## Results of Secondary 3 Mathematics in TSA 2015

The territory-wide percentage of S.3 students achieving Mathematics Basic Competency in TSA 2015 was 79.9%. The proportion achieving basic competency in 2015 was almost the same as that of last year.

## Secondary 3 Assessment Design

The design of assessment tasks for S.3 was based on the documents *Mathematics Curriculum: Basic Competency for Key Stage 3 (Tryout Version)* and *Syllabuses for Secondary Schools – Mathematics (Secondary 1 – 5), 1999*. The tasks covered the three dimensions of the mathematics curriculum, namely **Number and Algebra**, **Measures**, **Shape and Space**, and **Data Handling**. They focused on the Foundation Part of the S1 – 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 160 test items (217 score points), covering all of the 129 Basic Competency Descriptors. These items were organized into four sub-papers, each 65 minutes in duration and covering all three Dimensions. Some items appeared in more than one sub-paper to act as inter-paper links. Each student was required to attempt one sub-paper only. The number of items on the various sub-papers is summarized in Table 8.7. These numbers include several overlapping items that appear in more than one sub-paper to enable the equating of test scores.

**Table 8.7 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 (31) | 23 (30) | 23 (30) | 22 (28) | 71 (91) |
| Measures, Shape and Space | 21 (29) | 21 (28) | 21 (30) | 22 (31) | 71 (97) |
| Data Handling | 6 (9) | 6 (11) | 6 (9) | 6 (10) | 18 (29) |
| Total | 50 (69) | 50 (69) | 50 (69) | 50 (69) | 160 (217) |

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

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

**Table 8.8 Item Types of the Sub-papers**

| Section | Percentage of Score Points | Item Types |
|---|---|---|
| A | ~ 30% | • Multiple-choice questions: choose the best answer from among four options |
| B | ~ 30% | • Calculate numerical values<br>• Give brief answers |
| C | ~ 40% | • Solve application problems showing working steps<br>• Draw diagrams or graphs<br>• Open-ended questions requiring reasons or explanations |

## *Performance of S.3 Students with Minimally Acceptable Levels of Basic Competence in TSA 2015*

## *S.3 Number and Algebra Dimension*

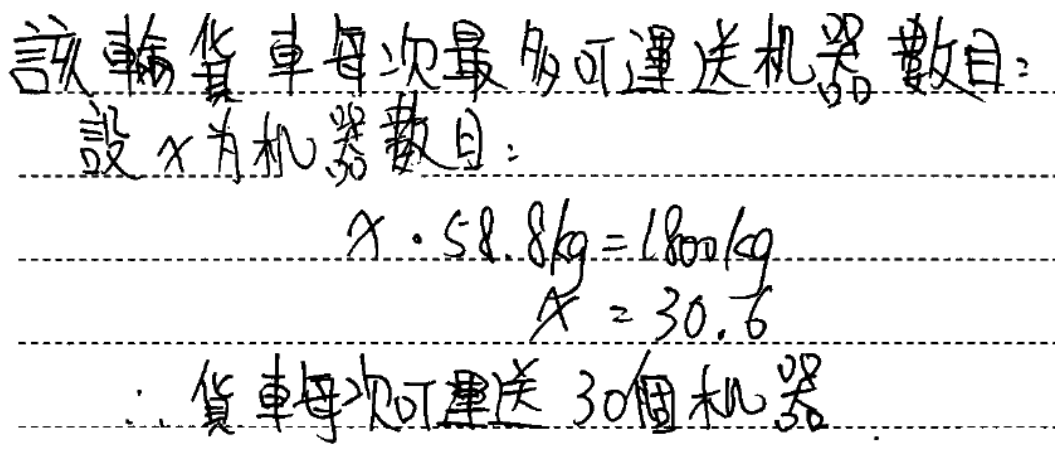
S.3 students performed more than satisfactorily in this Dimension. The majority of students demonstrated recognition of the basic concepts of directed numbers, approximation and errors, formulating problems with algebraic language and linear equations in one unknown. Performance was only fair in items related to using percentages, manipulations of simple polynomials and formulas. 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*.**

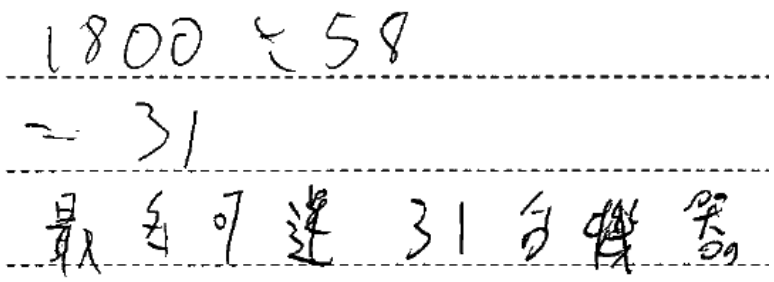
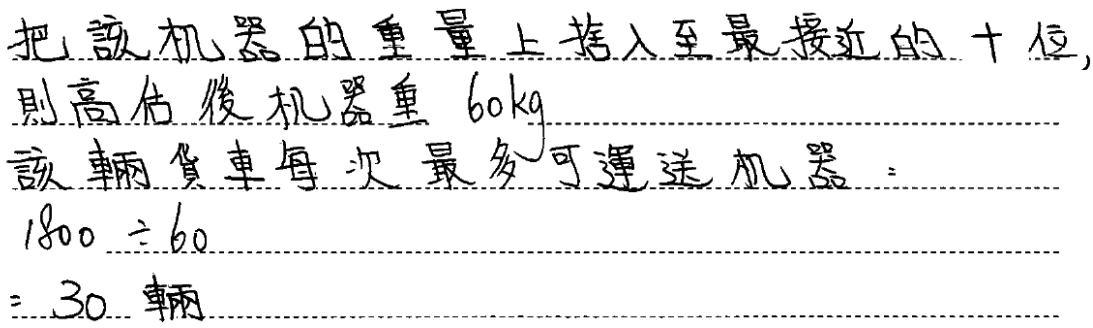
***Number and Number Systems***

- Directed Numbers and the Number Line: The performance of students was good. They could demonstrate recognition of the ordering of integers on the number line. They were able to handle the simple operation of directed numbers. However, some students could not use directed numbers to correctly describe real life situations.

| Q21/M2 |
| --- |
| Example of Student Work (Could not use a directed number to represent each of the following situations)<br><br>(i) ____+____ 人表示有 68 人在一號月台登上火車。<br><br>(ii) ____-____ 人表示有 95 人在二號月台離開火車。 |

- Numerical Estimation: The majority of students were able to determine whether the value mentioned in a simple context is obtained by estimation or by computation of the exact value. They were able to judge the reasonability of answers by the given information of the question. More than half of the students could estimate values with reasonable justifications. Nevertheless, some students were not able to use correct methods to estimate the approximate values.

| Q48/M3 |
| --- |
| Example of Student Work (Estimate the maximum number of machines that can be carried by the lorry each time – without giving an approximation for the weight of each machine)<br><br>  |

| Q48/M3 |
|---|
| Example of Student Work (Estimate the maximum number of machines that can be carried by the lorry each time – mistakenly rounding off the weight of each machine)<br>  <br> |
| Example of Student Work (Good performance)<br>  <br> |

- Approximation and Errors: When a number is greater than 1, students in general were able to correctly round the number to 3 significant figures. In addition, most students were able to convert numbers in scientific notation to integers.

- Rational and Irrational Numbers: Most students were able to demonstrate recognition of the integral part of $\sqrt{a}$. Many students could represent fractions on the number line.

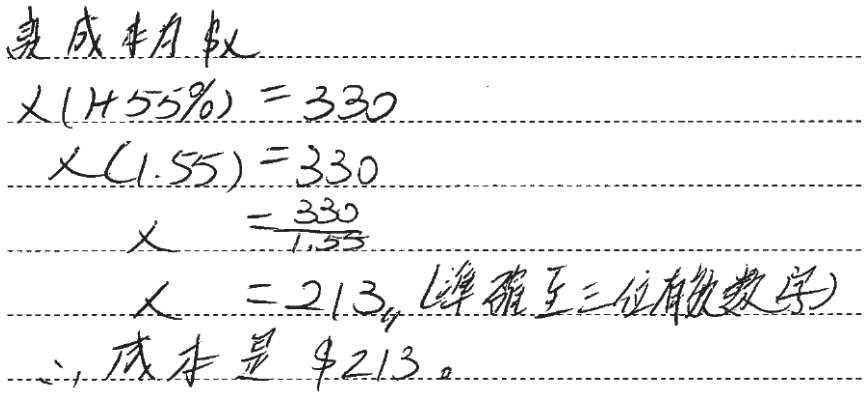
***Comparing Quantities***

- Using Percentages: Students did well in solving problems regarding selling prices and depreciations. However, finding the cost price and the principal were still their weak spots. Some students confused the formulae of finding simple interest with that of compound interest.

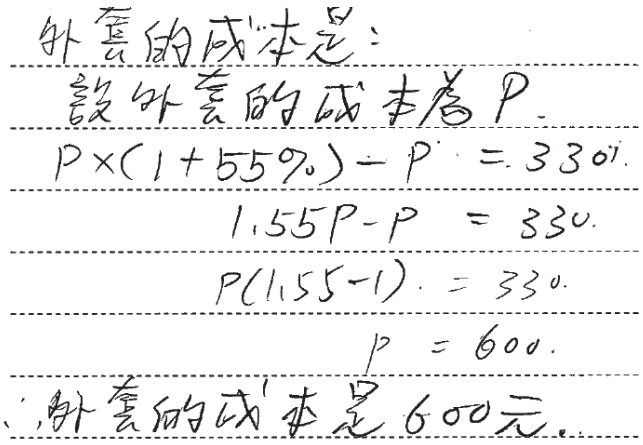
| Q42/M4 |
|---|
| Exemplar Item (Find the cost price)<br>Peter sells a jacket at a profit of 55%. If the profit is $330, find the cost price of the jacket. |

Q42/M4

Example of Student Work (Mistakenly treated the profit as the selling price)




Example of Student Work (Correct solution)

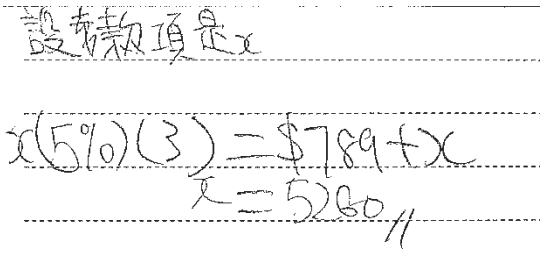



Q42/M2

Exemplar Item (Find the principal)

Vivian borrows a sum of money from a bank. The interest rate is 5% p.a. If she has to pay $789 as simple interest after 3 years, find the amount of money she borrows from the bank.

