



**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

SEPTEMBER 2022

MATHEMATICS P2 (DEAF)

MARKS: 150

TIME: 3 hours

This question paper has 14 pages, including a 1-page information sheet, and an answer book of 18 pages.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully.

1. This question paper has 10 questions.
2. **Answer ALL** the questions in the SPECIAL ANSWER BOOK provided_(given).
3. **Show ALL** calculations, diagrams, graphs, etc. which you have used in determining your answers.
4. Answers only will NOT necessarily be awarded full marks.
5. You may **use** an **approved scientific calculator** (non-programmable and non-graphical), unless stated otherwise.
6. **Round off answers** correct to TWO decimal places, unless stated otherwise.
7. Diagrams are NOT necessarily drawn to scale.
8. An **information sheet** with **formulae** is **included** at the **end** of the **question paper**.
9. Write neatly.

QUESTION 1

A hundred athletes took part in a long jump competition. The distance, in centimetres, of their best jumps is summarised in the table below.

Distance of Jumps (in cm)	Number of athletes
$420 < d \leq 460$	6
$460 < d \leq 500$	14
$500 < d \leq 540$	16
$540 < d \leq 580$	42
$580 < d \leq 620$	14
$620 < d \leq 660$	2
$660 < d \leq 700$	3
$700 < d \leq 740$	2
$740 < d \leq 780$	1

- 1.1 **Complete the cumulative frequency column in your ANSWER BOOK.** (2)
- 1.2 **Draw an ogive (cumulative frequency curve) to represent the above information in your ANSWER BOOK.** (4)
- 1.3 **Use your graph to estimate the median jump of the competition.** (2)
- 1.4 **What percentage of athletes jumped over 560 cm?** (2)

[10]

QUESTION 2

The following table shows a comparison of the distances (centimetres) jumped by 6 long jumpers and the hours spent practising their jumps in a week.

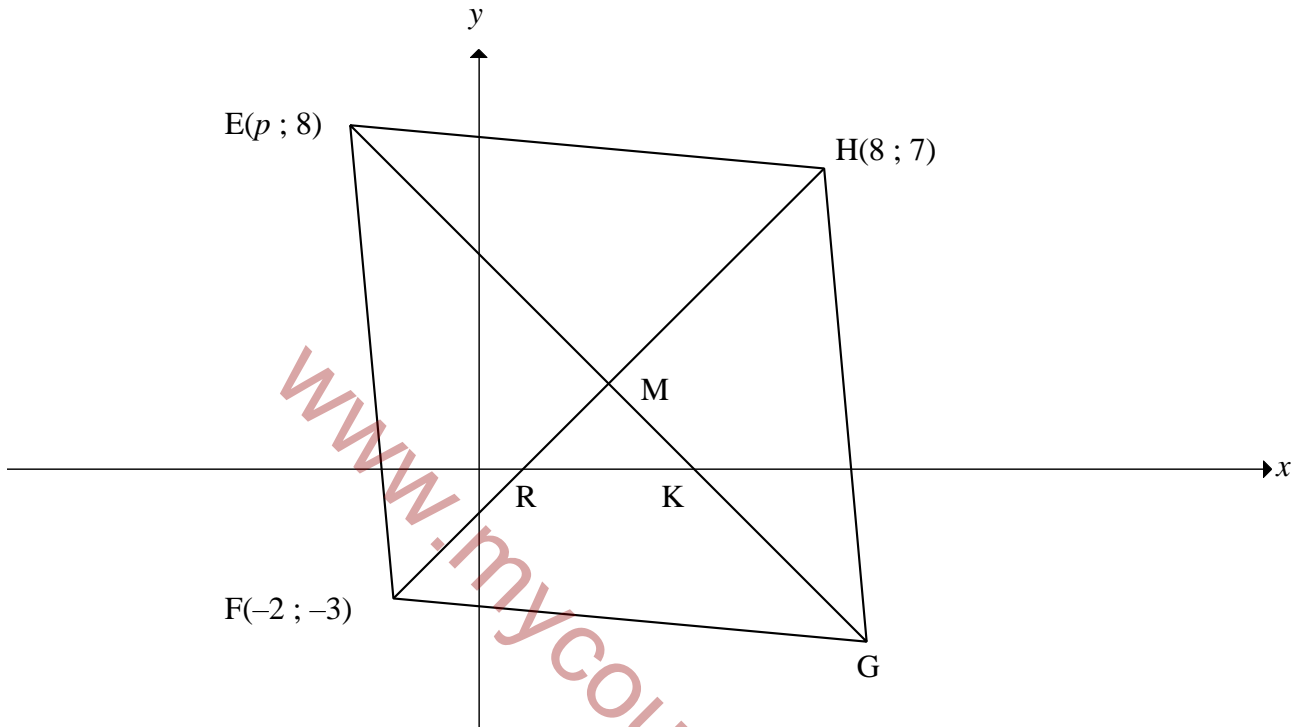
Long jumper	1	2	3	4	5	6
x: Hours practised	4,5	2	3,5	4	8	3
y: Distance jumped (cm)	650	420	580	490	780	525

