This memorandum consists of 14 pages.
**NOTE:**
- If a candidate answers a question TWICE and does not delete any attempt, only mark the FIRST attempt.
- If a candidate has crossed out an attempt of a question and not redone the question, mark the crossed out version.
- Consistent Accuracy applies in ALL aspects of the marking memorandum.
- A learner cannot use what s/he must prove to prove it (i.e. the circular argument.).

**QUESTION 1**

### 1.1

\[ T_{k+1} = T_k - 2; \quad k \geq 1; \quad T_1 = 12 \]

<table>
<thead>
<tr>
<th>Term</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(T_1)</td>
<td>12</td>
</tr>
<tr>
<td>(T_2)</td>
<td>10</td>
</tr>
<tr>
<td>(T_3)</td>
<td>8</td>
</tr>
<tr>
<td>(T_4)</td>
<td>6</td>
</tr>
</tbody>
</table>

\(\therefore 10\)  
\(\therefore 8\)  
\(\therefore 6\)  

### 1.2

\[ 12 + 10 + 8 + 6 + 4 + 2 + 0 + (– 2) + (– 4) + (– 6) + (– 8) + (– 10) + (– 12) = 0 \]

\(\therefore\) 13 terms

OR

There are 6 positive terms before the 7th term, which is 0. We need 6 negative terms of equal value to the positive terms so that the sum is zero.

6 positive terms + 1 zero term + 6 negative terms  
= 13 terms

**OR**

\[ \frac{n}{2} [2(12) + (n - 1)(-2)] = 0 \]

\[ \frac{n}{2} [24 + 2 - 2n] = 0 \]

\[ \frac{n}{2} [26 - 2n] = 0 \]

\[ 13n - n^2 = 0 \]

\[ n(13 - n) = 0 \]

\(n \neq 0\)  
\(\therefore n = 13\)  

\[ \therefore T_7 = 0 \]

\(\therefore 12\) terms  
\(\therefore 13\) terms  

\[ \therefore \text{substitution into the arithmetic sum formula} \]

\[ \frac{n}{2} [26 - 2n] = 0 \]

\(\therefore 13\) terms  
\[ (3) \]

\[ (6) \]
**QUESTION 2**

2.1 \[ 42 - 28 = 14 \] ✓ answer (1)

2.2 Approximately 88 kg ✓ answer (1)

**NOTE:** Accept a range from 86 to 89 kg

2.3 15 learners in the sample have a weight of less than 80 kg. One would expect \[ \frac{15}{50} \times 250 = 75 \] learners in the grade to have a weight of less than 80 kg.

OR

15 learners in the sample have a weight of less than 80 kg. One would expect \[ 15 \times 5 = 75 \] learners in the grade to have a weight of less than 80 kg.

**NOTE:**
- Accept \[ \frac{14}{50} \times 250 = 70 \]
- Answer as percentage: 1/2 marks
- Answer only: 2/2 marks

 ✓ Cumulative Frequency value read off the graph when less than 80 ✓ answer (2)

 ✓ Cumulative Frequency value read off the graph when less than 80 ✓ answer (2)

2.4 This sampling method is biased towards those who arrive early on a Monday morning. In this way all the learners in the Grade do not have the same chance of being selected for the sample. ✓ sensible explanation of random sample (1)

**QUESTION 3**

3.1 For mutually exclusive events
\[ P(A \text{ or } B) = P(A) + P(B) \]
\[ 0,7 = 0,4 + k \]
\[ k = 0,3 \]

**Note:**
- Answer only: FULL marks ✓ 0,7 = 0,4 + k ✓ answer (2)

**NOTE:**
If the candidate writes down \( k = 1 - 0,7 = 0,3 \): 0/2 marks

3.2 For independent events
\[ P(A \text{ and } B) = P(A) \times P(B) \]
\[ = 0,4k \]
\[ P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) \]
\[ 0,7 = 0,4 + k - 0,4k \]
\[ 0,3 = 0,6k \]
\[ k = 0,5 \]

**OR**

\[ 0,7 = 0,4 + k - 0,4k \]
\[ 0,3 = 0,6k \]
\[ k = 0,5 \]