Example of Student Work (Mistakenly used the formula for finding the simple interest)



| Q42/M2 |
|---|
| Example of Student Work (Mistakenly used the formula for finding the amount by taking compound interest as the formula for finding the simple interest)<br>設借款項的金額為x元<br>$x(1+5\%)^3 = 789$<br>$x = 681.6$<br>借款項的金額是681.6元。 |

| Q43/M1 |
|---|
| Exemplar Item (Find the compound interest)<br>David deposits $7500 in a bank at an interest rate of 6% p.a. compounded yearly. Find the interest he will receive after 2 years. |
| Example of Student Work (Confused compound interest with simple interest, as well as interest with amount)<br>$7500(1+6\%\times 2)$<br>$= 15900$<br>∴ 2年後葉傑獲得的利息是 $15900 |
| Example of Student Work (Confused compound interest with amount)<br>$\text{Interest} = 7500\times(1+\frac{6}{100})^2$<br>$= \$8427$ |

- Rate and Ratio: The performance of students was quite good, though there was room for improvement for some students when using ratio to solve real-life problems.

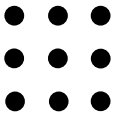
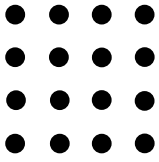
***Observing Patterns and Expressing Generality***

- Formulating Problems with Algebraic Language: Students did quite well. They could distinguish the difference between $(-3)^2$ and $-3^2$ ; $x^2$ and $2x$. They were able to translate word phrases/contexts into algebraic languages, substitute values into formulas and find the value of a variable and formulate simple equations from simple contexts. They could also write down the next few terms in sequences from several consecutive terms that were given. Nevertheless, some students could not intuitively find the *n*th term of a simple number sequence.

Q24/M1

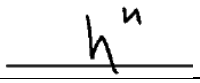
Exemplar Item (Find the *n*th term of a number sequence)

Figure 1 to Figure 4 consist of 1, 4, 9 and 16 dots respectively.

| | |
|---|---|
| Figure 1 |  |
| Figure 2 |  |
| Figure 3 |  |
| Figure 4 |  |

According to the above pattern, how many dots does Figure *n* consist of ? (Express the answer in terms of *n*)

Example of Student Work (Confused $n^n$ with $n^2$)

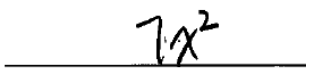
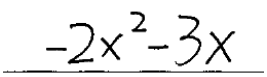


- Manipulations of Simple Polynomials: The majority of students were able to distinguish like terms and unlike terms in polynomials. On the other hand, many students could not distinguish polynomials from algebraic expressions. Their performance was still fair in dealing with the manipulations of simple polynomials.

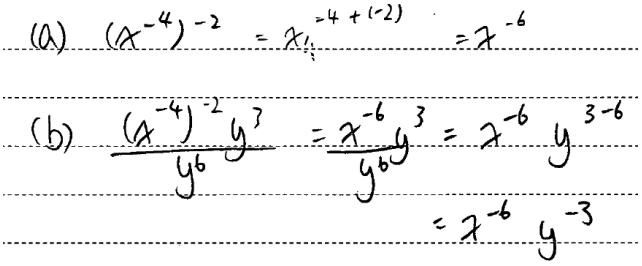
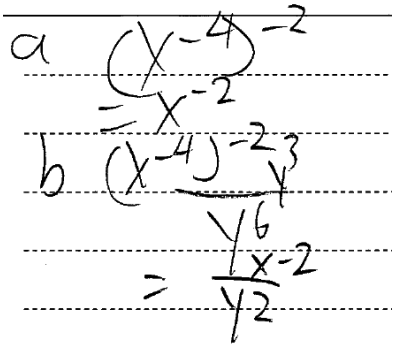
Q24/M3

Exemplar Item (Simplify a polynomial)

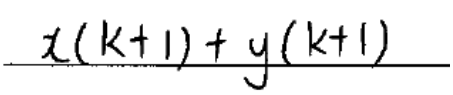
Simplify $(5x^2 + 3x) - (7x^2 - 6x)$.

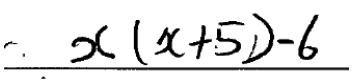
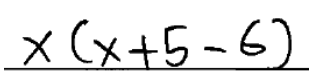
| Q24/M3 |
| --- |
| Example of Student Work (Mistakenly performed addition and subtraction of unlike terms)<br>  |
| Example of Student Work (Could not simplify $3x-(-6x)$ correctly)<br>  |

- Laws of Integral Indices: The performance of students was fair in simplifying algebraic expressions by laws of integral indices.

| Q44/M4 |
| --- |
| Example of Student Work (Has mistakenly taken $(x^m)^n = x^{m+n}$)<br>  |
| Example of Student Work (Has mistakenly taken $(x^m)^n = x^{m-n}$ and $\frac{x^m}{x^n} = x^{n \div m}$)<br>  |

- Factorization of Simple Polynomials: Student performed quite well in factorizing simple polynomials by using the perfect square expressions. Their performance was fair in using the cross method and grouping terms.

| Q26/M1 |
|---|
| Exemplar Item (Factorize the expression by grouping terms)<br><br>Factorize $kx+x+ky+y$. |
| Example of Student Work (Student knew to group some of the terms, but the expression could not be factorized completely)<br><br>  |

| Q27/M3 |
|---|
| Exemplar Item ( Factorize the expression by using the cross method)<br><br>Factorize $x^2+5x-6$. |
| Example of Student Work<br><br>  |
| Example of Student Work<br><br>  |

***Algebraic Relations and Functions***

- Linear Equations in One Unknown: Students were able to solve simple equations and formulate equations from simple contexts.

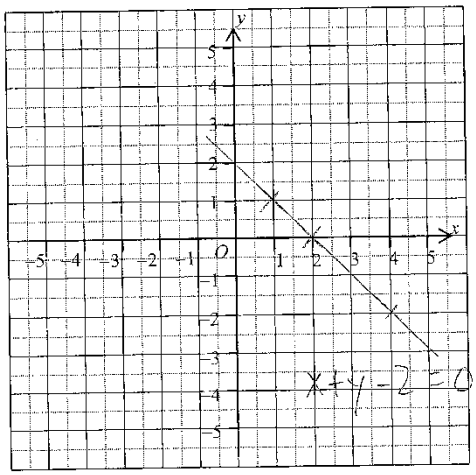
- Linear Equations in Two Unknowns: By providing a table with given *x* values and one corresponding *y* value, students were more able to plot graphs of linear equations in 2 unknowns. They could use graphical methods and algebraic methods to solve linear simultaneous equations. Besides, they could demonstrate recognition that graphs of equations of the form $ax + by + c = 0$ are straight lines. However, there is still room for improvement in plotting straight lines.

Q44/M3

Example of Student Work (Has mistakenly marked the point (–2, 4) on the position of (4, –2))

$x + y - 2 = 0$

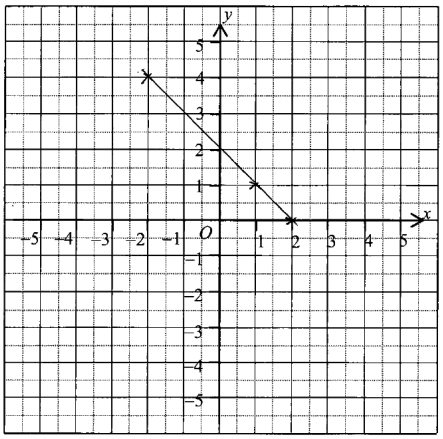
| $x$ | $-2$ | 1 | 2 |
|---|---|---|---|
| $y$ | 4 | 1 | 0 |




Example of Student Work (Did not extend at two ends)

$x + y - 2 = 0$

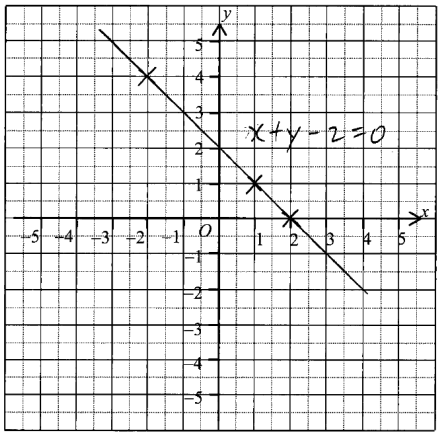
| $x$ | $-2$ | 1 | 2 |
|---|---|---|---|
| $y$ | 4 | 1 | 0 |



Example of Student Work (Good performance)

$x + y - 2 = 0$

| $x$ | $-2$ | 1 | 2 |
|---|---|---|---|
| $y$ | 4 | 1 | 0 |



Q44/M2

Example of Student Work (Solving simultaneous equations – the student tried to use the method of elimination, but mistakes occurred in the steps)

