COMPLETE STEP-BY-STEP MARKING SCHEME & DETAILED SOLUTIONS

MasterG.Net CBSE Curriculum Key • Evaluator Guidelines

Section A: Objective Answers (1 Mark Each)

1. Answer: (b) Zero
Step/Reason: Property 1 of A.M. establishes that $\Sigma(X - \bar{X}) = 0$ because positive and negative deviations from the mean cancel out exactly. Arithmetic mean is the center of gravity. [1 M]

2. Answer: (c) Rs. 270
Step/Reason: $\bar{X}_{1,2} = (N_1\bar{X}_1 + N_2\bar{X}_2) / (N_1 + N_2)$
$284 = [(70 \times 290) + (30 \times \bar{X}_2)] / 100 \Rightarrow 28,400 = 20,300 + 30\bar{X}_2 \Rightarrow 30\bar{X}_2 = 8,100 \Rightarrow \bar{X}_2 =$ Rs. 270. [1 M]

3. Answer: (b) 58
Step/Reason: When each item is increased by 5, new mean = 24 + 5 = 29. When each item is then multiplied by 2, final mean = 29 × 2 = 58. [1 M]

4. Answer: (b) 11
Step/Reason: Total sum = $N \times \bar{X} = 6 \times 6 = 36$.
Sum of 5 known items = 1 + 3 + 5 + 6 + 10 = 25. Therefore, missing value x = 36 – 25 = 11. [1 M]

5. Answer: (b) Larger weights are assigned to larger items, and smaller weights to smaller items.
Step/Reason: Heavy weights on higher observations inflate the numerator ΣWX faster than the denominator ΣW, making $\bar{X}_W > \bar{X}$. [1 M]

6. Answer: (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
Step/Reason: Mean relies on mid-point $m = (l_1 + l_2)/2$. Missing boundaries prevent calculating m without rational assumption. [1 M]

Section B: Very Short Answer Solutions (2 Marks Each)

7. Solution:
Any two valid requisites: (1) Rigidly Defined: Must be defined by a clear mathematical formula so that every evaluator gets identical results without ambiguity.
(2) Based on all observations: It must be calculated by taking into account every single item in the data series. [1 M + 1 M = 2 M]

8. Solution:
Formula: $\bar{X} = \Sigma X / N \Rightarrow 25 = (10 + 25 + 35 + 40 + X_5) / 5$ [1 M]
$125 = 110 + X_5 \Rightarrow X_5 = 125 - 110 = 15$. [1 M]

9. Solution (Corrected Mean):
Given: N = 20, Incorrect $\bar{X}$ = 89.4 kg.
Incorrect ΣX = 20 × 89.4 = 1,788 kg. [0.5 M]
Corrected ΣX = Incorrect ΣX – Wrong Item + Correct Item = 1,788 – 78 + 87 = 1,797 kg. [1 M]
Corrected Mean = 1,797 / 20 = 89.85 kg. [0.5 M]

10. Solution (Missing Item in Discrete Series):
Given Mean = 41. Total Frequency $\Sigma f = 8 + 12 + 20 + 10 + 6 + 4 = 60$.
$\Sigma fX = (20\times8) + (30\times12) + (40\times20) + (x\times10) + (60\times6) + (70\times4) = 160 + 360 + 800 + 10x + 360 + 280 = 1{,}960 + 10x$. [1 M]
$\bar{X} = \Sigma fX / \Sigma f \Rightarrow 41 = (1{,}960 + 10x) / 60 \Rightarrow 2{,}460 = 1{,}960 + 10x \Rightarrow 10x = 500 \Rightarrow x = 50$ marks. [1 M]

11. Solution (Combined Mean):
Male cohort: $N_1 = 25$, $\bar{X}_1 = 61$ in. Female cohort: $N_2 = 35$, $\bar{X}_2 = 58$ in. Total N = 60.
Formula: $\bar{X}_{1,2} = (N_1\bar{X}_1 + N_2\bar{X}_2) / (N_1 + N_2)$ [0.5 M]
$\bar{X}_{1,2} = [(25 \times 61) + (35 \times 58)] / 60 = (1{,}525 + 2{,}030) / 60 = 3{,}555 / 60 = 59.25$ inches. [1.5 M]

Section C: Short Answer Solutions (3 Marks Each)

