

CAT Advanced Practice Paper

Topic: Percentages, Fractions, and Multiplier Frameworks

SECTION 1: EASY DIFFICULTY LEVEL

Q1 • SUB-TOPIC: DIRECT CALCULATIONS

The income of *Anand* is 25% more than that of *Bala* and 25% less than that of *Charan*. If *Charan's* income decreases by 4% and *Bala's* income increases by 10%, then the percentage by which *Charan's* new income exceeds *Bala's* new income is nearest to:

- A) 41.5%
- B) 43.2%
- C) 45.5%
- D) 47.1%

Q2 • SUB-TOPIC: BASIC MULTIPLIER CONCEPTS

The population of a rapidly growing tech hub was 100,000 at the start of 2020. Due to migration patterns, it increased by 25% in 2021, decreased by 20% in 2022, and increased by 10% in 2023. What was the population at the end of 2023?

- A) 105,000
- B) 110,000
- C) 115,000
- D) 120,000

Q3 • SUB-TOPIC: STRAIGHTFORWARD PERCENTAGE-TO-FRACTION CONVERSIONS

The difference between 83.33% of a number and 37.5% of the same number is 220. What is 62.5% of that number?

- A) 250
- B) 300
- C) 320
- D) 350

Q4 • SUB-TOPIC: DIRECT CALCULATIONS

What is the exact value of **33.33%** of **15%** of **60%** of **4000**?

- A) **100**
- B) **120**
- C) **150**
- D) **180**

Q5 • SUB-TOPIC: BASIC MULTIPLIER CONCEPTS

A shopkeeper marks up a shirt by **50%** above its cost price. If he offers a discount of **20%** on this marked price, he makes a profit of **Rs. 400**. Find the original cost price of the shirt.

- A) **Rs. 1500**
- B) **Rs. 1800**
- C) **Rs. 2000**
- D) **Rs. 2400**

SECTION 2: MEDIUM DIFFICULTY LEVEL

Q6 • SUB-TOPIC: PRODUCT CONSTANCY LOOPS

Due to supply chain issues, the price of sugar increases by **25%**. To keep the total expenditure on sugar exactly the same, a family reduces its monthly consumption. By what percentage must the reduced consumption be increased to return to the original consumption level if the price later drops back to its original normal level?

- A) **20%**
- B) **25%**
- C) **16.66%**
- D) **33.33%**

Q7 • SUB-TOPIC: APPLICATIONS IN GEOMETRY

In a rectangular plot, the length is increased by **20%** and the breadth is decreased by **10%**. If the cost of fencing the plot is directly proportional to its perimeter, and the original length and breadth were in the ratio of **3:2**, what is the percentage change in the cost of fencing?

- A) **8% increase**
- B) **4% increase**
- C) **8% decrease**
- D) **10% increase**

Q8 • SUB-TOPIC: COMBINATIONS OF PERCENTAGES WITH PROFIT & LOSS

An item with a cost price of **Rs. 1200** is sold at a certain discount on the marked price to earn a profit of **33.33%**. If the discount percentage offered on the marked price is doubled, there is neither a profit nor a loss. What is the original rate of discount?

- A) **15%**
- B) **20%**
- C) **25%**
- D) **30%**

Q9 • SUB-TOPIC: MULTI-STEP WORD PROBLEMS

In May, John bought the same amount of rice and wheat as he had bought in April, but spent **Rs. 300** more due to a price increase of rice and wheat by **20%** and **15%**, respectively. If John had spent **Rs. 900** on rice in April, then how much did he spend on wheat in May?

- A) **Rs. 800**
- B) **Rs. 880**
- C) **Rs. 920**
- D) **Rs. 950**

Q10 • SUB-TOPIC: COMBINATIONS OF PERCENTAGES WITH RATIOS

A certain amount was divided among **A, B, C,** and **D**. **A** received **20%** of the total amount and **B** received **40%** of the remaining amount. **C** received **25%** less than **B**. If the difference between the shares of **A** and **D** is **Rs. 800**, what is the total amount that was initially divided?

