Results of Secondary 3 Mathematics in Territory-wide System Assessment 2024

The percentage of Secondary 3 students achieving Mathematics Basic Competency in 2024 is 79.0%.

Secondary 3 Assessment Design

- The design of assessment tasks for S.3 was based on the documents *Basic Competency Descriptors for Key Stage 3 Mathematics Curriculum* and *Mathematics Education Key Learning Area Curriculum Guide (Primary 1 – Secondary 6)* (2017). The tasks covered the three strands of the mathematics curriculum, namely **Number and Algebra**, **Measures**, **Shape and Space**, and **Data Handling**. They focused on the Foundation Part of the S.1 – 3 syllabuses in testing the relevant concepts, knowledge, skills and applications.

- The Assessment consisted of various item types including multiple-choice questions, fill in the blanks, answers-only questions and questions involving working steps. The item types varied according to the contexts of the questions. Some test items consisted of sub-items. Besides finding the correct answers, students were also tested in their ability to present solutions to problems. This included writing out the necessary statements, mathematical expressions and explanations.

- The Assessment consisted of 137 test items (191 score points), covering all of the 118 Basic Competency Descriptors. These items were organised into four sub-papers, each 65 minutes in duration and covering all three strands. Each student was required to attempt one sub-paper only. Some items appeared in more than one sub-paper to act as inter-paper links and to enable the equating of test scores. The number of items on the various sub-papers is summarised in Table 8.4. These numbers include several overlapping items.

Table 8.4 Number of Items and Score Points for S.3

Subject	No. of Items (Score Points)				
	Paper 1	**Paper 2**	**Paper 3**	**Paper 4**	**Total***
Mathematics					
Written Paper					
Number and Algebra	23 (29)	23 (30)	23 (30)	24 (29)	67 (87)
Measures, Shape and Space	17 (23)	18 (25)	17 (24)	17 (24)	53 (73)
Data Handling	7(13)	6 (10)	7 (11)	6 (12)	17 (31)
Total	47 (65)	47 (65)	47 (65)	47 (65)	137 (191)

***** Items that appear in different sub-papers are counted once only.

The item types of the sub-papers were as follows:

Table 8.5 Item Types of the Sub-papers

Section	Percentage of Score Points	Item Types
A	~ 30%	• Multiple-choice questions
B	~ 30%	• Calculate numerical values • Give brief answers
C	~ 40%	• Solve application problems showing working steps • Draw diagrams or graphs • Open-ended questions requiring reasons or explanations

Performance of Secondary 3 Students Achieving Basic Competency in 2024

Secondary 3 Number and Algebra Strand

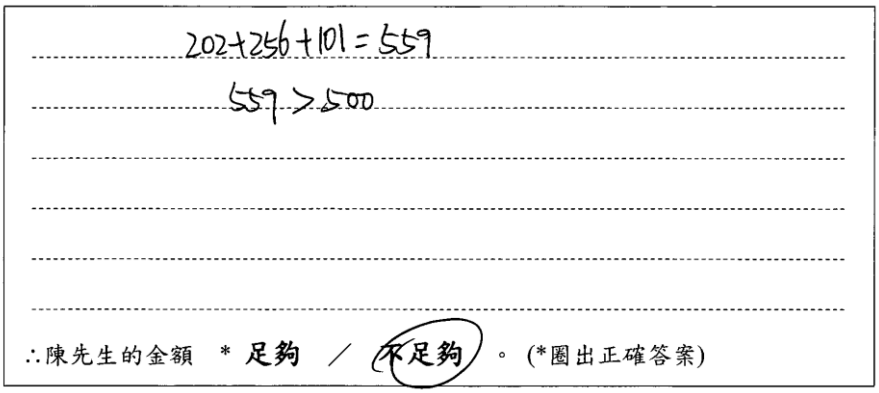
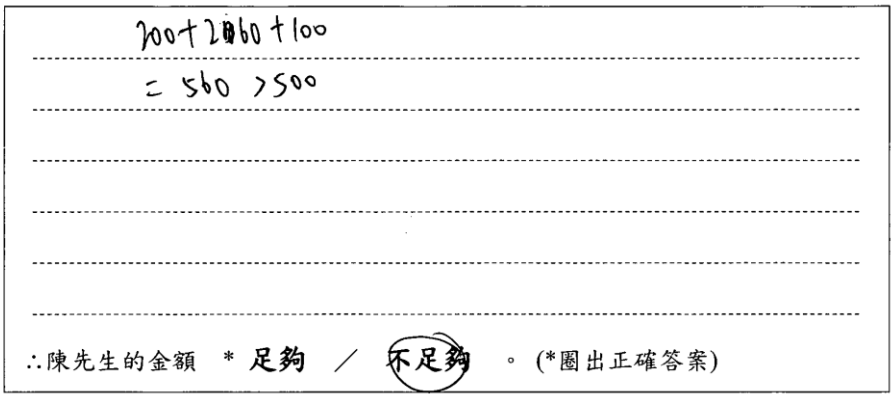
S.3 students performed steadily in this strand. The majority of students had a good grasp of the basic concepts of directed numbers and linear equations in one unknown. Their performance was fair when solving problems related to laws of integral indices, ratios, rates, and proportions, basic computation, rational and irrational numbers and algebraic expressions. However, their performance in approximations and numerical estimation was quite weak. Comments on students' performances are provided with examples cited where appropriate (question number *x* / sub-paper *y* quoted as Q*x*/M*y*). More examples may also be found in the section ***General Comments***.

- Basic Computation: Students did well in performing mixed arithmetic operations of positive integers involving two levels and at most three pairs of brackets. The majority of students could use powers to express the repeated multiplication of a number and use repeated multiplication to express the power of a number, but some students were not able to use powers to express. Almost half of the students could handle prime factorization of positive integers, but their performance was not satisfactory when finding the least common multiple using the prime factorization of two numbers.

Q21/M4
Exemplar Item（Use powers to express the repeated multiplication of a number） Express $11 \times 11 \times 11$ as a power.
Example of Student Work (1) 1331 （Not able to use powers to express） (2) 1.331×10^3 （Wrongly expressed in scientific notation）

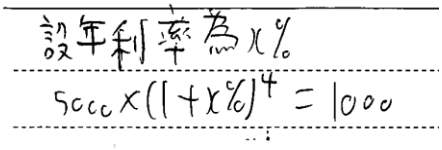
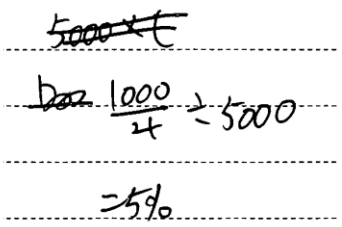
- Directed Numbers: Students did well in demonstrating recognition of the ordering of integers on the number line. The majority of them could use directed numbers to represent the number of tourists entering and leaving cities, though their performance in mixed arithmetic operations with directed numbers was fair.

- Approximate Values and Numerical Estimation: Many students could round off a number to 2 significant figures, and quite a number of them could round off a number to 2 decimal places. However, their performance in using suitable estimation strategies to solve simple real-life problems was weak, with a few students using rounding down as an estimation strategy.

Q40/M4
Exemplar Item（Estimate the total cost of purchasing gifts and judge whether Mr. Chan's budget is sufficient.） Mr Chan plans to spend $500 to buy 3 gifts. The prices of the gifts are $202, $256 and $101 respectively. Based on the description above, give an appropriate approximation for each **UNDERLINED VALUE**. Hence, estimate the total amount spent buying the gifts. Briefly, explain whether Mr Chan has enough money to buy these 3 gifts.
Example of Student Work（Did not give approximations for the price of each gift）   
Example of Student Work（Not able to use suitable estimation strategies）   

- Rational and Irrational Numbers: Many students could calculate the value of x in the expression $\sqrt{x} = a$ and $\sqrt[3]{a} = x$, where a is a positive integer. Quite a number of them could represent an irrational number on the number line, but half of the students could not recognize that $\sqrt{8}$ is irrational.

- Using Percentages: The majority of students could solve simple problems on profit or loss. Their performances in solving problems on percentage decrease and percentage change in mathematical context and solving simple problems on growths were acceptable. Nearly half of them could solve simple problems on compound interest, compounded yearly. Nevertheless, their performance in solving problems on simple interest was not satisfactory.

Q40/M1
Exemplar Item (Find the annual interest rate) Peter deposits \$5 000 in a bank. After 4 years, he will receive **simple interest** of \$1 000. Find the annual interest rate.
Example of Student Work（Confused simple interests with compound interests） 
Example of Student Work（Incomplete presentation） 

- Rates, Ratios and Proportions: The performance of students was fair in representing a ratio in the form *a : b* and solving simple real-life problems using rates, ratios, and direct proportions. There was room for improvement in distinguishing direct and inverse proportions.

