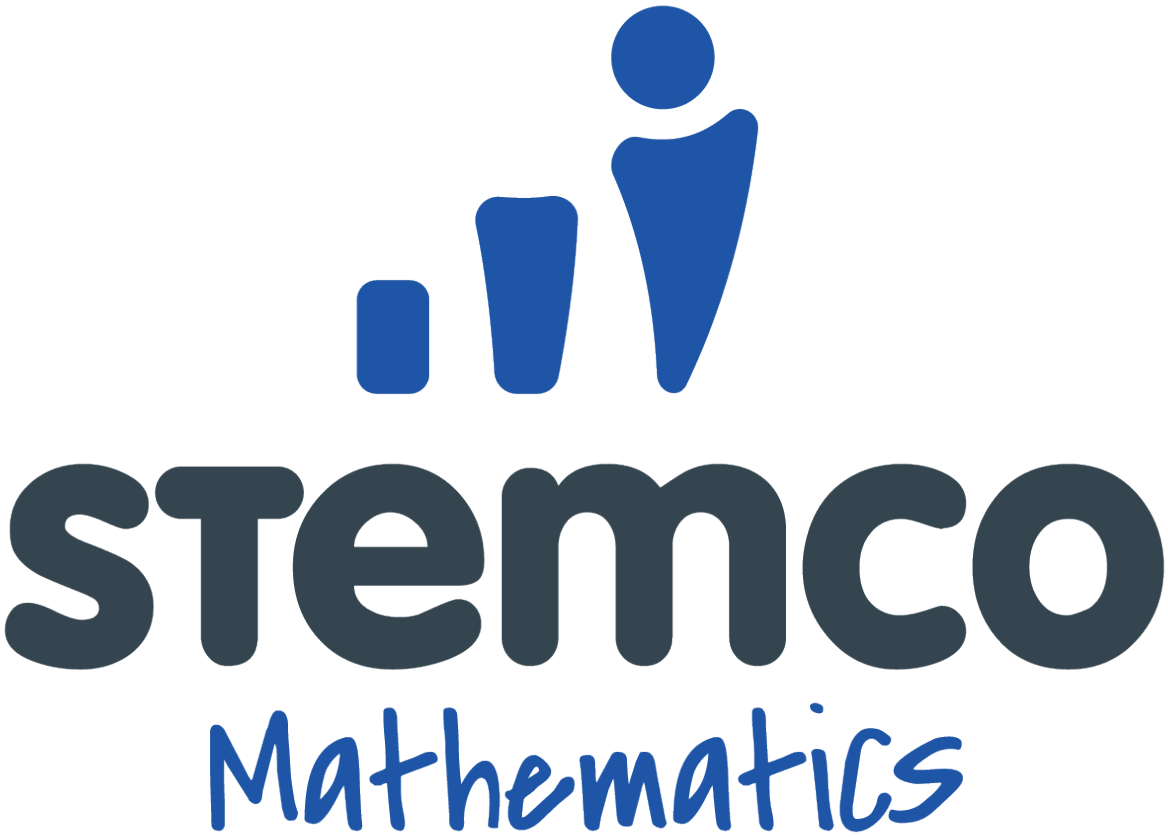


Syllabus

1. Overview

The StemCo syllabus is inspired by the Singapore education curriculum. Singapore is known for its excellence in PISA tests for both Sciences and Mathematics for the last few years. Results from PISA indicate the quality and equity of learning outcomes attained around the world. By adopting the Singapore education curriculum as a reference, StemCo provides an opportunity for students globally to learn from one of the best practices of education in the world.

Our approach prioritizes understanding, application, and analysis of scientific and mathematical concepts over rote memorization of factual material. This shift in focus is intentional, recognizing the need for students to develop skills with long-term value in an increasingly technological world. Rather than concentrating on large volumes of factual information with limited short-term relevance, StemCo emphasizes critical thinking and practical application of learned concepts.

2. Categories and Exam Format

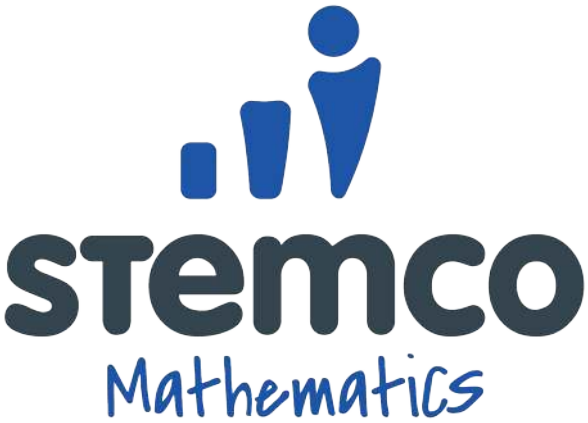
This document outlines the syllabus for each StemCo Mathematics category. The corresponding international grade levels and their Singapore grade-level equivalents are provided below for reference. All categories are assessed entirely through **Multiple-Choice Questions (MCQs)**.

Category	International Grade Level	Singapore Grade Level Equivalent	Number of Questions (MCQ)	Exam Duration (Minutes)
Singa 1	1	Primary 1	20	60
Singa 2	2	Primary 2	20	60
Singa 3	3	Primary 3	20	60
Singa 4	4	Primary 4	20	60
Singa 5	5	Primary 5	30	90
Singa 6	6	Primary 6	30	90
Singa 7	7	Secondary 1	30	90
Singa 8	8	Secondary 2	30	90
Singa Junior	9-10	Secondary 3-4	40	120
Singa Senior	11-12	Junior College 1-2	40	120

3. Syllabus

The StemCo syllabus is designed to cover essential areas and concepts crucial for a holistic understanding of subjects. While it provides a general framework for the topics featured in StemCo competitions, it is not intended to be exhaustive or overly detailed. Our goal is to provide an opportunity for students that encourages deep comprehension and real-world problem-solving, preparing them for future success in dynamic and unpredictable environments.

The syllabus includes a category called "Others" for concepts that don't fit into the main topics. This section may include questions about recent advancements, trends, and discoveries related to the subject area, designed to be inspiring. Questions in this category can also be more advanced.



Singa 1

Areas	Concepts
Numbers	Reading, Writing, Describing, Comparing, Simple Sequences & Patterns (up to 100)
Operations	Addition & Subtraction (within 100), Multiplication (within 40), Division (within 20)
Money	Dollars **OR** Cents (Up to $100, Manipulation of Either $ or Cents)
Measurement	Length (cm); Time (up to 5 minutes, using notations AM, PM, h, min)
Geometry	Identification, Description & Classification of 2D shapes
Statistics	Pictorial Graphs
Others	...

Sample Questions

1. Zoo Trip

James is at the zoo. He counts 38 lions and tigers altogether. 26 animals have black stripes (see image).

How many lions are at the zoo?

(a) 12

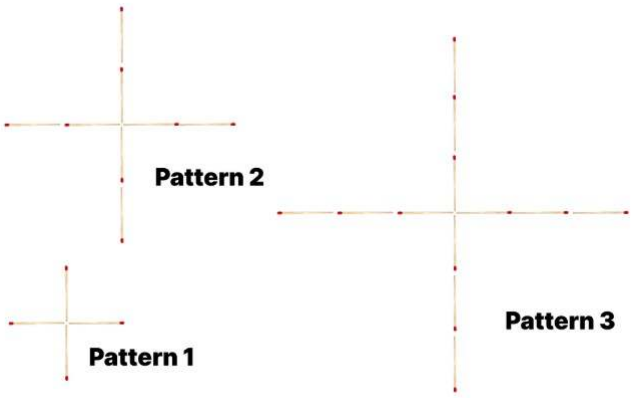
(b) 36

(c) 39

(d) 24

2. Matches

Glenn is making patterns with matches.



