This memorandum consists of 22 pages.
NOTE:
- If a candidate answers a question TWICE, 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.
- Assuming answers/values in order to solve a problem is not acceptable.

**QUESTION 1**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Median = 42</td>
<td>✓answer</td>
</tr>
</tbody>
</table>
| 1.2 | Lower quartile = 32  
     | Upper quartile = 46  
     | Inter quartile range = 46 – 32 = 14 | ✓lower quartile  
     | ✓upper quartile  
     | ✓answer  
     | Answer only: FULL MARKS |
| 1.3 | | ✓box-and-whisker with a median  
     | | ✓skewness  
     | | ✓indicating 5 number summary  
     | | 27; 32; 42; 46; 62  
     | | or correct scale  
     | | ✓greater spread  
     | | ✓right of median (42)  
     | | ✓greater spread  
     | | ✓top 50%  
     | | ✓spread closer  
     | | ✓left of median  
     | | ✓greater spread  
     | | ✓between Q₃ and max  
     | | ✓greater spread  
     | | ✓right of median (42)  
     | | ✓greater spread  
     | | ✓top 50%  
     | | ✓spread closer  
     | | ✓left of median  
     | | ✓greater spread  
     | | ✓between Q₃ and max  |

1.4 There is a **greater spread** of scores to the right of the median (42).

OR

There is a **greater spread** of scores in the top 50%.

OR

The spread of the scores on the left hand side of the median is closer to each other.

OR

The greatest spread of scores lies between Q₃ and the maximum value.

Note:
- Description about the spread based on the box-and-whisker diagram must be accepted.
- If it is indicated that it is skewed to the left because the mean is less than the median: full marks
### QUESTION 2

2.1  
\[ \text{Mean} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{580}{8} = 72.5 \]  
**Answer only:** FULL MARKS  
✓ 580  
✓ answer  
(2)

**Note:** If rounded off to 73: 1 mark

2.2  
Standard deviation \((\sigma) = 2.78 \quad (2.783882181...)\)  
**Note:** If rounded off to 2.8: 1 mark  
✓✓ answer  
(2)

2.3  
\[ \therefore 2 \text{ golfers' scores lie outside 1 standard deviation of the mean.} \]  
The interval for 1 standard deviation of the mean is  
\[ (72.5 - 2.78; 72.5 + 2.78) = (69.72; 75.28) \]  
**Answer only:** FULL MARKS  
✓ interval  
✓ number  
(2)  
[6]

### QUESTION 3

3.1  
| 30 | ✓ 30 | (1) |

3.2  
Linear, the points seem to form a straight line.  
✓ linear  
✓ reason  
(2)

3.3  
The greater the number of hours spent watching TV, the lower the test scores  
**OR**  
The less time a person spends watching TV, the higher the test score.  
**OR**  
Negative correlation between the variables  
**OR**  
Indirect relationship between the variables  
✓ deduction  
(1)

3.4  
60 marks. (Accept 50 - 70 marks)  
✓✓ deduction  
(2)  
[6]
QUESTION 4

4.1

<table>
<thead>
<tr>
<th>TIME</th>
<th>FREQUENCY</th>
<th>CUMULATIVE FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1 \leq t &lt; 3$</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>$3 \leq t &lt; 5$</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>$5 \leq t &lt; 7$</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>$7 \leq t &lt; 9$</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>$9 \leq t &lt; 11$</td>
<td>5</td>
<td>29</td>
</tr>
<tr>
<td>$11 \leq t &lt; 13$</td>
<td>1</td>
<td>30</td>
</tr>
</tbody>
</table>

Note: Only cumulative frequency column – full marks

4.2

Cumulative Frequency Graph of time taken to answer

- upper limit
- cumulative frequency (at least 4 of 6 y-values correctly plotted)
- grounding at (1; 0)
- shape (not joined by a ruler, smooth curve)

4.3

Estimated number of learners that took less than 4 minutes: approximately 5 learners (Accept 6)
Approximate percentage = 16.67% (Accept 20%)

Note:
If using 9 learners and approximate percentage = 30%: 1 mark
If using 5,5 learners and approximate percentage = 18.33%: 1 mark

One mark for every two correct cumulative frequency values

(3)

(4)

(2)