Q25/M1
Exemplar Item（representing a ratio in the form *a : b*） A fruit shop sold 150 apples and mangoes in total, 70 of which were mangoes. Find the ratio of the number of apples to the number of mangoes sold.
Example of Student Work (1) 蘋果的數目：芒果的數目 = 80 : 70 （Did not simplify the ratio） (2) Number of apples：Number of mangoes = 15 : 7 （Mistakenly used the total number of fruits as the number of apples for calculations）

- Algebraic Expressions: The majority of students could write down the next term of a sequence of square numbers with several consecutive terms given and many students were able to formulate algebraic expressions from word phrases. Their performance in finding particular terms from the general term of a sequence was acceptable, and nearly half could demonstrate recognition of notations of algebraic expressions such as x^2.

- Linear Equations in One Unknown: Many students could solve simple linear equations in one unknown, demonstrate understanding of the meaning of solutions of equations and formulate a linear equation in one unknown from a simple problem situation.

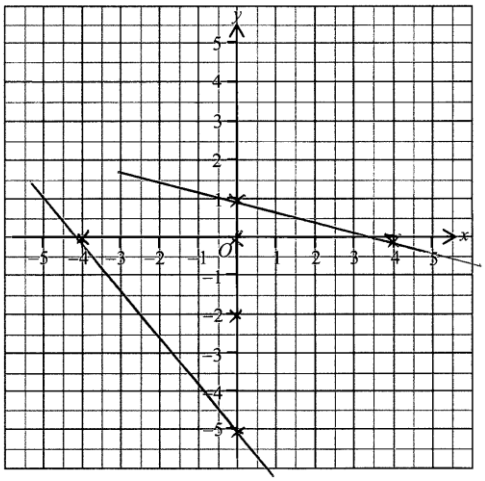
- Linear Equations in Two Unknowns: Students performed satisfactorily in solving simple simultaneous linear equations by algebraic methods and demonstrating recognition that graphs of equations of the form $ax + by + c = 0$ are straight lines. Quite a number of them were able to formulate simultaneous linear equations in two unknowns from simple problem situations. Their performances in plotting graphs of linear equations in two unknowns and solving simple simultaneous linear equations by algebraic methods were acceptable. However, there was room for improvement in determining whether a point lies on a straight line given its linear equation.

Q41/M1

Example of Student Work (Correctly calculate the corresponding y values, but failed to plot the corresponding graph.)

$y = \frac{3x-8}{4}$

x	-4	0	4
y	-5	-2	1

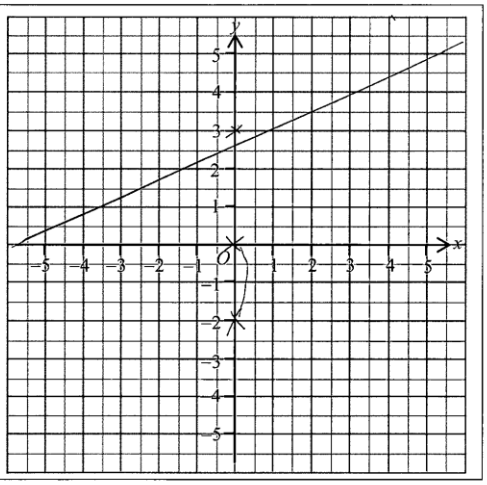


Q41/M3

Example of Student Work (Calculation errors)

$3x - 4y - 8 = 0$

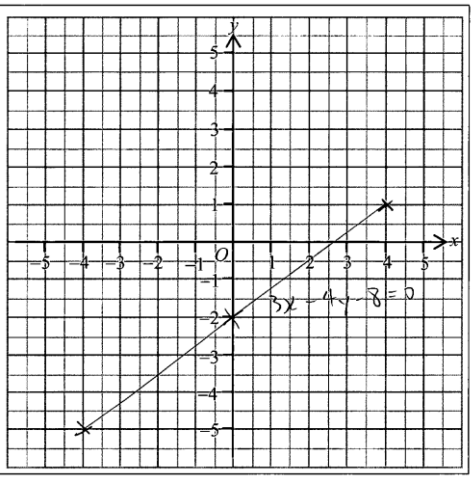
x	-4	0	4
y	3	-2	-8



Example of Student Work (Did not extend two ends of the line)

$3x - 4y - 8 = 0$

x	-4	0	4
y	-5	-2	1



- Laws of Integral Indices: Students performed well in converting a positive number expressed in scientific notation to an integer. Many of them were capable of finding the value of a^n (where a and n are negative integers). Quite a number of students could simplify simple algebraic expressions using integer exponent laws, though their performance in representing a positive number in scientific notations was quite weak.

Q26/M1
Exemplar Item（Represent a positive number in scientific notations） The diameter of the pollen of a plant is about 0.000 04 m. Use scientific notation to represent the diameter.
Example of Student Work（Did not represent in the correct form of scientific notations） (1) The diameter = 0.4×10^{-4} m (2) 該直徑 = $4,00 \times 10^{-5}$ m (3) 該直徑 = 4×10^{5} m

- Polynomials: The majority of students were able to distinguish factorisation and expansion of polynomials and many students could perform multiplication of a monomial by a trinomial. Their performance in factoring expressions of the form $ax^2 + bx + c$ was fair. Half of the students could perform multiplication of two binomial, addition or subtraction of two polynomials, and factoring by taking out common factors. Some students distinguished polynomials from algebraic expressions and arranged the terms of polynomial in ascending order, but many students could not demonstrate recognition of powers.

Q27/M1
Exemplar Item (Perform multiplication of two binomial) Expand $(x + 2)(3x – 5)$.
Example of Student Work (Wrong computation) (1) $3x^2 - x - 10$ (2) $3x^2 + 6x - 5x - 10$ (3) $3x^2 + x + 10$

Q27/M2
Exemplar Item (Perform addition or subtraction of two polynomials) Simplify $(5x – 4y) + (8y – 2x)$.
Example of Student Work (Wrong computation) (1) $3x - 4y$ (2) $7x + 4y$

Q28/M2		
Exemplar Item (Factorise by taking out common factors) Factorise $4x - 8x^2$.		
Example of Student Work		
(1)	$4x(1-4x)$	(Wrong computation)
(2)	$(2x+8)(2x-8)$	(Wrongly use of difference of two squares)

- Identities: Quite a number of students were able to indicate whether an equation was an identity and used the identity of difference of perfect square to factorise simple polynomials. However, there was room for improvement in using the identity of difference of two squares to expand simple algebraic expressions.

Q29/M2		
Exemplar Item (Use the identities of difference of two squares to expand simple algebraic expressions) Expand $(6x + 1)(6x - 1)$.		
Example of Student Work		
(1)	$(6x)^2 - 1^2$	(Incomplete expansion of algebraic expression)
(2)	$6x^2 + 12x + 1$	(Wrong computation)
(3)	$6x^2 - 1^2$	(Wrong computation)

- Formulae: Students performed satisfactorily in substituting values into formulas in which all exponents are positive integers and finding the value of a specified variable. Half of the students could perform changes of subject in simple formulas not involving radical signs. Their performance in adding two algebraic fractions (both the numerators and denominators being monomials) was acceptable, but their performance in multiplication was not satisfactory.

- Linear Inequalities in One Unknown: Students did well in determining whether a number satisfied a given inequality. The performance of students was fair in demonstrating recognition of the properties of inequalities, representing inequalities on the number line in mathematical expressions, solving simple linear inequalities in one unknown with integral coefficients and constants, and formulating a linear inequality in one unknown from a simple problem situation.

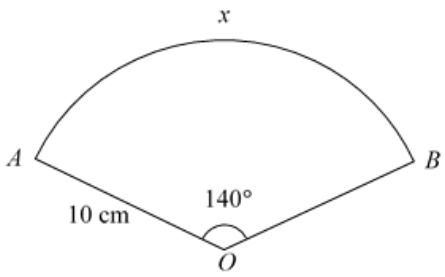
Q31/M1
Exemplar Item (Solve simple linear inequalities in one unknown with integral coefficients and constants) Solve the inequality $2x \leq -8$.
Example of Student Work (Wrong computation) (1) $x = -4$ (2) $x \geq -4$ (3) -4

Secondary 3 Measures, Shape and Space Strand

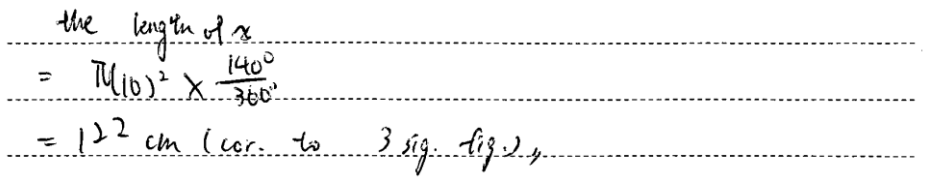
S.3 students performed steadily in this strand. In the learning unit of this strand, many of them could solve problems related to quadrilaterals and Pythagoras' Theorem. Their performance in angles and parallel lines, trigonometry, and the rectangular coordinate system was fair, while it was acceptable in polygons, mensuration, arc lengths and areas of sector, congruent triangles, and 3-D figures. Improvement was needed in errors in measurement and similar triangles, and their understanding of centres of triangle was not satisfactory. Comments on students' performances are provided with examples cited where appropriate (question number *x* /sub-paper *y* quoted as Q*x*/M*y*). More items may also be found in the section ***General Comments***.