- 2.1 Determine_(find out) the **equation** for the **least squares regression line** for the **data**. (3)
- 2.2 **Predict** the **distance jumped** by a **long jumper** who **practiced** for **5,4 hours**. (2)
- 2.3 **Comment** on the **validity** of your **answer** in QUESTION 2.2. **Motivate**_(give reasons) your answer. (2)
- 2.4 At the end of the event, they found that the measuring tape used was broken and all distances were decreased by 13 cm. **How** will this **influence** the:
- 2.4.1 Mean jump of the event? (1)
- 2.4.2 Range of the jumps during this event? (1)
- 2.4.3 Standard deviation? (1)

[10]

QUESTION 3

In the diagram below, $E(p; 8)$, $F(-2; -3)$, G and $H(8; 7)$ are **vertices** of **rhombus EFGH**.
The diagonals EG and FH intersect at M and cut the x -axis at K and R respectively.

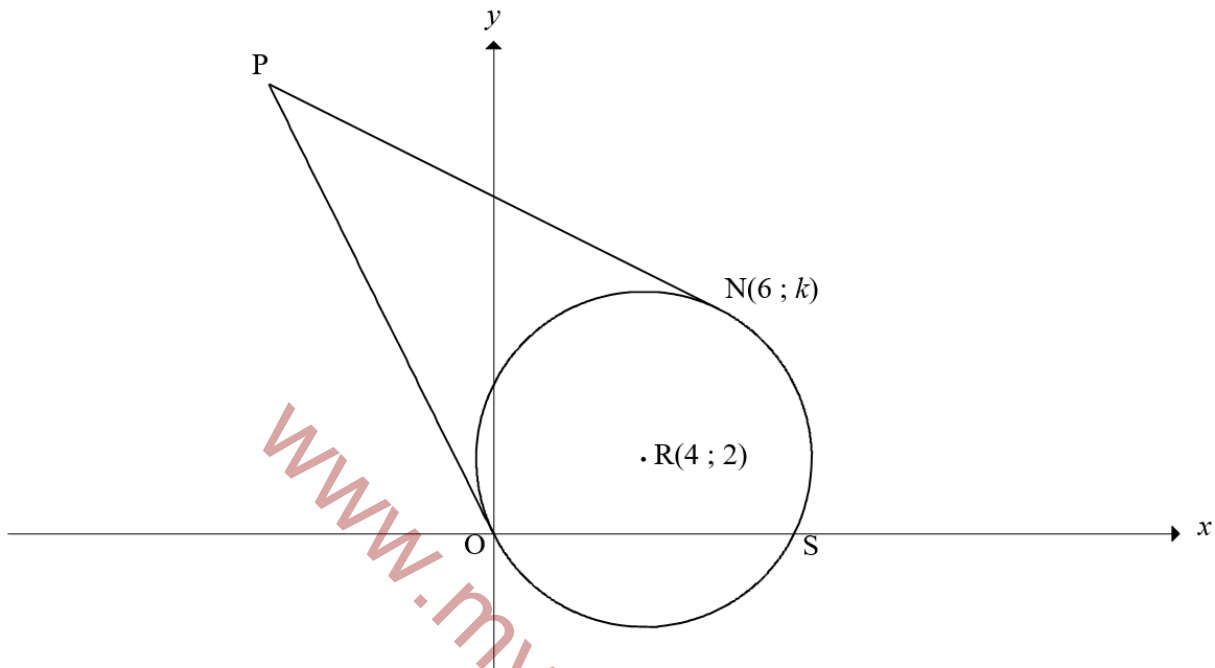


- 3.1 Calculate the:
- 3.1.1 Coordinates of M (2)
 - 3.1.2 Gradient of FH (2)
 - 3.1.3 Size of $\hat{M}KR$ (4)
- 3.2 Use the **properties** of a **rhombus** to **calculate** the **value** of p . (4)
- 3.3 Calculate the coordinates of G . (2)
- 3.4 The rhombus is reflected about the line $x = -3$. N is the image of M after the reflection.
Calculate the **length** of MN . (3)

[17]

QUESTION 4

