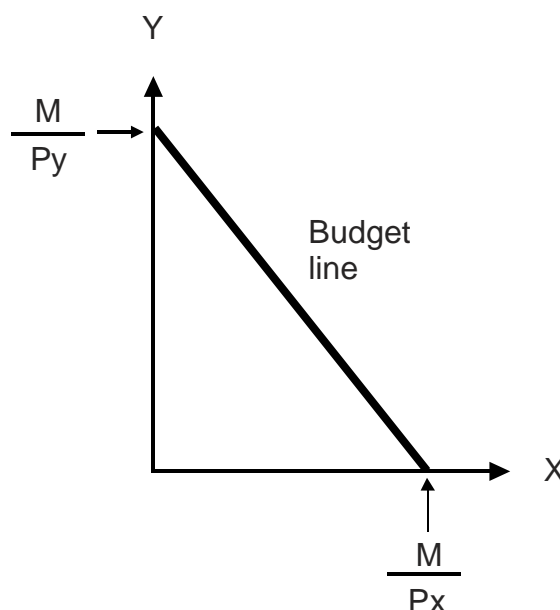


# Microeconomics and mathematics (with answers)

## 4 Budget line (Budget constraint)

**4.1** A consumer has a budget  $M$ .  $M$  is spent completely on buying good  $X$  and good  $Y$ . The price of  $X$  is  $P_x$  and the price of  $Y$   $P_y$ . Hence, the equation of the budget line is:  $M = P_x X + P_y Y$ . The graph of the budget line looks as follows:



4.11 Transform  $M = P_x X + P_y Y$  into  $Y = \dots$

4.12 What do the intercepts mean in view of spending  $M$ ?

4.13 Which slope has the budget line?

**4.2** A consumer has an income of 240 which is spent completely on buying goods  $X$  and  $Y$ .  $P_x = 20$ ,  $P_y = 30$

4.21 Determine the budget line ( $M = \dots$ ).

4.22 Which slope has the budget line?

4.23 Graph the budget line.

**4.3** Income = 300 (completely spent on buying  $X$  and  $Y$ ).  $P_x = 20$ ,  $P_y = 30$

4.31 What happens to the budget line if the income is increased to 360?

4.32 Graph the initial and the new budget line in the same diagram.

4.33 What happens to the slope of the budget line if the income is increased to 360?

**4.4** Income = 360 (completely spent on buying  $X$  and  $Y$ ).  $P_x = 30$ ,  $P_y = 40$

4.41 What happens to the budget line if  $P_x$  rises to 40.

4.42 Graph the initial and the new budget line in the same diagram.

4.43 Calculate the slope of the initial and of the new budget line.

<b>4.5</b>	<p>The following events happen simultaneously:</p> <ul style="list-style-type: none"><li>• the income (completely spent on buying X and Y) falls from 400 to 360;</li><li>• the price of X falls from 20 to 18, the price of Y remains unchanged at 40.</li></ul> <p>Calculate the slope of the initial and of the new budget line.</p>
<b>4.6</b>	<p>Sentence: A <b>halving</b> of the prices good A and good B has the same effect on the budget line as <b>doubling</b> the income.</p> <p>4.61 Is this sentence true or false? Show it by using the equation of the budget line (<math>M = \dots</math>).</p> <p>4.62 What about the opposite? <b>Doubling</b> the prices good A and good B has the same effect on the budget line as <b>halving</b> of the income.</p>

→ [Answers. Click here!](#)

# Answers *Microeconomics* and mathematics

## 4 Budget line (budget constraint)

4.1

$$\begin{aligned}4.11 \quad M &= P_x X + P_y Y \\ - P_y Y &= P_x X - M \\ P_y Y &= M - P_x X \\ Y &= \frac{M}{P_y} - \frac{P_x}{P_y} X\end{aligned}$$

4.12 Intercept  $\frac{M}{P_y}$  (or  $\frac{M}{P_x}$ ) means that **M is spent completely** on Y (or X).

$$4.13 \quad Y = \frac{M}{P_y} - \frac{P_x}{P_y} X \rightarrow \text{slope} = - \frac{P_x}{P_y}$$

or alternatively according to the graph in the question 4.1:

$$\text{slope} = \frac{- \frac{M}{P_y}}{\frac{M}{P_x}} = - \frac{P_x}{P_y}$$

4.2

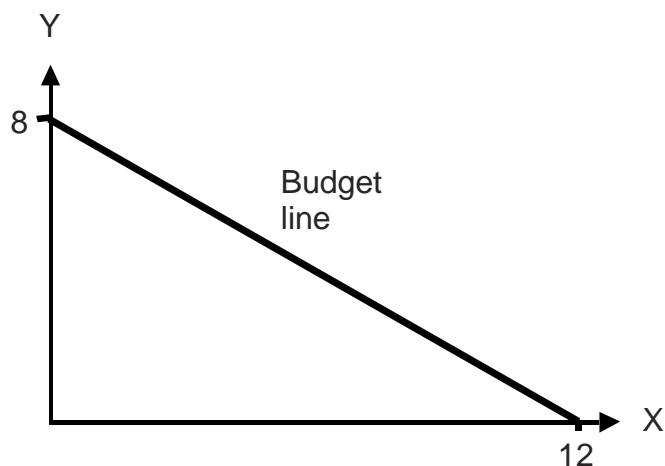
4.21 **Budget line:**  $240 = 20X + 30Y$

