Newton School of Technology

2025-2026

CNSAT Interview Toolkit

SECTION 1

Learnibility

Topic: Subtopic (concept)	Distance and Speed
Question Details/Question Stem	A person rides a scooter from Home to School, a distance of 30 kilometers. He travels the first 12 kilometers at a speed of 15 km/h. After that, he increases his speed to 20 km/h for the remaining trip. How long does it take the person to reach School? If the person had travelled the entire 30 kilometres at a constant speed of 18 km/h, how much time would he have saved compared to his actual trip with two different speeds?
Explanation	1. Total Distance: 30 kilometers 2. First Segment: 12 kilometers at 15 km/h 3. Second Segment: Remaining distance at 20 km/h Calculate Time for the First Segment To find the time taken for the first 12 kilometers: $\text{Time} = \frac{\text{Distance}}{\text{Speed}}$ $= \frac{12\text{km}}{15\text{km/h}}$ $= 0.8\,\text{hours}$ Converting hours to minutes: 0.8 hours×60 minutes/hour=48 minutes Calculate Distance for the Second Segment Now, calculate the remaining distance after the first segment: Remaining Distance=30 km−12 km=18 km Calculate Time for the Second Segment Now, find the time taken for the remaining 18 kilometers at 20 km/h: $\text{Time} = \frac{18\text{km}}{20\text{km/h}}$ $= 0.9\,\text{hours}$

	Converting hours to minutes: 0.9 hours×60 minutes/hour=54 minutes Total Time Add the times for both segments: Total Time=48 minutes+54 minutes=102 minutes The total time is 102 minutes. Calculate Time for the Entire Trip at Constant Speed of 18 km/h If the person travelled the entire 30 kilometers at a constant speed of 18 km/h: $\text{Time}_{\text{constant}} = \frac{30\text{km}}{18\text{km/h}} \approx 1.6667\text{hours} \approx 100\text{minutes}$ Calculate Time Saved Now, we find the difference between the actual time and the time at constant speed: $\text{Time Saved} = \text{Total Time} - \text{Time}_{\text{constant}} = 102\text{minutes} - 100\text{minutes} = 2\text{minutes}$ **It takes 102 minutes to reach the school. The t**ime saved by traveling at constant speed of 18 km/h is **2 minutes.**

Topic: Subtopic (concept)	Permutation
Question Details/Question Stem	A restaurant has 5 different types of desserts: cake, pie, ice cream, pudding, and tart. The chef wants to showcase them on a dessert cart.

	How many different ways can the chef arrange all 5 types of desserts on the cart? If the chef decides to arrange cake and pie together and arrange pudding and tart together then How many different ways can the chef arrange all 5 types of desserts?
Explanation	Types of Desserts: 5 types (cake, pie, ice cream, pudding, tart) Arranging All 5 Types of Desserts To find the number of ways to arrange all 5 types of desserts, we use the permutations formula: $n! = n \times (n-1) \times (n-2) \times \ldots \times 1$ For 5 types of desserts: $5! = 5 \times 4 \times 3 \times 2 \times 1 = 120$ So, there are 120 different ways to arrange all 5 types of desserts on the cart. Arranging cake and pie together, and pudding and tart together When we group cake and pie together as one unit, and pudding and tart together as another unit, we can treat these groups as single items. This gives us the following units to arrange: • Group 1: (Cake + Pie) • Group 2: (Pudding + Tart) • Ice Cream This results in 3 units to arrange: 1. (Cake + Pie) 2. (Pudding + Tart) 3. Ice Cream The number of ways to arrange these 3 units is: 3!=3×2×1=6 Next, we need to consider the arrangements within each group:

	Cake and Pie can be arranged in 2! ways: 2!=2 Pudding and Tart can also be arranged in 2! ways: 2!=2 Now, we multiply the arrangements of the groups with the arrangements within each group: 3!×2!×2!=6×2×2=24 **There are 120 different ways to arrange all 5 types of desserts on the cart.** **There are 24 different ways to arrange the desserts when cake and pie are together and pudding and tart are together.**

Topic: Subtopic (concept)	Ratio and Proportion
Question Details/Question Stem	In a classroom, the ratio of boys to girls is 5:7. After 8 new boys join the class, the ratio of boys to girls changes to 1:1. If the total number of students in the classroom before the new boys joined was 48, determine the original number of boys and girls. After the new boys join, how many girls need to be added to maintain a new ratio of boys to girls of 2:3?
Explanation	Determine the Original Number of Boys and Girls Given Ratios 1. The ratio of boys to girls is 5:7. 2. After 8 new boys join, the ratio changes to 1:1. 3. The total number of students before the new boys joined is 48. Let: • Number of boys = 5x • Number of girls = 7x Setting Up the Equation