- Errors in Measurement: Students did well in finding the range of measures in measurements of given degrees of accuracy, and some could calculate percentage error from given measurements. However, their performance in finding maximum absolute errors when using a ruler for measurement was weak.

- Arc Lengths and Areas of Sectors: Many students were able to calculate areas of sectors, but only almost half of the students could calculate arc lengths.

Q43/M1
Exemplar Item (Calculate arc length) In the figure, the radius of sector OAB is 10 cm and $\angle AOB = 140°$. Let x be the arc length of the sector, find x. Give the answer correct to 3 significant figures.   
Example of Student Work (Wrong formula) $\left(\frac{140°}{360°} \times 10 \times \pi\right)$ cm ≈ 12.2 cm $x = 12.2$ cm

Example of Student Work (Confused areas of sectors with arc lengths)



- 3-D Figures: Students showed fair performance in sketching the 2-D representations of right pyramids. Half of them could demonstrate recognition of the sections of circular cones, but their performance in demonstrating recognition of the concepts of right prisms and right pyramids was weak.

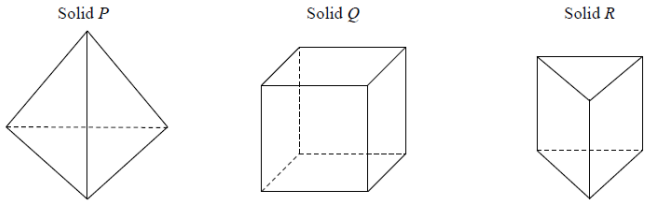
Q32/M1

Exemplar Item (Demonstrate recognition of the concepts of right prisms and right pyramids)

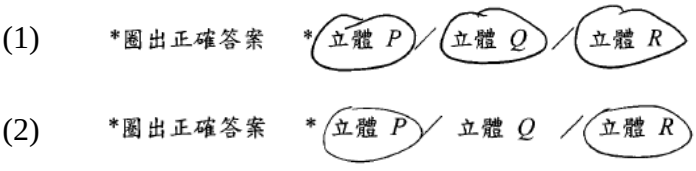
The figure shows Solids P, Q and R. If each surface of the solids is either a square or an equilateral triangle, which of the following solids can satisfy **ALL** descriptions below? (May be more than one answer)

I. It is a prism.

II. It is a right solid.



Example of Student Work (Wrong computation)



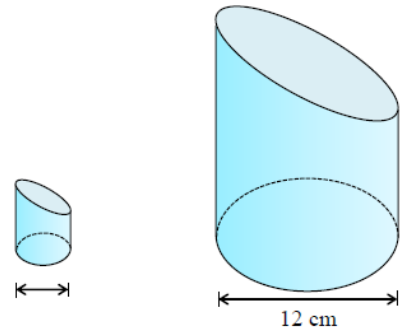
- Mensuration: The majority of students could calculate the volume of circular cones and many of them could calculate the surface area of right pyramids. Half of them could calculate the volumes of prisms and use formulas for the volumes of prisms and surface areas of right circular cylinders to find unknowns. However, students' performance in solving problems involving the relationship between sides and surface areas of similar 3-D figures was not satisfactory.

Q44/M1

Exemplar Item (Use the relationships between sides and surface areas of similar 3-D figures to solve problems)

In the figure, Solid A and Solid B are similar and the total surface areas are 200 cm^2 and 1 800 cm^2 respectively. Their bases are circles. The base diameter of Solid B is 12 cm .

Find the base diameter of Solid A .



Example of Student Work (Not able to use the relationship between sides and surface areas of similar 3-D figures)

$\because$ $A = 200\ cm^2$, $B = 1800\ cm^2$

$\therefore$ $1 : 9$

$\therefore$ $A = \frac{1}{3}$

Example of Student Work (Incomplete presentation)

$200 : 1800 = A^2 : 12^2$

$\frac{2}{18} = \frac{A^2}{12^2}$

$\frac{288}{18} = A^2$

$A^2 = 16$

$A = 4$

Example of Student Work (Good performance)

Let y be the base diameter of Solid A

$\left(\frac{y}{12}\right)^2 = \frac{200}{1800}$

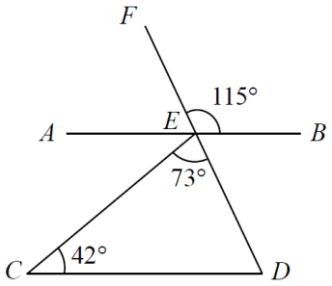
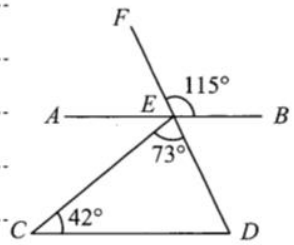
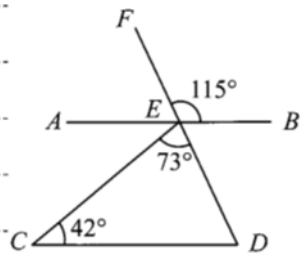
$\frac{y^2}{144} = \frac{200}{1800}$

$y^2 = 16$

$y = 4$

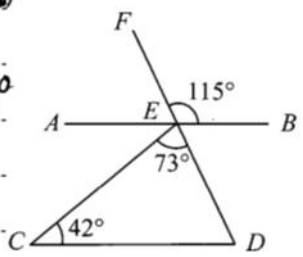
$\therefore$ The base diameter of Solid A is 4cm.

- Angles and Parallel Lines: Students were good at using properties of vertically opposite angles to find unknowns. Many of them could identify corresponding angles and interior angles, and quite a number of students used the properties of angles of triangles to find unknowns. Their performance in using angle properties associated with parallel lines to find unknowns was acceptable, but they were quite weak with using the conditions of alternate interior angles which are equal, corresponding angles which are equal, or interior angles which are supplementary to perform simple proof of two straight lines being parallel.

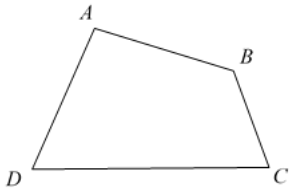
Q45/M1
Exemplar Item (Geometric proof) In the figure, *AEB* and *FED* are straight lines. It is given that $\angle ECD = 42°$, $\angle CED = 73°$ and $\angle FEB = 115°$. Prove that *AB* // *CD*. 
Example of Student Work (Incorrect logical reasoning in the proof – used the conclusion *AB* // *CD* as a reasoning) ∵ ∠AEC = ∠ECD = 42° ∠AEC + ∠CED = 42+73° = 115° ∴ ∠FEB = ∠AED (對頂角) ∴ AB // CD 
Example of Student Work (Not able to provide reasons) ∠BED = 65° ∠AEC = 42° ∠AEC = ∠ECD ∴ AB // CD 

Example of Student Work (Good performance)

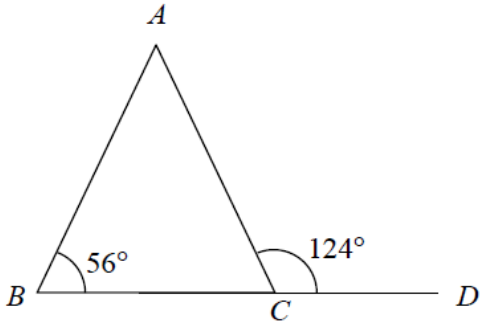
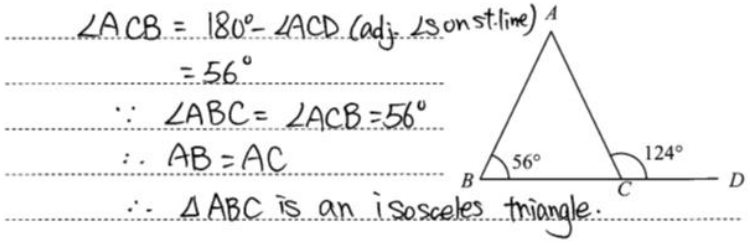
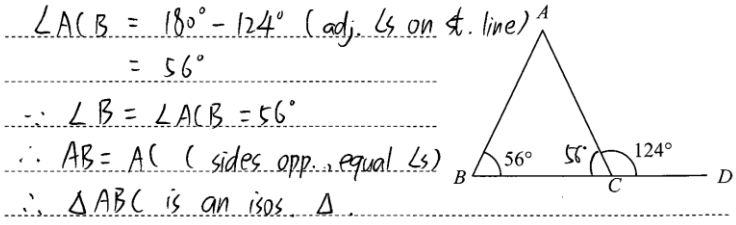
$\angle DEB = 180° - 115°$ (直線上的鄰角)
$= 65°$
$\because \angle BEC + \angle ECD = (65° + 73°) + 42°$
$= 180°$
$\therefore AB // CD$ (同旁內角互補)