How many matches does he need for Pattern 5?

(a) 15

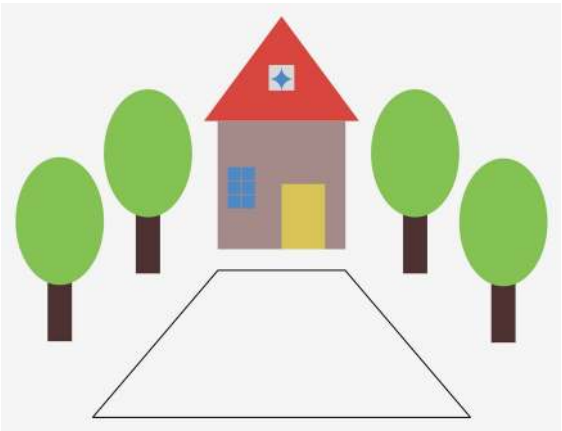
(b) 16

(c) 20

(d) 25

3. Aidar's Home

Aidar drew a picture of his home for his mum:



Which shape is not found in the picture?

(a) Square

(b) Triangle

(c) Circle

(d) Oval

4. Apples

John decided to record the number of apples he eats over 4 days:

Monday	
Tuesday	
Wednesday	
Thursday	

Which day did John eat the most apples?

(a) Monday

(b) Tuesday

(c) Wednesday

(d) Thursday

Singa 2

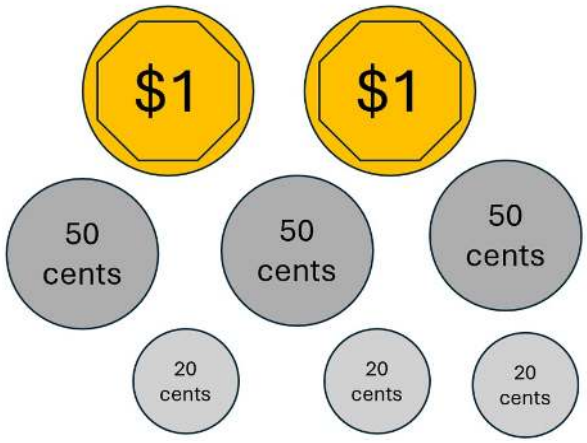
Numbers	Reading, Writing, Describing, Comparing, Simple Sequences & Patterns (up to 1000), Odd & Even Numbers
Operations	Addition & Subtraction (3 Digits), Multiplication & Division (within Multiplication Tables 2, 3, 4, 5 & 10),
Fractions	Addition, Subtraction, Representing & Comparing Simple Fractions (denominator ≤12, within 1 whole)

Money	Dollars & Cents (Up to $100, Representing & Converting using Decimal Notation)
Measurement	Length (m), Mass (g/kg), Volume (l), Time (h & min, including interconversions)
Geometry	Identification, Description & Classification of 3D Objects; Patterns involving 2D shapes
Statistics	Pictorial Graphs with Scales
Others	...

Sample Questions

1. Jane's Cupcakes

A shop is selling one cupcake for $1. Jane has these coins in her wallet:



If $1 is worth 100 cents, how many cupcakes can she buy?

(a) 3

(b) 4

(c) 5

(d) 6

2. Grace has a box of Ferrero Rocher Chocolates:

She would like to distribute all the chocolates in the box to 4 of her friends.

How many chocolates will each of her friends receive?

(a) 6

(b) 7

(c) 8

(d) 9

3. Pope Benedict XVI

Cardinal Joseph Aloisius Ratzinger was elected as Pope on 19 April 2005.

ROMAN NUMERALS

I	II	III	IV	V	VI	VII	VIII
1	2	3	4	5	6	7	8
IX	X	L	C	D	M		
9	10	50	100	500	1,000		

Once elected, he changed his name to Pope Benedict XVI. Referring to the Roman Numerals guide above, what does "XVI" (i.e., X + VI) mean?

(a) 14

(b) 15

(c) 16

(d) 17

4. Playground

Children are playing with the numbers 2, 4 and 9 in the playground. Jessica made the biggest three-digit number, while Rachel made the smallest.

If they can only use each number once, how much bigger is Jessica's number than Rachel's?

(a) 693

(b) 942

(c) 723

(d) 612

Singa 3

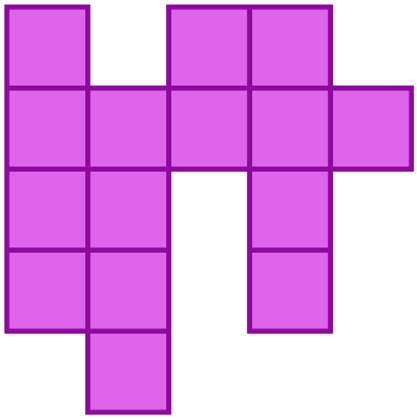
Numbers	Reading, Writing, Describing, Comparing, Simple Sequences & Patterns (up to 10000), Odd & Even Numbers
Operations	Addition & Subtraction (4 Digits), Multiplication & Division with Remainder (within Multiplication Tables 6, 7, 8 & 9; 3 digit by 1 digit Multiplication)
Fractions	Addition, Subtraction, Representing, Comparing & Simplifying Fractions (denominator ≤12)
Money	Dollars & Cents, Manipulation involving Decimal Notations

Measurement	Mass (kg/g), Length (cm/m/km), Volume (ml/l), Time (h/min/s, 24-hour clock) including easy interconversions of compound units
Geometry	Area & Perimeter (individual Squares or Rectangles; cm^2 or m^2); Comparison of Angles to a Right Angle, Parallel & Perpendicular Lines
Statistics	Bar Graphs with or without Scales
Others	...

Sample Questions

1. Irregular Shape

Michael has constructed an irregular figure using 1 cm × 1 cm squares.



What is the perimeter of this figure?

(a) 26cm

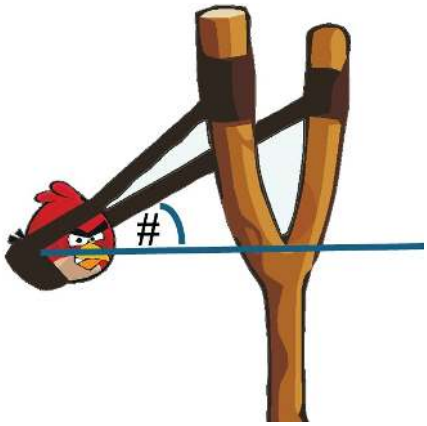
(b) 22cm

(c) 24cm

(d) 20cm

2. Angry Birds

Angry Birds is a popular game where birds are shot from a catapult in order to kill pigs:



How would you describe the angle "#"?

(a) It is a right angle.

(b) It is smaller than a right angle.

(c) It is greater than a right angle.

(d) It equals 2 right angles.

3. Pizza

Alex, Bob, and Mars ordered a pizza with 12 slices. Alex has eaten two more slices than Bob has, while Mars has eaten only 4 slices. Together they ate all of the pizza.

What fraction of the pizza did Bob eat?