In the diagram below, a circle centred at $R(4; 2)$ passes through the origin O , S and $N(6; y)$. From P , a point outside the circle, tangents are drawn to O and N .



4.1 **Determine**(find out) the equation of the circle in the form $(x-a)^2 + (y-b)^2 = r^2$. (3)

4.2 **Calculate** the **value** of k . (4)

4.3 **Determine**(find out) the **equation** of **NP** in the form $y = mx + c$. (5)

4.4 It is further given that the equation of **OP** is $y = -2x$.

Calculate the:

4.4.1 Coordinates of **P** (3)

4.4.2 Perimeter of **PNRO** (4)

4.5 Another circle, centred at **T**, is drawn to touch the circle, centred at **R**, at **S** externally. The radii of both circles are equal in length. **Determine**(find out) the coordinates of **T**. (4)

[23]

QUESTION 5

5.1 Given that: $\cos 26^\circ = p$

Express each of the **following** in **terms of p** , **without using a calculator**.

5.1.1 $\sin 26^\circ$ (2)

5.1.2 $\tan 154^\circ$ (3)

5.1.3 $\sin 13^\circ \cdot \cos 13^\circ$ (2)

5.2 Determine (find out), **without using a calculator**, the **value** of the following **expressions**:

5.2.1 $\frac{\cos(-\theta) \cdot \tan(180^\circ + \theta)}{2 \cos(90^\circ + \theta)}$ (5)

5.2.2 $1 + 2 \cos 105^\circ \cdot \sin 15^\circ$ (4)

5.3 Consider: $\frac{1 - \cos 2x - \sin x}{\sin 2x - \cos x} = \tan x$

5.3.1 **Prove the identity.** (4)

