

## 2. Języki i gramatyki – odpowiedzi

2.1.

$$\begin{aligned} S &\rightarrow A \mid B \mid C \\ A &\rightarrow ab \mid aaaA \\ B &\rightarrow bbc \mid bbbB \\ C &\rightarrow ccca \mid cccC \end{aligned}$$

2.2.

$$\begin{aligned} S &\rightarrow A \mid B \\ A &\rightarrow a \mid ab \mid abA \\ B &\rightarrow b \mid ba \mid baB \end{aligned}$$

2.3.

$$\begin{aligned} S &\rightarrow aA \\ A &\rightarrow bB \mid \varepsilon \\ B &\rightarrow cC \mid \varepsilon \\ C &\rightarrow aA \mid \varepsilon \\ &\text{lub:} \\ S &\rightarrow a \mid ab \mid abc \mid abcS \end{aligned}$$

2.4.

$$\begin{aligned} S &\rightarrow abb \mid abbA \\ A &\rightarrow aab \mid aabS \end{aligned}$$

2.5.

$$\begin{aligned} S &\rightarrow aAa \\ A &\rightarrow bAcc \mid bBcc \\ B &\rightarrow cB \mid c \end{aligned}$$

2.6.

$$\begin{aligned} S &\rightarrow AB \\ A &\rightarrow aAb \mid ab \\ B &\rightarrow bBa \mid ba \end{aligned}$$

2.7.

$$\begin{aligned} S &\rightarrow bAa \\ A &\rightarrow aaAc \mid aaBc \\ B &\rightarrow aB \mid a \end{aligned}$$

2.8.

$$\begin{aligned} S &\rightarrow bAc \\ A &\rightarrow aAa \mid aBa \\ B &\rightarrow Ba \mid ba \end{aligned}$$

2.9.

$$\begin{aligned} S &\rightarrow bAb \\ A &\rightarrow aAa \mid aBa \\ B &\rightarrow cBa \mid ca \end{aligned}$$

**2.10.** (uwaga: zapis  $x \in \{a, b\}^+$  oznacza słowa niepuste)

$$S \rightarrow aA \mid Aa \mid ab \mid ba$$

$$A \rightarrow bS \mid Sb$$

lub

$$S \rightarrow SS \mid aSb \mid bSa \mid ab \mid ba$$

**2.11.**

$$S \rightarrow aa \mid AaA \mid AaBaA$$

$$A \rightarrow a \mid b$$

$$B \rightarrow aB \mid bB \mid \varepsilon$$

**2.12.**

$$S \rightarrow AaaAbbbA \mid AbbbAaaA$$

$$A \rightarrow aA \mid bA \mid \varepsilon$$

**2.13.**

$$S \rightarrow bAb$$

$$A \rightarrow aAb \mid acb$$

**2.14.**

$$S \rightarrow aS \mid aSb \mid \varepsilon$$

**2.15.**

$$S \rightarrow aabbS \mid \varepsilon$$

**2.16.**

$$S \rightarrow aaaS \mid aaa$$

**2.17.**

$$S \rightarrow aSa \mid bSb \mid \varepsilon$$

**2.18.**

$$S \rightarrow aA \mid bB \mid \varepsilon$$

$$A \rightarrow aS \mid bC$$

$$B \rightarrow aC \mid bS$$

$$C \rightarrow aB \mid bA$$

**2.19.**

$$S \rightarrow abS \mid baS \mid \varepsilon$$

**2.20.**

$$S \rightarrow aSb \mid c$$

**2.21.**

$$S \rightarrow AB$$

$$S \rightarrow aAb \mid \varepsilon$$

$$S \rightarrow aB \mid a$$

2.22.

$S \rightarrow aSa \mid aBa$   
 $B \rightarrow bB \mid \varepsilon$

2.23.

$S \rightarrow SS \mid (S) \mid \varepsilon$

2.24.

$S \rightarrow aA \mid a$   
 $A \rightarrow baA \mid aA \mid ba \mid a$

2.25.

$S \rightarrow aS \mid bS \mid \varepsilon$

2.26.

$S \rightarrow \varepsilon$

2.27.

$S \rightarrow a \mid b \mid ab \mid ba \mid \varepsilon$

2.28.

$S \rightarrow A0A0A$   
 $A \rightarrow 0A \mid 1A \mid \varepsilon$

2.29.

$S \rightarrow A00A$   
 $A \rightarrow 0A \mid 1A \mid \varepsilon$

2.30.

$S \rightarrow A10 \mid A11$   
 $A \rightarrow 0A \mid 1A \mid \varepsilon$

2.31.

$S \rightarrow 01A \mid 11A$   
 $A \rightarrow 0A \mid 1A \mid \varepsilon$

2.32.

$S \rightarrow ABC$   
 $A \rightarrow aAb \mid ab$   
 $B \rightarrow bBa \mid ba$   
 $C \rightarrow aCb \mid ab$

2.33.

$S \rightarrow aSb \mid aAb$   
 $A \rightarrow bAa \mid bBa$   
 $B \rightarrow aBb \mid ab$

2.34.

$S \rightarrow AC$

$A \rightarrow aAb \mid aBb$

$B \rightarrow bBa \mid ba$

$C \rightarrow aCb \mid ab$

**2.35.**

$S \rightarrow aAb$

$A \rightarrow aA \mid bA \mid \varepsilon$

lub

$S \rightarrow aA$

$A \rightarrow aA \mid bA \mid b$