[9]
5.1 \( m_{PQ} \times m_{QR} = -1 \)
\[ \left( \frac{a-0}{4+4} \right) \left( \frac{a-0}{4-6} \right) = -1 \]
\[ \left( \frac{a}{8} \right) \left( \frac{a}{-2} \right) = -1 \]
\[ \frac{a^2}{-16} = -1 \]
\[ a^2 = 16 \]
\[ a = \pm 4 \]
\[ a = 4; \text{ since } a > 0 \]

\[ PQ^2 + QR^2 = PR^2 \]
\[ (8^2 + a^2) + (a^2 + 2^2) = 10^2 \]
\[ \therefore 2a^2 = 32 \]
\[ \therefore a^2 = 16 \]
\[ \therefore a = 4 \]

\[ \sqrt{a-0} \text{ or } \frac{a}{4+4} \quad \text{ or } \frac{a}{8} \]
\[ \sqrt{a-0} \text{ or } \frac{a}{4-6} \quad \text{ or } \frac{-2}{-2} \]
\[ \text{using gradient of perpendicular lines} \]
\[ a^2 = 16 \]

\[ \text{OR} \]

Let A be the midpoint of diagonal PR.
Then \( A(\frac{-4+6}{2}; \frac{0+0}{2}) = A(1;0) \).
AQ = AR (diagonals equal and bisect each other)
AQ^2 = AR^2
\[ (1-4)^2 + (0-a)^2 = 5^2 \]
\[ 9 + a^2 = 25 \]
\[ a^2 = 16 \]
\[ a = 4 \]

\[ \sqrt{8^2 + a^2} \]
\[ + (a^2 + 2^2) \]
\[ 10^2 \]
\[ \sqrt{a-0} \quad \text{or } \frac{a}{4-6} \quad \text{ or } \frac{-2}{-2} \]
\[ \text{using Pythagoras} \]
\[ (8^2 + a^2) \]
\[ + (a^2 + 2^2) \]
\[ 10^2 \]
\[ \sqrt{a-0} \quad \text{or } \frac{a}{4+4} \quad \text{ or } \frac{a}{8} \]
\[ \text{using Pythagoras} \]
\[ (1;0) \text{ is centre} \]
\[ AQ = AR \]
\[ 3^2 + a^2 = 5^2 \]
\[ a^2 = 16 \]

Note:
If candidate uses \( a = 4 \) at the beginning, then zero marks.
5.2

Equation of line SR:

\[ m_{PQ} = \frac{4 - 0}{4 - (-4)} = \frac{1}{2} \]

\[ m_{SR} = m_{PQ} = \frac{1}{2} \quad \text{PQ} \parallel \text{SR} \]

\[ y - y_1 = m(x - x_1) \]

\[ y - 0 = \frac{1}{2}(x - 6) \]

\[ y = \frac{1}{2}x - 3 \]

OR

\[ m_{PQ} = \frac{1}{2} \]

\[ m_{PQ} = m_{SR} = \frac{1}{2} \quad \text{PQ} \parallel \text{SR} \]

\[ y = \frac{1}{2}x + c \]

\[ 0 = \left( \frac{1}{2} \right) \left( \frac{6}{1} \right) + c \]

\[ -3 = c \]

\[ y = \frac{1}{2}x - 3 \]

OR

S(−2;−4) (translation)

\[ m_{RS} = \frac{0 + 4}{6 + 2} = \frac{1}{2} \]

\[ \therefore y + 4 = \frac{1}{2}(x + 2) \]

\[ \therefore y = \frac{1}{2}x - 3 \]

5.3

Eq. of RS: \[ y = \frac{1}{2}x - 3 \]

Eq. of SP: \[ y - 0 = -2(x + 4) \]

\[ \therefore \frac{1}{2}x - 3 = -2(x + 4) \]

\[ \therefore x = -2 \]

\[ y = -4 \]

\[ m = -2 \]

\[ \text{eq. of SP} \]

\[ \text{value of } x \]

\[ \text{value of } y \]

OR

\[ \text{Answer only: FULL MARKS} \]
Midpoint \( PR = M \left( \frac{-4+6}{2}, \frac{0+0}{2} \right) = (1, 0) \)