$$\begin{aligned}4.22 \quad - 30Y &= 20X - 240 \\ 30Y &= 240 - 20X \\ Y &= 8 - \frac{2}{3}X\end{aligned}$$

$$\text{slope} = - \frac{2}{3}$$

or alternatively:  $\text{slope} = - \frac{P_x}{P_y} = - \frac{2}{3}$

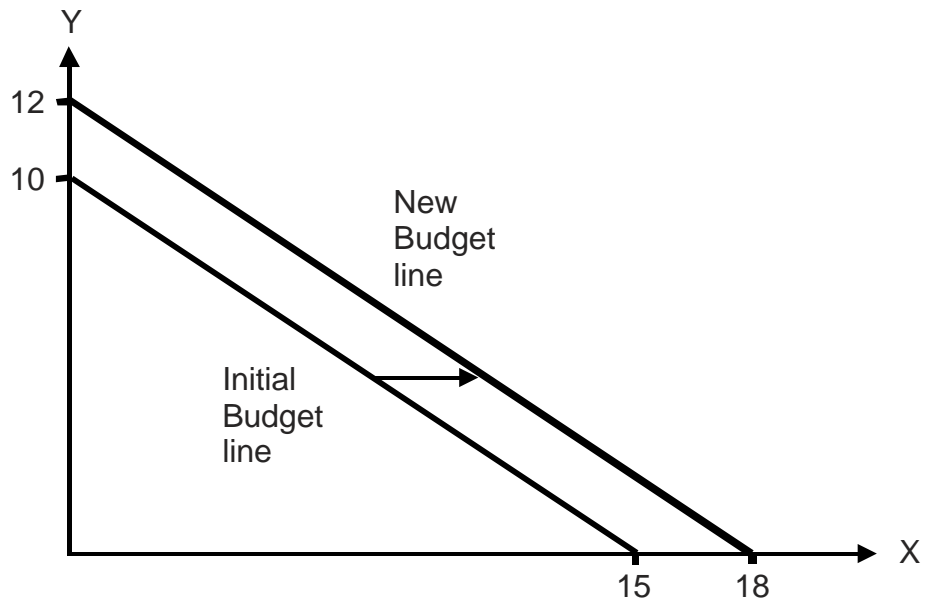
4.23



**4.3**

4.31 The budget line **moves to the right**; the new budget line is **parallel** to the initial one.

4.32



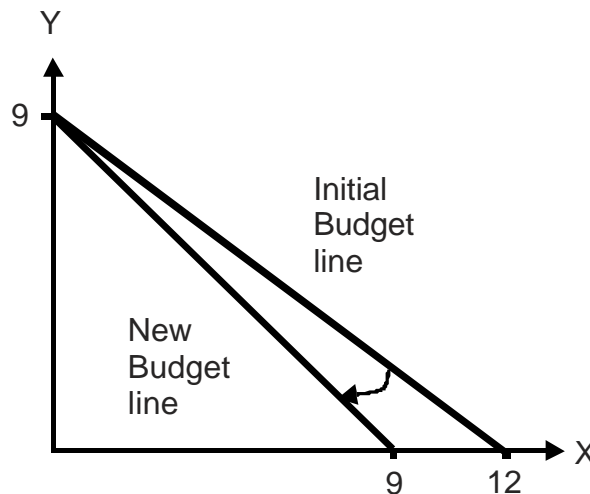
4.33 The **slope** of the budget line **remains the same**:

- Slope initial budget line  $= -\frac{10}{15} = -\frac{2}{3}$
- Slope new budget line  $= -\frac{12}{18} = -\frac{2}{3}$

**4.4**

4.41 If  $P_x$  rises to 40, the **budget line pivots to the left**.

4.42



- 4.43
- Slope of the **initial** budget line:  $-\frac{9}{12} = -\frac{3}{4}$
  - Slope of the **new** budget line:  $-\frac{9}{9} = -1$

The same slopes can be calculated by using  $(-\frac{P_x}{P_y})$ .

<b>4.5</b>	<p><b>Slopes</b> → <math>(-\frac{P_x}{P_y})</math>:</p> <ul style="list-style-type: none"> <li>• <b>Initial</b> budget line:  <math display="block">-\frac{20}{40} = -\frac{1}{2}</math></li> <li>• <b>New</b> budget line:  <math display="block">-\frac{18}{40} = -\frac{9}{20}</math></li> </ul>
<b>4.6</b>	<p>4.61 Initial budget line: <math>M = P_xX + P_yY</math>  New budget line:</p> <ul style="list-style-type: none"> <li>• Halving of the prices: <math>M = \frac{P_xX + P_yY}{2}</math> (Multiplying by 2)  <math>2M = P_xX + P_yY</math></li> <li>• Doubling the income: <math>2M = P_xX + P_yY</math></li> </ul> <p>Result: Halving of the prices and doubling the income result in the same budget line. <b>Sentence is true.</b></p> <p>4.62 Initial budget line: <math>M = P_xX + P_yY</math>  New budget line:</p> <ul style="list-style-type: none"> <li>• Doubling the prices: <math>M = 2(P_xX + P_yY)</math> (Dividing by 2)  <math>\frac{M}{2} = P_xX + P_yY</math></li> <li>• Halving of the income: <math>\frac{M}{2} = P_xX + P_yY</math></li> </ul> <p>Result: Doubling the prices and halving of the income result in the same budget line. <b>Sentence is true, too.</b></p>

→ Back to questions. Click here!