$\begin{cases} 5x + 2y = 31 \\ 3x + 2y = 25. \end{cases}$

$\begin{cases} 15x + 6y = 31 \\ 15x + 10y = 25. \end{cases}$

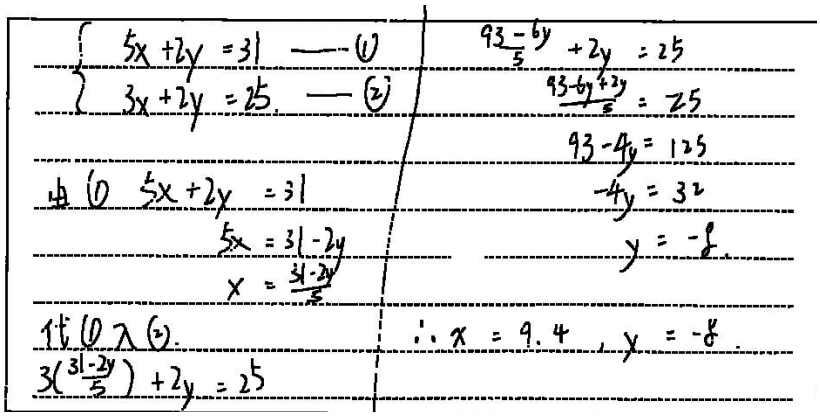
$6y + 10y = 56$

$16y = 56.$

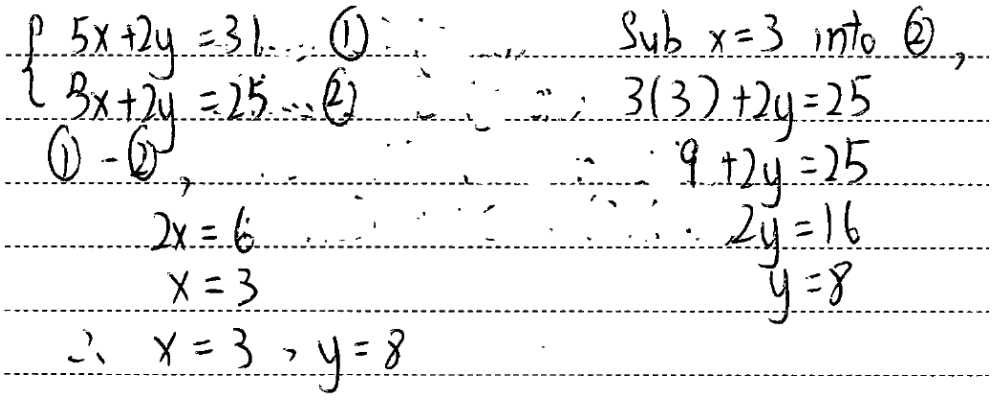
$y = 56 - 16$

$y = 40.$

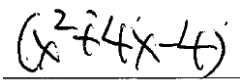
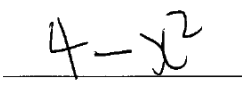
Example of Student Work (Solving simultaneous equations – although the student knew how to use the method of substitution, mistakes occurred in the computation )



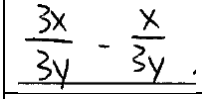
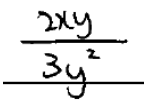

Example of Student Work (Good performance)



- Identities: Many students were able to distinguish equations from identities. However, their performance was only fair in using the perfect square expressions to expand simple algebraic expressions.

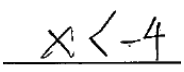
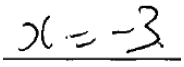
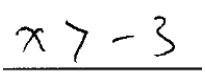
| Q29/M3 |
|---|
| Exemplar Item (Expand simple algebraic expressions by using the perfect square expressions)<br>Expand $(2-x)^2$. |
| Example of Student Work (Although the student knew how to expand the expression by perfect square, mistakes occurred in computation)<br>  |
| Example of Student Work (Has mistakenly taken $(a-b)^2 = a^2 - b^2$ as identity)<br>  |

- Formulas: Many students could find the value of a specified variable in the formula. The performance was fair in simplifying algebraic fractions and performing change of subject in simple formulas.

| Q29/M1 |
|---|
| Exemplar Item (Simplifying algebraic fractions)<br>Simplify $\frac{x}{y}-\frac{x}{3y}$. |
| Example of Student Work (Although the student was able to find the common denominator, the algebraic fractions was not simplified)<br>  |
| Example of Student Work (Could not simplify the algebraic fraction to its simplest form)<br>  |

| Q29/M1 |
| --- |
| Example of Student Work (Could not demonstrate recognition of the manipulation of algebraic fractions)<br>  |

- Linear Inequalities in One Unknown: Students could formulate inequalities from simple contexts. They demonstrated good recognition of the properties of inequalities. Their performance was fair in solving simple linear inequalities.

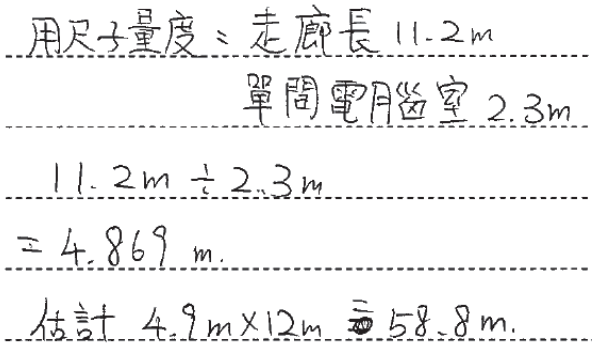
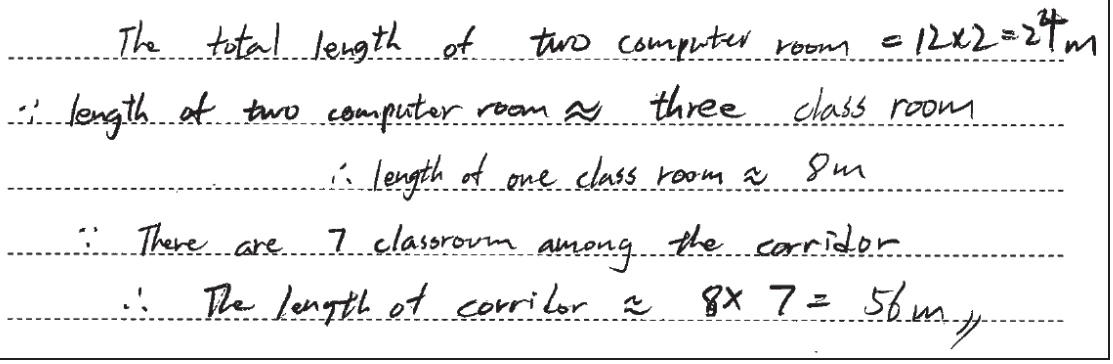
| Q31/M4 |
| --- |
| Exemplar Item (Solving inequalities)<br><br>Solve the inequality $2x+1>-7$. |
| Example of Student Work (Mistakes occurred in computation)<br>  |
| Example of Student Work (Mistakes occurred in computation and could not express the answer with inequality sign)<br>  |
| Example of Student Work (Mistakes occurred in computation)<br>  |

## S.3 Measures, Shape and Space Dimension

S.3 students performed steadily in this Dimension. They could find areas and volumes in 2-D and 3-D figures, angles related with lines and rectilinear figures, solve problems regarding transformation and symmetry, quadrilaterals and trigonometry. However, more improvement could be shown in items related to definitions of common terms in geometry as well as deductive geometry. 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***.

***Measures in 2-D and 3-D Figures***

- Estimation in Measurement: Students were able to find the range of measures from a measurement of a given degree of accuracy, choose an appropriate unit and the degree of accuracy for real-life measurements. Quite a number of students could estimate measures with justification.

| Q48/M2 |
| --- |
| Example of Student Work (Estimate the length of the corridor – using a ruler to measure instead of using estimation strategies)<br>  <br> |
| Example of Student Work (Good performance)<br>  <br> |

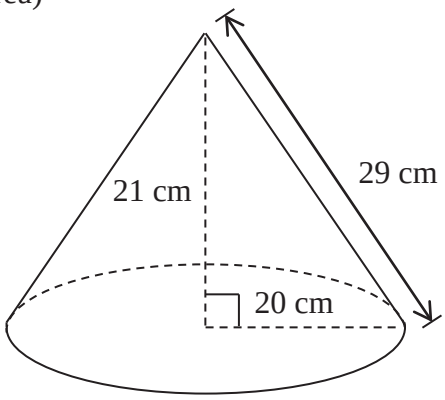
- Simple Idea of Areas and Volumes: Many students could use the formulas for circumferences and areas of circles to solve problems. Their performance was quite good in using formulas for the surface areas and volumes of solids.

- More about Areas and Volumes: Many students could use formulas to calculate arc lengths, areas of sectors, volumes of spheres and surface areas of cones. Almost half of the students were able to use relationships between the sides and volumes of similar figures to solve problems and distinguish among formulas for surface areas by considering dimensions.

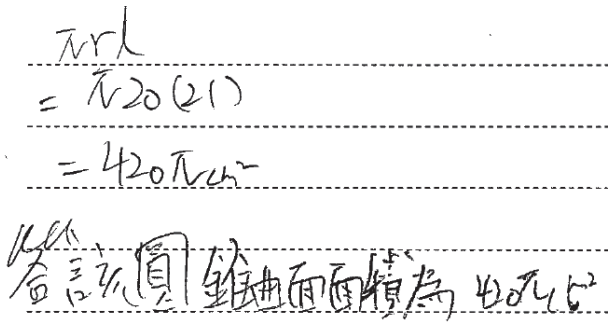
Q47/M1

Exemplar Item (Calculate the curved surface area)

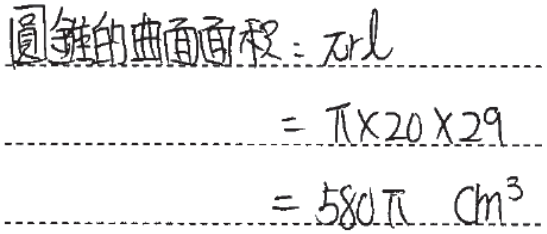
The figure shows a right circular cone of height 21 cm and base radius 20 cm.
Its slant height is 29 cm. Find the curved surface area of the cone in terms of $\pi$.