(a) 1/6

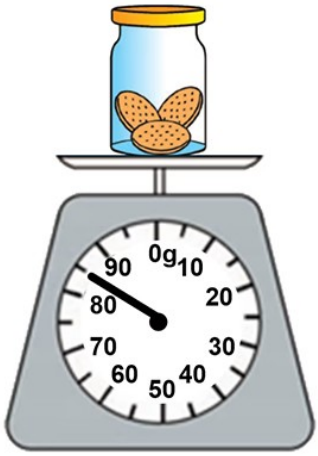
(b) 1/4

(c) 1/3

(d) 5/12

4. Jar of Cookies

A jar of cookies was placed on a weighing scale:



The empty jar weighs 40 grams. How many grams does 1 cookie weigh?

(a) 15g

(b) 10g

(c) 45g

(d) 22g

Singa 4

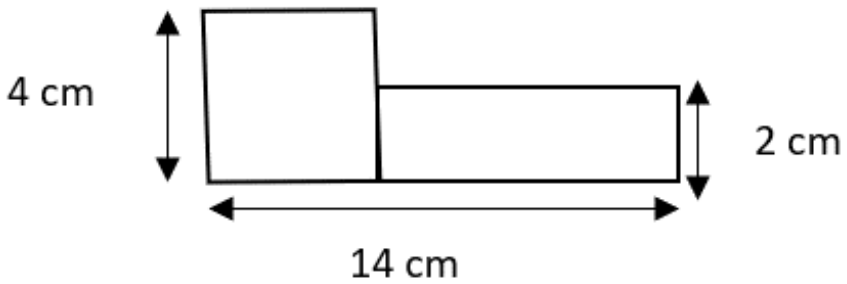
Numbers	Reading, Writing, Describing, Comparing, Sequences & Patterns (up to 100000); Approximation & using of ≈
Operations	Addition & Subtraction, Multiplication (4 digits by 1 digit or 3 digits by 2 digits) & Division with Remainder (Up to 4 digits by 1 digit), Factors & Multiples
Fractions & Decimals	Addition, Subtraction, Multiplication & Division of Mixed Numbers, Improper Fractions & Decimals (up to 3 decimal places), Simplifying

	Fractions (≤2 denominators of ≤12)
Money	Dollars & Cents, Manipulation involving Decimal Notations
Measurement	Mass (kg/g), Length (cm/m/km), Volume (ml/l), Time (h/min/s, 24-hour clock) including interconversions of compound units
Geometry	Area & Perimeter (Composite Figures of Squares & Rectangles; cm^2 or m^2); Symmetry, Measuring Angles, Cube Nets of 2D Cubes & 3D Solids
Data Interpretation	Tables, Line Graphs & Pie Charts
Others	...

Sample Questions

1. Square and Rectangle

The diagram below shows a square and a rectangle placed side by side.



The length of one side of the square is 4 cm. The breadth of the rectangle is 2 cm. What is the length of the rectangle, given that the total length of the square and rectangle is 14 cm as shown in the diagram?

(a) 10cm

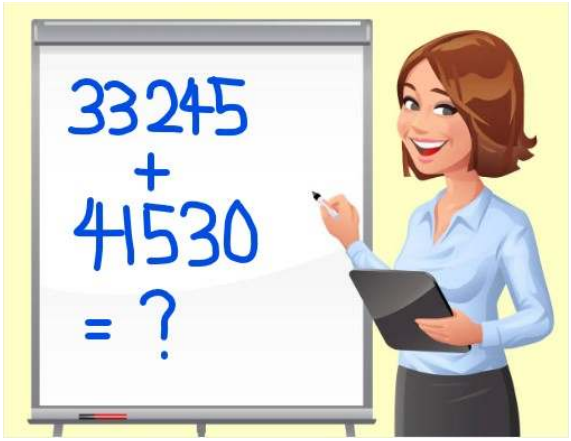
(b) 2cm

(c) 4cm

(d) 6cm

2. Jane's Math Equation

Ms. Jane was teaching a mathematics class today, and wrote the following equation on the Whiteboard:



Which of the following is the correct option for the result?

(a) Seven Hundred and Forty Seven Thousand and Seventy Five

(b) Seventy Four Hundred, Seventy Seven Hundred and Five

(c) Seventy Thousand, Four Hundred and Seventy Seven and Five

(d) Seventy Four Thousand, Seven Hundred and Seventy Five

3. Friendship Dinner

Alan, Beatrice and Clarissa are 3 good friends who met for dinner.

After the meal, they decided to split the bill amongst themselves in the following manner:

- Alan paid 3 times as much as Beatrice for the dinner.
- Beatrice paid the same amount as Clarissa for the dinner.

In the process, Alan, Beatrice and Clarissa used up 5/7, 5/8 and 1/4 of their money respectively. If the dinner cost $91.25, how much money in total did the 3 good friends have originally together?

(a) $178.85

(b) $186.15

(c) $237.25

(d) $273.75

4. MinJae’s Holiday Gaming

MinJae downloaded 2 games into his computer: Animal Crossing: New Horizons and Super Smash Bros.

During the Labour Day holiday, he got a break from school. He thus spent his day in the following manner:

Time	Activity
9:02am - ??:??am	Play Animal Crossings: New Horizons
??:??am - 11:35am	Play Super Smash Bros
11:35am - 12:35pm	Lunch

If MinJae played Animal Crossings: New Horizons for 1hour and 22mins, how long did he play Super Smash Bros?

(a) 1h 15mins

(b) 1h 13mins

(c) 1h 11mins

(d) 1h 9mins

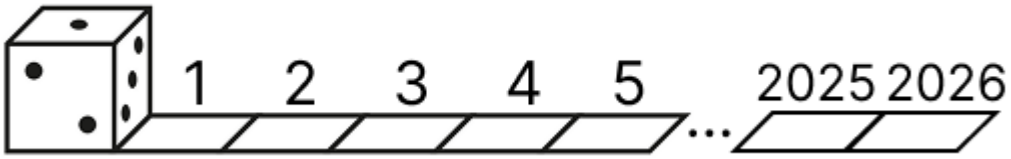
Singa 5

Areas	Concepts
Numbers	Addition, Subtraction, Multiplication & Division (up to 10000000); Reading; Writing; Describing; Sequences & Patterns; Order of Operations & Brackets
Fractions & Decimals	Addition, Subtraction, Multiplication & Division of Mixed Numbers, Improper Fractions & Decimals (up to 3 decimal places), Simplifying Fractions
Money	Dollars & Cents; utilising Percentage to Calculate Tax, Simple Discounts & Annual Interest
Measurement	Length (cm/m/km); Time (h/m/s); Mass (kg/g); Volume (ml/l) - Including conversions & using Decimals
Geometry	Perimeter (cm, m) & Area (cm^2, m^2) of Triangles, Composite Figures of Squares, Rectangles & Triangles; Volumes (cm^3, m^3) of Cubes & Cuboids
Angles	Angles on Straight Line, at a Point, Vertically Opposite Angles; Triangles (Isosceles, Equilateral, Right-Angled), Parallelograms, Rhombus & Trapeziums

Sample Questions

1. Rolling a Die in Year 2026

The total sum of the number of pips on opposite faces of a die is 7. A die was placed on the first square of a strip (see the picture) and then rolled to the right 2026 times (as we are now in the year 2026).



How many pips will be on the top face of the die after the last roll?

(a) 1

(b) 3

(c) 4

(d) 6

2. Toilet Paper

During the COVID-19 Pandemic, people were all rushing to stock up toilet paper rolls.

Kelvin has a family of 5, who all use toilet paper daily. He and his wife use 12 pieces of toilet paper, while each of their children uses 15 pieces of toilet paper everyday.

If each toilet paper roll has 400 pieces of toilet paper. How many toilet paper rolls do they need to ensure their house does not run out of a year's supply of toilet paper?