- A) **Rs. 15000**
- B) **Rs. 20000**
- C) **Rs. 25000**
- D) **Rs. 30000**

Q11 • SUB-TOPIC: COMBINATIONS OF PERCENTAGES WITH PROFIT & LOSS

Anil buys **100** pens. He sells **40** pens at a **20%** discount on the labeled price, and the remaining **60** pens at a **10%** discount on the labeled price. Thus, he gets a total revenue of **Rs. 4300** and makes an overall **7.5%** profit. With no discounts, his percentage of profit on the pens would have been:

- A) **15%**
- B) **20%**
- C) **25%**
- D) **30%**

Q12 • SUB-TOPIC: MULTI-STEP WORD PROBLEMS

The total of male and female populations in a city increased by **20%** from **2010** to **2020**. During the same period, the male population increased by **30%** while the female population increased by **10%**. In **2020**, if the female population is **44,000**, then what was the total population of the city in **2010**?

- A) **60,000**
- B) **80,000**
- C) **88,000**
- D) **100,000**

Q13 • SUB-TOPIC: MULTI-STEP WORD PROBLEMS

A vessel contained a certain amount of a solution of acid and water. When **4** litres of water was added to it, the new solution had a **40%** acid concentration. When **12** litres of acid was further added to this new solution, the final solution had a **60%** acid concentration. The original percentage of acid in the solution was:

- A) **40%**
- B) **45%**
- C) **48%**
- D) **50%**

Q14 • SUB-TOPIC: COMBINATIONS OF PERCENTAGES WITH RATIOS

In an examination, Meena scores **35%** and fails by **25** marks. If her score is increased by **40%**, she will have **45** marks more than the passing score. The percentage score needed for passing the examination is:

- A) **38%**
- B) **40%**
- C) **42%**
- D) **45%**

Q15 • SUB-TOPIC: APPLICATIONS IN GEOMETRY

The radius of a solid right circular cylinder is increased by **20%** and its height is decreased by **25%**. What is the overall percentage change in the volume of the cylinder?

- A) **8% increase**
- B) **5% decrease**
- C) **10% increase**
- D) **No change**

SECTION 3: HARD DIFFICULTY LEVEL

Q16 • SUB-TOPIC: VENN DIAGRAM / SET THEORY APPLICATIONS

Students in a college have to choose at least one subject from Chemistry, Mathematics, and Physics. **50%** of the students chose Mathematics, **45%** chose Physics, and **40%** chose Chemistry. **15%** chose Mathematics and Physics, **15%** chose Mathematics and Chemistry, and **10%** chose Physics and Chemistry. If exactly **15** students chose all three subjects, what is the total number of students in the college?

- A) 150
- B) 200
- C) 300
- D) 400

Q17 • SUB-TOPIC: SUCCESSIVE PERCENTAGE CHANGES WITH MULTIPLE VARIABLES

A fruit seller has a stock of mangoes, bananas, and apples. At the beginning of the day, mangoes make up **40%** of his stock. During the day, he sells exactly **50%** of the mangoes, exactly **120** bananas, and exactly **30%** of the apples. At the end of the day, his total fruit count is exactly **60%** of his initial stock. If the remaining apples are equal in number to the remaining bananas, find the initial total number of fruits in the stock.

- A) 900
- B) 1050
- C) 1200
- D) 1500

Q18 • SUB-TOPIC: DATA-HEAVY WORD PUZZLES

The salaries of three friends Sita, Gita, and Mita are initially in the ratio **4 : 5 : 6**. In the first year, they get salary hikes of **25%**, **20%**, and **16.66%**, respectively. In the second year, Sita and Mita get salary hikes of **20%** each, and the salary of Gita is adjusted so that it becomes exactly equal to the mean salary of the three friends. The percentage salary hike of Gita in the second year is:

- A) 15%
- B) 18%
- C) 20%
- D) 25%

Q19 • SUB-TOPIC: SUCCESSIVE PERCENTAGE CHANGES WITH MULTIPLE VARIABLES

In an election, constituency A had **10** candidates. The winning candidate received exactly **40%** of the total valid votes. The first runner-up received **30,000** less votes than the winning candidate. All the candidates who lost their security deposits put together polled **20%** of the total valid votes. If exactly **3** candidates saved their security deposits, and the third-place candidate received exactly **15%** of the valid votes, what is the total number of valid votes polled?