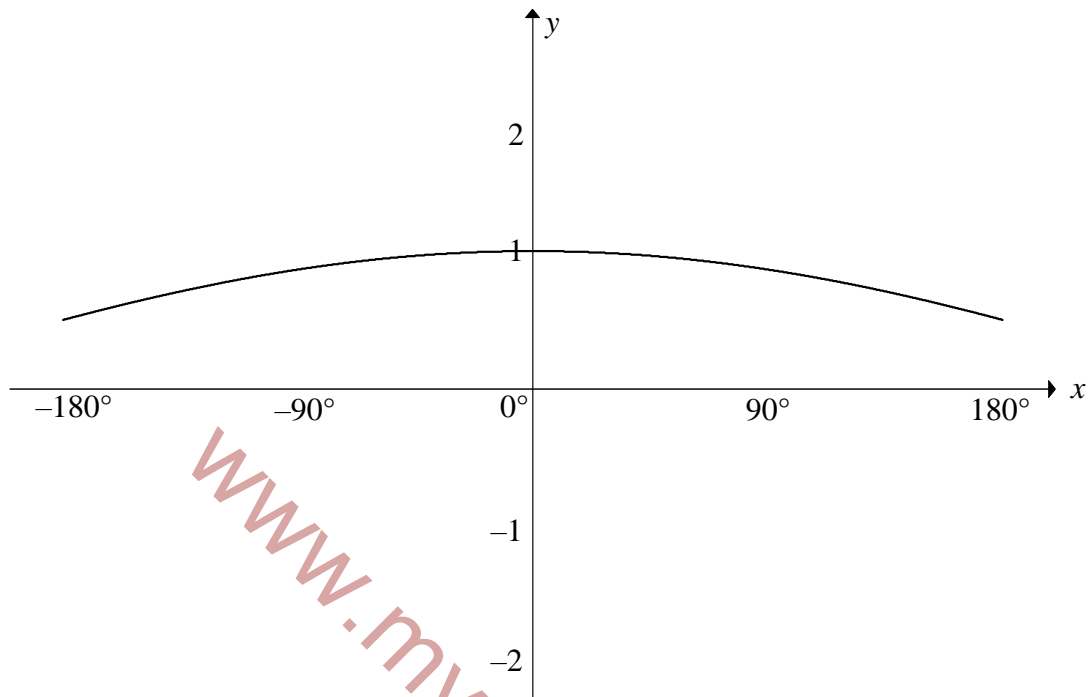
5.3.2 For **which value(s)** of x , in the interval $x \in [-180^\circ; 180^\circ]$, is the **identity not valid?** (3)

5.4 **Determine** (find out) the **general solution** of: $\sin^2 x + 2 \sin x \cos x = 3 \cos^2 x$ (7)

[30]

QUESTION 6

Sketched below is the graph of $f(x) = \cos\left(\frac{x}{3}\right)$, in the interval $x \in [-180^\circ; 180^\circ]$.

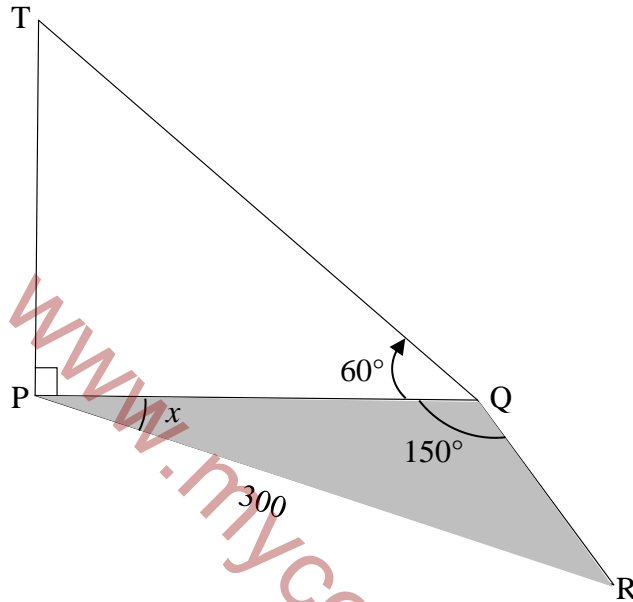


- 6.1 On the **grid given** in the ANSWER BOOK, **draw the graph** of $g(x) = \sin x + 1$, clearly **showing ALL intercepts** with the axes as well as the **coordinates of all turning points**. (3)
- 6.2 Write down the:
- 6.2.1 **Period** of f (1)
- 6.2.2 **Range** of $g(x) - 3$ (2)
- 6.3 **Determine** (find out) the **maximum distance** of $g(x) - h(x)$, where h is the reflection of g in the x -axis, in the interval $x \in [-180^\circ; 180^\circ]$. (2)
- 6.4 For **which values** of x in the **interval** $x \in [-180^\circ; 180^\circ]$ will $f(x) \cdot g'(x) > 0$? (2)
- 6.5 The graph of g undergoes a transformation to form a new graph $k(x) = \sin(x - 15^\circ)$.
Describe in words the transformation from g to k . (2)

[12]