(a) 60

(b) 61

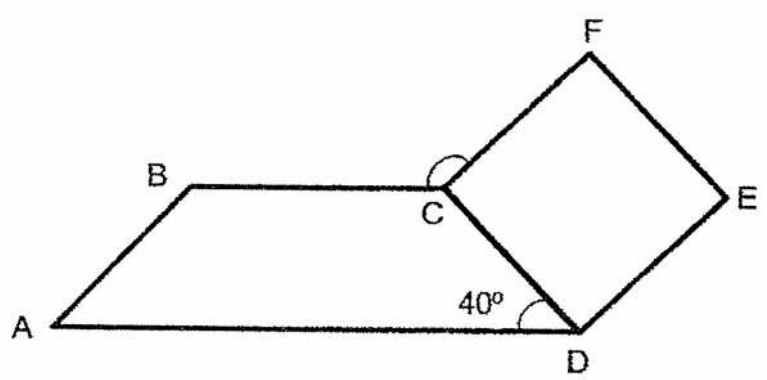
(c) 62

(d) 63

3. SAF PT Socks

The Singapore Armed Forces (SAF) issues a standard pair of Physical Training (PT) socks to all army personnel, as shown below:

Davies was so impressed by that pair of socks, that he decided to draw a small figure that resembles it:



If ABCD is a trapezium, CDEF is a square and angle ADC = 40°, what is the value of angle BCF?

(a) 110°

(b) 120°

(c) 130°

(d) 140°

4. Convenience Store

Sam went to a nearby convenience store to stock up on his groceries. He bought the following items:

ITEM	PRICE
2 Croissant	$3.98
1 Loaf	$2.99
3 Sausage Pack	$11.97
6 Coca-Cola	$9.54
3 Milk	$11.97
1 Cheese	$5.49
1 kg of Meat	$9.99
TOTAL:	$55.93

At the checkout, Sam has 4 different discount coupons, but he is allowed to use only 1 of them. The available coupons are:

Which coupon should Sam use to pay the least total amount for his groceries?

(a) 5% off the entire purchase

(b) Soft drinks only: buy 1 drink, get 1 drink free

(c) 30% off all dairy products

(d) 20% off all bakery products

Singa 6

Numbers & Decimals	Reading; Writing; Describing; 4 Operations, Sequences & Patterns; Order of Operations & Brackets
Fractions & Ratio	Addition, Subtraction, Multiplication & Division of Mixed Numbers, Improper Fractions, Simplifying, Comparing & Interchanging Fractions & Ratios, Percentage
Money	Dollars & Cents; Tax, Simple Discounts & Annual Interest
Measurement	Length (cm/m/km); Time (h/m/s); Mass (kg/g); Volume (ml/l/cm^3/m^3) - Including conversions & using Decimals
Geometry	Perimeter (cm, m) & Area (cm^2, m^2) of Composite Figures of Squares, Rectangles, Triangles & Circles (Including Semicircles & Quarter-Circles); Volumes (cm^3, m^3) of Cubes & Cuboids, use of Square & Cube Roots; Calculation of Angles in Composite Geometric Figures
Algebra	Simple Interpretations & Representations of Addition, Subtraction, Multiplication & Division
Statistics	Average (links to total value & number of data)
Others	...

Sample Questions

1. Jewel Changi Airport

Jewel Changi Airport is an iconic part of Singapore Changi Airport.

Among the attractions inside Jewel Changi Airport is the HSBC rain vortex, pictured here:

If the oculus (the circle where the water fountain falls out of) has a diameter of 12m, what is the area of the oculus? Take $\pi = 22/7$.

(a) 113 and 1/7 m^2

(b) 452 and 4/7 m^2

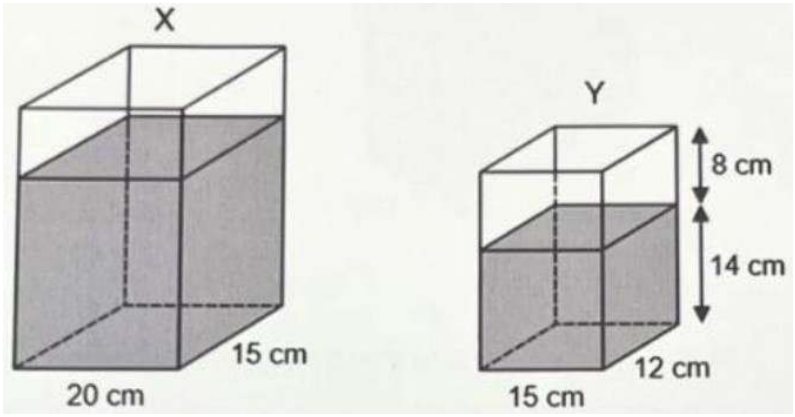
(c) 37 and 5/7 m^2

(d) 1 and 5/7 m^2

2. Minister Desmond's Question

In March 2026, Minister of Education Mr. Desmond Lee went viral for asking the Members of Singapore's Parliament to solve the following challenging Primary 6 exam question! He discussed about scaffolding mathematics questions to make it easier for the children.

The figure shows the amount of water in two rectangular containers, X and Y, at first.



The figure shows the amount of water in two rectangular containers, X and Y, at first.

Ray poured 1/5 of the water from Container X into Container Y, filling Container Y completely without overflowing. Sarah then poured all the water from Container Y into Container X, and 120 cm^3 of water overflowed.

Prove that you are smarter than Singaporean Grade 6 students by solving this without scaffolding!

What is the height of Container X?

(a) 48cm

(b) 40cm

(c) 32cm

(d) 24cm

3. New York - Paris Flight

The time difference between New York City and Paris is 6 hours apart, with Paris being ahead of New York.

Mike boarded a transatlantic flight from New York to Paris. Before takeoff, he changed his watch to Paris time so he could get used to the new time zone before landing.

During the flight, the airplane passed over a group of islands in the Atlantic Ocean, known as Cape Verde.

Mike looked at his watch and saw that it showed 0830. He later learned that Cape Verde's local time was 2 hours ahead of New York time.

What was the actual local time on Cape Verde at that moment?

(a) 0330

(b) 0430

(c) 0630

(d) 1030

4. 3 Friends' Salaries

3 friends want to calculate the average of their salaries, but none of them wants to reveal their individual salary. So, they come up with the following idea:

- The first friend picks a large random number (for example, $40,000) and adds his salary to it. He then tells the result to the second friend.

- The second friend adds his own salary to the number he received and passes the new total to the third friend.
- The third friend adds his salary to the received number and gives the final sum back to the first friend.

What calculation should the first friend perform to find the average salary?