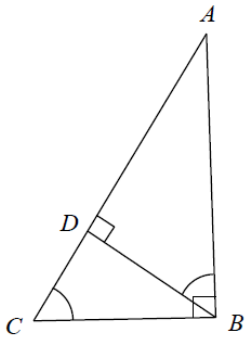
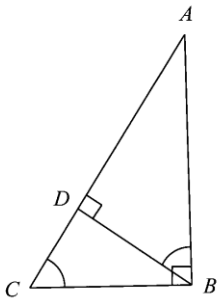
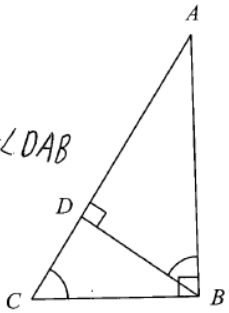
- Polygons: Most students could use the formula for the sum of the exterior angle of a convex polygon to find unknowns. Their performance in using common notations to represent quadrilaterals was fair. Half of the students could use the formula for the sum of the interior angles of a convex polygon to find unknowns, but they were room for improvement in demonstrating recognition of the concepts of regular polygons.

Q33/M1
Exemplar Item (use common notations to represent polygons) Use the given letters to represent the quadrilateral shown in the figure. 
Example of Student Work (Wrong representation) (1) ABDC (2) $\angle ABCD$ (3) ||gram ABCD

- Congruent Triangles: Many students could demonstrate recognition of the properties of congruent triangles, but half of them could not determine if a pair of triangles was congruent. Their performance in using conditions for congruent triangles to perform simple proofs was quite weak. Quite a number of students could use the relationship between sides and angles associated with isosceles triangles to find unknowns, but many of them could not use the condition for isosceles triangles to perform simple proofs.

Q45/M2
Exemplar Item (Geometric proof) In the figure, BCD is a straight line. It is given that $\angle ABC = 56°$ and $\angle ACD = 124°$. Prove that $\triangle ABC$ is an isosceles triangle. 
Example of Student Work (Not able to provide sufficient reasons) 
Example of Student Work (Good performance) 

- Similar Triangles: Almost half of the students couldn't demonstrate recognition of the properties and conditions of similar triangles. There was room for improvement in using the conditions for similar triangles to perform simple proofs.

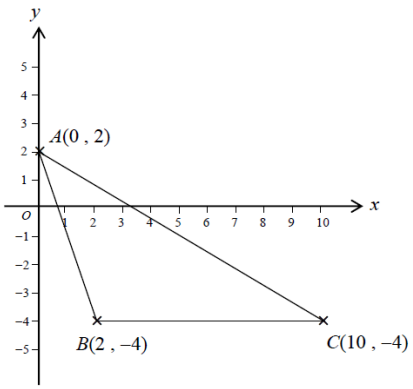
Q44/M4
Exemplar Item (Geometric proof) In the figure, ADC is a straight line. $\triangle ABC$ is a right-angled triangle, where $\angle ABC$ is the right angle. It is given that $AC \perp BD$ and $\angle ACB = \angle ABD$. Prove that $\triangle ABC \sim \triangle ADB$. 
Example of Student Work (Not able to use the conditions for similar triangles to perform proofs) 在△ABC及△ADB中, BD=DB (公共邊) ∠ACB = ∠ABD (已知) ∠ABC=∠ADB (已知) ∴△ABC ~ △ADB (ASA) 
Example of Student Work (Good performance) ∠ABC=∠ADB (given) ∠ACB=∠ABD (given) ∠BAC=DAB (common ∠) ∵ ∠ABC=∠ADB, ∠ACB=∠ABD and ∠BAC=∠DAB ∴ △ABC ~ △ADB (AAA) 

- Quadrilaterals: Students performed well in using the properties of parallelograms and rectangles to find unknowns.

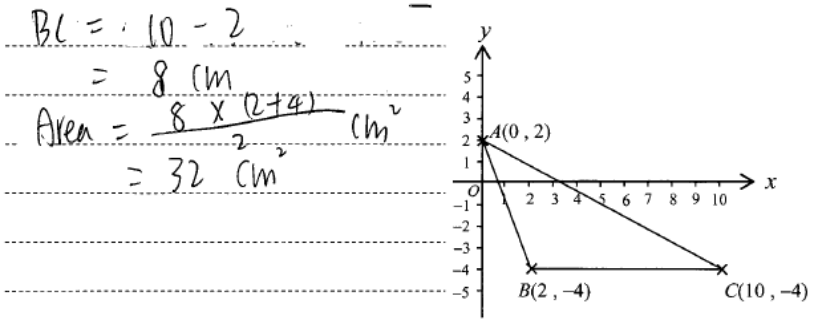
- Centres of Triangles: Students' performance in identifying perpendicular bisectors of a triangle was not satisfactory.

- Pythagoras' Theorem: Many students could use Pythagoras' Theorem to find unknowns and use the converse of Pythagoras' Theorem to identify right-angled triangles.

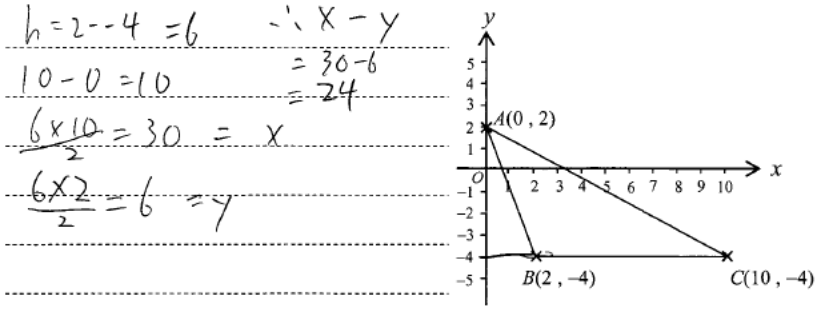
- Rectangular Coordinate System: In a rectangular coordinate plane, the majority of students could mark the point with given coordinates and many of them could use the slope formula to find the slope of the straight line which passes through two given points. Their performance in using the distance formula to find the distance and the midpoint formula to find the mid-point between two points was fair. More than half of students could demonstrate recognition of the relationship between the slopes of parallel lines, but only almost half of the students could find the image of a given point rotating about the origin through 90° in an anticlockwise direction. Their performance in calculating the area of triangles in the rectangular coordinate plane was not satisfactory.

Q46/M2
Exemplar Item (Calculate areas of triangles) Find the area of $\triangle ABC$ in the figure. 

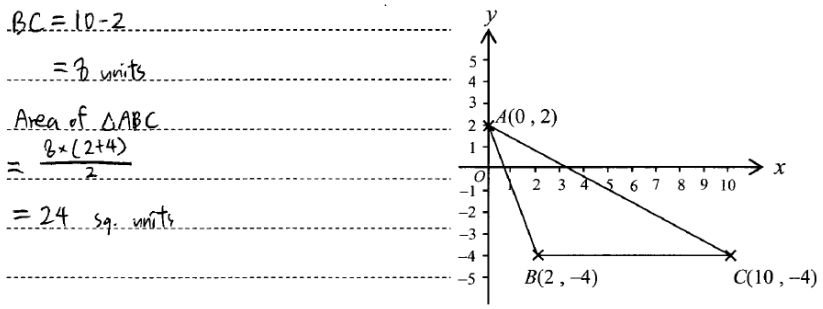
Example of Student Work (Wrong computation and unit)



Example of Student Work (Unclear expression)



Example of Student Work (Good performance)

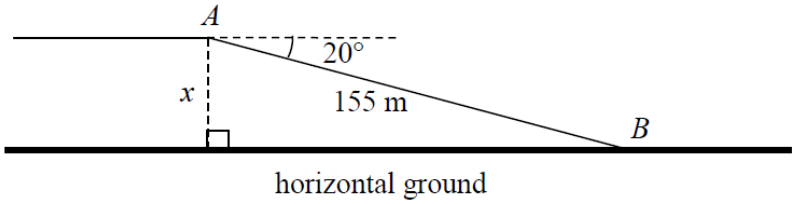


- Trigonometry: The majority of students could find the cosine of angles, and considerable number of students could find angles from given tangents. Many of them could solve right-angled triangles involving sine. Their performances in solving right-angled triangles involving cosine and demonstrating recognition the concepts of bearings were acceptable. Nevertheless, only almost half of students could solve simple problems involving one right-angled triangle.