**Note:**
- Answer only: 1/4 marks ✓ 0,7 = 0,4 + k ✓ answer (4)
- Wrong formula: 0/4 marks ✓ 0,7 = 0,4 + k - 0,4k ✓ answer (4)
**QUESTION 4**

4.1 21 minutes is 1 standard deviation from the mean
∴ 34% of the pizzas are delivered between 21 and 24 minutes

Note: Answer only: FULL marks

4.2 15 minutes is 3 standard deviations to the left of the mean ∴ 50%
27 minutes is 1 standard deviation to the right of the mean ∴ 34%
84% of the pizzas are delivered between 15 and 27 minutes

OR
2% + 14% + 34% + 34%
= 84%

Note: Answer only: FULL marks

4.3 The required 2% is the area found to the right of 2 standard deviations on the right hand side of the mean.
Maximum for delivery should be 24 + 2(3)
= 30 minutes

Note: Answer only: FULL marks

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**QUESTION 5**

5.1 Number of unique codes
\[ = 7 \times 7 \times 7 \]
\[ = 7^3 \]
\[ = 343 \]

Note: Answer only: FULL marks

5.2 Number of unique codes without repetition
\[ = 7 \times 6 \times 5 \]
\[ = 210 \]

OR
\[ \frac{7!}{4!} \]
\[ = 210 \]

Note: Answer only: FULL marks

5.3 Number of codes with repetition that are greater than 300 and divisible by 5
\[ = 4 \times 7 \times 2 - 1 \]
\[ = 55 \]

OR
For a 100 numbers there are 14 numbers divisible by 5
14 \times 4 = 56
56 – 1 = 55

Note: No CA marking for the answer.
• Answer only 3/3 marks

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Note: Answer only: FULL marks
QUESTION 6

6.1

\[ M \cap F = 79 - x \]
\[ M \cap S = 20 \]
\[ F \cap S = 19 - x \]
\[ M \cap F \cap S = x \]
\[ S = 11 \]
\[ F = 16 \]
\[ 40 - x \]

6.2

\[ 79 - x + 20 + x + 11 + 19 - x + 16 + 40 - x = 173 \]
\[ 185 - 2x = 173 \]
\[ x = 6 \]

\textbf{OR}

232 complaints and 173 people in total
94 complaints from 47 people
138 complaints from remaining 126 people
For the two to be equal
\[ 126 - x = 138 - 3x \]
\[ 2x = 12 \]
\[ x = 6 \]

\textbf{OR}

\[ 110 + 55 + 67 = 232 \]
\[ 2x + 20 + 11 + 16 = 232 - 173 \]
\[ 2x + 47 = 59 \]
\[ 2x = 12 \]
\[ x = 6 \]

6.3

\[ P(\text{at least two complaints}) = \frac{11 + 20 + 6 + 16}{173} \]
\[ = \frac{53}{173} \]
\[ = 0.31 \quad (0.30635838...) \]

\textbf{OR}

30.64%
QUESTION 7

<table>
<thead>
<tr>
<th>Noon temperature (in °C)</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>7</th>
<th>7</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units of electricity used</td>
<td>37</td>
<td>36</td>
<td>32</td>
<td>33</td>
<td>32</td>
<td>28</td>
<td>27</td>
<td>23</td>
<td>20</td>
</tr>
</tbody>
</table>

Scatter plot showing noon temperature vs electricity consumption

Note:
Please ignore the point (0 ; 41).

7.1 See scatter plot above

✓✓✓ all 9 points plotted correctly
2 marks if 5 – 8 points are plotted correctly
1 mark if 1 – 4 points are plotted correctly.

(3)
7.2 \[a = 40,97 \quad (40,97108844...)\]
\[b = -1,74 \quad (-1,73639558...)\]
\[\hat{y} = 40,97 - 1,74x\]

**Note:**
- Penalise 1 mark for incorrect rounding to ONE decimal place in either 7.2 or 7.3
- Answer only: FULL marks

**NOTE:**
If the candidate works the coefficients out manually that 
\[b = \frac{-204,2}{117,6}\] then 2 marks for \(b\).