QUESTION 7

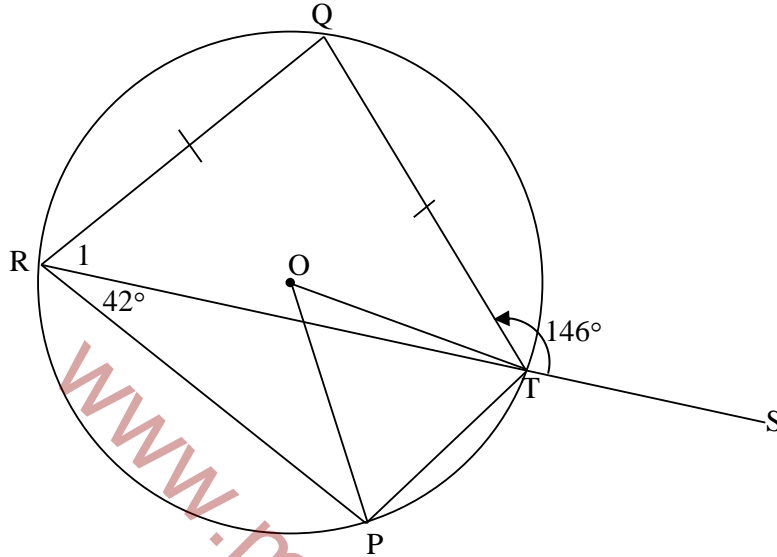
In the diagram below, TP represents the height of a building. The foot of the building P and the points Q and R are in the same horizontal plane. From Q, the angle of elevation to the top of the building is 60° . $\widehat{PQR} = 150^\circ$, $\widehat{QPR} = x$ and the distance between P and R is 300 metres.



- 7.1 Write down \widehat{R} in terms of x . (1)
- 7.2 Determine (find out) the length of PQ in terms of x . (3)
- 7.3 Show that: $TP = 300\sqrt{3}(\cos x - \sqrt{3}\sin x)$ (4)
- [8]

QUESTION 8

In the diagram, PRQT is a cyclic quadrilateral in the circle with $QR = QT$. Chord RT is produced to S and radii OP and OT are drawn. $\widehat{PRT} = 42^\circ$ and $\widehat{QTS} = 146^\circ$.



Determine (find out), giving reasons, the size of the following angles:

8.1 \widehat{POT} (2)

8.2 $\widehat{R_1}$ (2)

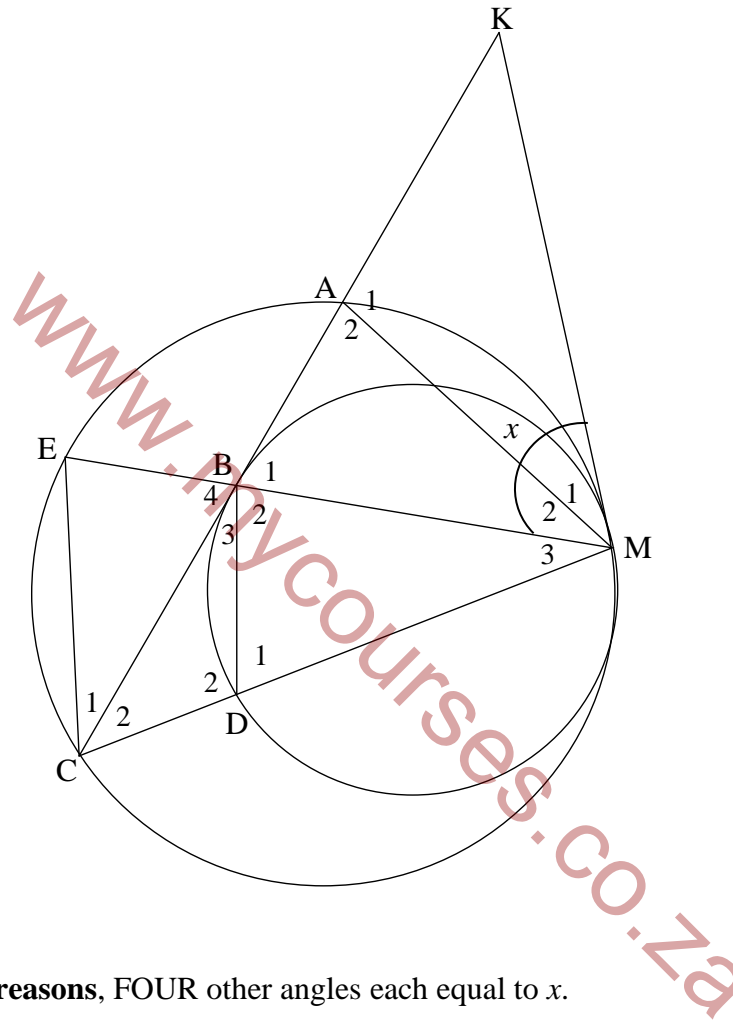
8.3 \widehat{RPT} (3)