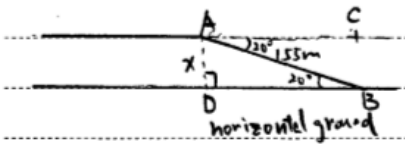
Q46/M4

Exemplar Item (Find the size of an angle)

In the figure, a roller coaster train travels from point A to point B which is on the horizontal ground. The distance between point A and point B is 155 m. The angle of depression of point B from point A is $20°$. It is given that the vertical distance between point A and the horizontal ground is x. Find x. Give the answer correct to 3 significant figures.



Example of Student Work (Wrong computation)



Refer to the figure

$\because AC // DB$

$\therefore \angle CAB = \angle ABC$ (alt. $\angle$s, $AC // BD$)

$\sin 20° = \frac{x}{155}$

$x \approx 47.9$ m.

Example of Student Work (Did not clearly define $\angle A$ and $\angle B$ and not able to correctly interpret the information in the question)

$\angle A = \angle B = 20°$ (alt. $\angle$s, // lines)

$\sin 20° = \frac{x}{150\text{m}}$

$x = 150 \sin 20°$ m

$= 51.3$ m (cor. to 3 sig. fig.)

Example of Student Work (Good performance)

Let the angle of elevation of point A from point B be θ

$\theta = 20°$ (alt. $\angle$s, // lines)

$\sin 20° = \frac{x}{155\text{ m}}$

$\sin 20° = \frac{x}{155}$ m

$x = 155 \sin 20°$ m

$x \approx 53.0131$ m

$x = 53.0$ m (cor. to 3 sig. fig.)

Secondary 3 Data Handling Strand

Students showed average performance in this strand. They were good at organising of data. Their performances in presenting data, measuring central tendency and finding probability were fair. Comments on students' performance are provided below with examples cited where appropriate (question number *x* / sub-paper *y* quoted as Q*x*/M*y*). More examples may also be found in the section ***General Comments***.

- Organisation of Data: Many students could organise the same set of data by different grouping methods.

- Presentation of Data: Students performed satisfactorily in interpreting stem-and-leaf plots, constructing cumulative frequency polygons, and choosing appropriate statistical charts to present data, but some students were unable to correctly construct a cumulative frequency polygon. Quite a number of students could interpret cumulative frequency curves, and more than half of them could identify the abuses from examples of abuses of statistical charts and construct histograms. However, their performance in reading off data from statistical charts representing two different sets of data was not satisfactory.

Q46/M1

Exemplar Item (Construct cumulative frequency polygon)

The following frequency distribution table shows the recovery time of 35 patients suffering from influenza.

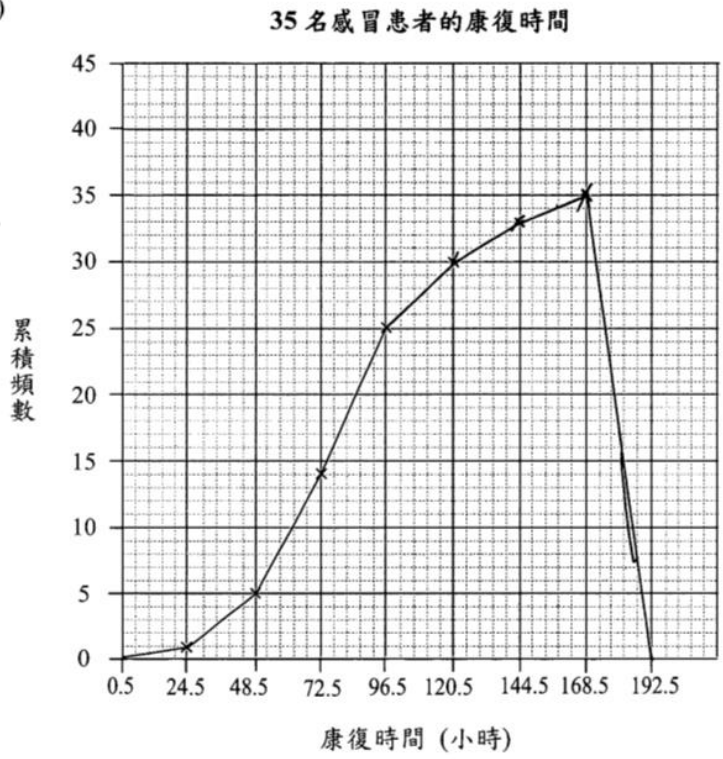
Recovery time (hours)	1 – 24	25 – 48	49 – 72	73 – 96	97 – 120	121 – 144	145 – 168
Frequency	1	4	9	11	5	3	2

(a) According to the above table, complete the cumulative frequency distribution table in the **ANSWER BOOKLET**.

(b) Construct a cumulative frequency polygon in the **ANSWER BOOKLET** to represent the above data.

Example of Student Work (Wrongly connected the line to the bottom)

(b)

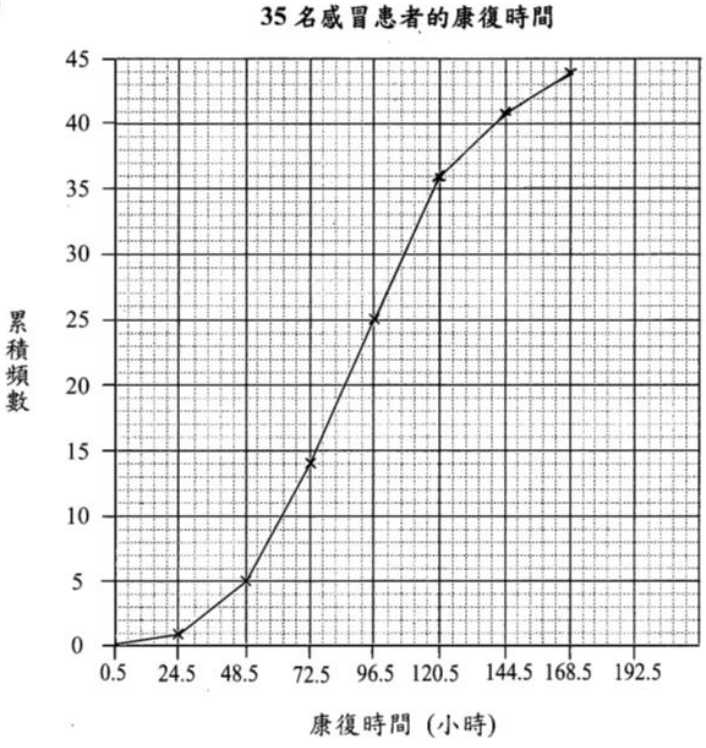


Example of Student Work (Not able to calculate cumulative frequency correctly)

(a)

康復時間少於 (小時)	24.5	48.5	72.5	96.5	120.5	144.5	168.5
累積頻數	1	5	14	25	36	41	44

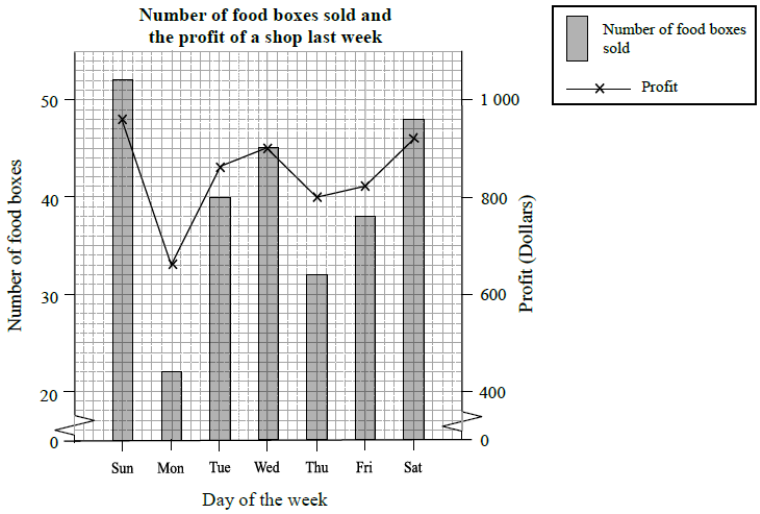
(b)



Q38/M2

Exemplar Item (Read off data from statistical charts representing two different sets of data)

The diagram below shows the number of food boxes sold and the profit of a shop last week.