12. Solution (3 Methods):
Data: 30, 45, 60, 40, 15, 65, 85, 20 (N = 8).
(i) Direct Method: $\Sigma X = 360 \Rightarrow \bar{X} = 360 / 8 = 45$ marks. [1 M]
(ii) Short-cut Method: Let Assumed Mean A = 40. Deviations d = X − 40: −10, +5, +20, 0, −25, +25, +45, −20. Sum $\Sigma d = +40$.
$\bar{X} = A + (\Sigma d / N) = 40 + (40 / 8) = 45$ marks. [1 M]
(iii) Step-Deviation Method: C = 5, d' = d / 5: −2, +1, +4, 0, −5, +5, +9, −4. Sum $\Sigma d' = +8$.
$\bar{X} = A + (\Sigma d' / N) \times C = 40 + (8 / 8) \times 5 = 45$ marks. [1 M]

13. Solution (Corrected Mean):
Initial N = 10, $\bar{X} = 68 \Rightarrow$ Initial $\Sigma X = 10 \times 68 = 680$. [1 M]
Two students left (marks 40, 39); one joined (marks 72).
New N = 10 − 2 + 1 = 9. [0.5 M]
Corrected $\Sigma X = 680 - 40 - 39 + 72 = 673$. [1 M]
Corrected Mean = 673 / 9 = 74.78 marks. [0.5 M]

14. Solution (Missing Frequency):
$\Sigma f = 5 + 7 + f + 18 + 5 + 3 = 38 + f$. [0.5 M]
$\Sigma fX = (5\times5) + (15\times7) + (25\times f) + (35\times18) + (45\times5) + (55\times3) = 25 + 105 + 25f + 630 + 225 + 165 = 1{,}150 + 25f$. [1 M]
Mean $\bar{X} = 29 \Rightarrow 29 = (1{,}150 + 25f) / (38 + f) \Rightarrow 1{,}102 + 29f = 1{,}150 + 25f \Rightarrow 4f = 48 \Rightarrow f = 12$. [1.5 M]

15. Solution (Merits & Demerits):
Merits (Any 3): (1) Simple to calculate & understand, (2) Rigidly defined by algebraic formula, (3) Capable of further algebraic treatment (combined mean). [1.5 M]
Demerits (Any 2): (1) Unduly distorted by extreme values (outliers), (2) Cannot be calculated for qualitative data (honesty, beauty) or open-end classes without assumptions. [1.5 M]

16. Solution (Continuous Series & Charlier's Check):
Let A = 37.5, C = 5. Table of step deviations: Mid-points: 22.5, 27.5, 32.5, 37.5, 42.5, 47.5, 52.5.
d' = −3, −2, −1, 0, +1, +2, +3.
fd' = −30, −24, −8, 0, +11, +8, +15 $\Rightarrow \Sigma fd' = -28$. Total $\Sigma f = 70$. [1 M]
Mean = $A + (\Sigma fd'/\Sigma f)\times C = 37.5 + (-28/70)\times5 = 37.5 - 2.0 = 35.50$. [1 M]
Charlier's Check: $\Sigma f(d' + 1) = \Sigma fd' + \Sigma f \Rightarrow 42 = -28 + 70 \Rightarrow 42 = 42$ (Calculations verified correct). [1 M]

17. Solution (Group Sizes from Combined Mean):
Let number of boys = N_1 and girls = $N_2 = 150 - N_1$. $\bar{X}_1 = 70$, $\bar{X}_2 = 55$, Combined = 60. [0.5 M]
$60 = [70N_1 + 55(150 - N_1)] / 150 \Rightarrow 9{,}000 = 70N_1 + 8{,}250 - 55N_1$ [1.5 M]
$15N_1 = 750 \Rightarrow N_1 = 50$ boys, $N_2 = 150 - 50 = 100$ girls. [1 M]

Section D: Long Answer Solutions (5 Marks Each)

18. Solution ("More Than" Cumulative Conversion & Mean):
Convert to simple class intervals: 0–10: 50–45=5 • 10–20: 45–38=7 • 20–30: 38–26=12 • 30–40: 26–10=16 • 40–50: 10–4=6 • 50–60: 4. Total Σf = 50. [2 M]
Mid-values (m): 5, 15, 25, 35, 45, 55. Let A = 25, C = 10.
d' = (m − 25)/10: −2, −1, 0, +1, +2, +3.
fd' = −10, −7, 0, +16, +12, +12 ⇒ $\Sigma fd'$ = +23. [1.5 M]
Mean $\bar{X} = A + (\Sigma fd'/\Sigma f) \times C = 25 + (23/50) \times 10 = 25 + 4.6 = 29.60$ marks. [1.5 M]