(a) Subtract the large number he initially chose from the final sum, then divide the result by 3

(b) Divide the final sum by 3

(c) Subtract three times the large number he originally chose from the final sum

(d) Divide the final sum by 3, then subtract the large number he initially chose

STEMCO Mathematics

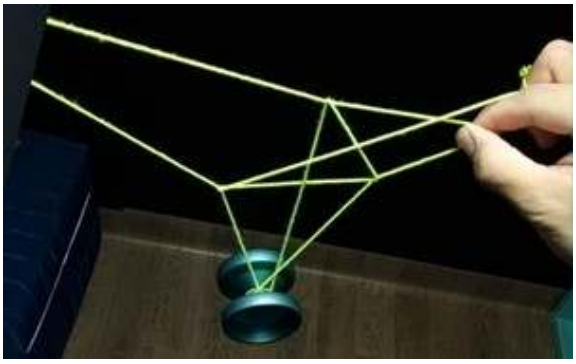
Singa 7

Areas	Concepts
Numbers	Real, Rational, Negative Numbers & Integers; Prime Factorisation, Highest Common Factor & Lowest Common Multiple, Inequalities, Significant Figures, Number Line
Algebra	Addition, Subtraction, Multiplication, Division; Order of Operations & Brackets, Common Factor Extraction, Linear Fractions, Inequalities, Expressions & Simple Graphs
Kinematics	Speed (km/h & m/s) - Including Unit Interconversion, Average & Constant Speeds; Rate
Geometry	Perimeter & Area (Parallelograms, Trapeziums & Composite Figures) in cm^2 & m^2; Volume & Surface Area (Prisms, Cylinders & Composite Solids) in cm^3, m^3
Angles	Right, Acute, Obtuse & Reflex Angles; Angles on Straight Line, at a Point, Vertically Opposite Angles, Corresponding, Alternate & Interior/Exterior Angles; Properties of Polygons
Statistics	Tables; Bar Graphs; Line Graphs; Pie Charts; Pictograms
Others	...

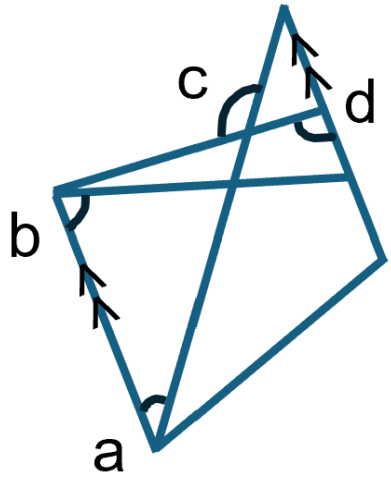
Sample Questions

1. Yo-yos

During the early 2000s, yo-yos were very popular among Millenials. Of course, with the rise of Generations Z, alpha and beta, this once popular toy is now obsolete today. Yo-yos can be made to form cool shapes, as seen in this example below:



The shape formed by the yo-yo expert can be approximated to the following figure:



If angle a = 35^{o}, angle b = 81^{o}, and angle c = 121^{o}, calculate angle d?

(a) 93^{o}

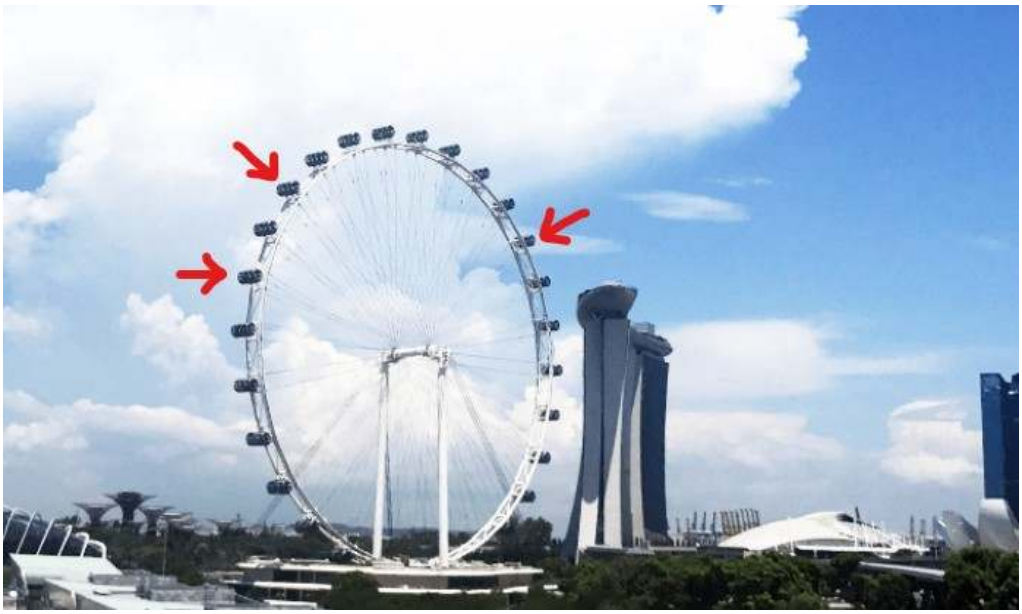
(b) 94^{o}

(c) 95^{o}

(d) 96^{o}

2. Singapore Flyer

The Singapore Flyer is an iconic landmark in Singapore. People often come to ride in the capsules (3 examples pointed with red arrows in the picture below) as the wheel rotates, enjoying a bird's-eye view of Singapore City.



Given that:

- The radius of the Singapore Flyer Wheel = 75m
- The time it takes for 1 capsule to complete 3 complete revolutions of the Singapore Flyer = 87mins

What is the speed of each capsule, as it travels with the rotation of the wheel?

(a) 0.975km/h

(b) 0.760km/h

(c) 0.487km/h

(d) 0.310km/h

3. Lee Hsien Loong

Mr. Lee Hsien Loong, now a senior Minister in the Prime Minister's Office of Singapore, was once Singapore's 3rd Prime Minister (August 2004 - May 2024):

In total, he served as Prime Minister of the Republic of Singapore for 7216 days. How many prime factors is 7216 made out of?

(a) 5

(b) 6

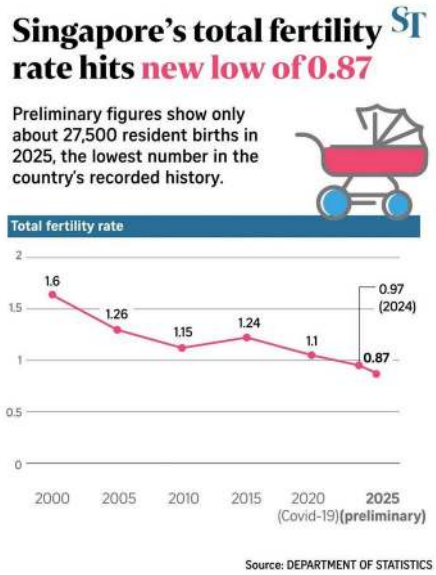
(c) 7

(d) 8

4. Singapore’s TFR Crisis

In February 2026, Singapore's Deputy Prime Minister Mr. Gan Kim Yong addressed the Singapore Parliament about the historic low 0.87 Total Fertility Rate (TFR) recorded in the year 2025. This means that the birth rate is falling drastically in Singapore and the population will struggle to replace itself in future, should this trend continue.

The graph below by The Straits Times (Singapore's newspaper media) shows how the fertility rate changed ever since year 2000:



By referencing only the above graph, which of the following statements is incorrect?

(a) Singapore's TFR in 2022 is lower than 2008

(b) The highest TFR in Singapore was recorded in 2000

(c) The average of the TFR for years 2005, 2010 and 2020 is 1.17

(d) Singapore's TFR only kept on decreasing steadily from 2000 - 2025.

Singa 8

Areas	Concepts
Algebra	Quadratic Expressions & Expansions, Subject of Formulae; Factorisation of Quadratic & Complex Linear Expressions, Manipulation, Simplification & Factorisation of Fractions with Quadratic &/or Linear Denominators, Inequalities
Graphs	Positive & Negative Quadratic Functions, Symmetry, Maximum & Minimum Points, Intersections of Linear &

	Quadratic Plots
Kinematics	Speed (km/h & m/s) - Including Unit Interconversion, Average & Constant Speeds; Rate
Geometry	Pythagoras' Theorem; Simple Trigonometry, Congruence & Similarity, Volume & Surface Area (Pyramid, Cone & Sphere), Perimeter & Area involving Map Scales
Angles	Right, Acute, Obtuse & Reflex Angles; Angles on Straight Line, at a Point, Vertically Opposite Angles, Corresponding, Alternate & Interior/Exterior Angles; Properties of Polygons
Statistics	Dot Diagrams, Histograms, Stem & Leaf Diagrams; Mean, Mode & Median, Simple Probability of Single Events
Others	...