[7]

QUESTION 9

In the diagram, the two circles touch internally at M. MK is a common tangent to the circles. A, E and C are points on the larger circle and B and D are points on the smaller circle. Chord CA is produced to meet the tangent at K. $\triangle MEC$ is drawn. CA and EM meet at B. KB is a tangent to the smaller circle at B. D is a point on CM. AM and BD are drawn.

Let $\widehat{KMB} = x$.



9.1 Name, giving reasons, FOUR other angles each equal to x . (5)

9.2 Prove, giving reasons, that:

9.2.1 $BD \parallel EC$ (2)

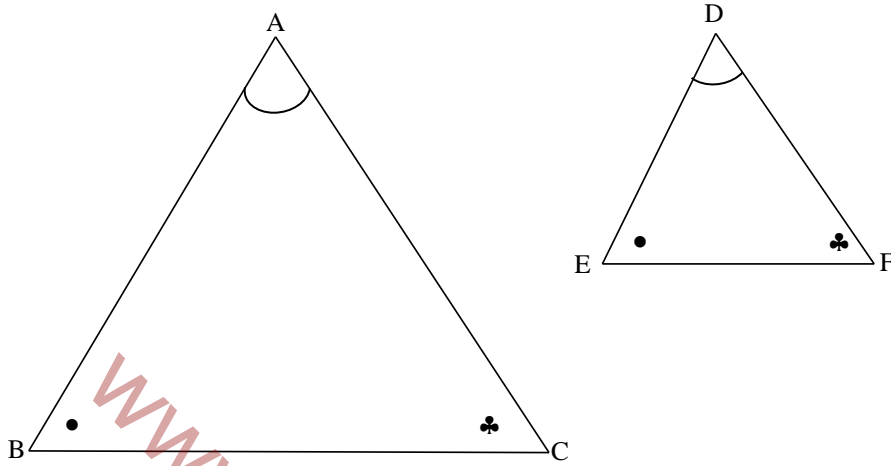
9.2.2 $\widehat{A}_2 = \widehat{B}_2$ (3)

9.2.3 $ME \times MD = MC \times MB$ (2)

[12]

QUESTION 10

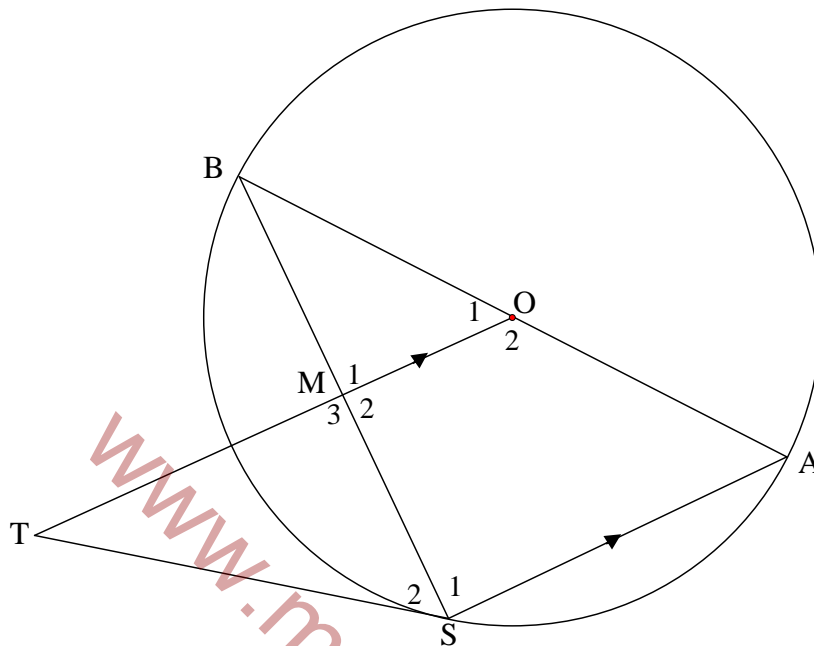
10.1 In the diagram below, $\triangle ABC$ and $\triangle DEF$ are given such that $\hat{A} = \hat{D}$, $\hat{B} = \hat{E}$ and $\hat{C} = \hat{F}$.