- A) **150,000**
- B) **200,000**
- C) **250,000**
- D) **300,000**

Q20 • SUB-TOPIC: DATA-HEAVY WORD PUZZLES

In a company, **60%** of the employees are engineers and the rest are managers. The number of male engineers is exactly **20%** more than the number of female engineers. The number of male managers is exactly **40%** less than the number of female managers. If the total number of female employees across the company is **460**, what is the total number of employees in the company?

- A) **800**
- B) **880**
- C) **920**
- D) **960**

ANSWER KEY

| Question No. | Correct Option | Question No. | Correct Option |
|--------------|-----------------|--------------|-----------------|
| Q1 | C (45.5%) | Q11 | C (25%) |
| Q2 | B (110,000) | Q12 | B (80,000) |
| Q3 | B (300) | Q13 | C (48%) |
| Q4 | B (120) | Q14 | B (40%) |
| Q5 | C (Rs. 2000) | Q15 | A (8% increase) |
| Q6 | B (25%) | Q16 | C (300) |
| Q7 | A (8% increase) | Q17 | B (1050) |
| Q8 | B (20%) | Q18 | C (20%) |
| Q9 | C (Rs. 920) | Q19 | B (200,000) |
| Q10 | B (Rs. 20000) | Q20 | B (880) |

SOLUTIONS & CONCEPTUAL EXPLANATIONS

Solution Q1: Correct Option C

Let Bala's initial income be $I_B = 120$.

Anand's income is 25% more than Bala's:

$$I_A = 120 \times 1.25 = 150$$

Anand's income is also 25% less than Charan's income (I_C):

$$I_A = 0.75 \times I_C \Rightarrow 150 = 0.75 \times I_C \Rightarrow I_C = 200$$

Now apply the given adjustments to their incomes:

New Charan's income: $I'_C = 200 \times (1 - 0.04) = 192$

New Bala's income: $I'_B = 120 \times (1 + 0.10) = 132$

The percentage by which Charan's new income exceeds Bala's new income is calculated as:

$$\text{Percentage Excess} = [(I'_C - I'_B) / I'_B] \times 100\% = [(192 - 132) / 132] \times 100\% = (60 / 132) \times 100\% \approx 45.45\%$$

Rounding to the nearest option yields 45.5%.

Solution Q2: Correct Option B

This problem utilizes successive percentage change multipliers. Let the initial population be $P_0 = 100,000$.

The sequence of annual changes corresponds to the following multipliers:

- Year 2021 (+25%): multiplier = 1.25

- Year 2022 (-20%): multiplier = 0.80

- Year 2023 (+10%): multiplier = 1.10

The final population P_3 at the end of 2023 is given by:

$$P_3 = P_0 \times 1.25 \times 0.80 \times 1.10$$

Notice that $1.25 \times 0.80 = (5/4) \times (4/5) = 1$. Thus:

$$P_3 = 100,000 \times 1 \times 1.10 = 110,000$$

Solution Q3: Correct Option B

Convert the given percentage values into standard fractions to simplify calculation:

$83.33\% = 5/6$, $37.5\% = 3/8$, and $62.5\% = 5/8$.

Let the unknown number be x . The difference equation is given by:

$$(5/6 - 3/8)x = 220$$

Find a common denominator to subtract the fractions:

$$[(20 - 9) / 24]x = 220 \Rightarrow (11/24)x = 220 \Rightarrow x = (220 \times 24) / 11 = 480$$

Now, compute 62.5% of x :

$$(5/8) \times 480 = 5 \times 60 = 300$$

Solution Q4: Correct Option B

Convert all cascading percentages directly into fractional form to find the answer efficiently:

$33.33\% = 1/3$, $15\% = 15/100 = 3/20$, and $60\% = 60/100 = 3/5$.

Set up the continuous product equation:

$$\text{Value} = (1/3) \times (3/20) \times (3/5) \times 4000$$

Cancel the common terms in the expression:

$$\text{Value} = [(1 \times 3 \times 3) / (3 \times 20 \times 5)] \times 4000 = (3/100) \times 4000 = 3 \times 40 = 120$$

Solution Q5: Correct Option C

Let the original Cost Price be $CP = 100x$.