Example of Student Work (Used the formula incorrectly)

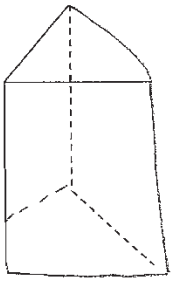
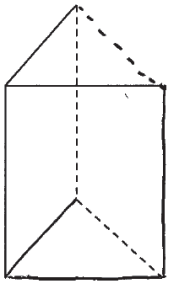



Example of Student Work (Wrong unit)




***Learning Geometry through an Intuitive Approach***

- Introduction to Geometry: Students could generally identify types of angles and 3-D solids from given nets. Quite a number of students were able to sketch a diagram of a triangular prism. However, their performance was weak in the recognition of regular polygons and equiangular polygons.

| Q32/M4 |
| --- |
| Example of Student Work (Sketch a diagram of a triangular prism – the dotted line was not drawn in a right position)<br>  |
| Example of Student Work (Sketch a diagram of a triangular prism – the student didn't use solid lines and dotted lines appropriately)<br>  |

- Transformation and Symmetry: Students' performance was good. They were able to grasp the concepts of axes of symmetry and the order of rotational symmetry, and they could also identify the effect on the size and shape of a figure under a single transformation.

- Congruence and Similarity: Students demonstrated recognition of the conditions for similar triangles. Nonetheless, some of them confused the reasons for congruent triangles with that for similar triangles. Quite a number of students were not able to identify the corresponding angles of two similar triangles.

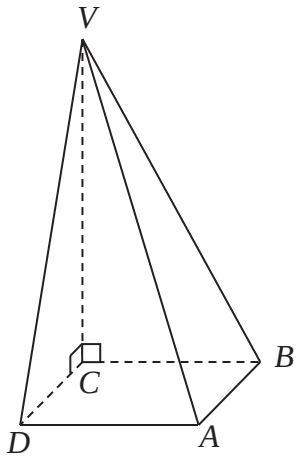
- Angles related with Lines and Rectilinear Figures: Students did well in solving simple geometric problems. Nevertheless, some students were weak in recognition of adjacent angles and applying the formula for exterior angles of convex polygons.

- More about 3-D figures: Students were able to identify the nets of cubes and match 3-D objects with various views. Nearly half of the students could name the angle between 2 planes. Nevertheless, some of them could not identify the angle between a line and a horizontal plane.

Q36/M4

Exemplar Item (Identify the angle between a line and a horizontal plane)

In the figure, *VABCD* is a pyramid with a rectangular base. Its base *ABCD* is a horizontal plane and its height is *VC*. Name the angle between *VB* and the plane *ABCD*.




Example of Student Work (Could not identify the correct angle)

(1) ∠VDB

(2) ∠VBD

(3) CB

(4) ∠VCB

***Learning Geometry through a Deductive Approach***

- Simple Introduction to Deductive Geometry: Students performed quite well in using the conditions for congruent and similar triangles to perform simple proofs. Their performance was quite poor when dealing with problems about angles and lines. Many of students could not provide reasons or complete the proof correctly. Moreover, quite a number of students were not able to identify perpendicular bisectors of a triangle.

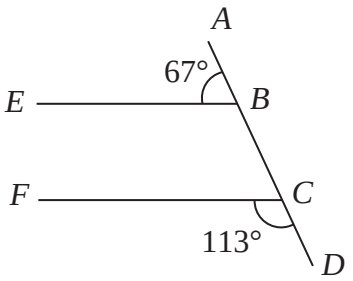
Q45/M1

Exemplar Item (Geometric proof)

In the figure, *ABCD* is a straight line.

$\angle ABE = 67°$ and $\angle FCD = 113°$.

Prove that $BE // CF$.



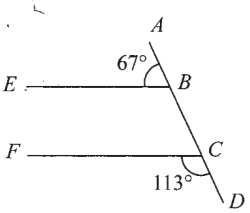

Example of Student Work (Could not provide reasons, and some necessary steps were missing)

$\angle EBC = 180° - 67°$

$= 113°$

$\because \angle EBC = \angle FCD$

$\therefore BE // CF$



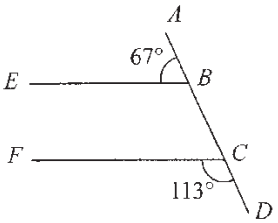

Example of Student Work (Wrongly used 'EBC' and 'FCD' to represent the angles in the diagram, and correct reasons were not stated)

EBC = 180 - 67° (直線上的補角)

= 113°

EBC = FCD (同位角)

∴ BE // CF




Example of Student Work (Good performance)

$\angle EBC + \angle ABE = 180°$ (adj ∠s on st line)

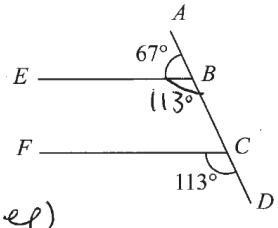
$\angle EBC + 67° = 180°$

$\angle EBC = 113°$

$\angle FCD = 113°$ (given)

$\angle EBC = \angle FCD = 113°$

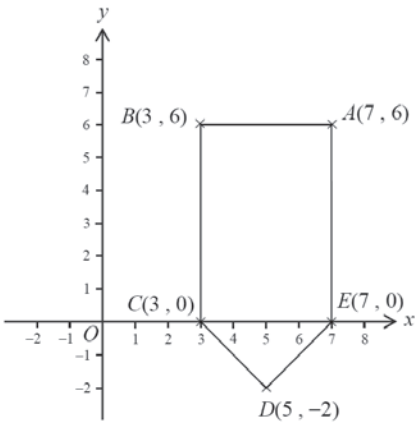
$BE // CF$ (corr ∠s eq)




- Pythagoras' Theorem: Many students could use Pythagoras' Theorem and the converse of Pythagoras' Theorem to solve simple problems.
- Quadrilaterals: Students performed well. They could use the properties of rhombuses in numerical calculations.

***Learning Geometry through an Analytic Approach***

- Introduction to Coordinates: Students could grasp the basic concepts of the rectangular coordinate system, but they only performed fair in problems regarding polar coordinates. They did not do well in items related to calculating areas of simple figures and a single transformation including rotation.

| Q49/M1 |
|---|
| Exemplar Item (Find the area of a figure)<br><br>Find the area of the pentagon *ABCDE* in the figure.<br><br>  <br> |
| Example of Student Work (Wrongly calculated the height of △*CDE* and its area)<br><br>BA = 7−3=4 4×6 ABCD+CEFD = 24+(−8)<br>BC = 6−0=6 =24 =16 units²<br>ABCE = 24 units².<br><br>CE = 7−3 = 4<br>Height of △DEF = −2<br>Area of △CEF = −2×4<br>= −8 units² |

- Coordinate Geometry of Straight Lines: Students could use the distance formula and the mid-point formula. However, their performance was only fair in finding slopes of straight lines and applying the conditions for parallel lines.

***Trigonometry***

- Trigonometric Ratios and Using Trigonometry: Students could grasp the basic concepts of sine, cosine and tangent ratios. Their performance was satisfactory in recognition of the idea of bearing. Quite a number of students were able to solve simple 2-D problems involving one right-angled triangle.

## S.3 Data Handling Dimension

The performances of S.3 students were satisfactory in this Dimension. They did well in items related to using simple methods to collect data, interpret simple statistical charts and choose appropriate diagrams to present a set of data. However, performance was weak when students were asked to construct stem-and-leaf diagrams, compare the presentations of the same set of data by using statistical charts and find the mean from a set of grouped data. 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***.

***Organization and Representation of Data***

- Introduction to Various Stages of Statistics: Students were able to use simple methods to collect data and organize data, organize the same set of data by different grouping methods. About half of the students could distinguish discrete and continuous data.
- Construction and Interpretation of Simple Diagrams and Graphs: Students could interpret simple statistical charts and choose appropriate diagrams/graphs to present a set of data. Nonetheless, many students were not able to construct stem-and-leaf diagrams correctly.

Q49/M2

Example of Student Work (Construction of stem-and-leaf diagrams – the student mistakenly added the commas between the data)

15 名學生在默書所得的分數

| 幹（10 分） | 葉（1 分） |
|---|---|
| 1 | 1 , 2 , 5 , 8 |
| 2 | 4 , 4 , 9 |
| 3 | 7 , 8 |
| 4 | 2 , 5 , 8 , 8 |
| 5 | 0 , 0 |

Q49/M2

Example of Student Work (Construction of stem-and-leaf diagrams – the student mistakenly arranged the data on the stem from largest to smallest)

15 名學生在默書所得的分數

| 幹（10 分） | 葉（1 分） |
|---|---|
| 5 | 0, 0 |
| 4 | 2, 5, 8, 8 |
| 3 | 7, 8 |
| 2 | 4, 4, 9 |
| 1 | 1, 2, 5, 8 |

***Analysis and Interpretation of data***

- Measures of Central Tendency: In finding averages from a set of ungrouped data, students performed quite well. On the other hand, many students could not find the mean from a set of grouped data. More than half of the students could not identify sources of deception in cases of misuse of averages.

Q50/M4

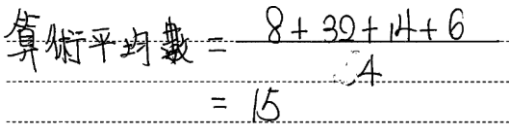
Exemplar Item (Find the mean from a set of grouped data)

The table below shows the weights of 60 suitcases.