According to the above diagram, answer the following questions.

(a) What was the total profit from the food boxes sold last week?

(b) What was the mean profit of each food box sold last Thursday?

Example of Student Work

(1)

(a) 該店舖上周賣出食物盒的總盈利是 216 元。

(b) 該店舖上星期四每個賣出的食物盒平均盈利是 0.8 元。

(Wrongly used values from the left *y*-axis for profit calculation)

(2)

(b) 該店舖上星期四每個賣出的食物盒平均盈利是 800 元。

(Mistakenly thought the total profit was the average profit)

(3)

(a) 該店舖上周賣出食物盒的總盈利是 5540 元。

(Mistakenly thought the quantity of food boxes for profit)

(b) 該店舖上星期四每個賣出的食物盒平均盈利是 20 元。

(Mistakenly thought the number of food boxes sold on Thursday was 40)

- Measures of Central Tendency: Many students could find mean and median from a set of ungrouped data and quite a number of them could find mean and modal class from a set of grouped data and calculate the weighted mean of a set of data. However, their performance in indicating the abuses from examples of abuses of mean was not satisfactory.

Q47/M1
Exemplar Item (Indicate the abuses) The following shows the monthly electricity consumption (kWh) of a company last year. 4 300, 5 300, 5 800, 6 300, 6 600, 7 200, 7 300, 8 100, 9 100, 11 600, 11 700, 12 700 It is given that the mean of the monthly electricity consumption of the company last year was 8 000 kWh. Hence, the manager claimed, "Last year, over half of the monthly electricity consumptions were more than 8 000 kWh ." Do you agree with the manager? Explain your answer.
Example of Student Work (Misunderstanding) ∵ There are some big number of kWh that affect the result of the mean, such as 12700, 11700 and 11600. ∴ I * **agree** / **disagree** with the manager. (* Circle the correct answer)
Example of Student Work (Good performance) 因为该公司在去年每月耗电量出现了三个极端数据，导致该公司每月耗电量平均数被拉高，但该公司全年只有5个月耗电量超过8000度（现实），其余都是少于8000度，所以可该公司全年超过一半的月份耗电量多于8000度。 ∴我 * 同意 / 不同意 經理的說法。 (*圈出正確答案)

- Probability: Students showed fair performance in calculating relative frequency and calculating probability by listing.

General Comments on Secondary 3 Student Performances

The overall performance of S.3 students was steady. They showed fair performance in the Data Handling Strand. Performance was also steady in the Number and Algebra Strand and Measures, Shape and Space Strand.

The areas in which students demonstrated adequate skills are listed below:

Basic Computation

- Perform mixed arithmetic operations of positive integers involving two levels and at most three pairs of brackets (e.g. Q21/M1)

Directed Numbers

- Demonstrate recognition of the ordering of integers on the number line (e.g. Q21/M2)
- Use positive numbers, negative numbers and zero to describe situations such as profit and loss, floor levels relative to the ground level, temperature, etc (e.g. Q21/M3)

Using Percentages

- Solve simple problems on discount and profit or loss (e.g. Q24/M3)

Algebraic Expressions

- Write down the next term of a sequence of odd numbers, even numbers, square numbers and triangular numbers with several consecutive terms given (e.g. Q25/M3)

Laws of Integral Indices

- Convert a positive number in scientific notations to an integer or a decimal (e.g. Q7/M3)

Polynomials

- distinguish factorisation and expansion of polynomials (e.g. Q8/M4)

Linear Inequalities in One Unknown

- Determine whether a number satisfies a given inequality of $x > a$, $x \geq a$, $x < a$ and $x \leq a$ (e.g. Q10/M3)

Errors in Measurement

- Find the range of measures in measurements of given degrees of accuracy (e.g. Q11/M3)

Angles and Parallel Lines

- Use the properties of adjacent angles on a straight line, vertically opposite angles, and angles at a point to find unknowns (e.g. Q33/M2)

Quadrilaterals

- Use the properties of parallelograms to find unknowns (e.g. Q36/M1)
- Use the properties of rectangles, rhombuses and squares to find unknowns (e.g. Q35/M4)

Pythagoras' Theorem

- Use Pythagoras' theorem to find unknowns (e.g. Q15/M1)

Rectangular Coordinate System

- Use coordinates to represent the position of a point and mark the point with given coordinates (e.g. Q17/M3)

Other than items in which students performed well, the assessment data also provided some entry points to strengthen learning and teaching. Items worthy of attention are discussed below:

Basic Computation

- Perform prime factorisation of a positive integer, which is less than 200 (e.g. Q1/M1): Almost half of the students chose the correct answer D. Over 20% chose option C, mistakenly thought that 1 was a prime number.

Q1/M1
Which of the following is the prime factorisation of 54? A. 6×9 B. $3^2 \times 6$ C. $1 \times 2 \times 3^3$ D. 2×3^3

Rational and irrational numbers

- Demonstrate recognition of the concepts of rational and irrational numbers (e.g. Q2/M2): Almost half of the students selected the correct answer C, but over 30% chose option B, mistakenly believed that recurring decimals were irrational. About 10% chose each of the remaining two options, incorrectly thought that decimals or fractions were irrational.

Q2/M2
Which of the following is an irrational number? A. 0.33 B. $0.\dot{1}$ C. $\frac{5}{11}$ D. $\sqrt{8}$

Algebraic expressions

- Demonstrate recognition of notations of algebraic expressions such as x^2 (e.g. Q3/M4): Almost half of the students chose the correct answer A. About 20% chose options C and D, mistakenly thought that there is no difference between the powers inside and outside the brackets.

Q3/M4
$(-x)^2 + (-x^2) =$ A. 0 . B. $-x^4$. C. $2x^2$. D. $-2x^2$.

Polynomials

- Arrange the terms of a polynomial in ascending order (e.g. Q8/M2): Less than 40% of the students chose the correct answer A. Over 30% chose option D, confusing ascending and descending order.

Q8/M2
Arrange the terms of the polynomial $1 + x^2 - x$ in ascending order of powers of x. Which of the following is correct? A. $1 - x + x^2$ B. $-x + 1 + x^2$ C. $x^2 + 1 - x$ D. $x^2 - x + 1$

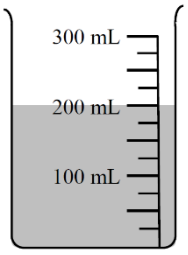
Formulae

- Perform addition of two algebraic fractions (both the numerators and denominators being monomials) (Q9/M4)：Half of the students chose the correct answer C, but over 20% chose option B, incorrectly performed addition of two algebraic fractions.

Q9/M4
$x + \frac{1}{3x} =$ A. $\frac{1}{3}$. B. $\frac{x+1}{3x}$. C. $\frac{3x^2+1}{3x}$. D. $\frac{9x^2+1}{3x}$.

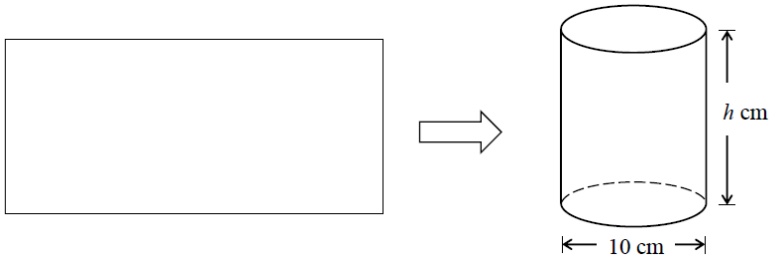
Errors in measurement

- Calculate percentage errors from given measurements (e.g. Q10/M1): 30% of students chose the correct answer B. About 20% chose options C or D, they were not able to calculate percentage error.

Q10/M1
Garfield uses a beaker to measure the volume of a can of drink and the result is 200 mL. Find the percentage error of the measured value. A. 4.17% B. 6.25% C. 12.5% D. 66.7%   

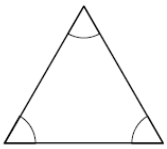
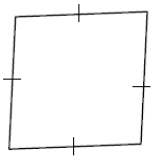
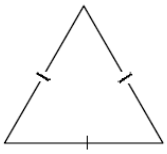
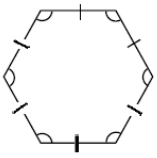
Mensuration

- Use the formulae for the surface areas of right circular cylinders to find unknowns (e.g. Q12/M1): Half of the students chose the correct answer C. Nearly 20% chose options A, B, or D, mistakenly used the volume formula or took the lateral surface area formula as πrh.