Let \( S(x, y) \). Then since \( M(1, 0) \) is this, the midpoint of QS is:

\[
\frac{x_1 + x_2}{2} = 1 \quad \text{and} \quad \frac{y_1 + y_2}{2} = 0
\]

\[
\therefore \frac{x + 4}{2} = 1 \quad \text{and} \quad \frac{y + 4}{2} = 0
\]

\[
x + 4 = 2 \quad y + 4 = 0
\]

\[
x = -2 \quad y = -4
\]

**OR**

The translation that sends \( Q(4; 4) \) to \( R(6; 0) \) also sends \( P(-4; 0) \) to \( S \).

\[
(6; 0) = (4 + 2; 4 - 4)
\]

\[
\therefore S = (-4 + 2; 0 - 4) = (-2; -4)
\]

**OR**

The translation that sends \( Q(4; 4) \) to \( P(-4; 0) \) also sends \( R(6; 0) \) to \( S \).

\[
(-4; 0) = (4 - 8; 4 - 4)
\]

\[
\therefore S = (6 - 8; 0 - 4) = (-2; -4)
\]

**OR**

\[
m_{PQ} = m_{SR}
\]

\[
\frac{1}{2} = \frac{y}{x - 6}
\]

\[
2y = x - 6 \quad (1)
\]

\[
m_{PS} = m_{SR}
\]

\[
\frac{y}{x + 4} = \frac{4}{-2}
\]

\[
-2y = 4x + 16 \quad (2)
\]

\[
(1) + (2) : 0 = 5x + 10
\]

\[
x = -2
\]

**Substitute**:

\[
2y = -2 - 6 = -8
\]

\[
y = -4
\]

**5.4**

\[
PR = 6 - (-4)
\]

\[
= 10
\]

**OR**

\[
PR^2 = (6 + 4)^2 + (0 - 0)^2
\]

\[
PR = 10
\]
5.5
midpoint \( PR = \left( \frac{6 + (-4)}{2} ; \frac{0 + 0}{2} \right) = (1; 0) \)

radius of circle = \( \frac{1}{2} PR = 5 \) units

\[ (x - 1)^2 + (y - 0)^2 = 25 \]

\( (x - 1)^2 + y^2 = 25 \)

**Answer only:**
FULL MARKS

- **Checklist**
- **midpoint**
- **radius**
- **eq. of circle in correct form**

5.6
\( (x - 1)^2 + y^2 = 25 \)

substitute Q(4 ; 4):
LHS =\( (4 - 1)^2 + 4^2 \)
\[ = 25 \]
\[ = \text{RHS} \]

\( \therefore \) Q is a point on the circle

**Note:**
If substitute point into equation resulting in \( 25 = 25 \): 1 mark
No conclusion: 1 mark

**OR**

Distance from centre (1 ; 0) to Q(4 ; 4)
\( \therefore \) Q is a point on circle, \( r = 5 \)

**OR**

PR is the diameter of circle PQR therefore Q lies on circle
\( (PQ)^2 = 90^\circ \)

\( (4 - 1)^2 + y^2 = 25 \)
\( y^2 = 16 \)
\[ \therefore y = 4 \]

\( \therefore \) Q is a point on the circle

**OR**

\( (x - 1)^2 + 4^2 = 25 \)
\( (x - 1)^2 = 9 \)
\( x - 1 = 3 \)
\[ x = 4 \]

\( \therefore \) Q is a point on the circle

**Checklist**
- \( = 5 \)
- **conclusion** (2)
- **diameter**
- **\( PQ \approx 90^\circ \)** (2)

5.7
P needs to shift at least 4 units to the right and S needs to shift at least 4 units up for the image of PQRS in first quadrant.

\( \therefore \) minimum value of \( k \) is 4 and minimum value of \( l \) is 4

\( \therefore \) minimum value of \( k + l \) is 8

**Answer only:**
FULL MARKS

- \( k = 4 \)
- \( l = 4 \)
- \( k + l = 8 \)

**Note:** No CA mark applies in 5.7 if \( k \) and \( l \) are not minimums.
### QUESTION 6

**Diagram:**
- Points labeled: A, B, C, D, O, F
- Line segments: AB, AC, BC, DC
- Right triangle OBC
- Angle θ

#### Solution:

**6.1**

| x_C = x_B = -1 | √ value of x |  
| y_C = y_B + 5 = 6 | √ value of y |

| ∴ C(-1;6) |  |

**6.2**

| BA ⊥ CA (tangent ⊥ radius) | √ BA ⊥ CA or |
| ∴ CA² = BC² - AB² (Pythagoras) | BAC = 90° |
| = (5)² - (√20)² = 5 | √ substitution into |
| CA = √5 or 2.24 units | Pythagoras |
| | √ answer |