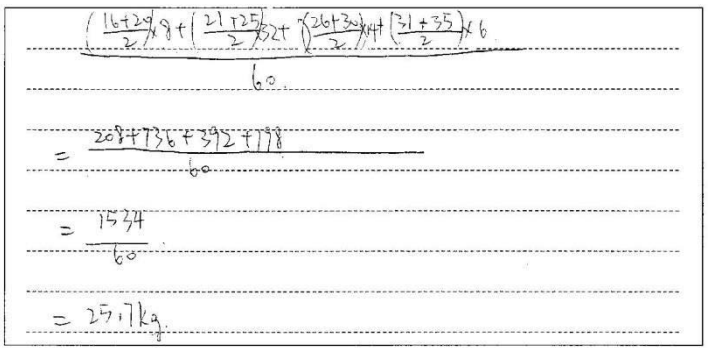
| Weight (kg) | 16 – 20 | 21 – 25 | 26 – 30 | 31 – 35 |
|---|---|---|---|---|
| Frequency | 8 | 32 | 14 | 6 |

Find the mean weight of the 60 suitcases.

Example of Student Work (Mistakenly considered the mean of frequencies)

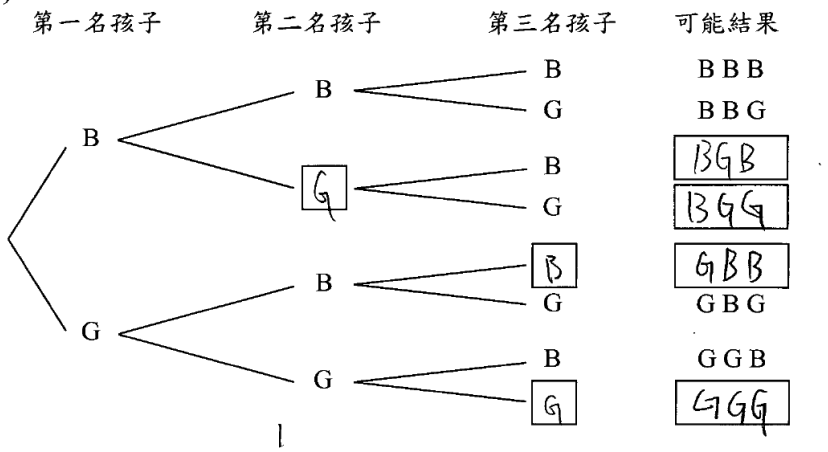
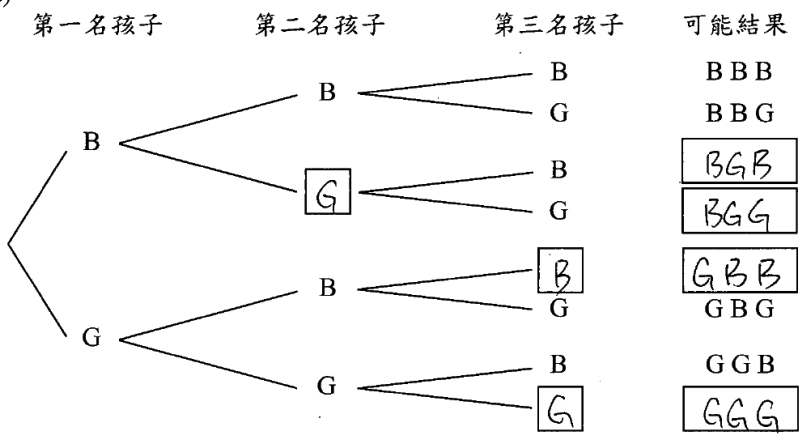



Example of Student Work (Correct formula but errors occurred in steps)



***Probability***

- Simple Idea of Probability: Students were able to find the theoretical probability by listing. Their performance was only fair in calculating the empirical probability.

| Q50/M3 |
|---|
| Exemplar Item (Calculate the theoretical probability)<br>Consider a family with 3 children.<br>(a) Let B represent a boy and G represent a girl. Complete the tree diagram provided in the **ANSWER BOOKLET** to list out all possible outcomes.<br>(b) Find the probability that only one child is a girl in the family. |
| Example of Student Work (Could not find the three possible outcomes which satisfy the condition from the tree diagram)<br>(a)<br>  <br><br>(b) 所求的概率 = 1/8 |
| Example of Student Work (Good performance)<br>(a)<br>  <br><br>(b) 所求的概率 = 3/8 |

## General Comments on S.3 Student Performances

The overall performance of S.3 students was steady. They did quite well in the Number and Algebra Dimension. Performance was satisfactory in the Measures, Shape and Space Dimension and in the Data Handling Dimension.

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

***Directed Numbers and the Number Line***

- Use positive numbers, negative numbers and zero to describe situations like profit and loss, floor levels relative to the ground level (e.g. Q21/M1).
- Demonstrate recognition of the ordering of integers on the number line (e.g. Q21/M3).
- Add, subtract, multiply and divide directed numbers (e.g. Q21/M4).

***Numerical Estimation***

- Determine whether to estimate or to compute the exact value in a simple context (e.g. Q1/M3).
- Judge, without actual calculations, the reasonableness of answers from computations (e.g. Q1/M2).

***Approximation and Errors***

- Round off a number to 3 significant figures (e.g. Q26/M3).
- Represent a large or a small number in scientific notation (e.g. Q2/M1).
- Convert numbers in scientific notation to integers or decimals (e.g. Q3/M2).

***Rational and Irrational Numbers***

- Demonstrate, without using calculators, recognition of the integral part of $\sqrt{a}$, where a is a positive integer not greater than 200 (e.g. Q3/M1).

***Using Percentages***

- Solve simple selling problems (e.g. Q42/M3).

***Rate and Ratio***

- Represent a ratio in the form $a : b$ (or $\frac{a}{b}$), $a : b : c$ (e.g. Q22/M4).

- Find the other quantity from a given ratio $a : b$ and the value of either $a$ or $b$ (e.g. Q22/M3).
- Use rate and ratio to solve simple real-life problems (e.g. Q23/M2).

***Formulating Problems with Algebraic Language***

- Distinguish the difference between $2x$ and $2 + x$; $(-2)^n$ and $-2^n$; $x^2$ and $2x$, etc. (e.g. Q3/M4).
- Translate word phrases/contexts into algebraic languages (e.g. Q4/M1).
- Substitute values into some common and simple formulas and find the value of a specified variable (e.g. Q23/M1).
- Formulate simple equations/inequalities from simple contexts (e.g. Q4/M3).
- Describe patterns by writing the next few terms in arithmetic sequences, geometric sequences, Fibonacci sequence or sequences of polygonal numbers from several consecutive terms of integral values (e.g. Q23/M4).

***Linear Equations in One Unknown***

- Solve simple equations (e.g. Q6/M1).

***Linear Equations in Two Unknowns***

- Demonstrate recognition that graphs of equations of the form $ax + by + c = 0$ are straight lines (e.g. Q7/M3).

***Linear Inequalities in One Unknown***

- Represent inequalities, such as $x < -2$, $x \geq 3$, etc., on the number line and vice versa (e.g. Q9/M1).

***Estimation in Measurement***

- Find the range of measures from a measurement of a given degree of accuracy (e.g. Q9/M3).
- Choose an appropriate unit and the degree of accuracy for real-life measurements (e.g. Q10/M2).

***More about Areas and Volumes***

- Calculate volumes of pyramids, circular cones and spheres (e.g. Q11/M2).

***Introduction to Geometry***

- Identify types of angles with respect to their sizes (e.g. Q13/M2).
- Make 3-D solids from given nets (e.g. Q13/M4).

***Transformation and Symmetry***

- Determine the order of rotational symmetry from a figure and locate the centre of rotation (e.g. Q32/M2).
- Name the single transformation involved in comparing the object and its image (e.g. Q14/M3).

***Congruence and Similarity***

- Demonstrate recognition of the conditions for congruent and similar triangles (e.g. Q15/M4).
- Demonstrate recognition of the properties of congruent and similar triangles (e.g. Q33/M1).

***Angles related with Lines and Rectilinear Figures***

- Use the angle properties associated with intersecting lines/parallel lines to solve simple geometric problems (e.g. Q34/M3).
- Use the properties of angles of triangles to solve simple geometric problems (e.g. Q33/M2).

***Quadrilaterals***

- Use the properties of rhombuses in numerical calculations (e.g. Q36/M2).

***Introduction to Coordinates***

- Use an ordered pair to describe the position of a point in the rectangular coordinate plane and locate a point of given rectangular coordinates (e.g. Q17/M3 and Q37/M3).
- Match a point under a single transformation with its image in the rectangular coordinate plane (e.g. Q38/M4).

***Coordinate Geometry of Straight Lines***

- Use the distance formula (e.g. Q17/M2).

***Introduction to Various Stages of Statistics***

- Use simple methods to collect data (e.g. Q20/M3).
- Organize the same set of data by different grouping methods (e.g. Q50/M1).

***Construction and Interpretation of Simple Diagrams and Graphs***

- Choose appropriate diagrams/graphs to present a set of data (e.g. Q19/M1).

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

***Approximation and Errors***

- Round off a number to a certain number of decimal places (e.g. Q2/M2): Quite a number of students chose the correct answer, option C. However, options B and D were chosen by about 20% of students respectively. They could not judge whether zeros should be added after the digit '8' or how many zeros should be added.

| Q2/M2 |
|---|
| Round off 0.079 95 to 3 decimal places.<br>A. 0.079 9<br>B. 0.08<br>C. 0.080<br>D. 0.080 0 |

***Manipulations of Simple Polynomials***

- Distinguish polynomials from algebraic expressions (e.g. Q4/M4): Only some students chose the correct answer, option B. Each of the remaining options was chosen by about 20% of students respectively. They did not grasp the concept of polynomials.

| Q4/M4 |
|---|
| Which of the following is a polynomial?<br>A. $2x^2 + 3\sqrt{x}$<br>B. $\frac{x^2}{2} + 3x$<br>C. $2^x + 3x$<br>D. $2x^2 + \frac{1}{3x}$ |

***Linear Equations in Two Unknowns***

- Plot graphs of linear equations in 2 unknowns (e.g. Q27/M2 and Q44/M3): Two different items about plotting graphs of linear equations in 2 unknowns were set in the assessment in different sub-papers. One of the items asked students to plot the graph directly. The other item provided a table preset with some coordinates to assist plotting.

