_1}{A_1} \times 100$$
$$= \frac{15A_1}{A_1} \times 100$$
$$= 1500$$

Step 4

This means the area of the triangle, A_1 is increased by 1500%.

(6) **c.** 23.08%

Step 1

Let the original salary be $\$100$.

Increase in salary = 30%

Salary after increase = $\$(100 + 30)$= $\$130$

Step 2

Now, to restore the original salary, reduction = $\$(130 - 100) = \$30$

Reduction$\%$ = $\left(\frac{30}{130} \times 100\right)\%$ = 23.08%

Hence, the required reduction on new salary is 23.08%.

(7) **c.** $16\frac{2}{3}\%$

Step 1

Let us assume that the price of milk is *x* and the consumption of milk by the family is *y*.
So, the expenditure on milk = xy -----(1)

Step 2

According to the question, the price of milk increases by 20%.

The new price of milk = $x + (x \times \frac{20}{100})$

$= x + \frac{1x}{5}$

$= \frac{6x}{5}$

Step 3

Let us assume that the new consumption of milk is *z*.

Step 4

The expenditure on milk = $\frac{6x}{5} \times z = \frac{6xz}{5}$

$\Rightarrow \frac{6xz}{5} = xy$ ...(Since, the expenditure on milk remains the same)

$\Rightarrow \frac{6z}{5} = y$

$\Rightarrow z = \dfrac{5y}{6}$

Step 5

Decrease in the consumption of milk by the family = y - z

$= y - \dfrac{5y}{6}$

$= \dfrac{y}{6}$

Step 6

% decrease in consumption = $\dfrac{y/6}{y} \times 100$

$= \dfrac{100}{6}$

$= 16\dfrac{2}{3}\ \%$

Step 7

Thus, option **c** is the correct answer.

(8) 23

Step 1

Let us assume that the length and the width of the rectangle are l and w, respectively. So, the area of the rectangle = lw

Step 2

According to the question, the length of the rectangle is increased by 10%.

New length of the rectangle = $l + \dfrac{l \times 10}{100} = l + \dfrac{l}{10} = \dfrac{11l}{10}$

Step 3

Width of the rectangle is decreased by 30%.

New width of the rectangle = $w - \dfrac{w \times 30}{100} = w - \dfrac{3w}{10} = \dfrac{7w}{10}$

Step 4

Now, the area of the rectangle = $\dfrac{11l}{10} \times \dfrac{7w}{10} = \dfrac{77lw}{100}$

Step 5

Change in the area = New area of the rectangle - Previously given area of the rectangle

$= \dfrac{77lw}{100} - lw$

$= \dfrac{77lw - 100lw}{100}$

$= \dfrac{-23lw}{100}$

Step 6

% change in area = $\dfrac{\text{Change in the area}}{\text{The area of the rectangle}} \times 100$

$= \dfrac{\dfrac{-23lw}{100}}{lw} \times 100$

$= \dfrac{-23lw}{100lw} \times 100$

= -23%

Step 7

Thus, the area of the rectangle is decreased by **23%**.

(9) 28

Step 1

Let us assume that the length and the width of the rectangle are l and w, respectively. So, the area of the rectangle = lw

Step 2

According to the question, the length of the rectangle is increased by 20%.

New length of the rectangle = $l + \frac{l \times 20}{100} = l + \frac{2l}{10} = \frac{12l}{10}$

Step 3

Width of the rectangle is decreased by 40%.

New width of the rectangle = $w - \frac{w \times 40}{100} = w - \frac{4w}{10} = \frac{6w}{10}$

Step 4

Now, the area of the rectangle = $\frac{12l}{10} \times \frac{6w}{10} = \frac{72lw}{100}$

Step 5

Change in the area = New area of the rectangle - Previously given area of the rectangle

$= \frac{72lw}{100} - lw$

$= \frac{72lw - 100lw}{100}$

$= \frac{-28lw}{100}$

Step 6

% change in area = $\frac{\text{Change in the area}}{\text{The area of the rectangle}} \times 100$

$= \frac{\frac{-28lw}{100}}{lw} \times 100$

$= \frac{-28lw}{100lw} \times 100$

= -28%

Step 7

Thus, the area of the rectangle is decreased by **28%**.

(10) 1

Step 1

Let us assume that the length and the width of the rectangle are l and w, respectively. So, the area of the rectangle = lw

Step 2

According to the question, the length of the rectangle is increased by 10%.

New length of the rectangle = $l + \frac{l \times 10}{100} = l + \frac{l}{10} = \frac{11l}{10}$

Step 3

Width of the rectangle is decreased by 10%.

New width of the rectangle = $w - \frac{w \times 10}{100} = w - \frac{w}{10} = \frac{9w}{10}$

Step 4

Now, the area of the rectangle = $\frac{11l}{10} \times \frac{9w}{10} = \frac{99lw}{100}$

Step 5

Change in the area = New area of the rectangle - Previously given area of the rectangle

$= \frac{99lw}{100} - lw$

$= \frac{99lw - 100lw}{100}$

$= \frac{-1lw}{100}$

Step 6

% change in area = $\frac{\text{Change in the area}}{\text{The area of the rectangle}} \times 100$

$= \frac{\frac{-1lw}{100}}{lw} \times 100$

$= \frac{-1lw}{100lw} \times 100$

= -1%

Step 7

Thus, the area of the rectangle is decreased by **1%**.