

ONE PAGE NOTES SPM MATHEMATICS VERSION 2022

SMARTSTUDY PAPER 2 ~ FOCUS 25

<i>BIL</i>	<i>TOPIC</i>	<i>PAGES</i>
1	STRAIGHT LINES	1
2	SIMULTANEOUS LINEAR EQUATIONS	2
3	MATRICES	3
4	GRAPH OF MOTION	4
5	PLANS AND ELEVATIONS	5
6	CONGRUENCY, ENLARGEMENT AND COMBINED TRANSFORMATIONS	6
7	MEASURES OF DISPERSION FOR UNGROUPED DATA	7
8	MEASURES OF DISPERSION FOR GROUPED DATA	8
9	OPERATIONS ON SETS	9
10	QUADRATIC FUNCTIONS & EQUATIONS	10
11	LINEAR INEQUALITIES IN TWO VARIABLES	11
12	PROBABILITY OF COMBINED EVENTS	12
13	LOGICAL REASONING	13
14	NETWORK IN GRAPH THEORY	14
15	FINANCIAL MANAGEMENT	15
16	INSURANCE	16 – 17
17	TAXATION	18 – 19
18	RATIOS AND GRAPHS OF TRIGONOMETRIC FUNCTIONS	20 – 21
19	VARIATION	22
20	GRAPHS OF FUNCTIONS	23
21	CIRCUMFERENCE AND AREA OF CIRCLE (ARC LENGTH & AREA OF SECTOR)	24
22	SAVINGS & INVESTMENT, CREDIT & DEBT	25
23	VOLUME AND TOTAL SURFACE AREA OF SOLIDS	26
24	NUMBER BASES	27
25	LOCI IN TWO DIMENSIONS	28
MATHEMATICAL FORMULAE		29 – 31

STRAIGHT LINES

(ONE PAGE NOTES ~ SMART PAPER 2 → FOCUS 1)

Formulae & Notes :

type 1

- given : 2 points $\underbrace{\hspace{2em}}$ m & 1 point $\underbrace{\hspace{2em}}$ c

type 2

- given : 1 equation & 1 point $\underbrace{\hspace{2em}}$ c

express y in terms of x

m and c

find equation of straight line

$y = mx + c$

coordinates \rightarrow coordinate-y

equation $y = ?$ \rightarrow y-intercept

coordinates \rightarrow coordinate-x

equation $x = ?$ \rightarrow x-intercept

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

$$m = -\left(\frac{\text{y-intercept}}{\text{x-intercept}}\right)$$

$$m = +\left(\frac{a}{b}\right) \quad m = -\left(\frac{a}{b}\right)$$

collinear have the same gradient

parallel $m_1 = m_2$

Pythagoras Theorem

3	4	5
6	8	10
9	12	15

5	12	13
7	24	25

8	15	17
---	----	----

- find x-intercept** \rightarrow substitute $\sim y = 0$
- find y-intercept** \rightarrow value of c @ substitute $\sim x = 0$
- point lies on line** \rightarrow point satisfies equation (substitute into equation)
- intersection point** \rightarrow simultaneous linear equation

y-coordinate similar $\rightarrow y = 5$

x-coordinate similar $\rightarrow x = 2$

distance

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

midpoint

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

Analysis of past year's questions :

SKILLS	YEAR / DISTRIBUTION OF QUESTIONS									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
TYPE	A7	A7	A5	A6	A6	A8*	A7	A7	A9	A7*
concept of parallel (2011)	2	1	2	1	1	2	2	1	1	1
equation of straight line										
(i) $y = mx + c$	(a)	(b)	(a)	(a)	(a)	(b)	(b)	✓	(b)(i)	(b)(ii)
(ii) $y = ?$							(a)		(a)	(a)
(iii) $x = ?$		(a)								
x-intercept	(b)	(c)	(b)	(b)	(b)	(a)	(c)		(b)(ii)	
y-intercept										
distance						(a)		✓		(b)(i)
“Pythagoras Theorem” numbers								✓	(a)	(b)(i)
midpoint										
point lies on line							(c)			
intersection of 2 straight lines										
MARKS	5	6	5	5	5	5	6	4	6	5

SIMULTANEOUS LINEAR EQUATIONS

(ONE PAGE NOTES ~ SMART PAPER 2 → FOCUS 2)

Formulae & Notes :

Steps of solution by using the "ELIMINATION" method :

- (1) equate the coefficient of the term to be eliminate, with the operation \times or \div
- (2) do the elimination :
 - (a) same sign, eliminate with the operation $(-)$
 - (b) different sign, eliminate with the operation $(+)$

Example, 2007, No.2 → Solve : $g + 2h = 1$ dan $4g - 3h = -18$

- eliminate term $g \sim$ same sign, use $(-)$

$$\begin{array}{r}
 \cancel{4g} + 8h = 4 \\
 -) \cancel{4g} - 3h = -18 \\
 \hline
 11h = 22 \\
 h = 2
 \end{array}$$

$$\begin{array}{l}
 g + 2(2) = 1 \\
 g = -3
 \end{array}$$

- eliminate term $h \sim$ different sign, use $(+)$

$$\begin{array}{r}
 3g + \cancel{6h} = 3 \\
 +) 8g - \cancel{6h} = -36 \\
 \hline
 11g = -33 \\
 g = -3
 \end{array}$$

$$\begin{array}{l}
 -3 + 2h = 1 \\
 h = 2
 \end{array}$$

check the answers using a calculator, $ax + by = c$

mode mode mode 1 2

$a_1 ? 1 =$ $b_1 ? 2 =$ $c_1 ? 1 =$

$a_2 ? 4 =$ $b_2 ? -3$ $c_2 ? -18 =$

→ $x = -3$

$y = 2$

Solution steps by using the "SUBSTITUTION" method ::

Example → Solve : $3y - 2x = 6$ dan $y = 2x - 2$

$$\begin{array}{l}
 3(2x - 2) - 2x = 6 \\
 6x - 6 - 2x = 6 \\
 4x = 12 \\
 x = 3
 \end{array}$$

$$\begin{array}{l}
 y = 2(3) - 2 \\
 y = 4
 \end{array}$$

- Examples of writing linear equations :

Eric put a total of RM5000 into two different banks.	$x + y = 5000$
The difference angle of sector between sodium and calcium intakes is 36° .	$S - C = 36$
5 packs of nasi lemak and 8 packs of fried noodles cost RM42.90.	$5N + 8F = 42.90$
The total number of legs for x chickens and y goats is 88.	$2C + 4G = 88$
The price of Adidas shoes is 1.5 times the price of Nike shoes.	$A = 1.5N$
Each teacher has to pay RM40 more than a student's fee.	$T - S = 40$
Pay for 7 slices of pizza with a RM45 voucher, need to add money equivalent to the price of a cake.	$P = 45 + C$
The ratio of banana trees to chilli trees is 2 : 5.	$\frac{B}{C} = \frac{2}{5} \rightarrow 5B = 2C$

Analysis of past year's questions :

SKILLS	YEAR / DISTRIBUTION OF QUESTIONS									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
	A4	A2	A2	A2	A3	A4	A5	A3	A6	A, C
routine form	✓	✓		✓	✓					
problem solving			✓			✓	✓	✓	✓	8 16(b) 17(b)
MARKS	4	4	4	4	4	5	4	5	4	4, 4, 4

MATRICES

(ONE PAGE NOTES ~ SMART PAPER 2 → FOCUS 3)

Formulae & Notes :

• **find inverse matrix :**

$$\bullet \begin{pmatrix} a & b \\ c & d \end{pmatrix}^{-1} = \frac{1}{ad-bc} \begin{pmatrix} d & -b \\ -c & a \end{pmatrix} \xrightarrow[\text{does not have an inverse}]{\text{inverse does not exist / undefine}} \begin{matrix} ad-bc = 0 \\ \text{(determinant)} \end{matrix}$$

$$\sim PQ = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} = I \left. \begin{matrix} \swarrow P = Q^{-1} \\ \searrow Q = P^{-1} \end{matrix} \right\} P[P^{-1}] = I @ Q^{-1}[Q] = I$$

$$\sim AI = IA = A \rightarrow \text{If } \begin{pmatrix} a & b \\ c & d \end{pmatrix} P = \begin{pmatrix} a & b \\ c & d \end{pmatrix}, \text{ then } P = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \text{ matrix identity, } I$$