Q27/M2

Draw the graph of the equation $x + y - 2 = 0$ on the rectangular coordinate plane given in the **ANSWER BOOKLET**. The range of $x$ must include the values from – 2 to 2.

Q44/M3

Complete the table for the equation $x + y - 2 = 0$ in the **ANSWER BOOKLET**.

| $x$ | – 2 | 1 | 2 |
|---|---|---|---|
| $y$ | | 1 | |

According to the table, draw the graph of this equation on the rectangular coordinate plane given in the **ANSWER BOOKLET**.

- According to the facilities, students did well in Q44/M3. However, the facility of Q27/M2 was only just over half of that of Q44/M3.

- Determine whether a point lies on a straight line with a given equation (e.g. Q7/M1): More than half of the students chose the correct answer, option D. However, many students still chose options B and C. They might only have considered 3 + 3 = 6 and 0 + 3 = 3 instead of considering the $x$-coordinate is –3 or not.

Q7/M1

Which of the following points lie on the straight line $x + 3 = 0$?

$P(3 , 6)$ , $Q(-3 , 0)$ , $R(0 , 3)$ , $S(-3 , 6)$

A. $P$ and $R$
B. $P$ and $S$
C. $Q$ and $R$
D. $Q$ and $S$

***Formulas***

- Perform change of subject in simple formulas but not including radical sign (e.g. Q28/M2 and Q30/M4): Two different items about change of subject in simple formulas were set in the assessment in different sub-papers. The two items are basically the same; the only difference is the two terms on the right hand side of the formulas are interchanged.

| Q28/M2 |
| --- |
| Make $P$ the subject of the formula $N = \frac{P}{4} + 1$. |

| Q30/M4 |
| --- |
| Make $P$ the subject of the formula $N = 1 + \frac{P}{4}$. |

- According to the result, the facility of Q30/M4 was higher than that of Q28/M2. In Q28/M2, more students rewrote the formula as $P = 4N - 1$.

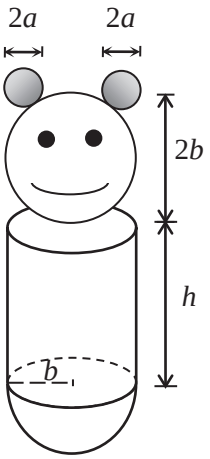
***More about Areas and Volumes***

- Distinguish among formulas for lengths, areas and volumes by considering dimensions (e.g. Q11/M3): Almost half of the students chose the correct answer, option A. However, about 40% of students chose options C and 10% of students chose D.

| Q11/M3 |
| --- |
| The ratio of the volumes of two similar cones is 1 : 27. Which of the following is the ratio of their corresponding heights?<br>A. 1 : 3<br>B. $1^2 : 3^2$<br>C. $1^3 : 3^3$<br>D. $1^3 : 27^3$ |

- Distinguish among formulas for lengths, areas, volumes by considering dimensions (e.g. Q12/M1): More than half of the students chose the correct answer, option B. However, options A and C were chosen by about 20% of students respectively.

Q12/M1




In the figure, the roly-poly toy can be divided into a head and a body. The head is formed by 3 spheres. The diameters of the spheres are $2a$, $2a$ and $2b$ respectively. The body is formed by a cylinder and a hemisphere. The base radius and the height of the cylinder are $b$ and $h$ respectively. The radius of the hemisphere is also $b$. By considering the **dimensions**, determine which of the following could express the total surface area of the roly-poly toy.

A. $\frac{\pi}{3}(8a^3 + 6b^3 + 3b^2h)$

B. $8\pi a^2 + \pi b(7b + 2h)$

C. $4\pi a + 5\pi b + 2h$

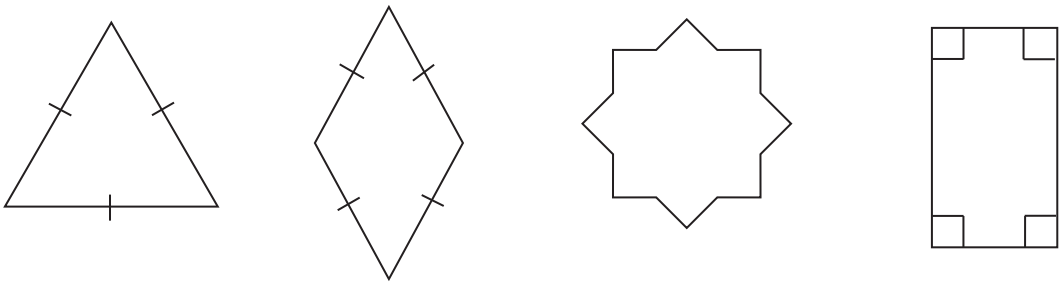
D. $2a + 3b + h$

***Introduction to Geometry***

- Determine whether a polygon is regular, convex, concave, equilateral or equiangular (e.g. Q32/M3): Only some of the students chose the correct answers (Figure P and Figure S). Quite a number of students thought that Figure Q and Figure R were also equiangular.

| Q32/M3 |
|---|
| Which of the following polygons **MUST** be equiangular? (May be more than one answer) |

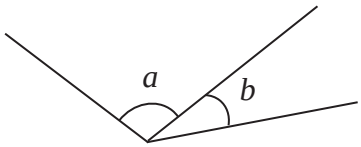
P. Q. R. S.



***Angles related with Lines and Rectilinear Figures***

- Demonstrate recognition of the angles with respect to their positions relative to lines and polygons (e.g. Q15/M3): Only half of the students chose the correct answer, option D. Quite a number of students mistakenly thought that *a* and *b* are angles at a point or interior angles on the same side.

| Q15/M3 |
|---|
| In the figure, *a* and *b* are<br>A. vertically opposite angles.<br>B. angles at a point.<br>C. interior angles on the same side.<br>D. adjacent angles. |

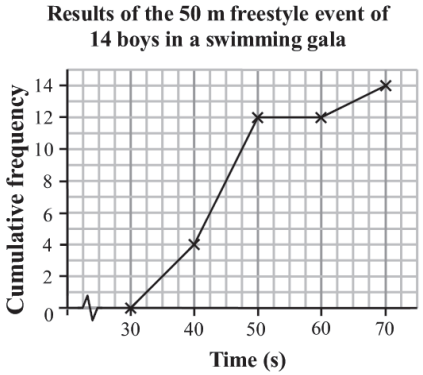


***Construction and Interpretation of Simple Diagrams and Graphs***

- Compare the presentations of the same set of data by using statistical charts (e.g. Q19/M4): About half of the students chose option A. They were not aware that the vertical axis of the histogram in each option is labelled as 'frequency' instead of 'cumulative frequency'.

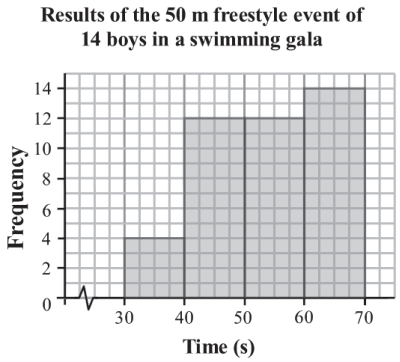
Q19/M4

The cumulative frequency polygon below shows the results of the 50 m freestyle event of 14 boys in a swimming gala.

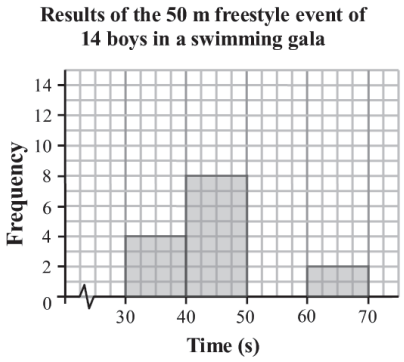



Which of the following histograms can be used to construct the above diagram?

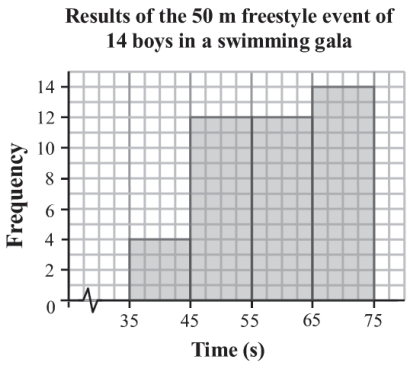
A.



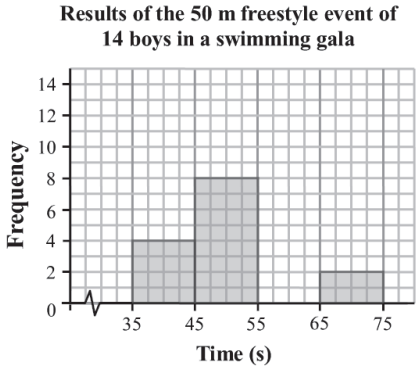

B.




C.




D.



## *Best Performance of S.3 Students in TSA 2015*

Students sitting for each sub-paper were ranked according to their scores and the performances of approximately the top 10% were singled out for further analysis. The performances of these students are described below.

Among these students, the majority of them achieved a full score or lost at most five score points in the whole assessment. They demonstrated good understanding and mastery of the concepts and skills assessed by the sub-papers they attempted.

These students were able to

- Determine whether to estimate or to compute the exact value in a simple context (e.g. Q1/M4).
- Convert numbers in scientific notation to integers or decimals (e.g. Q3/M2).
- Demonstrate, without using calculators, recognition of the integral part of $\sqrt{a}$, where $a$ is a positive integer not greater than 200 (e.g. Q3/M1).
- Solve simple selling problems (e.g. Q42/M3).
- Solve simple problems on growths and depreciations (e.g. Q43/M3).
- Find the other quantity from a given ratio $a : b$ and the value of either $a$ or $b$ (e.g. Q22/M3).
- Use rate and ratio to solve simple real-life problems including mensuration problems (e.g. Q23/M2).
- Translate word phrases/contexts into algebraic languages (e.g. Q4/M1).
- Substitute values into some common and simple formulas and find the value of a specified variable (e.g. Q23/M1).
- Formulate simple equations/inequalities from simple contexts (e.g. Q4/M3).
- Solve simple equations (e.g. Q6/M1).
- Plot graphs of linear equations in 2 unknowns (e.g. Q44/M3).
- Solve a system of simple linear simultaneous equations by algebraic methods (e.g. Q44/M2).
- Find the range of measures from a measurement of a given degree of accuracy (e.g. Q9/M3).