The markup value is 50%, so the Marked Price is:

$$MP = 100x \times 1.50 = 150x$$

A discount of 20% is offered on this marked price, resulting in the Selling Price:

$$SP = 150x \times (1 - 0.20) = 150x \times 0.80 = 120x$$

The total profit made is given as **Rs. 400**:

$$Profit = SP - CP \Rightarrow 120x - 100x = 400 \Rightarrow 20x = 400 \Rightarrow x = 20$$

Therefore, the original cost price of the shirt is:

$$CP = 100 \times 20 = \text{Rs. 2000}$$

Solution Q6: Correct Option B

According to the product constancy principle, $Price \times Consumption = Expenditure$.

When the price increases by 25% (a multiplier of $5/4$), the consumption must drop to its reciprocal value to maintain constant expenditure:

$$Reduced\ Consumption = (4/5) \times Original\ Consumption$$

This implies a 20% reduction in consumption. When the market prices normalize and drop back to the original level, the family can restore their original level of consumption.

The necessary fractional increase over the current reduced consumption base ($4/5$) to reach back up to 1 is:

$$Fractional\ Increase = [1 - (4/5)] / (4/5) = (1/5) / (4/5) = 1/4 = 25\%$$

Solution Q7: Correct Option A

Let the initial length and breadth be proportional to the ratio 3:2. We can pick convenient scaling values: $L_0 = 30$ and $B_0 = 20$.

The original perimeter of this plot is:

$$P_0 = 2 \times (L_0 + B_0) = 2 \times (30 + 20) = 100$$

Calculate the modified length and breadth based on the given percentage shifts:

- New length: $L_1 = 30 \times 1.20 = 36$

- New breadth: $B_1 = 20 \times 0.90 = 18$

Compute the new perimeter of the plot:

$$P_1 = 2 \times (36 + 18) = 2 \times 54 = 108$$

Because fencing cost is directly proportional to perimeter, the percentage change in cost is equal to the percentage change in the perimeter:

$$\% \text{ Change in Cost} = [(108 - 100) / 100] \times 100\% = 8\% \text{ increase}$$

Solution Q8: Correct Option B

The Cost Price (CP) is given as **Rs. 1200**. To achieve a profit of 33.33% ($= 1/3$), the initial selling price (SP_1) must be:

$$SP_1 = 1200 \times (1 + 1/3) = 1600$$

Let the total absolute value of the original discount be D . Thus, the relationship with Marked Price (MP) is:

$$MP - D = 1600 \quad [\text{Equation 1}]$$

When the discount percentage is doubled, the absolute discount becomes $2D$. Under these conditions, the transaction breaks even (zero profit/loss), meaning $SP_2 = CP = 1200$:

$$MP - 2D = 1200 \quad [\text{Equation 2}]$$

Subtract Equation 2 from Equation 1 to find D :

$$(MP - D) - (MP - 2D) = 1600 - 1200 \Rightarrow D = 400$$

Substitute $D = 400$ back into Equation 1 to solve for MP :

$$MP - 400 = 1600 \Rightarrow MP = 2000$$

The original rate of discount is:

$$\text{Discount \%} = (D / MP) \times 100\% = (400 / 2000) \times 100\% = 20\%$$

Solution Q9: Correct Option C

John bought the exact same quantities of items in both months. The incremental amount spent is entirely due to the individual price updates.

April Rice expenditure = **Rs. 900**. The price of rice increased by **20%**. The absolute increase in rice expenditure is:

$$\Delta E_{\text{rice}} = 900 \times 0.20 = \text{Rs. } 180$$

The total extra money spent in May across both categories combined is **Rs. 300**. Therefore, the incremental expenditure contribution from wheat is:

$$\Delta E_{\text{wheat}} = 300 - 180 = \text{Rs. } 120$$

This **Rs. 120** reflects the **15%** price hike on wheat. Let W_{April} be the April wheat expenditure:

$$0.15 \times W_{\text{April}} = 120 \Rightarrow W_{\text{April}} = 120 / 0.15 = \text{Rs. } 800$$

The final amount spent on wheat in May includes the price hike:

$$W_{\text{May}} = W_{\text{April}} + \Delta E_{\text{wheat}} = 800 + 120 = \text{Rs. } 920$$

Solution Q10: Correct Option B

Let the initial total sum of money be $T = 100x$.