**6.3**

| tan θ = \frac{\sqrt{5}}{\sqrt{20}} = \frac{\sqrt{5}}{2\sqrt{5}} = \frac{1}{2} | √ tan ratio (in any form) |

**6.4**

| m_{DC} \times m_{AB} = -1 | √ m_{DC} \times m_{AB} = -1 |
| m_{DC} = tan θ = \frac{1}{2} | √ m_{DC} = tan θ = \frac{1}{2} |
| m_{DC} = \frac{1}{2} | |
| m_{AB} = -2 | |

Notes:
- Use a right triangle for the angle calculation.
- Ensure all calculations are correct and consistent.
6.5

Eq. of DC: \( y - 6 = \frac{1}{2}(x + 1) \)
\[ y = \frac{1}{2}x + \frac{13}{2} \]

Eq. of AB: \( y - 1 = -2(x + 1) \)
\[ y = -2x - 1 \]

\[ -2x - 1 = \frac{1}{2}x + \frac{13}{2} \]
\[ \frac{5}{2}x = \frac{15}{2} \]
\[ x = -3 \]
\[ y = -2(-3) - 1 \]
\[ y = 5 \]

\[ \therefore \text{A} (-3;5) \]

OR

Eq. of DC: \( y - 6 = \frac{1}{2}(x + 1) \)
\[ y = \frac{1}{2}x + \frac{13}{2} \]

Eq. of AB: \( y - 1 = -2(x + 1) \)
\[ y = -2x - 1 \]

At A:
\[ x - 2(-2x - 1) + 13 = 0 \]
\[ x + 4x + 2 + 13 = 0 \]
\[ 5x = -15 \]
\[ x = -3 \]

and \( y = -2(-3) - 1 = 5 \)

\[ \therefore \text{A}(-3;5) \]

OR

Eq. of DC: \( y - 6 = \frac{1}{2}(x + 1) \)
\[ y = \frac{1}{2}x + \frac{13}{2} \]

Eq. of circle: \( (x + 1)^2 + (y - 1)^2 = 20 \)

At A:
\[ (x + 1)^2 + \left( \frac{1}{2}x + \frac{13}{2} - 1 \right)^2 = 20 \]
\[ (x + 1)^2 + \left( \frac{1}{2}x + \frac{11}{2} \right)^2 = 20 \]
\[ \frac{1}{4}x^2 + \frac{15}{2}x + 11 \frac{1}{4} = 0 \]

\[ \therefore x^2 + 6x + 9 = 0 \]
\[ (x + 3)^2 = 0 \]

\[ \therefore x = -3 \]

and \[ y = \frac{1}{2}(-3) + \frac{13}{2} = 5 \]

\[ \therefore \text{A}(-3;5) \]
OR

\[ \cos \theta = \frac{2\sqrt{5}}{5} = \frac{AE}{\sqrt{5}} = \frac{BE}{2\sqrt{5}} \]
\[ \therefore AE = \frac{2 \times 5}{5} = 2 \]
\[ BE = \frac{4 \times 5}{5} = 4 \]
\[ x_A = -1 - AE = -1 - 2 = -3 \]
\[ \therefore y_A = 1 + BE = 4 + 1 = 5 \]
\[ \therefore A(-3, 5) \]

\[ (x + 1)^2 + (y - 1)^2 = 20 \quad (1) \]
\[ y = -2x - 1 \quad (2) \]
\[ (x + 1)^2 + (-2x - 2)^2 = 20 \]
\[ x^2 + 2x + 1 + 4x^2 + 8x + 4 - 20 = 0 \]
\[ 5x^2 + 10x - 15 = 0 \]
\[ x^2 + 2x - 3 = 0 \]
\[ (x + 3)(x - 1) = 0 \]
\[ x = -3 \text{ or } x = 1 \]
\[ \text{subst (1) in (2)} \]
\[ \therefore y = 5 \]