Q12/M1
A piece of paper with an area of 200 cm^2 is folded into a hollow right circular cylinder without overlapping. The base diameter and the height of the cylinder are 10 cm and h cm respectively. Find the value of h. Give the answer correct to 3 significant figures. A. 2.55 B. 3.18 C. 6.37 D. 12.7   

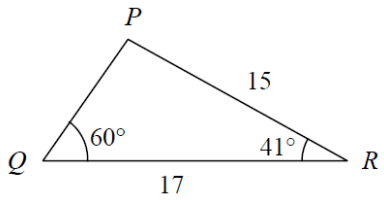
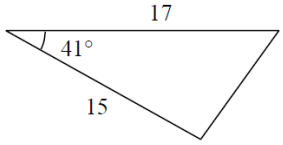
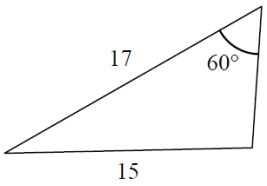
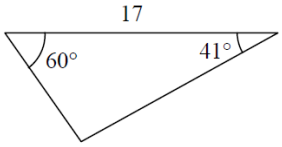
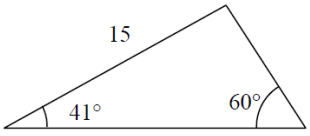
Polygons

- Demonstrate recognition of the concepts of regular polygons (e.g. Q14/M1): Nearly half of the students chose the correct answer B. About 40% chose option A, mistakenly thought that a triangle with three equal angles is not a regular polygon.

Q14/M1
Which of the following **MAY NOT** be a regular polygon? A.  B.  C.  D. 

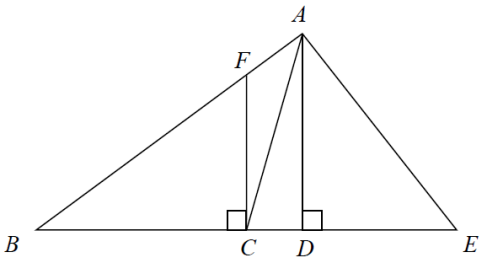
Congruent Triangles

- Demonstrate recognition of the conditions for congruent triangles (e.g. Q15/M4): Half of the students chose the correct answer B. Nearly 20% chose each of the other options. Those who chose A, C and D mistakenly thought that 'SAS', 'ASA' and 'AAS' were not a congruence condition respectively.

Q15/M4
 Which of the following triangles **MAY NOT** be congruent to $\triangle PQR$ shown above? A.  B.  C.  D. 

Centres of Triangles

- Identify perpendicular bisectors of a triangle (e.g. Q15/M2): Less than 40% of the students chose the correct answer C. Over 30% chose option A, mistakenly thought that perpendicular lines are the perpendicular bisectors. About 20% chose option B, not considering that *AC* was not perpendicular to *BE*.

Q15/M2
In $\triangle ABE$, AFB and $BCDE$ are straight lines. It is given that $BC = CE$, $FC \perp BE$ and $AD \perp BE$. Which of the following is a perpendicular bisector of $\triangle ABE$? A. AD B. AC C. FC D. BC 

Good Performance of Secondary 3 Students in 2024

- Students with good performance demonstrated mastery of the concepts and skills assessed by the sub-papers. Their performance in numeracy skills and problem-solving skills was good. They were able to solve the problems relating to basic computation, approximate values and numerical estimation, rational and irrational numbers, using percentages, rates, ratios and proportions. Students had a thorough conceptual understanding of algebra and could demonstrate understanding of the meaning of solutions of equations. They were able to deal with the operations, factorisations and expansions of simple polynomials, and were familiar with laws of integral indices and linear inequalities in one unknown. They were capable of solving equations by using algebraic and graphical methods. They could also plot graphs of linear equations in two unknowns.

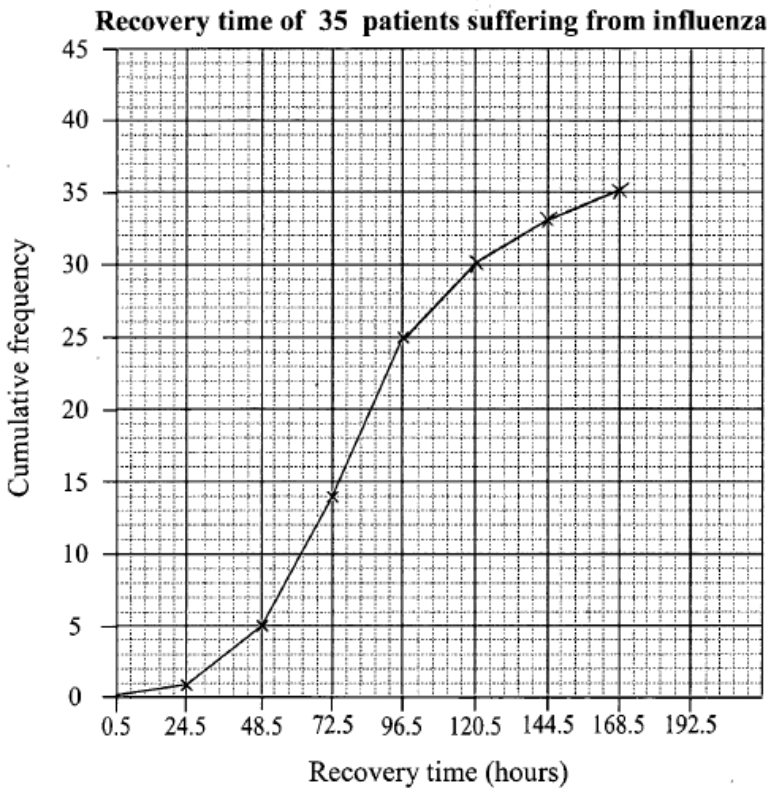
- Students with good performance were good at calculating arc lengths, areas of sectors, surface areas and volumes of 3-D figures. They were able to demonstrate good recognition of angles and parallel lines, congruent and similar triangles, rectangular coordinate system, polygons, quadrilaterals, trigonometry and Pythagoras' Theorem. They were able to complete the geometric proofs with the correct steps and sufficient reasons provided.

- Students with good performance had a good knowledge of organisation and presentation of data. They also grasped the basic concepts of probability. They were able to construct and interpret simple statistical charts, choose appropriate statistical charts to present data, find the mean, median and mode/modal class from a set of data, indicate the abuses from examples of abuses of mean.

- The examples of work by these students are illustrated as follows:

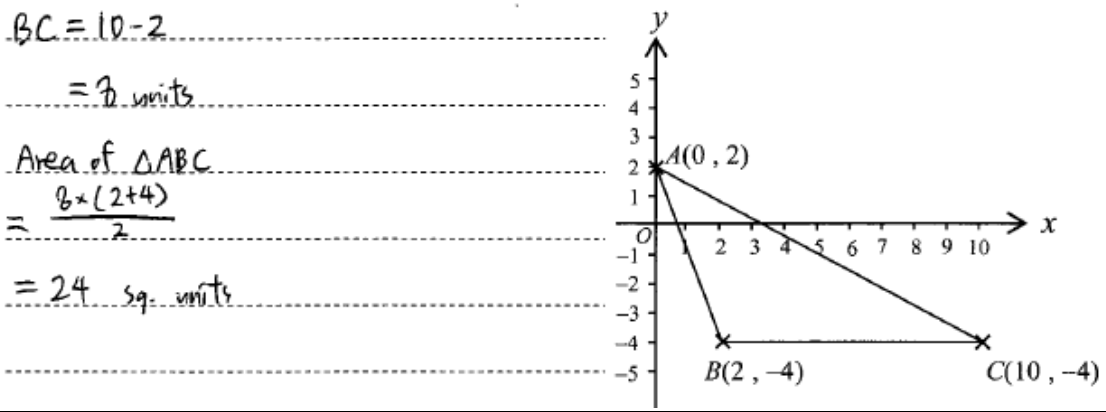
Students were able to construct simple statistical charts by using the given data.

Q46/M1
Example of Student Work (Construct simple statistical charts)

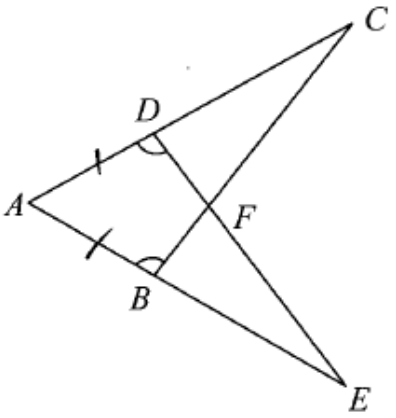


Students were able to solve the problem correctly with complete and clear presentation.