19. Solution (Scholarship Award Problem):
(a) Simple Mean (N = 4):
Student A = (60+62+55+67)/4 = 244/4 = 61.00 marks.
Student B = (57+61+53+77)/4 = 248/4 = 62.00 marks.
Student C = (62+67+60+49)/4 = 238/4 = 59.50 marks. [1.5 M]
(b) Weighted Mean (**Σ**W = 4 + 3 + 2 + 1 = 10):
Student A: $\Sigma WX = (4\times60) + (3\times62) + (2\times55) + (1\times67) = 240 + 186 + 110 + 67 = 603 \Rightarrow \bar{X}_{WA} = 603/10 = 60.30$ marks.
Student B: $\Sigma WX = (4\times57) + (3\times61) + (2\times53) + (1\times77) = 228 + 183 + 106 + 77 = 594 \Rightarrow \bar{X}_{WB} = 594/10 = 59.40$ marks.
Student C: $\Sigma WX = (4\times62) + (3\times67) + (2\times60) + (1\times49) = 248 + 201 + 120 + 49 = 618 \Rightarrow \bar{X}_{WC} = 618/10 = 61.80$ marks. [2 M]
(c) Recommendation & Justification: Student C must receive the scholarship. Simple mean misleads because it treats English (W=1) equally with core subjects (Maths W=4, Business W=3). Student C excelled in the highest weighted subjects, achieving the highest weighted score of 61.80. [1.5 M]

20. Solution (Missing Continuous Frequency):
Let missing frequency of 50–60 be f.
Mid-values (m): 15, 25, 35, 45, 55, 65, 75.
fm: (15×5)=75, (25×3)=75, (35×4)=140, (45×7)=315, (55×f)=55f, (65×6)=390, (75×13)=975.
Σf = 38 + f, Σfm = 1,970 + 55f. [2 M]
Mean = 52 ⇒ 52 = (1,970 + 55f) / (38 + f) ⇒ 1,976 + 52f = 1,970 + 55f ⇒ 3f = 6 ⇒ f = 2. [2 M]
Open-end rule: The missing lower/upper boundaries are estimated based on the uniform interval width of adjacent classes (width = 10). Thus, "Below 20" becomes 10–20 (m = 15) and "Above 70" becomes 70–80 (m = 75). [1 M]

Section E: Case-Based Integrated Solutions (4 Marks Each)

21. Case Study 1 (Payroll Audit):
(i) Initial ΣX = 1,000 × 180.40 = Rs. 1,80,400. [0.5 M]
Corrected ΣX = 1,80,400 − (297 + 165) + (197 + 185) = 1,80,400 − 462 + 382 = Rs. 1,80,320. [1 M]
Corrected Mean = 1,80,320 / 1,000 = Rs. 180.32. [0.5 M]
(ii) $180.40 = [(600 \times 190) + (400 \times \bar{X}_2)] / 1{,}000 \Rightarrow 1{,}80{,}400 = 1{,}14{,}000 + 400\bar{X}_2 \Rightarrow 400\bar{X}_2 = 66{,}400 \Rightarrow \bar{X}_2$ = Rs. 166.00. [2 M]
OR: Adding bonus k = 25 ⇒ New Mean = 180.32 + 25 = Rs. 205.32. After 5% deduction (multiplying by 0.95) ⇒ Final Mean = 205.32 × 0.95 = Rs. 195.05. [2 M]

22. Case Study 2 (Food Price Indexation):
(i) Simple Mean of prices = (10 + 20 + 15 + 7) / 4 = 52 / 4 = Rs. 13.00 per kg. [1 M]
(ii) ΣW = 300 + 400 + 200 + 500 = 1,400 kg.
ΣWX = (300×10) + (400×20) + (200×15) + (500×7) = 3,000 + 8,000 + 3,000 + 3,500 = Rs. 17,500. [1 M]
Weighted Mean $\bar{X}_W$ = 17,500 / 1,400 = Rs. 12.50 per kg. [1 M]
(iii) Rationale: Simple mean distorts true expenditure because it assumes equal consumption of all items. In actual economics, households buy large quantities of staples (potatoes 500 kg @ Rs. 7) and less of expensive goods. Weighted mean reflects the actual cost of living burden. [1 M]
OR: Weighted Mean is less than Simple Mean when smaller weights are attached to larger items and larger weights to smaller items. Example: X = 80 (W = 1) and X = 20 (W = 5). Simple Mean = (80+20)/2 = 50. Weighted Mean = (80 + 100)/6 = 180/6 = 30. Here 30 < 50. [2 M]

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