Sample Questions

1. Mount Kinabalu Trail

Mount Kinabalu is the tallest mountain located in Southeast Asia, located in Sabah, Malaysia.

The trail that leads to the summit of Mount Kinabalu (Low's Peak) is known as the Timpohon trail - this is famous for its thousands of uneven, steep and often high-step wooden stairs. An example of such a section is as shown below:

Adams was currently trekking on the Timpohon trail of Mount Kinabalu and wanted to find out the length of stairs (represented by the green line of the triangle in the picture) in this particular section. If the red line (15m) and yellow line (3m) forms a right angled triangle with the green line, what is the length of the flight of stairs?

(a) 12m

(b) 15.1m

(c) 15.3m

(d) 18m

2. Vieta's Theorem

Jake was deriving Vieta's Theorem on the board.

He started with a quadratic equation:

$ax^2 + bx + c = 0$, and said its roots are s and t.

Then he wrote that the polynomial can be factored using its roots:

$a(x-t)(x-s)=0$

Next, he expanded the brackets and wrote:

$a(x-t)(x-s) = ax^2 - axt - asx + ast = ax^2 - ax(t-s) + ast = 0$

From this, Jake concluded:

-a(t-s) = b, t - s = -b/a and ast = c, s * t = c/a

So he stated: "The product of roots = c/a, and the difference of roots = -b/a"

Where did Jake make a mistake?

(a) He factored incorrectly: it should be (x+s)(x+t) instead of $(x-s)(x-t)$.

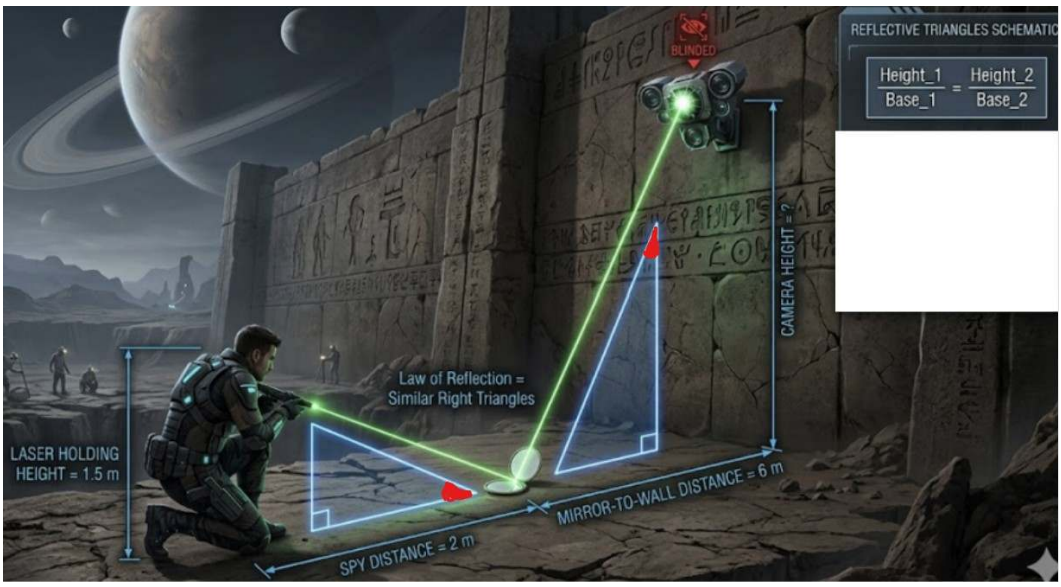
(b) He made an error *while expanding the brackets*: $a(x-t)(x-s)$, should be equal to $ax^2 - axt + ast + ast$

(c) He made an error *after expanding*, when combining like terms - axt - ast, it should be - ax(t+s)

(d) Difference of roots is equal to -b/c, not b/a

3. Mission Impossible

When a beam of light (that does not obey the laws of Physics) bounces off a flat mirror resting on the ground, it creates 2 similar right-angled triangles on either side of the mirror, as shown in the figure below:



A spy is trying to blind a security camera mounted on a vertical fortress wall. He places a flat pocket mirror on the ground. Then he stands 2m away from the mirror and aims a laser pointer directly at the center of the mirror from a holding height of 1.5m. The mirror reflects the laser beam and it hits the lens of the security camera. The mirror is resting on the ground exactly 6m away from the base of the wall where the camera is placed.

Given that the shaded angles above in red are equal, what is the height at which the camera is mounted?

(a) 6.5m

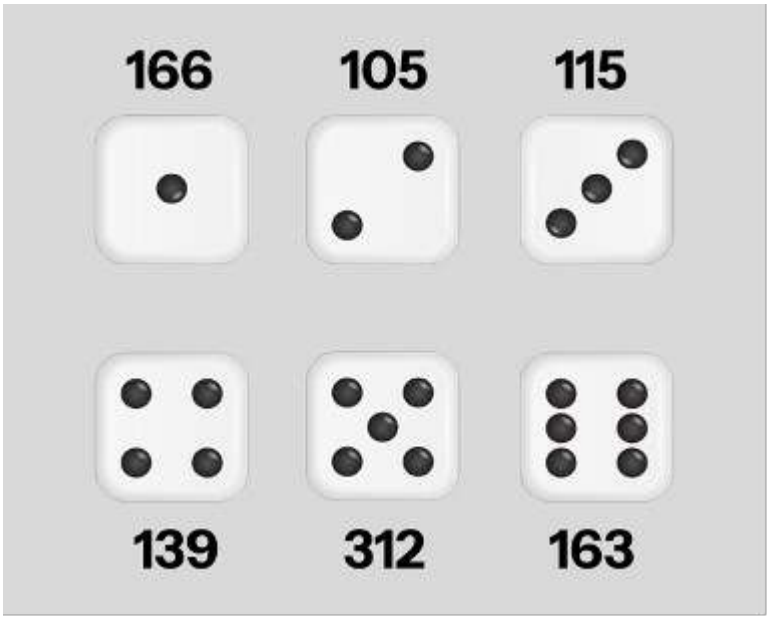
(b) 8.0m

(c) 3.0m

(d) 4.5m

4. A Fair Dice

Alex bought a fair die from a board game shop. As he examined it, he noticed that it felt slightly different from the other dice he had used before. Curious about its fairness, he decided to test it by rolling the die 1,000 times and recording the outcomes.



Which statement about the fair dice is false?