• **solve simultaneous linear equations using “matrix method” :**

$$\Rightarrow \begin{matrix} ax+by=e \\ cx+dy=f \end{matrix} \Rightarrow \begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} e \\ f \end{pmatrix} @ (x \ y) \begin{pmatrix} a & c \\ b & d \end{pmatrix} = (e \ f)$$

Example $\rightarrow \begin{matrix} 2x-5y = -17 \\ x+3y = 8 \end{matrix} \Rightarrow \begin{pmatrix} 2 & -5 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} -17 \\ 8 \end{pmatrix} \dashrightarrow \begin{pmatrix} a_1 & b_1 \\ a_2 & b_2 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} c_1 \\ c_2 \end{pmatrix}$

$$\begin{pmatrix} x & y \end{pmatrix} \begin{pmatrix} 2 & 1 \\ -5 & 3 \end{pmatrix} = (-17 \ 8)$$

$$\begin{pmatrix} x & y \end{pmatrix} = (-17 \ 8) \left[\frac{1}{6-(-5)} \begin{pmatrix} 3 & -1 \\ 5 & 2 \end{pmatrix} \right]$$

$$x = -1, y = 3$$

$$\begin{pmatrix} x \\ y \end{pmatrix} = \frac{1}{6-(-5)} \begin{pmatrix} 3 & 5 \\ -1 & 2 \end{pmatrix} \begin{pmatrix} -17 \\ 8 \end{pmatrix}$$

$$\left. \begin{matrix} x = -1 \\ y = 3 \end{matrix} \right\} \begin{matrix} \text{mode} & \text{mode} & \text{mode} & 1 & 2 \\ a_1? & 2 & b_1? & -5 & c_1? & -17 \\ a_2? & 1 & b_2? & 3 & c_2? & 8 \end{matrix} \sim \text{calculator}$$

• **multiplication of two matrices**

~ order of A : $m \times n$, order of B : $n \times p \rightarrow$ multiplication AB can be performed – order of AB : $m \times p$

$\begin{pmatrix} a & b \end{pmatrix} \begin{pmatrix} c \\ d \end{pmatrix} = (ac+bd)$	$\begin{pmatrix} a \\ b \end{pmatrix} (c \ d) = \begin{pmatrix} ac & ad \\ bc & bd \end{pmatrix}$	$\begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{pmatrix} e \\ f \end{pmatrix} = \begin{pmatrix} ae + bf \\ ce + df \end{pmatrix}$
$\begin{pmatrix} a & b \end{pmatrix} \begin{pmatrix} c & e \\ d & f \end{pmatrix} = (ac + bd \quad ae + bf)$	$\begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{pmatrix} e & f \\ g & h \end{pmatrix} = \begin{pmatrix} ae+bg & af+bh \\ ce+dg & cf+dh \end{pmatrix}$	
$\begin{pmatrix} a & b \\ c & d \\ e & f \end{pmatrix} \begin{pmatrix} p & q & r \\ s & t & u \end{pmatrix} = \begin{pmatrix} ap+bs & aq+bt & ar+bu \\ cp+ds & cq+dt & cr+du \\ ep+fs & eq+ft & er+fu \end{pmatrix}$		$\begin{pmatrix} a & b & c \\ d & e & f \end{pmatrix} \begin{pmatrix} p & q \\ r & s \\ t & u \end{pmatrix} = \begin{pmatrix} ap+br+ct & aq+bs+cu \\ dp+er+ft & dq+es+fu \end{pmatrix}$

Analysis of past year's questions :

SKILLS	YEAR / DISTRIBUTION OF QUESTIONS									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
	A11	A10	A8	A10	A8	A7	A8	A5	A8	B14
TYPE	2	2	1	3	3	3	2	3	3	3
inverse matrix + concept *	(a)	(a)	(a)	(a)			(a)			
solve linear equations simultaneously	(b)	(b)	(b)	(b)	✓	✓	(b)	✓	✓	(a)
multiplication + concept *										(b)
MARKS	6	6	6	6	5	5	6	5	5	9

GRAPHS OF MOTION

(ONE PAGE NOTES ~ SMART PAPER 2 → FOCUS 4)

Formulae & Notes :

• distance-time

hour

$\xleftrightarrow{\times 60}$
 $\xleftrightarrow{\div 60}$

minute

$$\text{speed} = \frac{\text{change of distance}}{\text{change of time}}$$

$$\text{average speed} = \frac{\text{total distance travelled}}{\text{total time taken}}$$

• speed-time

$$\text{Rate of change of speed} = \text{Gradient of graph, } m$$

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

distance = Area under the graph

area = $a \times b$

area = $\frac{1}{2} \times a \times b$

area = $\frac{1}{2} \times (a + b) \times h$

NOTE :

rate of change of speed = 5
→ with **acceleration of 5**

rate of change of speed = -5
→ with **deceleration of 5**

Price rate (RM per kg)

area under graph = price

→ mass (kg)

Analysis of past year's questions :

SKILLS	YEAR / DISTRIBUTION OF QUESTIONS									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
	A8	A8	A6	A7	A11	A11	A9	A8	A75	A16, 17
distance-time graph										
~ duration of stop / rest / stationary		a~ 1				b~ 1	a~ 1			ai~ 1
~ meet : time / duration @ time			ai~ 1			a~ 1		b~ 1		
~ distance from a location			ai~ 1			c~ 2				
~ speed first / last t s 1 / average speed2		b1~ 2	b2~ 2			d2~ 2	b, c~ 4	c2~ 2		aii2~ 2
~ problem1 / graphical represnt2		c1~ 3	aii2~ 1					a1~ 2		
speed-time graph										
~ duration uniform speed1 / unifrom speed2	a1~ 1			a1~ 1	a2~ 1					
~ rate of change of speed first / last t s	b~ 2			b~ 2	b~ 2				a~ 2	
~ distance travelled										ci~ 2
~ problem involve distance	c~ 3			c~ 3	c~ 3				c~ 3	cii~ 3
~ average speed1 / graphical represnt2										
MARKS	6	6	5	6	6	6	5	5		3 / 5

MEASURES OF DISPERSION FOR UNGROUPED DATA

(ONE PAGE NOTES ~ SMART PAPER 2 → FOCUS 7)

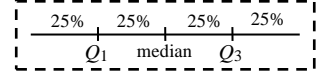
Formulae & Notes :

MEASURE OF CENTRAL TENDENCY ~ describe the information of entire data with only one value

- mode = the value of data with the highest frequency ~ used for category data : favorite items, popular items
- median, Q_2 = the middle value when a set of data is arranged in ascending order [*descending*]

~ n odd, median = data at $-\left(\frac{n+1}{2}\right)$; n even, median = $\frac{\text{data at } -\left(\frac{N}{2}\right) + \text{data at } -\left(\frac{N}{2}+1\right)}{2}$ → exist of extreme value / outlier

- mean, $\bar{x} = \frac{\sum x}{n}$ & $\bar{x} = \frac{\sum fx}{\sum f}$ → involves the entire data



MEASURE OF DIPERSION ~ give an idea of how the values of a set of data are scattered / quantitative measures

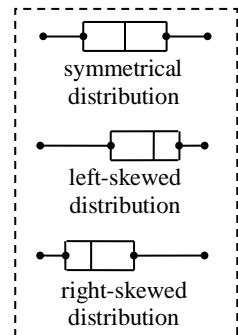
- range = (highest – lowest) data ~ ungrouped data
- first / lower quartile, Q_1
= the value that divides the set of data that are less than median into two equal parts
- third / upper quartile, Q_3
= the value that divides the set of data that are more than median into two equal parts
- interquartile range = $Q_3 - Q_1$

- variance, $\sigma^2 = \frac{\sum x^2}{n} - (\bar{x})^2$ @ $\sigma^2 = \frac{\sum (x - \bar{x})^2}{n}$ & $\sigma^2 = \frac{\sum fx^2}{\sum f} - (\bar{x})^2$ @ $\sigma^2 = \frac{\sum f(x - \bar{x})^2}{\sum f}$

- standard deviation, $\sigma = \sqrt{\frac{\sum x^2}{n} - (\bar{x})^2} = \sqrt{\frac{\sum (x - \bar{x})^2}{n}}$ & $\sigma = \sqrt{\frac{\sum fx^2}{\sum f} - (\bar{x})^2} = \sqrt{\frac{\sum f(x - \bar{x})^2}{\sum f}}$

Note :