- Share of **A** = **20% of 100x = 20x**.
- Remaining amount after accounting for **A** = $100x - 20x = 80x$.
- Share of **B** = **40% of 80x = 32x**.
- Share of **C** is **25%** less than **B**:

$$C = 32x \times (1 - 0.25) = 32x \times 0.75 = 24x$$

- Share of **D** is whatever remains from the total pool:

$$D = T - (A + B + C) = 100x - (20x + 32x + 24x) = 100x - 76x = 24x$$

The absolute difference between the allocations of **A** and **D** is given as **Rs. 800**:

$$|D - A| = 24x - 20x = 4x \Rightarrow 4x = 800 \Rightarrow x = 200$$

Thus, the initial total amount is:

$$T = 100 \times 200 = \text{Rs. } 20000$$

Solution Q11: Correct Option C

Let the Cost Price of each pen be C . For 100 pens, the total cost price is $100C$.
Anil earns an overall profit of 7.5% , generating a total revenue of **Rs. 4300**:

$$100C \times 1.075 = 4300 \Rightarrow 107.5C = 4300 \Rightarrow C = 4300 / 107.5 = 40$$

Let the labeled price of a single pen be L . Formulate total revenue via the two discounted groups:

$$\text{Revenue} = 40 \times (0.80L) + 60 \times (0.90L) = 4300$$

$$32L + 54L = 4300 \Rightarrow 86L = 4300 \Rightarrow L = 4300 / 86 = 50$$

If no discounts were offered, each pen would sell at its full labeled price $L = 50$. The baseline profit percentage would be:

$$\text{Profit \%} = [(L - C) / C] \times 100\% = [(50 - 40) / 40] \times 100\% = (10 / 40) \times 100\% = 25\%$$

Solution Q12: Correct Option B

Let the initial male and female populations in 2010 be M and F , respectively.

The total population in 2010 was $P_{2010} = M + F$.

The total population increased by 20% over the decade, driven by a 30% increase in males and a 10% increase in females:

$$1.30M + 1.10F = 1.20(M + F)$$

Expand and group like terms to find the relationship between M and F :

$$1.30M + 1.10F = 1.20M + 1.20F \Rightarrow 0.10M = 0.10F \Rightarrow M = F$$

In 2020, the female population is given as $44,000$ after its 10% increase:

$$1.10F = 44,000 \Rightarrow F = 44,000 / 1.10 = 40,000$$

Since $M = F$, the male population in 2010 was also $40,000$. The total 2010 city population was:

$$P_{2010} = M + F = 40,000 + 40,000 = 80,000$$

Solution Q13: Correct Option C

Let the original volume of the entire solution be V and the initial absolute volume of pure acid be A .

Step 1: Adding 4 litres of water results in a total volume of $V + 4$ with an acid concentration of 40%:

$$A / (V + 4) = 0.40 \Rightarrow A = 0.40V + 1.6 \quad [\text{Equation 1}]$$

Step 2: Adding 12 litres of pure acid increases both the acid volume and the total solution volume. The concentration becomes 60%:

$$[A + 12] / [(V + 4) + 12] = 0.60 \Rightarrow [A + 12] / (V + 16) = 0.60 \Rightarrow A + 12 = 0.60V + 9.6$$

$$A = 0.60V - 2.4 \quad [\text{Equation 2}]$$

Equate Equation 1 and Equation 2 to solve for V :

$$0.40V + 1.6 = 0.60V - 2.4 \Rightarrow 4.0 = 0.20V \Rightarrow V = 4.0 / 0.20 = 20 \text{ litres}$$

Now substitute $V = 20$ into Equation 1 to find A :

$$A = 0.40(20) + 1.6 = 8 + 1.6 = 9.6 \text{ litres}$$

The initial percentage concentration of acid in the solution was:

$$\text{Original \%} = (A / V) \times 100\% = (9.6 / 20) \times 100\% = 48\%$$

Solution Q14: Correct Option B

Let T be the total maximum marks and P be the absolute passing mark.