\[ \sqrt{\frac{2\sqrt{5}}{5}} = \frac{AE}{\sqrt{5}} \]
\[ \sqrt{\frac{2\sqrt{5}}{5}} = \frac{BE}{2\sqrt{5}} \]
\[ \sqrt{\frac{2\sqrt{5}}{5}} = \text{BE} = 1 \]
\[ \sqrt{-3} \]
\[ \sqrt{5} \]

\[ \text{value of x} \]
\[ \text{value of y} \]
Equation AC: \[ y = \frac{1}{2}x + 6 \frac{1}{2} \]

\[ C (-1; 6) \]

\[ \tan \theta = \frac{1}{2} \]

\[ \theta = 26.57^\circ \]

\[ AP = \sqrt{5} \cos 26.57^\circ \]

\[ AP = 2 \]

\[ CP = \sqrt{5} \sin 26.57^\circ \]

\[ CP = 1 \]

\[ \therefore x = -1 - 2 = -3 \]

\[ y = 6 - 1 = 5 \]

\[ \therefore A(-3; 5) \]

6.6

Area \( \Delta ABC = \frac{1}{2}(\sqrt{5})(\sqrt{20}) = 5 \)

Eqn. of DC is \[ y = \frac{1}{2}x + \frac{13}{2} \]

Therefore \[ OF = \frac{13}{2} \] and \[ OD = 13 \].

Area \( \Delta ODF = \frac{1}{2}\left(\frac{13}{2}\right)(13) = \frac{169}{4} \)

Area \( \Delta ABC \): Area \( \Delta ODF = 5 \cdot \frac{169}{4} = 20 \cdot 169 \)

\[ DF^2 = 13^2 + \left(\frac{13}{2}\right)^2 = \frac{845}{4} \]

\[ DF = \frac{13\sqrt{5}}{2} \]

\[ \frac{\Delta ABC}{\Delta ODF} = \frac{\frac{1}{2}(5)(\sqrt{20}) \sin \theta}{\frac{1}{2}\left(\frac{13}{2}\right)\left(\frac{13\sqrt{5}}{2}\right) \sin \theta} \]

\[ = \frac{20}{169} \]

\[ \theta = 26.57^\circ \]

\[ AP = \sqrt{5} \cos 26.57^\circ \]

\[ AP = 2 \]

\[ CP = 1 \]

\[ \text{value of } x \]

\[ \text{value of } y \] (6)
QUESTION 7

7.1 \[(x; y) \rightarrow (x + 4; y) \rightarrow (x - 4; -y)\]

OR
\[(x; y) \rightarrow (-x - 4; -y)\]

\[\sqrt{x + 4}\]
\[\sqrt{y}\]
\[\sqrt{-x - 4}\]
\[\sqrt{-y}\]

7.2 New centre = (-2 ; -5)
\[(x + 2)^2 + (y + 5)^2 = 16\]
\[x^2 + 4x + 4 + y^2 + 10y + 25 - 16 = 0\]
\[x^2 + y^2 + 4x + 10y + 13 = 0\]

\[\sqrt{(-2 ; -5)}\]
\[\sqrt{(x + 2)^2 + (y + 5)^2}\]
\[\sqrt{16}\]
\[\sqrt{\text{simplification}}\]

QUESTION 8

8.1 Rotation of 90° anticlockwise about the origin.

OR
Rotation of 270° clockwise about the origin.

Note: if reflection of 90 anticlockwise: 0 marks

8.2 D(5 ; -4)
D' (4 ; 5)

\[\sqrt{4}\]
\[\sqrt{5}\]

8.3 G (-7 ; -6)

\[\sqrt{-7}\]
\[\sqrt{-6}\]

8.4 Area ABCD = 5 \times 2 = 10 square units
Area MNRP = \(10 \times \left(\frac{3}{2}\right)^2 = \frac{45}{2}\)

Area ABCD \times Area MNRP
= \(10 \times \frac{9}{4} \times 10\)
= 225 (units)^4

\[\sqrt{\text{area ABCD} = 10}\]
\[\sqrt{\text{area MNRP} = \frac{45}{2}}\]
\[\sqrt{225}\]
### QUESTION 9

#### 9.1

<table>
<thead>
<tr>
<th>9.1.1</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{3}{2}$</td>
<td>$\frac{3}{2}$</td>
</tr>
</tbody>
</table>