From the total number of students:

5x+7x=48

Combine like terms:

12x=48

Now solve for x:

$$x = \frac{48}{12}$$
$$= 4$$

Finding the Number of Boys and Girls

Now calculate the number of each type of student:

Boys:

Boys=5x=5×4=20

Girls:

Girls=7x=7×4=28

New Counts After Adding Boys

After 8 new boys join:

New Boys=20+8=28

Check the New Ratio

The new ratio of boys to girls is given as 1:1. Let's set up the equation:

$$\frac{28}{28} = \frac{1}{1}$$

To find the number of girls needed to maintain the new ratio of boys to girls as 2:3, let y be the number of additional girls needed.

Setting Up the New Ratio Equation

After adding y girls, the count will be:

- Boys: 28

	• Girls: 28+y Setting up the equation based on the new desired ratio: $\frac{28}{28+y}=\frac{2}{3}$ Cross-multiply to solve for y: $2(28+y)=3\times 28$ Expanding gives: $56+2y=84$ $2y=84-56$ $2y=28$ $y=\frac{28}{2}$ $=14$ **Original number of boys is 20 and girls is 28.** **The number of girls should be added is 14.**

Topic: Subtopic (concept)	Time and Work
Question Details/Question Stem	A factory has 30 machines that can complete a batch of products in 20 days, working 8 hours per day. After 10 days, 5 machines break down. To compensate, the factory increases the working hours to 12 hours per day from the 11th day onward. Will the factory still be able to complete the batch in the original 20 days?
Explanation	Total work in machine-hours $\text{Total work} = 30\times 8\times 20$ $= 4800 \text{ machine-hours}$ Work done in first 10 days

	30×8×10=2400 machine-hours Remaining work 4800−2400=2400 machine-hours After breakdown Remaining machines = 25 New working hours/day = 12 Daily capacity=25×12=300 machine-hours/day Days needed to finish remaining work: $\frac{2400}{300} = 8\,\text{days}$ Total time used First phase = 10 days Second phase = 8 days Total = 10 + 8 = 18 days **Yes, the factory can complete the batch in 20 days.**

Topic: Subtopic (concept)	Pipes and Cisterns
Question Details/Question Stem	A large water tank has three pipes: Pipe A, Pipe B, and Pipe C. • Pipe A can fill the tank in 6 hours. • Pipe B can fill the tank in 8 hours. • Pipe C can empty the tank in 12 hours. 1. If all three pipes are opened at the same time, how long will it take to fill the tank completely? 2. After the tank is filled, all pipes remained closed for 30 minutes. Then Pipe C is reopened, and it starts to empty the tank. The tank was filled at 7:30 am. At what time the water level drops to half the tank's capacity after Pipe C is reopened? 3. If Pipe A is closed after 1 hour of operation (when all pipes are started together), how much time will it take to fill the tank completely from that point onward?

Explanation	Pipe A: Fills the tank in 6 hours (rate = 1/6 tank/hour) Pipe B: Fills the tank in 8 hours (rate = 1/8 tank/hour) Pipe C: Empties the tank in 12 hours (rate = −1/12 tank/hour) Calculate Combined Filling Rate When all three pipes are opened together, their combined rate is: $\text{Combined Rate} = \frac{1}{6} + \frac{1}{8} - \frac{1}{12}$ Finding a common denominator (24): $\frac{4+3-2}{24} = \frac{5}{24}\,\text{tank / hour}$ Time to Fill the Tank To find the time t to fill the tank: $t = \frac{1\,\text{tank}}{\text{Combined rate}}$ $= \frac{1}{\frac{5}{24}}$ $= \frac{24}{5}$ $= 4.8\,\text{hours}$ Time for Water Level to Drop to Half After the tank is filled, it remains full for 30 minutes. The volume of water emptied by Pipe C in this time: Thus, the tank is still full after 30 minutes. Now, when Pipe C is opened to empty the tank, we need to find how long it takes to drop to half the tank's capacity (0.5 tank). The rate of Pipe C is: Rate=-1/12 tank/hour

To find the time to empty half the tank:

$$\text{Time} = \frac{0.5 \tan k}{\left(\frac{-1}{12}\right)}$$
$$= 0.5 \times -12$$
$$= 6 \text{ hours}$$

After the tank is filled, all pipes remained closed for 30 minutes. Then Pipe C is reopened, and it starts to empty the tank. The tank was filled at 7:30 am. All pipes closed for 30 mins. So, at 8:00am pipe C is reopened. It takes 6 hrs when water level drops to half the tank's capacity after Pipe C is reopened. So, at 2:00pm water level drops to half the tank's capacity after Pipe C is reopened.