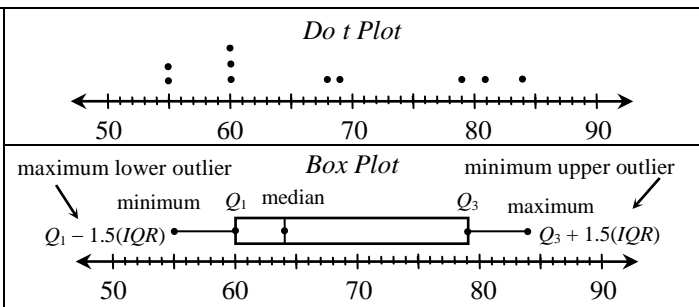
~ more consistent @ data is scattered / dispersed close to the mean → a lower / smaller standard deviation



DATA REPRESENTATIVES : 55, 55, 60, 60, 60, 68, 69, 79, 81, 84

Stem and Leaf Plot	
Stem	Leaf
5	5 5
6	0 0 0 8 9
7	9
8	1 4

Key : 5/2 means 52 marks



If each data in a set of data, is added @ subtracted by a constant k, then :

- $\bar{x}_{\text{new}} = \bar{x} (+/-) k$
- median_{new} = median (+/-) k
- mode_{new} = mode (+/-) k
- Q_1 (new) = Q_1 (+/-) k
- Q_3 (new) = Q_1 (+/-) k
- range_{new} = range
- interquartile range_{new} = interquartile range
- $\sigma^2_{\text{new}} = \sigma^2$
- $\sigma_{\text{new}} = \sigma$

If each data in a set of data, is multiplied @ divided by a constant k, then :

- $\bar{x}_{\text{new}} = \bar{x} (\times / \div) k$
- median_{new} = median (\times / \div) k
- mode_{new} = mode (\times / \div) k
- Q_1 (new) = Q_1 (\times / \div) k
- Q_3 (new) = Q_1 (\times / \div) k
- range_{new} = range (\times / \div) k
- interquartile range_{new} = interquartile range (\times / \div) k
- $\sigma^2_{\text{new}} = \sigma^2 (\times / \div) k^2$
- $\sigma_{\text{new}} = \sigma (\times / \div) k$

Analysis of past year's questions :

SKILLS	YEAR / DISTRIBUTION OF QUESTIONS							
	2021	2022	2023	2024	2025	2026	2027	2028
range, Q_1 , Q_3 , interquartile range (1,2)	C16							
variance, standard deviation (1, 2)*								
construct and interpret box plot								
effect of data changes (1, 2)								
compare, interpret and made conclusion	d ~ (2)*							
problems solving								
MARKS	5							

OPERATION ON SETS

(ONE PAGE NOTES ~ SMART PAPER 2 → FOCUS 9)

Formulae & Notes :

- set → collection of objects with certain characteristics

examples :

odd numbers = { 1, 3, 5, 7, 9, 11, 13, ... }	even numbers = { 2, 4, 6, 8, 10, 12, 14, ... }
Prime numbers = { 2, 3, 5, 7, 11, 13, 17, ... }	perfect square = { 1, 4, 9, 16, 25, 36, 49, ... }
Multiples of 3 = { 3, 6, 9, 12, 15, 18, 21, ... }	factors of 12 = { 1, 2, 3, 4, 6, 12 }
vowels = { a, e, i, o, u }	consonants = { b, c, d, f, g, h, . . . , x, y, z }

- empty set, { } or ϕ → set which does not contains any element
- Venn diagram
 - ~ universal set (ξ) ; element of a set (\in) ; number of elements (n) ; complement of a set ($'$) ; subsets (\subset)

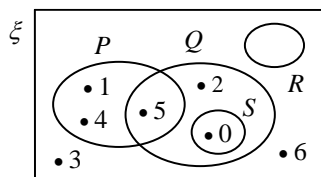


Diagram (a)

$\xi = \{ 0, 1, 2, 3, 4, 5, 6 \} \rightarrow n(\xi) = 7$
 $P = \{ 1, 4, 5 \} \rightarrow 1 \in P, 2 \notin P, 3 \notin P, 4 \in P, 5 \in P, \dots$
 $Q = \{ 0, 2, 5 \} ; R = \{ \} @ R = \phi ; S = \{ 0 \}$
 $\sim P' = \{ 0, 2, 3, 6 \} ; Q' = \{ 1, 3, 4, 6 \}$
 $\sim S \subset Q, P \not\subset Q, R \not\subset P$

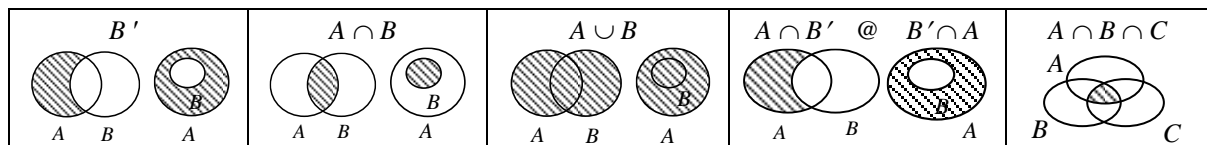
Note 1 : the number of subsets = $2^n \rightarrow$ example : number subset of $P = 2^3 = 8$
 ~ subsets of $P = \{ \}, \{ 1 \}, \{ 4 \}, \{ 5 \}, \{ 1, 4 \}, \{ 1, 5 \}, \{ 4, 5 \}, \{ 1, 4, 5 \}$

Note 2 : all sets have an empty set as its subset

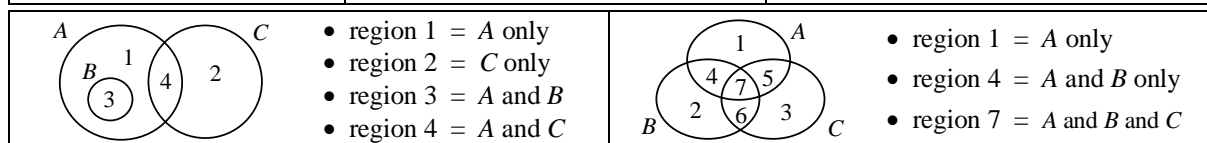
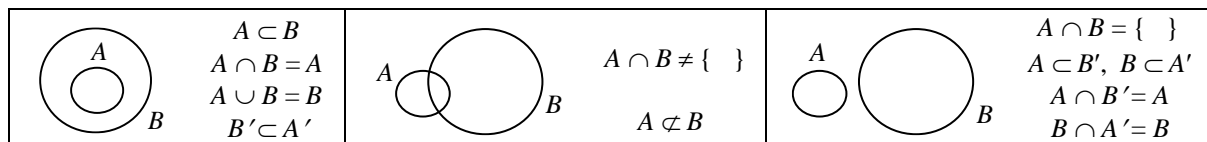
- the equality of sets → set $A =$ set B , if each elements in set A and set B are the same

- Operations on sets : intersecting of sets (\cap / and) ; union of sets (\cup / or)
 ~ refer diagram (a) → $P \cap Q = \{ 5 \} ; P \cap S = \{ \} ; Q \cap S = \{ 0 \}$
 → $P \cup Q = \{ 1, 4, 5, 2, 0 \} ; P \cup S = \{ 1, 4, 5, 0 \} ; Q \cup S = \{ 5, 2, 0 \}$

additional notes :



→ $(A \cap B)' = A' \cup B'$ and $(A \cup B)' = A' \cap B'$



→ $n(A \cup B) = n(A) + n(B) - n(A \cap B)$ dan $n(A \cup B) \cup n(A \cup B)' = n(\xi) = n(A \cap B) \cup n(A \cap B)'$
 → $n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(A \cap C) - n(B \cap C) + n(A \cap B \cap C)$

Analysis of past year's questions :

SKILLS	YEAR / DISTRIBUTION OF QUESTIONS									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	21~B
shade the region for the given operation on set	✓ ~3	✓ ~3	✓ ~3			✓ 3	✓ 3	✓ 3	✓ 3	✓ 3
write the operation on set / relation which represents the shaded region							(b) ~2	(a) ~1		b(ii) ~2
complete / draw Venn diagram							(a) ~1	(b) ~2	(b) ~2	b(i) ~3
elements of set / solve problems										(a) ~3
MARKS	3	3	3			3	3	3	3	8