**Note:** CA will apply if $\left(\frac{3}{2}\right)^2$ used in calculation.

#### 9.1.2

<table>
<thead>
<tr>
<th>9.1.2</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{\sqrt{40}}{7}$</td>
<td>$\frac{\sqrt{40}}{7}$</td>
</tr>
</tbody>
</table>

#### 9.2

<table>
<thead>
<tr>
<th>9.2</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{\cos 100^\circ \times \tan^2 120^\circ}{\sin (-10^\circ)}$</td>
<td>$\frac{-\cos 80^\circ \times \tan 60^\circ}{\sin 10^\circ}$</td>
</tr>
</tbody>
</table>

---

**Note:** If $\frac{\cos 80^\circ}{\sin 10^\circ}$ (assume two negatives cancelled), no penalty
\[
\cos 100^\circ \times \tan^2 120^\circ \\
\frac{\sin(-10^\circ)}{(-\sin 10^\circ)} \\
= \frac{(-\cos 80^\circ)(-\tan 60^\circ)^2}{(-\sin 10^\circ)} \\
= \frac{(-\sin 10^\circ) \times (\sqrt{3})^2}{(-\sin 10^\circ)} \\
= 3
\]

\[
\cos 100^\circ \times \tan^2 120^\circ \\
\frac{\sin(-10^\circ)}{(-\sin 10^\circ)} \\
= \frac{\cos(90^\circ + 10^\circ) \times \tan^2 60^\circ}{-\sin(10^\circ)} \\
= \frac{-\sin 10^\circ \times (\sqrt{3})^2}{-\sin 10^\circ} \\
= 3
\]

\[
\begin{align*}
\text{Q} & \quad \text{O} \\
\text{P}(4; 3) & \quad \text{R} \\
\text{M}(a; b) & \quad \text{x} \quad \text{y}
\end{align*}
\]

<table>
<thead>
<tr>
<th>9.3</th>
<th>9.3.1</th>
<th>(r = 5)</th>
<th>(\sin R\hat{O}P = \frac{3}{5} = 0,6)</th>
<th>(\checkmark 5)</th>
<th>(\checkmark \text{ratio})</th>
</tr>
</thead>
</table>

\[
9.3.2 \quad R\hat{O}P = 36,87^\circ \\
Q\hat{O}P = 180^\circ - 36,869^\circ \ldots \checkmark 36,869^\circ \ldots \checkmark 143,13^\circ \\
\checkmark 143,13^\circ \ldots \checkmark \text{Answer only: Full Marks}
\]

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9.3.3 \[ x_m = x \cos \theta + y \sin \theta \]
\[ a = 4 \cos 115^\circ + 3 \sin 115^\circ \]
\[ a = 1.03 \]

Note: Penalise 1 mark for rounding incorrectly
Note: If incorrect angle is used in the \( x \)-formula:
1 mark

OR

Rotation of 115° clockwise = 245° anticlockwise
\[ x_m = x \cos \theta - y \sin \theta \]
\[ a = 4 \cos 245^\circ - 3 \sin 245^\circ \]
\[ a = 1.03 \]

OR

\[ \tan P\hat{O}R = \frac{3}{4} \]
\[ \hat{P}OR = 36.86\ldots^\circ \]
\[ \hat{M}OR = 78.13\ldots^\circ \]
\[ \cos \hat{M}OR = \frac{a}{5} \]
\[ a = 5 \cos 78.13^\circ \]
\[ a = 1.03 \]

QUESTION 10

10.1 \( f(225^\circ) = 2 \)
\[ \therefore a \tan 225^\circ = 2 \]
\[ \therefore a = 2 \]
\[ g(0) = 4 \]
\[ \therefore b \cos 0^\circ = 4 \]
\[ \therefore b = 4 \]

Answer only: Full marks

✓ substitution
✓ \( a = 2 \)

10.2 Minimum value of \( g(x) + 2 = -4 + 2 = -2 \)

Answer only: Full marks

✓ \(-4\)
✓ \(-2\)

10.3 Period = \( \frac{180^\circ}{\frac{1}{2}} = 360^\circ \)

Answer only: Full marks

✓ \( \frac{180^\circ}{\frac{1}{2}} \)
✓ \( 360^\circ \)
### QUESTION 11

#### 11.1

**Area \( \Delta ABC \)**

\[
\text{Area } \Delta ABC = \frac{1}{2} \cdot AB \cdot BC \cdot \sin 50^\circ
\]

\[
= \frac{1}{2} \cdot 5 \cdot 5 \sin 50^\circ
\]

\[
= 9.58 \text{ units}^2
\]