Prove the theorem that states if two triangles are equiangular, then their sides are in proportion, i.e., prove that: $\frac{DE}{AB} = \frac{DF}{AC}$

(6)

10.2 In the diagram, AB is a diameter of the circle centred at O. $\triangle ABS$ is drawn with S a point on the circle. M is a point on BS and OM is produced to T such that $AS \parallel OM$. TS is drawn such that BOST is a cyclic quadrilateral.



Prove, giving reasons, that:

10.2.1 TS is a tangent to the circle at S (4)

10.2.2 TS is the diameter of a circle passing through points T, M and S (5)

10.2.3 $\triangle ABS \sim \triangle STM$ (3)

10.2.4 $AS \cdot MT = 2SM^2$ (3)

[21]

TOTAL: 150

INFORMATION SHEET: MATHEMATICS

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$A = P(1 + ni)$$

$$A = P(1 - ni)$$

$$A = P(1 - i)^n$$

$$A = P(1 + i)^n$$

$$\sum_{i=1}^n 1 = n$$

$$\sum_{i=1}^n i = \frac{n(n+1)}{2}$$

$$T_n = a + (n-1)d$$

$$S_n = \frac{n}{2}(2a + (n-1)d)$$

$$T_n = ar^{n-1}$$

$$S_n = \frac{a(r^n - 1)}{r - 1}; \quad r \neq 1$$

$$S_\infty = \frac{a}{1 - r}; \quad -1 < r < 1$$

$$F = \frac{x[(1+i)^n - 1]}{i}$$

$$P = \frac{x[1 - (1+i)^{-n}]}{i}$$

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$M\left(\frac{x_1 + x_2}{2}; \frac{y_1 + y_2}{2}\right)$$

$$y = mx + c$$

$$y - y_1 = m(x - x_1)$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \tan \theta$$

$$(x - a)^2 + (y - b)^2 = r^2$$

$$\text{In } \triangle ABC: \quad \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} \quad a^2 = b^2 + c^2 - 2bc \cdot \cos A \quad \text{area } \triangle ABC = \frac{1}{2} ab \cdot \sin C$$

$$\sin(\alpha + \beta) = \sin \alpha \cdot \cos \beta + \cos \alpha \cdot \sin \beta \quad \sin(\alpha - \beta) = \sin \alpha \cdot \cos \beta - \cos \alpha \cdot \sin \beta$$

$$\cos(\alpha + \beta) = \cos \alpha \cdot \cos \beta - \sin \alpha \cdot \sin \beta \quad \cos(\alpha - \beta) = \cos \alpha \cdot \cos \beta + \sin \alpha \cdot \sin \beta$$

$$\cos 2\alpha = \begin{cases} \cos^2 \alpha - \sin^2 \alpha \\ 1 - 2\sin^2 \alpha \\ 2\cos^2 \alpha - 1 \end{cases}$$

$$\sin 2\alpha = 2\sin \alpha \cdot \cos \alpha$$

$$\bar{x} = \frac{\sum x}{n}$$

$$\sigma^2 = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n}$$

$$P(A) = \frac{n(A)}{n(S)}$$

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$\hat{y} = a + bx$$

$$b = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sum (x - \bar{x})^2}$$