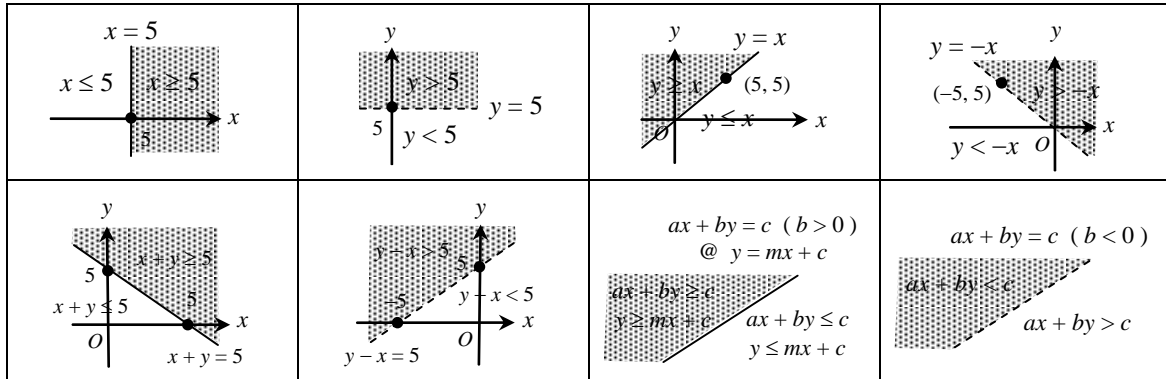
LINEAR INEQUALITIES IN TWO VARIABLES

(ONE PAGE NOTES ~ SMART PAPER 2 → FOCUS 11)

Formulae & Notes :

- determine and shade the region that satisfies a linear inequality

~ examples :



Notes : $m = \frac{y_1 - y_2}{x_1 - x_2} = \frac{y_2 - y_1}{x_2 - x_1} = -\left(\frac{\text{y-intercept}}{\text{x-intercept}}\right) = \pm \left(\frac{\text{vertical distance}}{\text{horizontal distance}}\right)$

x-axis → y = 0
y-axis → x = 0

- steps to determine the region that satisfies a system of linear inequalities :

- (i) mark the region involved for each linear inequalities (with different and easily spotted markings)
- (ii) identify the common region for all the markings involved
- (iii) shade the common region completely (make sure that the shading is *not* outside the common region)

- represent situations in the form of system of linear inequalities

~ notes :

- ◆ less than → <
- ◆ more than → >
- ◆ at least, not less than, the minimum → ≥
- ◆ at most, not more than, the maximum → ≤

~ examples :

y is less than x	⇒ y < x	y is more than x	⇒ y > x
y is not more than x	⇒ y ≤ x	y is not less than x	⇒ y ≥ x
the maximum of y is k	⇒ y ≤ k	the minimum of x is k	⇒ x ≥ k
y is at most k times of x	⇒ y ≤ kx	y is at least k times of x	⇒ y ≥ kx
the total of x and y is at most k	⇒ x + y ≤ k	y exceed x by at least k	⇒ y - x ≥ k
y is at most k % that of x	⇒ y ≤ $\frac{k}{100}x$	the ratio of y to x is at least 1 : 3	⇒ y : x ≥ 1 : 3

Analysis of past year's questions :

SKILLS	YEAR / DISTRIBUTION OF QUESTIONS									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
				A1	A1					B15
the points in the region and the solution of certain linear inequalities										✓ (c) ~1
determine and shade the region that satisfies a linear inequality system (1), and vice-verse (2)				✓ (1)	✓ (1)					✓ (1) (b) ~4
represent situations in the form of system of linear inequalities										✓ (a) ~2
solve problems involving systems of linear inequalities in two variables.										✓ (d) ~3
MARKS				3	3					10

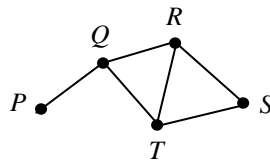
NETWORK IN GRAPH THEORY

(ONE PAGE NOTES ~ SMART PAPER 2 → FOCUS 14)

Formulae & Notes :

- Network ~ a graph which has at least a pair of related dots / points.
~ has a many-to-many relation.

- Simple graph ~ undirected graph
~ no loop → 1 loop = 2 degrees
~ no multiple edges

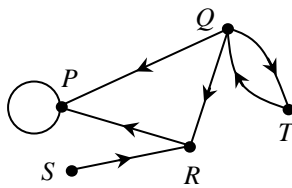


- ~ set of vertices, $V = \{ P, Q, R, S, T \}$ → number of vertices, $n(V) = 5$
- ~ set of vertex pairs, $E = \{ (P, Q), (Q, R), (Q, T), (R, T), (R, S), (T, S) \}$
→ number of edges, $n(E) = 6$
- ~ simple graph with degrees of vertices $P, Q, R, S, T = 1, 3, 3, 2, 3$
→ $\sum d(v) = 12$ [**degree**, d = number of edges that connect 2 vertices]
- Note :** $\sum d(v) = 2[n(E)]$ ~ the sum of the degrees of the vertices is **even**

Note : isolated vertex = vertex that is not connected to any other vertices in the graph

- Undirected graph ~ a graph drawn without any any direction being assigned.
~ has two-way direction along the edges of the graph.
~ the order of the vertices written is not important.

- Directed graph ~ a graph in which a direction is assigned to the edge that connecting two vertices.



- ~ set of vertices, $V = \{ P, Q, R, S, T \}$
- ~ set of vertex pairs, $E = \{ (Q, P), (Q, R), (Q, T), (T, Q), (R, P), (P, P), (S, R) \}$
- ~ $d_{in}(P) = 3, d_{in}(Q) = 1, d_{in}(R) = 2, d_{in}(S) = 0, d_{in}(T) = 1$
- ~ $d_{out}(P) = 1, d_{out}(Q) = 3, d_{out}(R) = 1, d_{out}(S) = 1, d_{out}(T) = 1$
- ~ $\sum d(V) = 2 \times 7 = 14$

- Weighted graph ~ is an undirected graph or a directed graph.
~ has values to each of the edges.

- Subgraph ~ part of a graph @ the whole graph, which is redrawn

- A **tree** of a graph ~ a **subgraph** of the graph with the following properties :
→ a simple graph
→ all the vertices are connected
→ $n(E) = n(V) - 1$

Note :

- ~ tree is used to determine the “*minimum*” or “*maximum*” value of total weight
→ **example :** *the shortest path* with condition all vertices are traversed only once

Analysis of past year's questions :

SKILLS	YEAR / DISTRIBUTION OF QUESTIONS							
	2021	2022	2023	2024	2025	2026	2027	2028
network								
graph ~ $V, E, d(V), \sum d(V)$								
simple graph								
undirected / directed graph								
weighted graph								
subgraph								
tree	d							
represent information in networks								
MARKS	3							

INSURANCE

(ONE PAGE NOTES ~ SMART PAPER 2 → FOCUS 16)

Formulae & Notes :

- Risk → unpredictable & involve loss
- Importance of insurance :
 - (1) as financial assistance due to unexpected disasters
 - (2) as compensation to reduce the losses incurred
 - (3) cover high medical and treatment cost
 - (4) managing living expenses, debts and commitment, if loss source of employment, . . . and so on.
- In Malaysia, the insurance industry is controlled and regulated by *Bank Negara Malaysia*, under the Insurance Act 1996, which replaces the Insurance Act 1963.
- Principle of indemnity ~ *life insurance is excluded*
 - to restore the financial position of the policyholder to the pre-loss condition
 - the policyholder cannot earn profit from the compensation of the loss (amount not exceeding the loss incurred)
- Types of main insurance :
 - (1) Life insurance → whole life, term, Mortgage reducing term (MRTA), endowment (fixed term), . . .
 - (2) General insurance → motor / fire / medical and health / personal accident / travel
 - (3) Group insurance → group insurance for organisation, group insurance for pupils
- Coverage of 4 types motor insurance :

Coverage \ Policy	Act	Third party	Third party, fire dan theft	Comprehensive
Liability to third party due to injury and death	✓	✓	✓	✓
Loss of property suffered by third party		✓	✓	✓
Loss to own vehicle due to accidental fire or theft			✓	✓
Loss and damage to own vehicle due to accident				✓

Notes : first party = driver (policyholder) ; second party = insurance company ; third party = any other individuals that are involved in a accident caused by the driver, *excluding the passenger*

- premium of life insurance = $\frac{\text{face value of policy}}{\text{RM } x} \times \text{premium rate per RM } x$