Meena's initial score is 35% of T , which falls short of the passing marks by 25:

$$0.35T = P - 25 \quad [\text{Equation 1}]$$

When her score is increased by 40%, her new score becomes $0.35T \times 1.40 = 0.49T$. This score exceeds the passing mark by 45:

$$0.49T = P + 45 \quad [\text{Equation 2}]$$

Subtract Equation 1 from Equation 2 to eliminate P :

$$0.49T - 0.35T = (P + 45) - (P - 25) \Rightarrow 0.14T = 70 \Rightarrow T = 70 / 0.14 = 500$$

Substitute $T = 500$ back into Equation 1 to solve for P :

$$0.35(500) = P - 25 \Rightarrow 175 = P - 25 \Rightarrow P = 200$$

The percentage score required to pass the examination is:

$$\text{Passing \%} = (P / T) \times 100\% = (200 / 500) \times 100\% = 40\%$$

Solution Q15: Correct Option A

The mathematical formula for the volume of a right circular cylinder is $V = \pi r^2 h$.

Let the original parameters be r and h . The modified dimensions are:

- New radius: $r' = 1.20r$

- New height: $h' = 0.75h$

Substitute these modified variables into the volume formula:

$$V' = \pi (r')^2 h' = \pi (1.20r)^2 (0.75h) = \pi (1.44r^2) (0.75h)$$

Multiply the constants to determine the final coefficient:

$$1.44 \times 0.75 = 1.44 \times (3/4) = 0.36 \times 3 = 1.08$$

So, the new volume is:

$$V' = 1.08 \pi r^2 h = 1.08V$$

The overall change in volume represents a $1.08 - 1 = 0.08$ change, which is an **8%** increase.

Solution Q16: Correct Option C

Let us use the standard three-set Venn diagram principle. Since every single student chooses at least one subject, the union of all sets equals **100%**:

$$n(M \cup P \cup C) = n(M) + n(P) + n(C) - n(M \cap P) - n(M \cap C) - n(P \cap C) + n(M \cap P \cap C)$$

Substitute the given percentages directly into the set equation:

$$100\% = 50\% + 45\% + 40\% - 15\% - 15\% - 10\% + n(M \cap P \cap C)$$

Simplify the expression step by step:

$$100\% = 135\% - 40\% + n(M \cap P \cap C) \Rightarrow 100\% = 95\% + n(M \cap P \cap C)$$

$$n(M \cap P \cap C) = 100\% - 95\% = 5\%$$

We are given that exactly **15** students chose all three subjects, meaning **5%** of the total population is equal to **15**:

$$5\% \text{ of Total} = 15 \Rightarrow \text{Total} = (15 \times 100) / 5 = 300$$

Solution Q17: Correct Option B

Let the total initial stock of fruits be $I = 100x$.

- Initial Mangoes: $M = 40x$.
- Combined initial volume of Bananas and Apples: $B + A = 60x \Rightarrow B = 60x - A$.

During the day, the seller disposes of:

- 50% of mangoes = $20x$
- 120 bananas
- 30% of apples = $0.30A$

The remaining stock is 60% of I , meaning 40% of the total stock was sold:

$$20x + 120 + 0.30A = 40x \Rightarrow 0.30A = 20x - 120 \Rightarrow A = (200x - 1200) / 3 \quad [\text{Eq 1}]$$

We are told the final quantities of remaining apples and remaining bananas are equal:

- Remaining Apples = $0.70A$
- Remaining Bananas = $B - 120 = (60x - A) - 120$

$$0.70A = 60x - A - 120 \Rightarrow 1.70A = 60x - 120 \quad [\text{Eq 2}]$$

Substitute Equation 1 into Equation 2:

$$1.70 [(200x - 1200) / 3] = 60x - 120 \Rightarrow 1.70(200x - 1200) = 3(60x - 120)$$

$$340x - 2040 = 180x - 360 \Rightarrow 160x = 1680 \Rightarrow x = 1680 / 160 = 10.5$$

Therefore, the initial total stock of fruits is:

$$I = 100 \times 10.5 = 1050$$

Solution Q18: Correct Option C

Let the initial salaries of Sita, Gita, and Mita be $40k$, $50k$, and $60k$ respectively based on the ratio 4:5:6.

