

# SCIENCE CROSSWORD PUZZLES WITH ANSWERS FOR CLASS 7

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### Science Crossword Puzzles with Answers for Class 7

Crossword puzzles are an engaging and fun way for students to learn and reinforce science concepts. Here is a crossword puzzle with questions and answers tailored for Class 7 students:

#### Across

1. The force that pulls objects towards each other (**Gravity**)
2. The smallest unit of living matter (**Cell**)
3. The process by which plants convert sunlight into energy (**Photosynthesis**)

**Down** 2. The layer of gases that surrounds the Earth (**Atmosphere**) 3. The name given to the process of sound transmission (**Sound waves**) 4. The force that opposes the motion of an object (**Friction**) 5. The process by which animals take in food and convert it into energy (**Digestion**)

#### Answers

##### Across

1. Gravity
2. Cell
3. Photosynthesis

**Down** 2. Atmosphere 3. Sound waves 4. Friction 5. Digestion

**Question 1:**

**Prove that if  $L$  is a regular language, then  $L$  is accepted by a DFA with at most  $|L|$  states.**

**Answer:**

Construct a DFA with states  $q_0, q_1, \dots, q_{|L|}$ , where  $q_0$  is the start state. For each string  $w$  in  $L$ , create a transition from  $q_0$  to  $q_w$ . For each string  $w$  not in  $L$ , create a transition from  $q_0$  to a sink state. This DFA accepts  $L$  and has exactly  $|L|$  states.

**Question 2:**

**Show that the language  $L = \{a^m b^n \mid m > n\}$  is not regular.**

**Answer:**

Assume that  $L$  is regular. Then, it is accepted by a DFA with a finite number of states. Let  $k$  be the number of states. Choose  $m = 2k$  and  $n = k+1$ . Then, the string  $a^m b^n$  is in  $L$ , but it requires  $k+1$  transitions to accept. This contradicts the fact that the DFA has only  $k$  states.

**Question 3:**

**Prove that the pumping lemma for regular languages implies that the language  $L = \{a^n b^n \mid n \geq 1\}$  is not regular.**

**Answer:**

Use the pumping lemma to decompose a string  $ab^n$  into  $xyz$  such that  $|xy| \leq k$  and  $|y| > 0$ . If  $|y|$  is odd, then the string  $xy^2z$  is in  $L$  but not in the language pumped from the prefix  $xy$ . If  $|y|$  is even, then the string  $xyz$  is in  $L$  but not in the language pumped from the prefix  $xy$ .

**Question 4:**

**Show that the language  $L = \{w \mid w \text{ is the binary representation of a prime number}\}$  is not context-free.**

**Answer:**

Suppose that  $L$  is context-free and let  $G$  be a CFG that generates it. Let  $n$  be the integer represented by the shortest string in  $L$ . Then, the language  $L_n = \{w \mid w \text{ is the binary representation of a prime number less than or equal to } n\}$  is also context-free and generated by some grammar  $G'$ . But  $L_n$  is not context-free, since it cannot be generated by a grammar with a finite number of productions.

**Question 5:**

**Prove that the language  $L = \{a^n b^n c^n \mid n \geq 1\}$  is not decidable.**

**Answer:**

Assume that  $L$  is decidable and let  $M$  be a TM that decides it. Construct a TM  $N$  that simulates  $M$  on all inputs of the form  $a^n b^n c^n$ . If  $M$  accepts, then  $N$  loops forever. If  $M$  rejects, then  $N$  halts after  $2n$  steps. If  $M$  halts with no output, then  $N$  loops forever. This contradicts the fact that  $N$  is a TM and implies that  $L$  is not decidable.

**Thermodynamics Questions and Answers for Mechanical Engineering****1. What is the first law of thermodynamics?**

The first law of thermodynamics states that energy cannot be created or destroyed, only transferred or transformed. In other words, the total energy of an isolated system remains constant.

**2. What is the second law of thermodynamics?**

The second law of thermodynamics states that the entropy of an isolated system never decreases. Entropy is a measure of disorder or randomness. This law implies that systems tend to become more disordered over time.

**3. What is a thermodynamic system?**

A thermodynamic system is any region of space that is isolated for the purpose of analysis. The system interacts with its surroundings through the exchange of energy and matter.

#### **4. What is a thermodynamic process?**

A thermodynamic process is a change in the state of a system. Processes can be classified as isothermal (constant temperature), adiabatic (no heat transfer), isobaric (constant pressure), or isochoric (constant volume).

#### **5. What is the Carnot cycle?**

The Carnot cycle is a theoretical thermodynamic cycle that describes the most efficient way to convert heat into work. The cycle consists of two isothermal and two adiabatic processes.

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