- premium of motor insurance
 - (a) act policy, third party policy = rate for the first RM1000 (tariff) ~ engine capacity
 - (b) comprehensive policy ~ engine capacity, current value insured
 - ~ *Pennisular Malaysia*
 - = rate for the first RM1000 (tariff) + $\text{RM}26 \times \left(\frac{\text{current value insured} - 1000}{1000} \right)$
 - ~ *Sabah and Sarawak*
 - = rate for the first RM1000 (tariff) + $\text{RM}20.30 \times \left(\frac{\text{current value insured} - 1000}{1000} \right)$
 - (c) third party, fire and theft policy = 75% × comprehensive policy

Notes : maximum *NCD* (No Claim Discount) discount is **55%**

- Deductible

- an amount that must be borne by the policyholder before they can make a claim from the insurance company.
- found in the contract of property insurance, medical and health insurance, and motor insurance.
- **not** in the *life insurance* and *personal liability insurance*.
- (a) $\text{loss} \leq \text{deductible} \rightarrow \text{compensation} = 0$
- (b) $\text{loss} > \text{deductible} \rightarrow \text{compensation} = \text{loss} - \text{deductible}$

Notes : In motor insurance, the policyholder is responsible for a compulsory deductible of RM400, if the insured vehicle :

- is driven by an individual who is not named in the policy,
- who is named in the policy but is under 21 years old,
- who is the holder of a provisional (L),
- driving licence or the holder of a full driving licence of less than 2 years.

- Co-insurance

- a cost sharing where the policyholders borne a certain percentage of the loss with the insurance company.

Notes : the premium becomes lower with deductible and co-insurance in insurance policy

- Co-insurance in property insurance

- if the polycyholder wishes to recover full compensation for the partial loss incurred, he must insure the property in accordance with his co-insurance provisions.

- Amount of required insurance = percentage of co-insurance \times insurable value of property

(a) If the insured value = amount of required insurane

~ compensation = amount of loss – deductible ;

[amount of loss \leq amount of insurance purchased]

(b) Suffered a total loss

~ compensation = amount of insurance purchased – deductible

(c) If the insured value < amount of required insurance

~ compensation = $\left(\frac{\text{Amount of insurance purchased}}{\text{Amount of required insurance}} \times \text{amount of loss} \right) - \text{deductible}$

~ co-insurance penalty = amount of loss – $\left(\frac{\text{Amount of insurance purchased}}{\text{Amount of required insurance}} \times \text{amount of loss} \right)$
 = amount of loss – (compensation + deductibel)

- co-insurance in health insurance

- 80 / 20 co-insurance = the insurance company will be bear 80% of the medical cost covered by the policy, and 20% will be borne by the policyholder.

- medical cost after deductible, $S = \text{medical cost} - \text{deductible}$

(a) cover by insurane company = $S \times \frac{x}{100}$

(b) cover by policyholder = $S \times \frac{y}{100} + \text{deductible}$

~ with co-insurance x / y , where $x + y = 100$

Analysis of past year's questions :

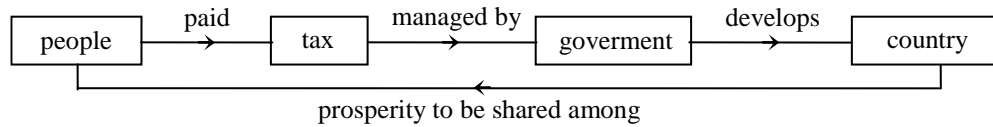
SKILLS	YEAR / DISTRIBUTION OF QUESTIONS							
	2021	2022	2023	2024	2025	2026	2027	2028
	A6							
concept of risk and insurance								
premium of life insurance								
premium of motor insurance ~ (a), (b), (c)								
deductible								
co-insurance in property insurance ~ (a), (b), (c)								
co-insurance in health insurance ~ (a), (b)	(b)							
MARKS	3							

TAXATION

(ONE PAGE NOTES ~ SMART PAPER 2 → FOCUS 17)

Formulae & Notes :

- Taxation process :



- direct & indirect tax :

~ direct tax → Inland Revenue Board (IRB)

→ taxes levied on a person's income and wealth and paid directly to the government (the tax burden cannot be distributed or transferred by the payer to another)

→ this tax is progressive ; **examples** : income tax, property assessment tax, quit rent, stamp duty

~ indirect tax → Royal Malaysian Customs Department

→ taxes levied on the taxpayer, but the burden can be transferred to others

→ **examples** : sales and service tax, customs duty, excise duty, entertainment duty, extraordinary profit levy, . . .

- The purpose of taxation :

(1) source of government revenue ~ govern the country, finance the country's development projects, redistribute income to address inequality in the society, . . .

(2) government policy implementation tool ~ cultivate caring community (tax relief for parents' medical expenses), reduce excessive property investment activities (real property gains tax), . . .

(3) control of sales of goods or services ~ discourage from buying cigarettes and alcohol, and the use of gambling services (tobacco tax, alcohol tax, and gambling tax), . . .

(4) financial tool to stabilise the economy ~ **examples** : by raising taxes or introducing new taxes, the government can reduce the purchasing power of the people to spend, reduce purchases and new infrastructure projects, reduce aggregate demand in the country, and hence will lower the inflation, . . .

- The authority that collects taxes :

<i>Income tax</i>	Inland Revenue Board (IRB)
<i>Road tax</i>	Road Transport Department
<i>Property assessment tax</i>	Local Authority ~ Municipal Council @ District Council
<i>Quit rent</i>	State Land Authority ~ State Land Office
<i>Sales and Service tax</i>	Royal Malaysian Customs Department

- Consequences of tax evasion ~ legal and financial aspects:

~ income tax → Income Tax Return Form : individual (BE form, 30 April), business (B form, 30 Jun)

failure to submit ITRF if eligible for tax payment	Income Tax Act 1967 [Act 53, Section 112(1)]	fine of RM200 to RM20000 @ imprisonment of not exceeding of 6 months @ both
does not report actual income in the ITRF	Income Tax Act 1967 [Act 53, Section 113(1)(a)]	fine of RM1000 to RM10000, and a penalty of 200% for under-reporting tax
give incorrect information about income tax payable for own or other person	Income Tax Act 1967 [Act 53, Section 113(1)(b)]	
evade tax intentionally @ assist other person to evade tax	Income Tax Act 1967 [Act 53, Section 114(1)]	fine of RM1000 to RM20000 @ imprisonment of not exceeding 3 years @ boths, and a penalty of 300% for under-reporting tax

~ road tax

using a vehicle without valid road tax	Road Transport Act 1987 [Act 333, Section 23(1)]	fine of not exceeding RM2000
--	--	------------------------------

Note : vehicle with expired road tax of more than 1 year → sent to **Puspakom** for inspection

~ property assessment tax

does not pay the tax within the designated period	Local Government Act 1976 [Act 171, Section 147 & 148]	notice in Form E will be issued
still failed to pay the tax within 15 days after the notice the notice issued		issued a detention warrant in Form F, and portable property could be seized

~ quit rent → is interpreted as "**lease**" & must be paid on 1 January to 31 May each year

does not pay the tax within the designated period	National Land Code 1965 [Section 97]	notice of claim in form 6A will be issued
still failed to pay the tax within the started period in the notice of claim	National Land Code 1965 [Section 100]	the land can be seized

Note : parcel tax = tax levied on strata ownership (apartments, condominiums, . . .)

~ sales and service tax → similar penalties under the Service Tax Act 2018 (Act 807, Section 71)

evade tax intentionally @ assist other person to evade tax	Sales Tax Act 2018 [Akta 806] [Section 86(1) & 86(2)]	First offence : fine of 10 to 20 times the amount of sales tax @ imprisonment of not exceeding 5 years @ both
		Second or subsequent offence : fine of 20 to 40 times the amount of sales tax @ imprisonment of not exceeding 7 years @ both
the amount of tax evasion cannot be ascertained	Sales Tax Act 2018 [Act 806, Section 86(3)]	fine of RM50000 to RM500000 @ imprisonment of not exceeding 7 years @ both
the party who assist in preparation of false tax statements	Sales Tax Act 2018 [Act 806, Section 86(4)]	fine of RM2000 to RM20000 @ imprisonment of not exceeding 3 years @ both

Notes : Parties who need to register under the Sales Tax Act 2018 @ Service Tax Act 2018 :

- (i) Manufacturers or importers with sales revenue exceeding RM500000 per annum.
- (ii) Service providers with revenue exceeding RM500000 per annum.
- (iii) Provider of food and beverage preparation services with revenue exceeding RM1500000 per annum.