7.3 \[r = -0,97 \quad (-0,9699269087...)\]

**NOTE:** If the candidate gives \(b = \frac{6,139218}{3,42928}\) and not simplified then 1 mark.

7.4 There is a strong negative correlation between the noon temperature and the units of electricity used.

**OR**
As the noon temperature increases, the units of electricity used decreases.

**OR**
As the noon temperature decreases, the units of electricity used increases.

7.5 \[\hat{y} = 40,97 - 1,74(8)\]
\[\approx 27,05\]

**OR**
\[\hat{y} = 27,0799 \approx 27,08\]

**Note:**
- Answer only: 2/2 marks
- Accept a range of 26,5 – 27,5 if the least squares regression line is drawn and the answer is read off: 2/2 marks
QUESTION 8

8.1 Draw diameter AM and join M to B.
\[ \hat{A}_1 + \hat{A}_2 = 90^\circ \] (rad \( \perp \) tangent)
\[ \hat{B}_1 + \hat{B}_2 = 90^\circ \] (\( \angle \)s in a semi circle)
\[ \hat{B}_2 = \hat{A}_2 \] (\( \angle \)s in same seg)
\[ \hat{B}_1 = \hat{A}_1 \]

OR

Draw radii OC and OA
Let \( \hat{A}_2 = x \)
\[ \hat{C}_1 = x \] (\( \angle \) opp = radii)
\[ \hat{A}_1 = 90^\circ - x \] (rad \( \perp \) tan)
\[ \angle AOC = 180^\circ - 2x \] (\( \angle \) sum \( \Delta \))
\[ \angle ABC = 90^\circ - x \] (\( \angle \) circ cent = 2 \( \angle \) circumference)
\[ \angle ABC = \hat{A}_1 \] (= 90\(^\circ\) – \( x \))

\[ \text{NOTE:} \]
If there is no construction: 0 / 5 marks
If candidate changes lettering and states “Similarly”: full marks

OR

Draw QA extend to P. Draw tangent CP at C.
\[ \angle PCQ = \angle PAQ \] (tan from comm pt)
\[ \hat{C}_2 = \hat{A}_1 \] (\( \angle \) opp = sides)
\[ \angle COA = 2\hat{ABC} \]
(\( \angle \) circ cent = 2 \( \angle \) circumference)
\[ \hat{A}_1 + \hat{A}_2 = 90^\circ \] (tan \( \perp \) radius)
\[ \angle COA = 180^\circ - (90^\circ - \hat{A}_1 + 90^\circ - \hat{C}_2) \]
\[ = \hat{A}_1 + \hat{C}_2 \]
\[ = \hat{A}_1 + \hat{A}_1 \]
\[ = 2\hat{A}_1 \]
\[ \hat{A}_1 = \frac{1}{2} \angle COA \]
\[ = \hat{CBA} \]

\[ \text{OR} \]
Draw diameter AM and Join M and C

\[
\hat{M}CA = 90^\circ \quad (\angle \text{s in semi circle})
\]

\[
\hat{A}MC + \hat{A}_2 = 90^\circ \quad (\angle \text{ sum } \Delta)
\]

\[
\hat{A}_1 + \hat{A}_2 = 90^\circ \quad (\text{rad } \bot \text{ tangent})
\]

\[
\hat{A}MC = \hat{A}_1
\]

\[
\hat{A}MC = \hat{B} \quad (\angle \text{s in same seg})
\]

\[
\hat{A}_1 = \hat{B}
\]

\[
\hat{A}_1 + \hat{A}_2 = 90^\circ
\]

\[
\text{tan } \bot \text{ radius}
\]