**OR**

Area of \( \Delta ABC \)

\[
= \frac{1}{2} \cdot (2 \cdot 5 \sin 25^\circ \cdot 5 \cos 25^\circ)
\]

\[
= 9.58 \text{ units}^2
\]

**OR**

Area of \( \Delta ABC \)

\[
= \left[ \frac{1}{2} \cdot (5 \cos 65^\circ \cdot 5 \sin 65^\circ) \right] \cdot 2
\]

\[
= 9.58 \text{ units}^2
\]
11.2 $AC^2 = 5^2 + 5^2 - 2(5)(5)\cos 50^\circ$
$AC^2 = 17,86061952$
$AC = 4,23\ units$

OR

$\hat{A} = \hat{C} = 65^\circ$ (angles opposite equal sides)

$$\frac{\sin 65^\circ}{5} = \frac{\sin 50^\circ}{AC}$$

$$AC = \frac{5\sin 50^\circ}{\sin 65^\circ} = 4,23\ units$$

OR

$$\sin 25^\circ = \frac{\frac{1}{2}(AC)}{5}$$

$$AC = 2(5)\sin 25^\circ = 4,23\ units$$

OR

$$\cos 65^\circ = \frac{\frac{1}{2}(AC)}{5}$$

$$AC = 2(5)\cos 65^\circ$$

$$AC = 4,23\ units$$

11.3 $\tan 25^\circ = \frac{CF}{AC}$

$\therefore CF = 4,23 \times \tan 25^\circ$

$\therefore CF = 1,97\ units$

OR

$$\frac{FC}{\sin 25^\circ} = \frac{4,23}{\sin 65^\circ}$$

$$FC = \frac{4,23\sin 25^\circ}{\sin 65^\circ} = 1,97\ units$$

[8]
QUESTION 12

12.1

\[ LHS = \frac{\sin(360° + 90° + x - \alpha)}{\cos(\alpha - x)} \]
\[ = \frac{\sin(90° + x - \alpha)}{\cos(\alpha - x)} \]
\[ = \frac{\cos(x - \alpha)}{\cos(\alpha - x)} \]
\[ = \frac{\cos(\alpha - x)}{\cos(\alpha - x)} \]
\[ = 1 \]

\[ \checkmark \text{subtracting } 360° \]
\[ \checkmark \cos(x - \alpha) \]
\[ \checkmark \cos(\alpha - x) \]

OR

\[ LHS = \frac{\sin[90° - (\alpha - x)]}{\cos(\alpha - x)} \]
\[ = \frac{\cos(\alpha - x)}{\cos(\alpha - x)} \]
\[ = 1 \]
\[ = \text{RHS} \]

\[ \checkmark \text{subtracting } 360° \]
\[ \checkmark \text{writing as } 90° - (\alpha - x) \]
\[ \checkmark \cos(\alpha - x) \]

(3)

12.2

\[ \cos 2x = 1 - 3 \cos x \]
\[ 2 \cos^2 x - 1 = 1 - 3 \cos x \]
\[ 2 \cos^2 x + 3 \cos x - 2 = 0 \]
\[ (2 \cos x - 1)(\cos x + 2) = 0 \]
\[ \cos x = \frac{1}{2} \quad \text{or } \cos x = -2 \]
\[ \text{n/a} \]
\[ x = 60° + k.360° ; k \in \mathbb{Z} \text{ or } x = 300° + k.360° ; k \in \mathbb{Z} \]

\[ \checkmark \]
\[ \cos 2x = 2 \cos^2 x - 1 \]
\[ \checkmark \text{factorisation} \]
\[ \checkmark \cos x = \frac{1}{2} \]
\[ \checkmark 60° \]
\[ \checkmark 300° \]
\[ \checkmark + k.360° \]
\[ k \in \mathbb{Z} \]

(7)

OR

\[ x = \pm 60° + k.360° ; k \in \mathbb{Z} \]