• Chargeable income = Total annual income – tax exemption – tax relief

<p>* Total annual income should be deducted by tax - exempted allowances.</p>	<p>~ salary ~ interests ~ bonus ~ wages ~ dividends ~ royalties</p> <p style="text-align: center;">↓</p>	<p>~ donations ~ gifts ~ contributions</p> <p style="text-align: center;">↓</p>	<p>~ EPF ~ Insurances ~ education fees ~ medical treatment</p> <p style="text-align: center;">↓</p>
---	--	---	--

- income tax = base tax + tax on the next balance – tax rebate
~ tax rebate = all zakat payments & RM400 if taxable income does not exceed RM35000

Note 1 : minimum month salary eligible for PCB (after EPF deduction)

→ single individual, RM2851 ; married individual whose spouse is not working, RM3851

~ tax payable > PCB

→ insufficient tax payment = tax payable – PCB

→ insufficient tax payment must be made to IRB

~ tax payable < PCB

→ excess deduction of PCB = PCB – tax payable

→ excess deduction of PCB will be refunded by IRB to taxpayer's bank account

Note 2 : joint tax assessment → *cuase the tax payment increase dramatically.*

~ tax assessment filed by husband (or wife)

~ husband's income (or wife's income) is aggregated with wife's income (or husband's income) when filing tax assessment, and *the claimable tax relief considered for calculation only once*

• road tax = base rate + progressive rate × (cc vehicle – cc maximum previous base rate)

• property assessment tax = property assessment tax rate × annual value
→ annual value = estimated monthly rental × 12

• quit rent = quit rent rate per unit area × total land area

- sales and service tax
→ sales tax rates on goods are different, which is 5%, 10% or other rates depending on the goods.
→ service tax rate is 6%. (*service tax on each credit card is RM25 per year*)

Analysis of past year's questions :

SKILLS	YEAR / DISTRIBUTION OF QUESTIONS							
	2021	2022	2023	2024	2025	2026	2027	2028
	A6							
Taxation process and purpose								
Tax collecting authority / Type								
Consequences of tax evasion								
(1) Income tax	(b)							
(2) Road tax								
(3) Property Assessment tax								
(4) Quit rent								
(5) Sales and Service tax								
MARKS	3							

RATIOS AND GRAPHS OF TRIGONOMETRIC FUNCTIONS

(ONE PAGE NOTES ~ SMART PAPER 2 → FOCUS 18)

Formulae & Notes :

• **trigonometric ratios**

$$\sin \theta = \frac{O}{H}$$

$$\cos \theta = \frac{A}{H}$$

$$\tan \theta = \frac{O}{A} = \frac{\sin \theta}{\cos \theta} = \text{gradient}$$

$$\sin(90 - \theta) = \cos \theta$$

$$\cos(90 - \theta) = \sin \theta$$

$$\tan(90 - \theta) = \frac{\cos \theta}{\sin \theta}$$

$$H = \sqrt{O^2 + A^2}$$

$$O = \sqrt{H^2 - A^2}$$

$$A = \sqrt{H^2 - O^2}$$

3	4	5
6	8	10
9	12	15
12	16	20

5	12	13
10	24	26
9	40	41
20	21	29

7	24	25
8	15	17
9	40	41
20	21	29

• **special angle value**

	30°	45°	60°	0°	90°	180°	270°	360°
sin	1/2	1/√2	√3/2	0	1	0	-1	0
cos	√3/2	1/√2	1/2	1	0	-1	0	1
tan	1/√3	1	√3	0	∞	0	∞	0

• **value of sine, cosine and tangent for angle θ, 0° ≤ θ ≤ 360°**

<p>Quadrant II ~ obtuse (90° < θ < 180°)</p> <ul style="list-style-type: none"> • sin θ → + • cos θ → - • tan θ → - 	<p>Quadrant I ~ acute (0° < θ < 90°)</p> <ul style="list-style-type: none"> • sin θ → + • cos θ → + • tan θ → + 	<p>sin $\left\{ \begin{array}{l} + \text{ (I, II)} \\ - \text{ (III, IV)} \end{array} \right.$</p> <p>cos $\left\{ \begin{array}{l} + \text{ (I, IV)} \\ - \text{ (II, III)} \end{array} \right.$</p> <p>tan $\left\{ \begin{array}{l} + \text{ (I, III)} \\ - \text{ (II, IV)} \end{array} \right.$</p>	<div style="text-align: center;"> $\boxed{\text{I}} \xleftrightarrow{180 - \text{I}} \boxed{\text{II}}$ $\xleftarrow{180 - \text{II}}$ </div> <div style="text-align: center; margin-top: 10px;"> $\boxed{\text{I}} \xleftrightarrow{180 + \text{I}} \boxed{\text{III}}$ $\xleftarrow{\text{III} - 180}$ </div> <div style="text-align: center; margin-top: 10px;"> $\boxed{\text{I}} \xleftrightarrow{360 - \text{I}} \boxed{\text{IV}}$ $\xleftarrow{360 - \text{IV}}$ </div>
---	---	---	--

θ (I)

θ (II)

θ (III)

θ (IV)

⟨⟨ I = corresponding reference angle ⟩⟩

In an **unit circle**, which is a circle with centre *O*, and radius 1 unit

⇒ sin θ = **y-coordinate** ;

 kos θ = **x-coordinate** ;

tan θ = $\frac{\text{y-coordinate}}{\text{x-coordinate}} = \frac{\sin \theta}{\cos \theta}$

P horizontal line

$\alpha = \beta$

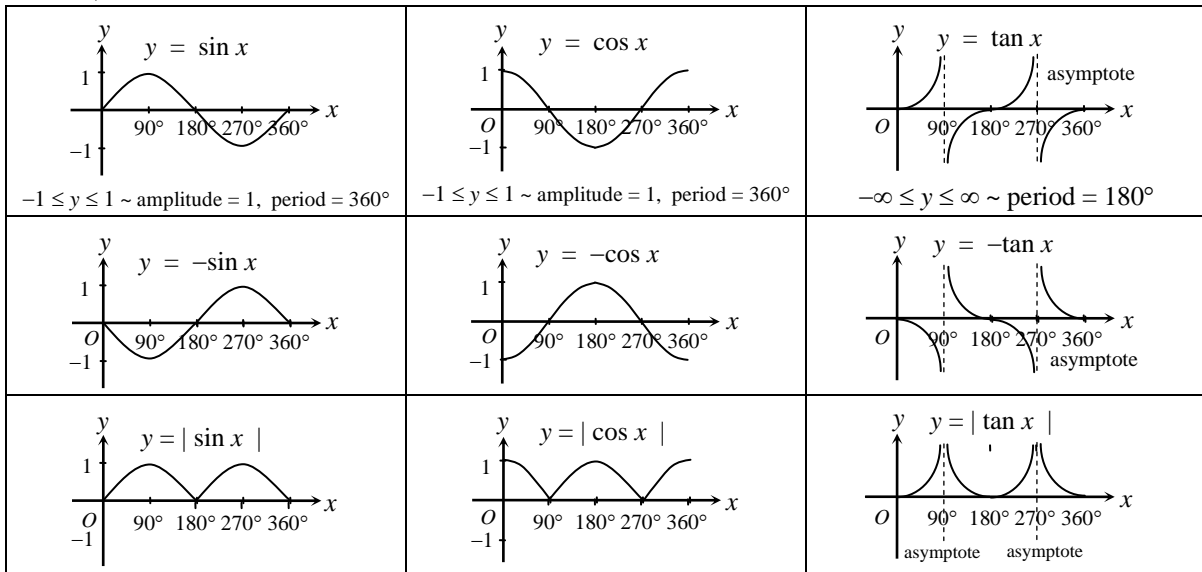
α → angle depression of *Q* from *P*

P horizontal line

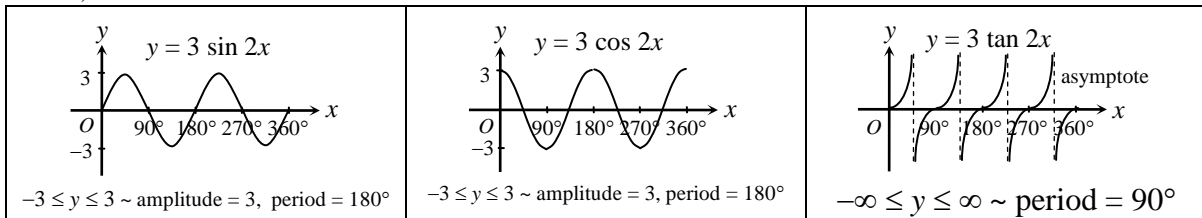
θ → angle elevation of *Q* from *P*

• **graphs of trigonometric functions** ~ $y = a \sin bx$; $y = a \cos bx$; $y = a \tan bx$