\begin{table}[h]
\begin{tabular}{|c|c|c|}
\hline
\textbf{8.2.1} & \textbf{WR}S = 90^\circ & \checkmark \text{ statement} \\
\hline
\textbf{8.2.2} & \textbf{R}\hat{ST} = 50^\circ & \checkmark \text{ S/R} \\
& \hat{W} = 40^\circ & \checkmark \hat{W} = 40^\circ \\
& \checkmark \hat{W} + \hat{R}_1 = \hat{T}_1 & \checkmark \hat{W} = 40^\circ \\
& \hat{W} = 40^\circ & \checkmark \hat{W} + \hat{R}_1 = \hat{T}_1 \\
\textbf{OR} & \hat{T}_1 = 90^\circ & \checkmark \hat{W} + \hat{R}_1 = \hat{T}_1 \\
& \hat{W} + \hat{R}_1 = \hat{T}_1 & \checkmark \hat{W} = 40^\circ \\
& \hat{W} = 40^\circ & \checkmark \hat{W} + \hat{R}_1 = \hat{T}_1 \\
\hline
\textbf{8.2.3} & \hat{R}_2 = 40^\circ & \checkmark \hat{R}_2 = 40^\circ \\
& \hat{P}_1 = 40^\circ & \checkmark \hat{P}_1 = 40^\circ \\
& \checkmark \angle \text{s in same seg} & \checkmark \angle \text{s in same seg} \\
\hline
\end{tabular}
\end{table}
8.2.4 \[ \hat{P}_1 = \hat{W} \quad (= 40^\circ) \]
WVPT is a cyclic quadrilateral  (ext \( \angle = \text{int opp} \)
\[ \hat{V}_1 = \hat{P}\hat{T}\hat{S} \quad (\text{ext} \ \angle \ \text{cyclic quad}) \]

OR
\[ \hat{T}_1 = 90^\circ \quad (\angle \text{s in semi circle}) \]
\[ \hat{P}\hat{T}\hat{S} = 90^\circ + \hat{T}_2 \]
\[ \hat{T}_2 = \hat{S}_1 \quad (\angle \text{s in same seg}) \]
\[ \hat{P}\hat{T}\hat{S} = 90^\circ + \hat{S}_1 \]
\[ \hat{V}_1 = 90^\circ + \hat{S}_1 \quad (\text{ext} \ \angle \ \Delta) \]
\[ \hat{V}_1 = \hat{P}\hat{T}\hat{S} \]

OR
\[ \hat{P}_2 = 140^\circ \quad (\angle \text{s on str line}) \]
\[ \hat{W} + \hat{P}_2 = 180^\circ \]
WVPT is cyclic quad (opp \( \angle \text{s suppl} \)
\[ \hat{V}_1 = \hat{P}\hat{T}\hat{S} \quad (\text{ext} \ \angle \ \text{cyclic quad}) \]

OR
\[ \hat{V}_1 = \hat{R}_1 + \hat{R}_2 + \hat{S}_1 \quad (\text{ext} \ \angle \ \Delta) \]
\[ \hat{V}_1 = 90^\circ + \hat{S}_1 \]
\[ \hat{P}\hat{T}\hat{S} = 90^\circ + \hat{T}_2 \]
But \[ \hat{T}_2 = \hat{S}_1 \quad (\angle \text{s in same seg}) \]
\[ \hat{V}_1 = \hat{P}\hat{T}\hat{S} \]

OR
In \( \triangle \text{PTS and } \triangle \text{WVS} \)
\[ \hat{P}_1 = \hat{W} \quad (= 40^\circ) \]
\( \hat{S}_2 \) is common
\[ \hat{V}_1 = \hat{P}\hat{T}\hat{S} \quad (\angle \text{sum} \ \Delta) \]

\[ \hat{P}_1 = \hat{W} \]
\( \text{WVPT is a cyclic quadrilateral} \)
\( \text{ext } \angle = \text{in opp} \)
\( \text{ext } \angle = \text{cyclic quad} \)

\[ \hat{V}_1 = \hat{P}\hat{T}\hat{S} \]
\( \text{WVPT is a cyclic quadrilateral} \)
\( \text{ext } \angle = \text{in opp} \)
\( \text{ext } \angle = \text{cyclic quad} \)

\[ \hat{T}_1 = 90^\circ \quad (\angle \text{s in semi circle}) \]
\( \hat{P}\hat{T}\hat{S} = 90^\circ + \hat{T}_2 \)
\( \hat{T}_2 = \hat{S}_1 \)
\( \angle \text{s in same seg} \)

\[ \hat{W} + \hat{P}_2 = 180^\circ \]
\( \text{WVPT is a cyclic quadrilateral} \)
\( \text{opp } \angle \text{ suppl} \)
\( \text{ext } \angle = \text{cyclic quad} \)

\[ \hat{V}_1 = 90^\circ + \hat{S}_1 \]
\( \hat{P}\hat{T}\hat{S} = 90^\circ + \hat{T}_2 \)
\( \hat{T}_2 = \hat{S}_1 \)
\( \angle \text{s in same seg} \)

\[ \text{identification of triangles} \]
\( \hat{P}_1 = \hat{W} \)
\( \hat{S}_2 \) is common
\( \angle \text{sum } \Delta \)
QUESTION 9