12.3.1

\[ \text{LHS:} \]
\[ \frac{\sin A \cos B - \cos A \sin B}{\sin B \cos B} \]
\[ = \frac{\sin(A - B)}{\sin B \cos B} \]
\[ \text{RHS:} \]
\[ = \frac{2 \sin(A - B)}{2 \sin B \cos B} \]
\[ = \frac{\sin(A - B)}{\sin B \cos B} \]
\[ = \text{LHS} \]

\[ \checkmark \text{writing as single fraction} \]
\[ \checkmark \text{comp. angle expansion} \]
\[ \checkmark \text{comp. angle expansion} \]
\[ \checkmark \text{simplification} \]

(4)
<table>
<thead>
<tr>
<th>LHS:</th>
<th>RHS:</th>
</tr>
</thead>
</table>
| \[
\frac{\sin A \cos B - \cos A \sin B}{\sin B \cos B} = \frac{\sin(A - B)}{\sin B \cos B} = \frac{2 \sin(A - B)}{2 \sin B \cos B} = \frac{2 \sin(A - B)}{\sin 2B} = \frac{RHS}{sin 2B} = \frac{2 \sin(A - B)}{\sin 2B} = \frac{2 \sin B \cos B}{\sin A \cos B - \cos A \sin B} = \frac{\sin A \cos B - \cos A \sin B}{\sin B \cos B} = \frac{\sin A}{\sin B} \cdot \frac{\cos A}{\cos B} = LHS
\] | ✓ writing as single fraction ✓ comp. angle expansion ✓ mult. by 2 ✓ comp. angle expansion |

(4)

(4)
12.3.2(a) \( A = 5B \)
\[
\frac{\sin 5B}{\sin B} - \frac{\cos 5B}{\cos B} = \frac{2\sin(5B-B)}{\sin 2B} = \frac{2\sin 4B}{\sin 2B} = \frac{4 \sin 2B \cos 2B}{\sin 2B} = 4 \cos 2B
\]

OR
\[
\frac{\sin 5B}{\sin B} - \frac{\cos 5B}{\cos B} = \frac{\sin 5B \cos B - \cos 5B \sin B}{\sin B \cos B} = \frac{\sin (5B-B)}{\sin B \cos B} = \frac{\sin 4B}{\sin 2B} = \frac{1}{2} \frac{2 \sin 2B \cos 2B}{\sin 2B} = \frac{1}{2} \sin 2B = 4 \cos 2B
\]

12.3.2(b) \( B = 18^\circ \)
\[
\frac{\sin 90^\circ}{\sin 18^\circ} = \frac{\cos 90^\circ}{\cos 18^\circ} = 4 \cos 2(18^\circ)
\]
\[\therefore 1 \quad \frac{1}{\sin 18^\circ} = 0 = 4 \cos 36^\circ\]
\[\therefore \quad \frac{1}{\sin 18^\circ} = 4 \cos 36^\circ\]

12.3.2(c) Let \( \sin 18^\circ = a \)
\[
\frac{1}{\sin 18^\circ} = 4 \cos 36^\circ
\]
\[
\frac{1}{\sin 18^\circ} = 4(1 - 2 \sin^2 18^\circ)
\]
\[\therefore \quad \frac{1}{a} = 4(1 - 2a^2)\]
\[\therefore \quad 1 = 4a - 8a^3\]
\[\therefore \quad 8a^3 - 4a + 1 = 0\]

Hence \( \sin 18^\circ \) is a solution of \( 8x^3 - 4x + 1 = 0 \)

OR
\[
\frac{1}{\sin 18^\circ} = 4 \cos 36^\circ \\
\frac{1}{\sin 18^\circ} = 4(1 - 2 \sin^2 18^\circ) \\
\frac{1}{\sin 18^\circ} = 4 - 8 \sin^2 18^\circ \\
8(\sin 18^\circ)^3 - 4(\sin 18^\circ) + 1 = 0
\]
Hence \( \sin 18^\circ \) is a solution of \( .: 8x^3 - 4x + 1 = 0 \)

Note: substituting \( x = \sin 18^\circ \) into \( 8x^3 - 4x + 1 \) using a calculator showing equal to 0: 0 marks

\[\checkmark \cos 36^\circ \\
\checkmark 1 - 2 \sin^2 18^\circ \\
\checkmark \text{simplification} \\
\checkmark \text{equation i.t.o} \\
\checkmark \sin 18^\circ \\
\checkmark \text{replacing} \\
\sin 18^\circ = x \]

(4) [24]

TOTAL: 150