~ $a = 1, b = 1$



~ $a = 3, b = 2$



In general :	$y = a \sin bx + c$	$y = a \cos bx + c$	$y = a \tan bx + c$
amplitude	$ a = \frac{\text{maximum-}y - \text{minimum-}y}{2}$		no amplitude
period (\angle for one circle)	$\frac{360^\circ}{b}$		$\frac{180^\circ}{b}$
b	$\frac{360^\circ}{\text{period}}$		$\frac{180^\circ}{\text{period}}$
c	$\frac{\text{maximum-}y + \text{minimum-}y}{2}$		movement of the origin point up or down on the y-axis

- ~ a changes → the maximum and minimum value change
- ~ b changes → the graph will be compressed or expanded
- ~ c changes → the graph will be move vertically up or down

Note :
for sketch graph,
class interval size = $\frac{90^\circ}{b}$

Analysis of past year's questions :

SKILLS	YEAR / DISTRIBUTION OF QUESTIONS							
	2021	2022	2023	2024	2025	2026	2027	2028
* trigonometric ratios	A3, C16							
value of sine, cosine and tangent for angle $\theta, 0^\circ \leq \theta \leq 360^\circ$	~3, (c)~3							
find values between 0° and 360° , when given the values of $\sin \theta, \cos \theta$, or $\tan \theta$								
unit circle								
solve problems involving sine, cosine and tangent								
graphs of sine, cosine and tangent functions								
solve problems involving graphs of sine, cosine and tangent functions								
effects of changes in constants a, b and c on the graphs of trigonometric functions								
MARKS	6							

VARIATION

(ONE PAGE NOTES ~ SMART PAPER 2 → FOCUS 19)

Formulae & Notes :

• **Direct Variation** : if $x \uparrow$, then $y \uparrow$ @ if $x \downarrow$, then $y \downarrow$

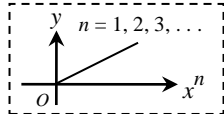
~ y varies directly as $x \Rightarrow y \propto x \rightarrow y = kx$ @ $\frac{y}{x} = k \Rightarrow \frac{y_1}{x_1} = \frac{y_2}{x_2}$

~ y varies directly as the square of $x \Rightarrow y \propto x^2 \rightarrow y = kx^2$ @ $\frac{y}{x^2} = k \Rightarrow \frac{y_1}{(x_1)^2} = \frac{y_2}{(x_2)^2}$

~ y varies directly as the cube of $x \Rightarrow y \propto x^3 \rightarrow y = kx^3$ @ $\frac{y}{x^3} = k \Rightarrow \frac{y_1}{(x_1)^3} = \frac{y_2}{(x_2)^3}$

~ y varies directly as the square root of $x \Rightarrow y \propto \sqrt{x} \rightarrow y = k\sqrt{x}$ @ $\frac{y}{\sqrt{x}} = k \Rightarrow \frac{y_1}{\sqrt{x_1}} = \frac{y_2}{\sqrt{x_2}}$

~ y varies directly as the cube root of $x \Rightarrow y \propto \sqrt[3]{x} \rightarrow y = k\sqrt[3]{x}$ @ $\frac{y}{\sqrt[3]{x}} = k \Rightarrow \frac{y_1}{\sqrt[3]{x_1}} = \frac{y_2}{\sqrt[3]{x_2}}$



• **Inverse Variation** : if $x \uparrow$, then $y \downarrow$ @ if $x \downarrow$, then $y \uparrow$

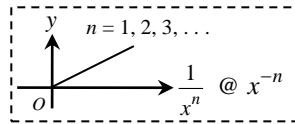
~ y varies inversely as $x \Rightarrow y \propto \frac{1}{x} \rightarrow y = \frac{k}{x}$ @ $yx = k \Rightarrow y_1x_1 = y_2x_2$

~ y varies inversely as the square of $x \Rightarrow y \propto \frac{1}{x^2} \rightarrow y = \frac{k}{x^2}$ @ $yx^2 = k \Rightarrow y_1(x_1)^2 = y_2(x_2)^2$

~ y varies inversely as the cube of $x \Rightarrow y \propto \frac{1}{x^3} \rightarrow y = \frac{k}{x^3}$ @ $yx^3 = k \Rightarrow y_1(x_1)^3 = y_2(x_2)^3$

~ y varies inversely as the square root of $x \Rightarrow y \propto \frac{1}{\sqrt{x}} \rightarrow y = \frac{k}{\sqrt{x}}$ @ $y\sqrt{x} = k \Rightarrow y_1(x_1)^{\frac{1}{2}} = y_2(x_2)^{\frac{1}{2}}$

~ y varies inversely as the cube root of $x \Rightarrow y \propto \frac{1}{\sqrt[3]{x}} \rightarrow y = \frac{k}{\sqrt[3]{x}}$ @ $y\sqrt[3]{x} = k \Rightarrow y_1(x_1)^{\frac{1}{3}} = y_2(x_2)^{\frac{1}{3}}$



• **Combined / Joint Variation** :

~ y varies directly as x^m and z^n

$\Rightarrow y \propto x^m z^n \rightarrow y = kx^m z^n$ @ $\frac{y}{x^m z^n} = k \Rightarrow \frac{y_1}{(x_1)^m (z_1)^n} = \frac{y_2}{(x_2)^m (z_2)^n}$

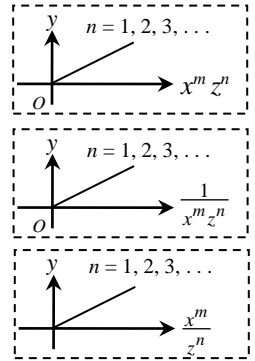
~ y varies inversely as x^m and z^n

$\Rightarrow y \propto \frac{1}{x^m z^n} \rightarrow y = \frac{k}{x^m z^n}$ @ $yx^m z^n = k \Rightarrow y_1(x_1)^m (z_1)^n = y_2(x_2)^m (z_2)^n$

~ y varies directly as x^m and inversely as z^n

$\Rightarrow y \propto \frac{x^m}{z^n} \rightarrow y = \frac{kx^m}{z^n}$ @ $\frac{yz^n}{x^m} = k \Rightarrow \frac{y_1(z_1)^n}{(x_1)^m} = \frac{y_2(z_2)^n}{(x_2)^m}$

Catatan : $\sqrt[n]{x} = x^{\frac{1}{n}} \rightarrow \sqrt{x} = x^{\frac{1}{2}}, \sqrt[3]{x} = x^{\frac{1}{3}}$



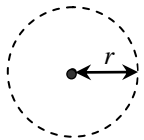
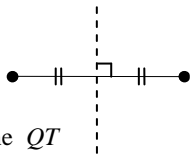
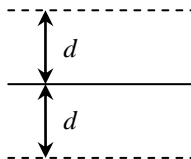
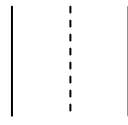
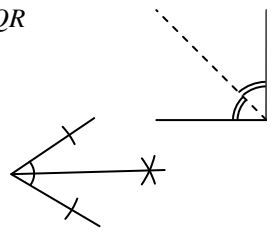
Analysis of past year's questions :

SKILLS	YEAR / DISTRIBUTION OF QUESTIONS							
	2021	2022	2023	2024	2025	2026	2027	2028
	A5							
direct variaton								
inverse variation								
combined / joint variation								
~ direct / direct								
~ inverse / inverse								
~ direct / inverse	✓							
MARKS	4							

LOCI IN TWO DIMENSIONS

(ONE PAGE NOTES ~ SMART PAPER 2 → FOCUS 25)

Formulae & Notes :