9. \( \hat{C} = 90^\circ \) (\( \angle \)s in semi circle)
\( \text{OEA} = 90^\circ \) (corres \( \angle \)s; OD \( \parallel \) BC)
AE = 8 cm (line from circ cent \( \perp \) ch bis ch)
OE = 6 cm (Pythagoras)
ED = 10 – 6
   = 4 cm

OR
\( \hat{C} = 90^\circ \) (\( \angle \)s in semi circle)
\( \text{OEA} = 90^\circ \) (corres \( \angle \)s; OD \( \parallel \) BC)
OE || BC (given)
OA = OB (radii)
AE = EC = 8 cm (midpoint theorem)
OE = 6 cm (Pythagoras)
ED = 10 – 6
   = 4 cm

OR
\( \hat{C} = 90^\circ \) (\( \angle \)s in semi circle)
\( BC^2 = (20)^2 - (16)^2 \)
\( BC^2 = 144 \)
\( BC = 12 \)
OE = \( \frac{1}{2} \) BC (midpoint theorem)
OE = 6 cm
OD = 10 cm
ED = 10 – 6
   = 4 cm

OR
\( \hat{C} = 90^\circ \) (\( \angle \)s in semi circle)
\( BC^2 = (20)^2 - (16)^2 \)
\( BC^2 = 144 \)
\( BC = 12 \)
OE = \( \frac{1}{2} \) BC (midpoint theorem)
OE = 6 cm
ED = 4 cm

\[5\]
# QUESTION 10

### 10.1

<table>
<thead>
<tr>
<th>Step</th>
<th>Equation/Description</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>( \hat{A} = \hat{D}_4 = x ) (tan ch th)</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>( \hat{E}_2 = x ) (tan ch th)</td>
<td>OR (( \angle s ) in same seg)</td>
</tr>
<tr>
<td>3.</td>
<td>( \hat{D}_2 = \hat{A} = x ) (alt ( \angle s ); CA</td>
<td></td>
</tr>
</tbody>
</table>

### 10.2

1. \( \hat{B}_2 = \hat{F} \) (\( \angle s \) in same seg)
2. \( \hat{D}_3 = \hat{D}_1 \) (= chs subt = \( \angle s \))

**Proof:**

\[ \triangle BHD \parallel \triangle FED \ (\angle \angle \angle) \]

### 10.3

\[ FE = FD \]  
\[ BH \parallel BD \]  
But \( FE = AB \) (given)

\[ \frac{AB}{BD} = \frac{FD}{BH} \]

\[ AB \cdot BD = FD \cdot BH \]

### Diagram

- Points: A, B, C, D, E, F, G, H
- Lines: AB, AC, AD, AE, AF, BH, BD, FE

**Diagram Notes:**

- Points A, B, C, D, E, F, G, H are labeled.
- Lines AB, AC, AD, AE, AF, BH, BD, FE are drawn.
- \( \hat{A} = \hat{D}_4 = x \) (tan ch th)
- \( \hat{E}_2 = x \) (tan ch th)
- \( \hat{D}_2 = \hat{A} = x \) (alt \( \angle s \); CA || DF)
- \( \hat{B}_2 = \hat{F} \) (\( \angle s \) in same seg)
- \( \hat{D}_3 = \hat{D}_1 \) (= chs subt = \( \angle s \))
QUESTION 11

|   | \( AF = FC \) (diags of parallelogram bisect) | ✓ \( AF = FC \)  
|   | \( FE \parallel CD \)  
|   | \( AE = ED \) (Prop Th; \( FE \parallel CD \)) **OR** (Midpoint Theorem) | ✓ reason  
|   |   | (2)  