Q46/M2
Example of Student Work (Find the area of a triangle)



Students were able to make good use of the given conditions and solve the problem systematically.

Q44/M3
Example of Student Work (Geometric proof) ∵ ∠ABC = ∠ADE (given) AB = AD (given) ∠DAB = ∠BAD (Common ∠) ∴ △ABC ≅ △ADE (ASA) 

Some common weaknesses of high-achieving students were that:

- Some students were not able to demonstrate recognition of powers.
- Some students were not able to use suitable estimation strategies to solve simple real-life problems.

Overview of Secondary 3 Student Performances in Mathematics in 2019, 2023 and 2024

The percentage of students achieving Basic Competency in the Territory-wide System Assessment this year was 79.0%.

The percentages of students achieving Basic Competency from 2019, 2023 and 2024 are listed below:

Table 8.6 Percentages of S.3 Students Achieving Mathematics Basic Competency in 2019, 2023 and 2024**

Year	% of Students Achieving Mathematics Basic Competency
2019	79.6
2023	76.6
2024	79.0

** Due to the volatility of the COVID-19 epidemic, the TSA 2020, 2021 and 2022 were suspended and no data was provided.

A comparison of the strengths and weaknesses of S.3 students in 2019, 2023 and 2024 provides useful information for teachers to help students improve their learning. The following tables provide an overview of student performances in each strand for these years.

Table 8.7 Overview of S.3 Student Performances in Mathematics in 2019, 2023 and 2024

Year / Number and Algebra	2019	2023	2024	Remarks
Strengths	• Students did well in the operations of directed numbers. They demonstrated recognition of the ordering of integers on the number line. • Students were capable of converting numbers in scientific notation to integers. • Students were good at formulating simple inequalities from simple contexts. • Students are able to describe patterns by writing the next few terms in arithmetic sequences from several consecutive terms of integral values. • Students could solve simple equations. • Students demonstrated good recognition of using inequality signs to compare numbers.	• Students could use powers to express the repeated multiplication of a number and use repeated multiplication to express power of a number. • Students were good at performing mixed arithmetic operations of positive integers. • Students could demonstrate recognition of the ordering of integers on the number line. • Students could write down the next term of a sequence of triangular numbers with several consecutive terms given. • Students could convert a positive number in scientific notations to an integer. • Students could substitute values into formulae (in which all exponents are positive integers) and find the value of a specified variable.	• Students were good at performing mixed arithmetic operations of positive integers involving two levels and at most three pairs of brackets. • Students could use powers to express the repeated multiplication of a number and use repeated multiplication to express power of a number. • Students could demonstrate recognition of the ordering of integers on the number line. • Students could convert a positive number in scientific notations to an integer. • Students could find the value of a^n (where a and n are negative integers). • Students were good at determining whether a number satisfied a given inequality.	

Year / Number and Algebra	2019	2023	2024	Remarks
Weaknesses	• Many students were not able to estimate values according to the given context with reasonable justifications. • Half of the students were not able to solve problems on simple interest to find the interest rate. • Students' performance was not satisfactory in expanding simple algebraic expressions by using the perfect square expressions. • Students were weak in performing change of subject in simple formulas. • Students' performance was only fair in using the laws of integral indices to simplify simple algebraic expressions. • Students' recognition of plotting graphs of linear equations in 2 unknowns was insufficient.	• Many students were not able to perform prime factorisation of a positive integer. • The minority of students were able to use suitable estimation strategies to solve simple real-life problems. • Students were weak in solving simple problems on discount. • Only some students could demonstrate recognition of coefficients. • There was room for improvement in expanding simple algebraic expressions by using the perfect square expressions. • Students' performance was not satisfactory in performing change of subject in simple formulae not involving radical sign.	• Many students were not able to find the least common multiple using the prime factorisation of two numbers. • Students' performance in using rounding down as an estimation strategy to solve simple real-life problems was weak. • Only some students could solve problems on simple interest. • Students were weak in solving simple problems on discount. • Many students could not demonstrate recognition of powers. • Students' performance in distinguishing polynomials from algebraic expressions was not satisfactory. • Only some students could multiply two algebraic fractions (both the numerators and denominators being monomials).	• Students always use rounding off for estimation without considering the actual requirements of questions. • Students were willing to show their working steps and strategies used in solving problems, but sometimes the solutions were incomplete.

Year / Measures, Shape and Space	2019	2023	2024	Remarks
Strengths	• Students were able to choose an appropriate unit and the degree of accuracy for real-life measurements. • Students were able to select the appropriate ways to reduce errors in measurements. • Students were able to identify 3-D solids from given nets. • Students were capable of demonstrating recognition of interior angles of polygons. • Students were able to use the angle properties associated with intersecting lines/parallel lines to solve simple geometric problems. • Students were able to use the formula for the sums of the interior angles of convex polygons. • Students did well in using the relations between sides and angles associated with isosceles triangles. • Students were good at using the properties of rectangles in numerical calculations. • Students had good knowledge of the rectangular coordinate system.	• Students were able to find the range of measures in measurements of given degrees of accuracy. • Students were able to sketch the 2D-representation of a right prism. • Students could demonstrate recognition of the concepts of right pyramids. • Students were able to use the properties of vertical opposite angles to find unknowns. • Students were able to use the angle properties associated with parallel lines to find unknowns. • Students could demonstrate recognition of the conditions for congruent triangles. • Students did well in using the properties of rectangles and parallelograms to find unknowns. • Students were able to find the image of a given point under a translation in the rectangular coordinate plane.	• Students were able to find the range of measures in measurements of given degrees of accuracy. • Students were able to calculate the volume of circular cones. • Students were good at using properties of vertically opposite angles to find unknowns. • Students performed well in using the properties of parallelograms and rectangles to find unknowns. • Students were able to use Pythagoras' Theorem to find unknowns. • In a rectangular coordinate plane, the majority of students could mark the point with given coordinates. • Students were good at finding the cosine of angles.	

Year / Measures, Shape and Space	2019	2023	2024	Remarks
Weaknesses	• Students' performance in using the relationships between sides and volumes of similar figures to solve related problems was fair. • Students were unable to distinguish among formulas for volumes by considering dimensions. • Students were weak in identifying regular polygons and concave polygons. • Students were not able to identify whether two triangles are congruent/similar with simple reasons. • Students in general were not able to complete the proofs of simple geometric problems.	• Students were weak in calculating percentage errors from given measurements. • Quite a number of students were not able to calculate arc lengths of sectors. • Students were weak in using the relationships between sides and volumes of 3-D figures to solve problems. • Students were weak in demonstrating recognition of the concepts of regular polygons. • Many students were not able to use the condition for isosceles triangles or the conditions for similar triangles to perform simple proofs.	• Students were weak in calculating maximum absolute errors when using a ruler for measurement. • Only some students could calculate percentage errors from given measurements. • Students' understanding of the concepts of right prisms and right pyramids was weak. • Many students were not able to use the conditions for isosceles triangles to perform simple proofs. • Students' performance in the conditions for similar triangles to perform simple proofs needed improvement. • Students' performance in calculating the area of triangles in the rectangular coordinate plane was not satisfactory.	• In doing geometric proofs, many students could not complete the proof such as using circular arguments, giving illogical reasoning and giving incorrect reasons. • Inappropriate or incorrect presentation frequently occurred (such as confused $\angle ABC$ with $\triangle ABC$, $AB = BC$ with $AB \parallel BC$). • Units were often omitted in the answers.

Year / Data Handling	2019	2023	2024	Remarks
Strengths	• Students could organise the same set of data by different grouping methods. • Students could interpret simple statistical charts and compare the presentations of the same set of data by using statistical charts. • Students could calculate the theoretical probability by listing.	• Students were able to organise the same set of data by different grouping methods. • Students did well in reading off data from statistical charts representing two different sets of data. • Students were good at interpreting histograms. • Students were able to calculate the probability by listing.	• Students were able to organise the same set of data by different grouping methods. • Students performed satisfactorily in interpreting stem-and-leaf plots, constructing cumulative frequency polygons, and choosing appropriate statistical charts to present data. • Many students could find mean and median from a set of ungrouped data.	
Weaknesses	• Students were weak in distinguishing discrete and continuous data. • The performance of students in identifying sources of deception in cases of misuse of means was not satisfactory.	• The performance of students was not satisfactory in indicating the abuses from examples of abuses of mean.	• Students' performance in reading off data from statistical charts representing two different sets of data was not satisfactory. • Only some students could indicate the abuses from examples of abuses of mean.	• Many students did not use rulers to draw statistical charts. • When answering questions about the abuses of mean, students often stated the given information only. They could not indicate the abuses from examples and give sufficient explanations.