- Use the formulas for circumferences and areas of circles (e.g. Q46/M3).
- Calculate arc lengths (e.g. Q46/M2).
- Calculate areas of sectors (e.g. Q46/M1).
- Calculate volumes of pyramids, circular cones and spheres (e.g. Q47/M2).
- Name the single transformation involved in comparing the object and its image (e.g. Q14/M3).
- Demonstrate recognition of the conditions for congruent and similar triangles (e.g. Q33/M4).
- Use the angle properties associated with intersecting lines/parallel lines to solve simple geometric problems (e.g. Q34/M3).
- Use the relations between sides and angles associated with isosceles/equilateral triangles to solve simple geometric problems (e.g. Q47/M3).
- Use the properties of rhombuses in numerical calculations (e.g. Q36/M2).
- Use the mid-point formula (e.g. Q18/M4).
- Solve simple 2-D problems involving one right-angled triangle (e.g. Q49/M4).
- Use simple methods to collect data (e.g. Q20/M3).
- Interpret simple statistical charts (e.g. Q39/M4).
- Calculate the theoretical probability by listing (e.g. Q50/M3).

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

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

| Q49/M3 |
|---|
| Example of Student Work (Construct simple statistical charts) |

15 名學生在默書所得的分數

| 幹（10 分） | 葉（1 分） |
|---|---|
| 1 | 1 2 5 8 |
| 2 | 4 4 9 |
| 3 | 7 8 |
| 4 | 2 5 8 8 |
| 5 | 0 0 |

Students with the best performance could solve the problem correctly with complete and clear presentation.

Q44/M1

Example of Student Work (Solve simultaneous equations)

$5x+2y=31$ — (1)

$3x+2y=25$ — (2)

將(1) − (2).

$(5x+2y)-(3x+2y)=31-25$ — (3)

$2x=6$

$\therefore x=3$ //

將 $x=3$ 代入 (1).

$2y=16$ $\therefore y=8$ //

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

Q48/M4

Example of Student Work (Estimate the length of the corridor)

由於每三間課室等於 2 間電腦室，

6 間課室的長度是 $(12+12)\times 2=48$cm，

第 t 間課室的長度是 $(12+12)\div 3=8$cm

因此走廊的長度是 $48+8=56$cm

Q45/M2

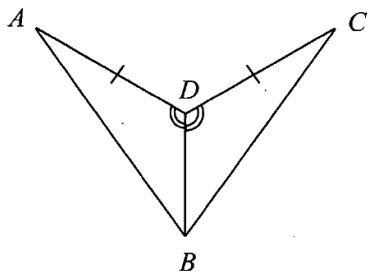
Example of Student Work (Geometric proof)

DB = DB ( common side)

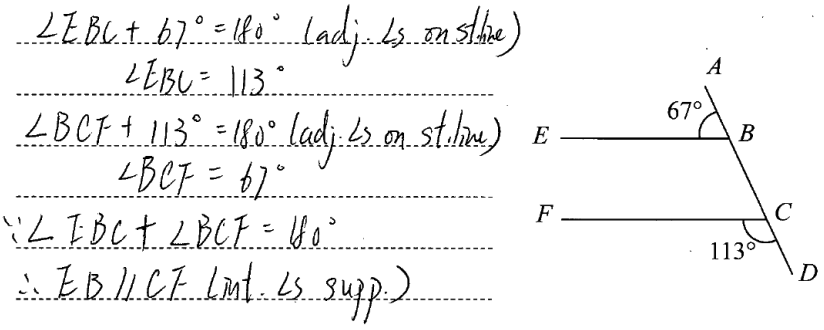
AD = CD ( given)

∠ ADB = ∠ CDB (given)

∴ △ ABD ≅ △ CBD ( SAS)



| Q45/M3 |
| --- |
| Example of Student Work (Geometric Proof) |




Some common weaknesses of high-achieving students are as follows:

- Some students could not compare the presentations of the same set of data by using statistical charts.
- Some students could not distinguish polynomials from algebraic expressions.
- Some students could not determine whether a polygon is regular, convex, concave, equilateral or equiangular.

## *Overview of Student Performances in Mathematics at Secondary 3 TSA 2013-2015*

This was the tenth year that Secondary 3 students participated in the Territory-wide System Assessment. The percentage of students achieving Basic Competency this year was 79.9% which was about the same as last year.

The percentages of students achieving Basic Competency from 2013 to 2015 are listed below:

**Table 8.9 Percentages of S.3 Students Achieving Mathematics Basic Competency from 2013 to 2015**

| Year | % of Students Achieving Mathematics Basic Competency |
|---|---|
| 2013 | 79.7 |
| 2014 | 79.9 |
| 2015 | 79.9 |

The performances of S.3 students over the past three years in each Dimension of Mathematics are summarized as follows:

**Table 8.10 Overview of Student Performances in Mathematics at S.3 TSA 2013-2015**

| Year / Number and Algebra | 2013 | 2014 | 2015 | Remarks |
|---|---|---|---|---|
| **Strengths** | • Students did well in the operations of directed numbers. They could also use directed numbers to describe real life situations.<br>• Students could determine whether to estimate or to compute the exact value in a simple context.<br>• Students could convert numbers in scientific notation to integers.<br>• Students could solve simple problems by using rate.<br>• Students could formulate equations from simple contexts.<br>• Students could observe the pattern of the number sequences and wrote down the next few terms. | • Students did well in the operations of directed numbers. They demonstrated recognition of the number line.<br>• Students could determine whether to estimate or to compute the exact value in a simple context.<br>• Students could convert numbers in scientific notation to decimals.<br>• Students could solve simple problems by using rate.<br>• Students could translate word phrases/contexts into algebraic languages.<br>• Most students were capable of solving simple equations. They could also substitute values into formulas to find the unknown value.<br>• Students could formulate equations from simple contexts.<br>• Students demonstrated recognition of the properties of inequalities. | • Students demonstrated recognition of the number line. They could also use directed numbers to describe real life situations.<br>• Students were able to determine whether to estimate or to compute the exact value in a simple context.<br>• Students were able to round off a number to a certain number of significant figures. They demonstrated recognition of scientific notation.<br>• Students were able to solve simple selling problems and problems on depreciations.<br>• Students were able to solve problems by using ratio.<br>• Students were able to translate word phrases/contexts into algebraic languages.<br>• Students were able to substitute values into formulas to find the unknown value.<br>• Students were able to formulate equations from simple contexts. | • Many students were not familiar with the concepts of some terminologies (e.g. loss percent, compound interest) and so they used the formulas incorrectly.<br>• The presentation of some students' answers remained incomplete and careless mistakes occurred frequently in solving problems.<br>• Many students did not use a ruler to draw straight lines.<br>• Answers were often not corrected to the required degree of accuracy.<br>• Units were often omitted in the answer.<br>• Students could not master abstract concepts (such as the *n*th term of a sequence). |

| Year / Number and Algebra | 2013 | 2014 | 2015 | Remarks |
|---|---|---|---|---|
| **Weaknesses** | • When students were asked to round off a number to a certain number of decimal places, they mistakenly rounded off the number by considering significant figures.<br>• Students' performance was weak in using percentages to find the original value of an object.<br>• Students mixed up the formulas for finding simple interest and compound interest.<br>• Many students could not intuitively find the *n*th term of a number sequence.<br>• Performance was weak when students were asked to simplify algebraic expressions with negative indices.<br>• Students' performance was only fair in factorization of simple polynomials.<br>• Students were quite weak in recognizing the meaning of roots of equations.<br>• Students could not distinguish whether an equality is an equation or an identity.<br>• Students were quite weak in recognizing the properties of inequalities. | • When students were asked to round off a number to a certain number of decimal places, they mistakenly rounded off the number by considering significant figures.<br>• Many students could not represent a number in scientific notation.<br>• Students were quite weak in recognizing the concepts of percentage change, percentage decrease and loss percentage. They mistakenly substituted the cost price and selling price in the formulas.<br>• Students mixed up the formulas for finding simple interest and compound interest.<br>• Students could not distinguish polynomials from algebraic expressions.<br>• Students were weak in recognizing the terminologies of polynomials.<br>• Students' performance was only fair in factorization of simple polynomials.<br>• Students could not distinguish whether an equality is an equation or an identity. | • Students were quite weak in recognizing the concepts of profit, selling price and so many of them could not find the cost price correctly.<br>• Many students confused compound interest with simple interest, as well as amount with interest. Consequently, they used wrong methods.<br>• Many students could not distinguish polynomials from algebraic expressions.<br>• Students' performance was only fair in factorization and expansion of simple polynomials.<br>• Without being given a table to assist calculation of coordinates, many students were not able to plot the graph of a linear equation correctly.<br>• Students' performance was weak when they were asked to perform change of subject in simple formulas. | |