|   | \( AC = \frac{1}{2} \) (given)  
|   | \( CP \)  
|   | \( AD = \frac{1}{2} \) (given)  
|   | \( DQ \)  
|   | \( \frac{AC}{CP} = \frac{AD}{DQ} \)  
|   | \( CD \parallel PQ \) (converse proportionality theorem)  
|   | \( CD \parallel FE \) (given)  
|   | \( \therefore PQ \parallel FE \)  
|   |   | **OR**  
|   | \( AC = \frac{1}{3} \)  
|   | \( AP \)  
|   | \( AD = \frac{1}{3} \)  
|   | \( AQ \)  
|   | \( \frac{AC}{AP} = \frac{AD}{AQ} \)  
|   | \( CD \parallel PQ \) (converse proportionality theorem)  
|   | \( CD \parallel FE \) (given)  
|   | \( \therefore PQ \parallel FE \)  
|   |   | **OR**  
|   | \( AF = \frac{1}{6} \)  
|   | \( AP \)  
|   | \( AE = \frac{1}{6} \)  
|   | \( AQ \)  
|   | \( \frac{AF}{AP} = \frac{AE}{AQ} \)  
|   | \( \therefore PQ \parallel FE \) (converse proportionality theorem)  
|   |   | **OR**  
|   | \( AF = \frac{1}{6} \)  
|   | \( AP = \frac{AE}{AQ} \)  
|   | conv prop theorem  
|   |   | (3)  

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11.3 In \( \triangle AEF \) and \( \triangle APQ \):

1. \( \hat{A} \) is common
2. \( \hat{A} \hat{E} \hat{F} = \hat{A} \hat{Q} \hat{P} \) (corres \( \angle s; \) \( FE \parallel PQ \))
3. \( \hat{A} \hat{F} \hat{E} = \hat{A} \hat{P} \hat{Q} \) (corres \( \angle s; \) \( FE \parallel PQ \))

\( \therefore \) \( \triangle AEF \parallel \parallel \triangle AQP \) (\( \angle \angle \angle \))

\[
\frac{FE}{PQ} = \frac{AF}{AP} \quad (\parallel \triangle s)
\]

\[
\frac{FE}{60} = \frac{1}{6}
\]

\( FE = 10 \text{ cm} \)

**OR**

In \( \triangle ADC \) and \( \triangle APQ \):

1. \( \hat{A} \) is common
2. \( \hat{A} \hat{D} \hat{C} = \hat{A} \hat{Q} \hat{P} \) (corres \( \angle s; \) \( CD \parallel PQ \))
3. \( \hat{A} \hat{C} \hat{D} = \hat{A} \hat{P} \hat{Q} \) (corres \( \angle s; \) \( CD \parallel PQ \))

\( \therefore \) \( \triangle ADC \parallel \parallel \triangle AQP \) (\( \angle \angle \angle \))

\[
\frac{AC}{AP} = \frac{AD}{AQ} = \frac{1}{3} \quad (\parallel \triangle s)
\]

\[
CD = \frac{1}{3} PQ
\]

\( CD = 20 \text{ cm} \)

But \( AF = FC \)

\( AE = ED \quad \text{(Midpoint Theorem)} \)

\[
\frac{FE}{2} = \frac{1}{2} \quad \text{(5 marks)}
\]

\( FE = 10 \text{ cm} \)

**NOTE:** If the similarity has not been proven, then max 3/5 marks

\[
\begin{align*}
\checkmark & \text{ first pair of angles equal with reason} \\
\checkmark & \text{ second pair of angles equal with reason} \\
\checkmark & \frac{AF}{AP} = \frac{1}{6} \\
\checkmark & \frac{FE}{PQ} = \frac{AF}{AP} \\
\checkmark & \text{ answer} \\
\end{align*}
\]

\( (5) \)

\[
\begin{align*}
\checkmark & \text{ first pair of angles equal with reason} \\
\checkmark & \text{ second pair of angles equal with reason} \\
\checkmark & CD = \frac{1}{3} PQ \\
\checkmark & FE = \frac{1}{2} CD \\
\checkmark & \text{ answer} \\
\end{align*}
\]

\( (5) \)

**TOTAL:** 100