Apply the first-year salary hikes (+25%, +20%, and +16.66% \approx +1/6):

- Sita's Year 1 Salary: $40k \times 1.25 = 50k$
- Gita's Year 1 Salary: $50k \times 1.20 = 60k$
- Mita's Year 1 Salary: $60k \times (1 + 1/6) = 70k$

Apply the second-year updates. Sita and Mita receive another 20% hike:

- Sita's Year 2 Salary: $50k \times 1.20 = 60k$
- Mita's Year 2 Salary: $70k \times 1.20 = 84k$

Let Gita's adjusted salary in Year 2 be G_2 . It equals the mean salary of the three friends:

$$G_2 = (60k + G_2 + 84k) / 3 \Rightarrow 3G_2 = 144k + G_2 \Rightarrow 2G_2 = 144k \Rightarrow G_2 = 72k$$

Gita's salary changed from $60k$ to $72k$ in the second year. The percentage hike is:

$$\text{Gita's Year 2 Hike} = [(72k - 60k) / 60k] \times 100\% = (12k / 60k) \times 100\% = 20\%$$

Solution Q19: Correct Option B

Let the total number of valid votes cast be $V = 100x$.

Exactly 3 candidates saved their security deposits. This group must comprise the top 3 finishers (Winner, 1st Runner-up, and 3rd Place candidate). The remaining 7 candidates lost their deposits and collectively captured 20% ($= 20x$) of the total valid votes.

We are given the following individual metrics:

- Winner's votes = 40% of $V = 40x$

- Third-place votes = 15% of $V = 15x$

Since the total vote share equals $100x$, we can find the share captured by the first runner-up by subtraction:

$$\text{1st Runner-up votes} = 100x - (40x + 15x + 20x) = 100x - 75x = 25x$$

The difference between the winner and the first runner-up is given as 30,000 votes:

$$40x - 25x = 30,000 \Rightarrow 15x = 30,000 \Rightarrow x = 30,000 / 15 = 2000$$

Thus, the total number of valid votes polled is:

$$V = 100 \times 2000 = 200,000$$

Solution Q20: Correct Option B

Let the total number of employees in the firm be T .

- Engineers = 60% of $T = 0.60T$

- Managers = $100\% - 60\% = 40\%$ of $T = 0.40T$

Let us evaluate the engineer segment. The number of male engineers (M_E) is 20% more than female engineers (F_E). This implies a ratio of $6:5$:

$$F_E = 5y, \quad M_E = 6y \Rightarrow \text{Total Engineers} = 11y = 0.60T \quad [\text{Equation 1}]$$

Now evaluate the manager segment. The number of male managers (M_M) is 40% less than female managers (F_M). This implies a ratio of $3:5$:

$$F_M = 5z, \quad M_M = 3z \Rightarrow \text{Total Managers} = 8z = 0.40T \quad [\text{Equation 2}]$$

Take the ratio of Equation 1 to Equation 2 to establish a bridge relationship between our scaling factors y and z :

$$(11y / 8z) = 0.60T / 0.40T = 3/2 \Rightarrow 22y = 24z \Rightarrow 11y = 12z$$

We can assign a common structural variable k such that $y = 12k$ and $z = 11k$.

The total number of female employees across both departments is given as 460 :

$$\text{Total Females} = F_E + F_M = 5y + 5z = 5(12k) + 5(11k) = 60k + 55k = 115k$$

$$115k = 460 \Rightarrow k = 460 / 115 = 4$$

Using $k = 4$, solve for y :

$$y = 12 \times 4 = 48$$

Substitute $y = 48$ back into Equation 1 to calculate total engineers:

$$\text{Total Engineers} = 11 \times 48 = 528$$

Since engineers constitute 60% ($= 0.60T$) of the total workforce:

$$0.60T = 528 \Rightarrow T = 528 / 0.60 = 880$$

The total number of employees in the company is 880 .