Time to Fill the Tank After Closing Pipe A

$$\text{Water Filled in 1 hour} = \left(\frac{1}{6} + \frac{1}{8} - \frac{1}{12}\right) \times 1$$
$$= \frac{5}{24} \text{ tank}$$

If Pipe A is closed after 1 hour, then calculate how much water is remaining to be filled:

After 1 hour, the remaining volume to fill the tank:

$$\text{Remaining Volume} = 1 - \frac{5}{24}$$
$$= \frac{19}{24} \text{ tank}$$

Now, with only Pipe B and Pipe C open, the combined rate is:

$$\text{New Combined Rate} = \frac{1}{8} - \frac{1}{12}$$
$$= \frac{3}{24} - \frac{2}{24}$$
$$= \frac{1}{24} \tan k / \text{hour}$$

Time to Fill Remaining Volume

	To fill the remaining $\frac{19}{24}$ tank: $\text{Time} = \frac{\frac{19}{24}}{\frac{1}{24}}$ $= 19\text{hours}$ **If all three pipes are opened at the same time, it takes 4.8 hours to fill the tank.** **At 2:00pm water level drops to half the tank's capacity after Pipe C is reopened**. **If Pipe A is closed after 1 hour of operation, it takes 19 hours more to completely fill the tank.**

SECTION 2

Coding

Arrays

Given an array of integers, return indices of the two numbers such that they add up to a specific target.

Input: nums = [2, 7, 11, 15], target = 9
Output: [0, 1]

```
import java.util.*;

public class Main {
public static int[] twoSum(int[] nums, int target) {
for (int i = 0; i < nums.length; i++) {
for (int j = i + 1; j < nums.length; j++) {
if (nums[i] + nums[j] == target) {
return new int[] { i, j };
}
}
}
return new int[] {};
}

public static void main(String[] args) {
int[] result = twoSum(new int[] {2, 7, 11, 15}, 9);
System.out.println(Arrays.toString(result));
}
}
```

String

Count the number of vowels in a given string.

Input: "hello"
Output: 2

```
public class Main {
public static int countVowels(String str) {
int count = 0;
String vowels = "aeiouAEIOU";

for (char c : str.toCharArray()) {
if (vowels.indexOf(c) != -1) {
count++;
}
}

return count;
}
```

```
public static void main(String[] args) {
System.out.println(countVowels("hello"));
}
}
```

Maths

A number is Kaprekar if the square can be split into two parts that add up to the original number.
Example:
Input: 45 → 45² = 2025 → 20 + 25 = 45 → Output: True

```
def isKaprekar(num):
sq = str(num * num)
for i in range(1, len(sq)):
left = int(sq[:i]) if sq[:i] else 0
right = int(sq[i:]) if sq[i:] else 0
if right > 0 and left + right == num:
return True
return num == 1

n = int(input("Enter a number: "))
if isKaprekar(n):
print(f"{n} is a Kaprekar number")
else:
print(f"{n} is not a Kaprekar number")
```

Strings

Given a string, count substrings where first and last chars are the same. Example: Input = "abcab", Output = 7 (substrings: "a","b","c","a","b","abca","bcab")

```
def countSubstrings(s):
n=len(s)
res=0
for i in range(n):
for j in range(i,n):
if s[i]==s[j]:
res+=1
return res
```

Arrays
Given a list of stock prices by day, find the maximum profit you can make by buying on one day and selling on a later day. You can only do one transaction (buy once and sell once). Example: Input: [7, 1, 5, 3, 6, 4] Output: 5 (Buy at price 1, sell at price 6)

def max_profit(prices):
max_profit = 0
for i in range(len(prices)):
for j in range(i + 1, len(prices)):
profit = prices[j] - prices[i]
if profit > max_profit:
max_profit = profit
return max_profit
 	
print(max_profit([7, 1, 5, 3, 6, 4]))