<p>type 1 ~ locus from 1 fixed point ⇒ a circle with centre (?) and radius r units</p> <ul style="list-style-type: none"> ◆ Locus of Z given that $\overline{ZL} = 3 \text{ cm} \Rightarrow$ a circle with centre L and radius 3 cm ◆ Locus of Y such that it is 3 units from $R \Rightarrow$ a circle with centre R and radius 3 units ◆ Locus of P such that $\overline{MP} = DC \Rightarrow$ a circle with centre M and radius DC ◆ Locus of M that is constantly 3 units from the $(2, 1) \Rightarrow$ a circle with centre $(2, 1)$ and radius 3 units 	
<p>type 2 ~ locus from 2 fixed points ⇒ a perpendicular bisector of (?)</p> <ul style="list-style-type: none"> ◆ Locus of Y, given that $\overline{YJ} = \overline{YK} \Rightarrow$ a perpendicular bisector of the line JK ◆ Locus of Q such $\overline{AQ} = \overline{BQ} \Rightarrow$ a perpendicular bisector of the line AB ◆ Locus of P such that it is equidistant from point Q and $T \Rightarrow$ a perpendicular bisector of the line QT ◆ Locus of Z such that its distance from point E and H is the same ⇒ a perpendicular bisector of the line EH 	
<p>type 3 ~ locus from 1 straight line ⇒ two parallel lines, with perpendicular distance d units from the line</p> <ul style="list-style-type: none"> ◆ Locus of P such that it is 2 units from $MK \Rightarrow$ two straight lines, with perpendicular distance 2 units from MK ◆ Locus of Y such that Y is always 3 units from $MN \Rightarrow$ two straight lines, with perpendicular distance 3 units from MN ◆ Locus of Z such that its perpendicular distance from EG is always 1.5 cm ⇒ two straight lines, with perpendicular distance 1.5 units from EG 	
<p>type 4 ~ locus from 2 parallel lines ⇒ a straight line in the middle of two parallel lines</p> <ul style="list-style-type: none"> ◆ Locus of Z such that it is equidistant from lines PT and QR, where $PT \parallel QR \Rightarrow$ a parallel line in middle of lines PT and QR ◆ W moves such that it is equidistant from the straight lines PS and QU, where $PS \parallel QU \Rightarrow$ a parallel line in middle of lines PS and QU 	
<p>type 5 ~ locus from 2 intersecting lines ⇒ an angle bisector of $\angle (?)$</p> <ul style="list-style-type: none"> ◆ Locus of H such that it is equidistant from QR and $QP \Rightarrow$ angle bisector of $\angle PQR$ ◆ Locus of X moves in such a way that it is always equidistant from AF and $FH \Rightarrow$ angle bisector of $\angle FEH$ ◆ Locus of Z such that its perpendicular distance from PQ and QR are the same ⇒ angle bisector of $\angle PQR$ ◆ Locus of P such that $\angle PAC = \angle PAD \Rightarrow$ angle bisector of $\angle CAD$ 	

Analysis of past year's questions :

SKILLS	YEAR / DISTRIBUTION OF QUESTIONS							
	2021	2022	2023	2024	2025	2026	2027	2028
type of loci (1, 2, 3, 4, 5)								
intersection of loci ~ 1								
intersection of loci ~ 2 (<, >)								
MARKS								

RUMUS MATEMATIK / MATHEMATICAL FORMULAE

Rumus-rumus berikut boleh membantu anda menjawab soalan. Simbol-simbol yang diberi adalah yang biasa digunakan.

The following formulae may be helpful in answering the questions. The symbols given are the ones commonly used.

NOMBOR DAN OPERASI NUMBER AND OPERATIONS

1. $a^m \times a^n = a^{m+n}$
2. $a^m \div a^n = a^{m-n}$
3. $(a^m)^n = a^{mn}$
4. $a^{\frac{m}{n}} = (a^m)^{\frac{1}{n}}$
5. Faedah mudah / *Simple interest*, $I = Prt$
6. Nilai matang / *Maturity value*, $MV = P\left(1 + \frac{r}{n}\right)^{nt}$
7. Jumlah bayaran balik / *Total amount payable*, $A = P + Prt$

PERKAITAN DAN ALGEBRA RELATIONS AND ALGEBRA

1. Jarak / *distance* = $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
2. Titik tengah / *Midpoint*, $(x, y) = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$
3. Laju purata = $\frac{\text{jarak yang dilalui}}{\text{masa yang diambil}}$ /
Average speed = $\frac{\text{distance travelled}}{\text{time taken}}$
4. $m = \frac{y_2 - y_1}{x_2 - x_1}$
5. $m = -\frac{\text{pintasan-y}}{\text{pintasan-x}}$
 $m = -\frac{\text{y-int ercept}}{\text{x-int ercept}}$
6. $A^{-1} = \frac{1}{ad - bc} \begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$

SUKATAN DAN GEOMETRI MEASUREMENT AND GEOMETRY

1. Teoram Pithagoras / *Pythagoras Theorem*, $c^2 = a^2 + b^2$
2. Hasil tambah sudut pedalaman poligon = $(n - 2) \times 180^\circ$
Sum of interior angles of a polygon = $(n - 2) \times 180^\circ$
3. Lilitan bulatan = $\pi d = 2\pi j$
Circumference of circle = $\pi d = 2\pi r$
4. Luas bulatan = πj^2
Area of circle = πr^2
5.
$$\frac{\text{panjang lengkok}}{\text{lilitan bulatan}} = \frac{\text{sudut dicangkum pada pusat}}{360^\circ}$$

$$\frac{\text{length of arc}}{\text{circumference of circle}} = \frac{\text{angle subtended at centre}}{360^\circ}$$
6.
$$\frac{\text{luas sektor}}{\text{luas bulatan}} = \frac{\text{sudut dicangkum pada pusat}}{360^\circ}$$

$$\frac{\text{area of sector}}{\text{area of circle}} = \frac{\text{angle subtended at centre}}{360^\circ}$$
7. Luas layang = $\frac{1}{2} \times$ hasil darab panjang dua pepenjuru
Area of kite = $\frac{1}{2} \times$ product of the length of the two diagonals
8. Luas trapezium = $\frac{1}{2} \times$ hasil tambah dua sisi selari \times tinggi
Area of trapezium = $\frac{1}{2} \times$ sum of parallel sides \times height
9. Luas permukaan silinder = $2\pi j^2 + 2\pi jt$
Surface area of cylinder = $2\pi r^2 + 2\pi rh$
10. Luas permukaan kon = $\pi j^2 + \pi js$
Surface area of cone = $\pi r^2 + \pi rs$
11. Luas permukaan sfera = $4\pi j^2$
Surface area of sphere = $4\pi r^2$
12. Isi padu prisma = luas keratan rentas \times panjang
Volume of prism = cross sectional area \times height
13. Isipadu silinder = $\pi j^2 t$
Volume of cylinder = $\pi r^2 h$

14. Isipadu kon = $\frac{1}{3}\pi r^2 h$

$$\text{Volume of cone} = \frac{1}{3}\pi r^2 h$$

15. Isipadu sfera = $\frac{4}{3}\pi r^3$

$$\text{Volume of sphere} = \frac{4}{3}\pi r^3$$

16. Isipadu piramid = $\frac{1}{3} \times \text{luas tapak} \times \text{tinggi}$

$$\text{Volume of pyramid} = \frac{1}{3} \times \text{base area} \times \text{height}$$

17. Faktor skala, $k = \frac{PA'}{PA}$

$$\text{Scale factor, } k = \frac{PA'}{PA}$$

18. Luas imej = $k^2 \times \text{luas objek}$

$$\text{Area of image} = k^2 \times \text{area of object}$$

STATISTIK DAN KEBARANGKALIAN STATISTICS AND PROBABILITY

1. Min / Mean, $\bar{x} = \frac{\sum x}{N}$

2. Min / Mean, $\bar{x} = \frac{\sum fx}{\sum f}$

3. Varians / Variance, $\sigma^2 = \frac{\sum x^2}{N} - (\bar{x})^2 = \frac{\sum (x - \bar{x})^2}{N}$

4. Varians / Variance, $\sigma^2 = \frac{\sum fx^2}{\sum f} - (\bar{x})^2 = \frac{\sum f(x - \bar{x})^2}{\sum f}$

5. Sisihan piawai / standard deviation, $\sigma = \sqrt{\frac{\sum x^2}{N} - \bar{x}^2} = \sqrt{\frac{\sum (x - \bar{x})^2}{N}}$

6. Sisihan piawai / standard deviation, $\sigma = \sqrt{\frac{\sum fx^2}{\sum f} - \bar{x}^2} = \sqrt{\frac{\sum f(x - \bar{x})^2}{\sum f}}$

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

8. $P(A') = 1 - P(A)$