(a) The number 5 appeared approximately three times more often than expected

(b) The die does not appear to be fair

(c) The counts for 2 & 3 were significantly lesser than expected

(d) The counts for 1 and 6 are close to the expected value

Singa Junior

Areas	Concepts
Numbers & Money	Index Notation; Matrices; Set Language & Notation; Compound Interest; Complex Currency Exchanges
Algebra	Quadratic Inequalities; Simultaneous Linear Equations; Partial Fractions; Surds; Exponential & Logarithmic Functions; Binomial Theorem; Graphical Analysis
Trigonometry	Normal & Inverse Functions (Degrees & Radians); Rules; Double Angle Formula; Solving, Proof-ing & Simplifying Expressions; Graphical Analysis; Area of Triangle
Geometry	Geometrical Proofs (Including Midpoint & Tangent-Chord Theorem); Symmetry & Angle Properties, Arc Length & Segment Area of Circles; 2D Vectors
Calculus	Differentiation & Integration (Implicit Differentiation, Integration by Parts & Integration of Inverse Trigonometric Functions **NOT** required)
Statistics	Cumulative Frequency Diagrams; Box & Whisker Plots; Quartiles; Percentiles; Interquartile Range; Standard Deviation; Probability of Combined Events

Others

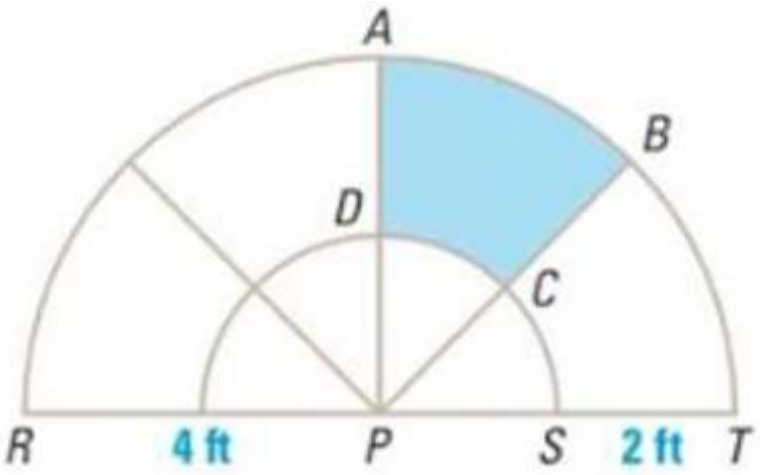
...

Sample Questions

1. Flowers Around a Tree

Martina is planting flowers in a circular pattern around a tree:

She decided to divide one semicircular garden bed into eight sectors and plans to plant tulips in one of them:



It is known that RP = 4 ft, ST = 2 ft, APB = (π / 4) radians. What is the area of the sector, where tulips were planted?

(a) 1.5π ft^2

(b) 3.0π ft^2

(c) 4.0π ft^2

(d) 2.5π ft^2

2. Integration Bee

Every year, StemCo Mathematics Challenge organises an Integration Bee competition, similar to the annual Integration Bee of the Massachusetts Institute of Technology (MIT). This is a competition where competitors compete to see who can solve Integrals faster.

Chris, a participant in this year's StemCo Integration Bee, was faced with the following integral...

$$\int_0^3 \frac{5x \ln(x^2+2)}{(x^2+2)} dx$$

... in which he did not know how to solve. His girlfriend in the audience, Valerie, eager to help her boyfriend shouted: "substitute, substitute, substitute!!" With Valerie's hint, what is the solution of the integral?

(a) 4.22

(b) 6.59

(c) 9.53

(d) 13.17

3. 4th Degree Polynomial

In advanced algebra, expanding high-degree expressions can quickly become messy and time-consuming. However, some quadratic equations hide elegant patterns that allow them to be solved through clever grouping and substitution instead of brute-force expansion.

For the equation (x+3)(x+5)(x+7)(x+9) = 9: by carefully pairing binomial factors whose constants share a common relationship and replacing terms to simplify a quadratic equation into a repeat of something similar; finding the 4th polynomial; or otherwise; what is the sum of all distinct roots of the above equation?

(a) 3

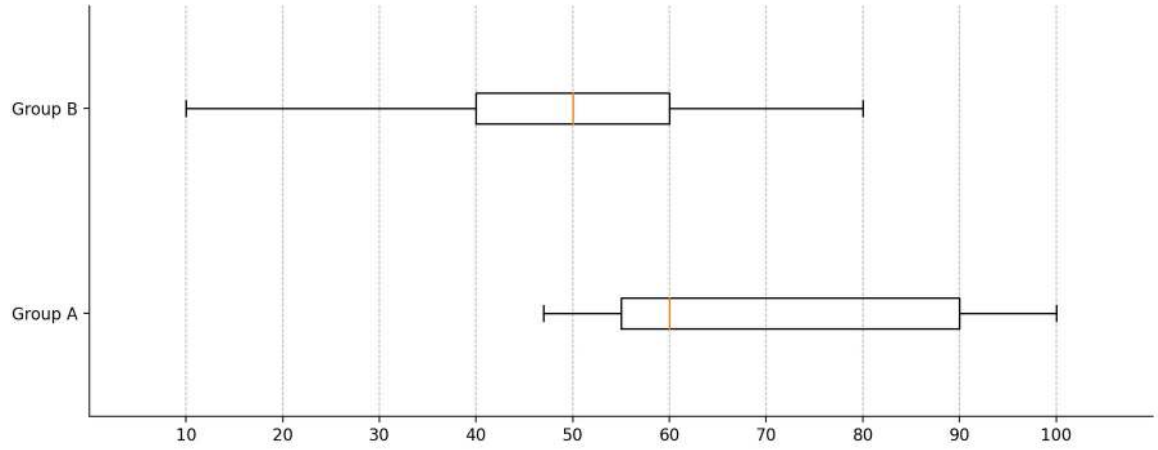
(b) -6

(c) 12

(d) -18

4. University Statistics Course

Professor Schwartz teaches a university statistics course to two sections: the morning class (Group A) and the afternoon class (Group B) with 40 students in each group. After the midterm exam, he collected the scores and created box plots for both groups.



He then made 3 claims about the exam results:

1. The standard deviation of Group A is greater than the standard deviation of Group B.
2. The student with the lowest score in Group A scored higher than 50% of the students in Group B.
3. The range of Group A is larger than the range of Group B.

Which statements are correct?

(a) Statement 1 and 3

(b) Statements 2 and 3

(c) Statements 1 and 2

(d) All 3 statements are correct

Singa Senior

Areas	Concepts
Algebra	Inequalities; Functions & Inverse Functions; Graph Transformations, Utilisation of Graphing Calculator; Binomial Expansion; Maclaurin Series
Sequences & Series	Arithmetic & Geometric Series: Limits; Infinity; Convergence, Sum & Differences of 2 Series; n^{th} Term Expression; Mathematical Induction
Geometry	3D Vectors; Dot, Cross Products & their Geometrical Interpretations; Ratio Theorem; Cartesian Equations & Relationship between Lines & Planes
Calculus	Differentiation & Integration (Includes Implicit Differentiation, Integration by Parts & Integration of Inverse Trigonometric Functions)
Complex Numbers	Addition & Subtraction; Cartesian Form; Argand Diagrams; Manipulation of Quadratic Equations; Modulus, Argument & Conjugate
Statistics & Probability	Permutations & Combinations; Probability; Binomial, Poisson & Normal Distributions; Hypothesis Testing; Correlation & Linear Regression
Others	...

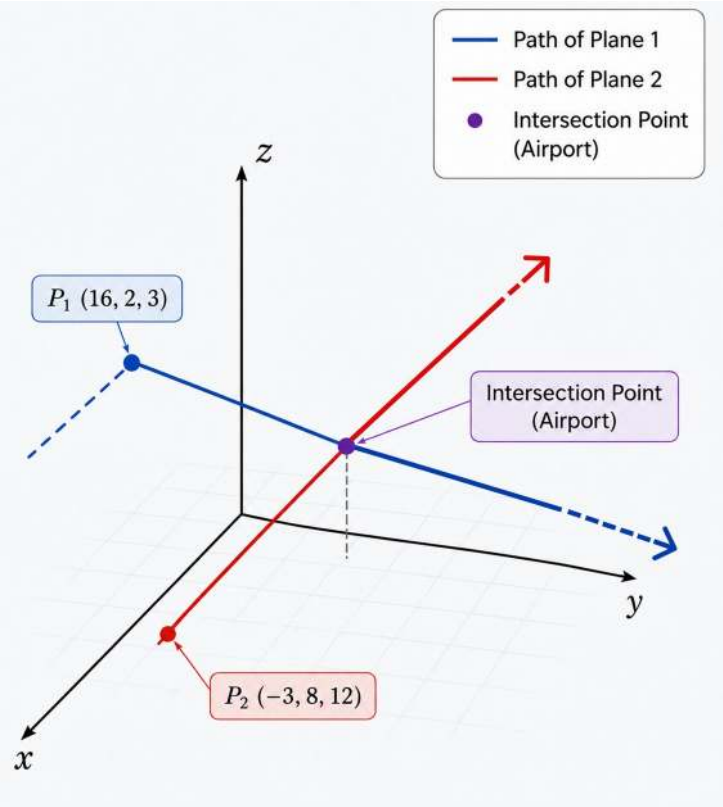
Sample Questions

1. Airplanes and Airport

An air traffic control system is tracking 2 airplanes flying toward the same airport. The vectors of the 2 airplanes are as follows:

r = 16i + 2j +3k + α(3i + 2j – k)

r = -3i + 8j + 12k + β(5i – 6j – 3k)



If the location of the airport is on the exact intersection point of these 2 flight paths, what is the radius-vector representing the precise location of the airport?

(a) 6i + 3j - 8k

(b) 7i - 4j + 6k

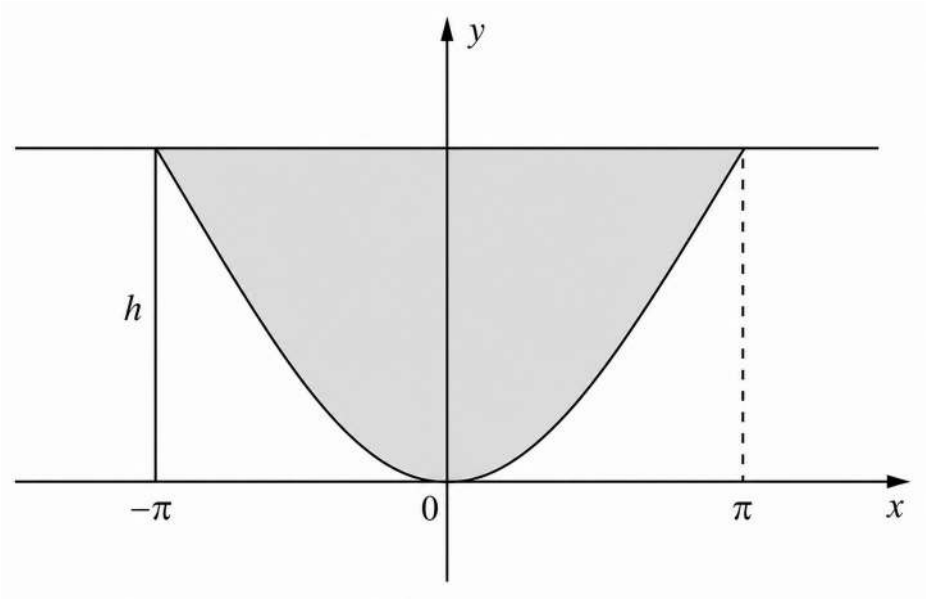
(c) i + 2j + 4k

(d) 7i + 7j - 2k

2. Water Channel

A civil engineer is designing a straight concrete water channel. The uniform cross-section of the water channel (the shaded region in the design schematic) is bounded at the bottom by a curved bed described by the equation: y = xsin(x/2)

The top of the channel is perfectly level and aligns with the highest points of this curve at the edges.



To calculate the total volumetric capacity of the channel later, the engineer must first find the exact geometric area of this single cross-section. What is the exact cross-sectional area of the full water channel?

(a) $(\pi^2 + 4)$ units^2

(b) $(16\pi - 16)$ units^2

(c) $(\pi^3/3 + \pi)$ units^2

(d) $(2\pi^2 - 8)$ units^2

3. Cybersecurity Firm

A cybersecurity firm has designed a physical encryption key consisting of 6 data modules plugged into a single horizontal server rack with 6 slots. To avoid overheating and data corruption, the modules must be arranged according to strict physical rules. The 6 modules are:

- 2 identical Alpha Cores (A)
- 2 identical Beta Drives (B)
- 1 Gamma Processor (G)
- 1 Delta Router (D)

The placement rules are:

- The 2 alpha cores must be placed on slots with different parities (1 must be in an odd-numbered slot, and the other in an even-numbered slot).
- The gamma processor must be placed somewhere between the 2 beta drives. (They do not have to be adjacent, but reading left to right, the order must be B – G – B).

How many valid ways are there to arrange the 6 modules in the server rack?

(a) 36

(b) 40

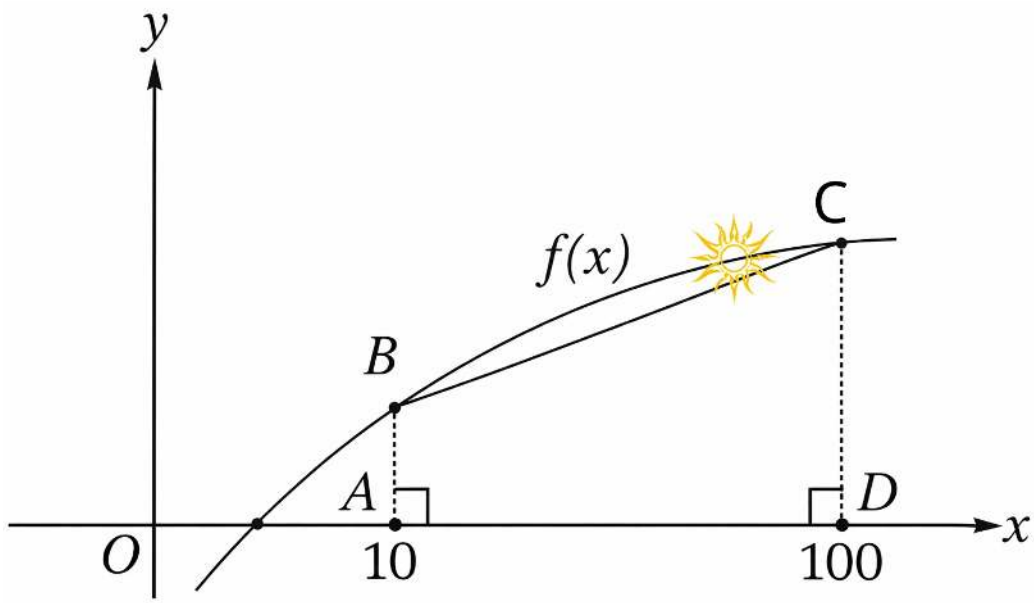
(c) 45

(d) 48

4. Sunset Trajectory

Marcus lives next to a bridge. Every day, he watches the sun set and he notices that its apparent path lines up nicely with the curved shape of the bridge.

He decides to model this “sunset trajectory” with the function $y = \log_{10}x$.



On the bridge diagram, two vertical support columns stand at x=10 and x=100.

The quadrilateral ABCD forms a trapezoid (with parallel sides AB and CD).

What is the area of trapezoid ABCD?

(a) 135 units^2

(b) 150 units^2

(c) 180 units^2

(d) 90 units^2