| Year / Measures, Shape and Space | 2013 | 2014 | 2015 | Remarks |
|---|---|---|---|---|
| **Strengths** | • Students were able to find the areas of sectors.<br>• Students could identify the relationship between simple 3-D solids and their corresponding 2-D figures. They could also recognize the cross-sections of simple solids.<br>• Students could draw the axes of symmetry.<br>• When the object and its image were given, students could identify the single transformation involved.<br>• Students could use the angle properties associated with intersecting lines/parallel lines and the properties of triangles to solve simple geometric problems.<br>• Students could use the properties of angles of triangles and the relations between sides and angles associated with isosceles triangles to solve simple geometric problems.<br>• Students were able to use the properties of quadrilaterals in numerical calculations.<br>• Students had good knowledge of the rectangular coordinate system. | • Students were able to find the range of measures from a measurement of a given degree of accuracy and choose an appropriate unit and the degree of accuracy for real-life measurements.<br>• Students could choose the method from the given options that gave a more accurate reading.<br>• Students were able to find the areas of sectors and the surface areas of spheres.<br>• Students could demonstrate recognition of common terms in geometry.<br>• Students could identify the relationship between simple 3-D solids and their corresponding 2-D figures.<br>• Students could determine the number of axes of symmetry and locate the centre of rotation from a figure.<br>• When the object and its image were given, students could identify the single transformation involved.<br>• Students could use the angle properties associated with intersecting lines/parallel lines and the properties of triangles to solve simple geometric problems.<br>• Students had good knowledge of the rectangular coordinate system. | • Students were able to find the range of measures from a measurement of a given degree of accuracy and choose an appropriate unit and the degree of accuracy for real-life measurements.<br>• Students were able to find the areas of sectors and the volumes of pyramids.<br>• Students were able to identify the relationship between simple 3-D solids and their corresponding 2-D figures.<br>• Students were able to determine the order of rotational symmetry from a figure.<br>• When the object and its image were given, students were able to identify the single transformation involved.<br>• Students were able to demonstrate recognition of the conditions for congruent and similar triangles.<br>• Students were able to use the angle properties associated with intersecting lines/parallel lines and the properties of triangles to solve simple geometric problems.<br>• Students had good knowledge of the rectangular coordinate system. | • Students did well in straightforward questions (such as numerical calculation in simple geometric problems). However, their performance was only fair in items involving more judgments.<br>• Students were willing to attempt geometric proofs. However, they usually could not use logical reasoning and correct reasons to complete the proofs.<br>• Students could not master abstract concepts (such as projection of an edge on a plane, planes of reflectional symmetries of cubes).<br>• Inappropriate or incorrect presentation frequently occurred (such as confused $\angle ABC$ with $\triangle ABC$, $AB = BC$ with $AB \parallel BC$).<br>• Answers were often not corrected to the required degree of accuracy.<br>• Units were often omitted in the answer.<br>• Many students were not familiar with the formulas. |

| Year / Measures, Shape and Space | 2013 | 2014 | 2015 | Remarks |
|---|---|---|---|---|
| **Weaknesses** | • Students' performance was weak in finding the area of a semi-circle.<br>• Students were weak in abstract concepts (such as using the relationship of similar figures to find measures).<br>• Students could not demonstrate recognition of common terms in geometry.<br>• Students could not determine whether a polygon is convex.<br>• Many students were unable to sketch simple solids.<br>• Students could not demonstrate recognition of the conditions for congruent and similar triangles.<br>• Students were weak in identifying the planes of reflectional symmetries and axes of rotational symmetries of cubes. | • Students were unable to distinguish among formulas for volumes by considering dimensions.<br>• Students could not determine whether a polygon is regular.<br>• Quite a number of students could not identify the image of a figure after reflection.<br>• Students could not demonstrate recognition of the conditions for congruent and similar triangles.<br>• Students were weak in identifying the planes of reflectional symmetries of cubes.<br>• Many students could not identify the projection of an edge on a plane.<br>• Students' performance was only fair in applying the conditions for perpendicular lines. | • Students were weak in abstract concepts (such as using relationship of similar figures to find measures).<br>• Many students could not determine whether a polygon is equiangular.<br>• Students could not demonstrate recognition of adjacent angles.<br>• Quite a number of students could not identify the angle between a line and a horizontal plane.<br>• Students in general could not complete the proofs of simple geometric problems related with angles and lines.<br>• Quite a number of students could not identify perpendicular bisectors of a triangle. | |

| Year / Data Handling | 2013 | 2014 | 2015 | Remarks |
|---|---|---|---|---|
| **Strengths** | • Students could organize the same set of data by different grouping methods.<br>• Students' performance was quite good in calculating the empirical probability and the theoretical probability by listing. | • Students could use simple methods to collect data.<br>• Students could interpret simple statistical charts.<br>• Students' performance was quite good in calculating the empirical probability and the theoretical probability by listing. | • Students could use simple methods to collect data.<br>• Students could read information from diagrams and interpret the information.<br>• Students could choose appropriate diagrams/graphs to present a set of data.<br>• Students were able to calculate the theoretical probability by listing. | • Many students did not use rulers to draw statistical charts.<br>• Students were weak in recognizing the discrete and continuous data. |
| **Weaknesses** | • Quite a number of students could not distinguish between discrete and continuous data.<br>• Students in general could not choose appropriate diagrams /graphs to present a set of data and compare the presentations of the same set of data by using statistical charts.<br>• Quite a number of students were not able to find averages from a set of grouped data. | • Students' performance was only fair in distinguishing discrete and continuous data.<br>• Students in general could not choose appropriate diagrams /graphs to present a set of data.<br>• Quite a number of students were not able to find averages from a set of grouped data. | • Students' performance was only fair in distinguishing discrete and continuous data.<br>• Students in general could not construct stem-and-leaf diagrams correctly.<br>• Many students could not compare the presentations of the same set of data by using statistical charts.<br>• Quite a number of students were not able to find averages from a set of grouped data. | |

## *Comparison of Student Performances in Mathematics at Primary 3, Primary 6 and Secondary 3 TSA 2015*

The percentages of P.3, P.6 and S.3 students achieving Basic Competency from 2004 to 2015 are as follows:

**Table 8.11 Percentages of Students Achieving Mathematics Basic Competency**

| Year / Level | % of Students Achieving Mathematics BC | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** |
| P.3 | 84.9 | 86.8 | 86.9 | 86.9 | 86.9 | # | 87.0 | 87.0 | 87.3 | 87.5 | 87.4 | 87.6 |
| P.6 | -- | 83.0 | 83.8 | 83.8 | 84.1 | # | 84.2 | 84.1 | ^ | 84.2 | ^ | 84.0 |
| S.3 | -- | -- | 78.4 | 79.9 | 79.8 | 80.0 | 80.1 | 80.1 | 79.8 | 79.7 | 79.9 | 79.9 |

# Due to Human Swine Influenza causing the suspension of primary schools, the TSA was cancelled and no data has been provided.

^ The 2012 and 2014 P.6 TSA were suspended. As participation in the 2012 and 2014 P.6 TSA was on a voluntary basis, not all P.6 students were involved and hence no territory-wide data is provided in this report.

A comparison of strengths and weaknesses of P.3, P.6, and S.3 students in TSA enables teachers to devise teaching strategies and tailor curriculum planning at different key stages to adapt to students' needs. The dimensions of Mathematics Curriculum at each key stage belong to different dimensions as shown below:

**Table 8.12 Dimensions of Mathematics Curriculum for Primary 3, Primary 6 and Secondary 3**

<table>
<tr><th></th><th>Primary 3</th><th>Primary 6</th><th>Secondary 3</th></tr>
<tr><td rowspan="5">Dimension</td><td rowspan="2">Number</td><td>Number</td><td rowspan="2">Number and Algebra</td></tr>
<tr><td>Algebra</td></tr>
<tr><td>Measures</td><td>Measures</td><td rowspan="2">Measures, Shape and Space</td></tr>
<tr><td>Shape and Space</td><td>Shape and Space</td></tr>
<tr><td>Data Handling</td><td>Data Handling</td><td>Data Handling</td></tr>
</table>

The following table compares students' performances at P.3, P.6 and S.3 in Mathematics TSA 2015:

**Table 8.13 Comparison of Student Performances in Mathematics at Primary 3, Primary 6 and Secondary 3 TSA 2015**

| Level / Dimension | P.3 | P.6 | S.3 |
|---|---|---|---|
| **Number** | • Most P.3 students were capable of recognizing the place values in whole numbers and the value of the digit.<br>• The majority of the P.3 students could perform arithmetic calculations with numbers up to 3 digits.<br>• P.3 students were capable of comparing fractions and recognizing the relationship between fractions and the whole. Some students could not fully understand the basic concept of a fraction as parts of one whole.<br>• P.3 students were capable of solving simple application problems involving mixed operations by presenting clear working steps and explanations, but they sometimes misinterpreted questions due to carelessness.<br>• Many students were able to solve application problems involving the calculation of money. | • P.6 students were capable of recognizing the place values in whole numbers and decimals.<br>• P.6 students could perform arithmetic operations on whole numbers, fractions and decimals, including small brackets. However, some students forgot the computational rule of 'performing multiplication/division before addition/subtraction'.<br>• P.6 students understood the concept of fractions as parts of one whole and could compare fractions.<br>• P.6 students were capable of choosing a suitable mathematical expression for estimating the value.<br>• P.6 students could solve application problems with clear working steps and explanations. However, some students were weak in solving application problems involving fractions or unfamiliar contexts. | • Students could recognize the concept of directed numbers and their operations.<br>• Students could use rate and ratio to solve problems.<br>• Students could judge the reasonableness of answers from computations. However, some of them used the incorrect methods for the estimation. Their explanations were also incomplete when they gave justifications.<br>• Students did well in using percentages to solve simple application problems. Some students confused the formula of finding simple interest with that of compound interest. |
| **Algebra** | N.A. | • P.6 students were capable of using symbols to represent numbers.<br>• P.6 students were capable of solving equations involving at most two steps in the solutions.<br>• P.6 students were capable of solving problems by using simple equations. | • Students could formulate equations from simple contexts and solve equations.<br>• Students could observe the pattern of the number sequences and wrote down the next few terms, but they were not able to intuitively find the *n*th term of a number sequence.<br>• Students' performance was fair in addition, subtraction, expansion and factorization of polynomials.<br>• Students performed satisfactorily when they applied the laws of integral indices and properties of inequalities to solve problems. |

| Level / Dimension | P.3 | P.6 | S.3 |
|---|---|---|---|
| **Measures** | • The majority of P.3 students could find the correct dates and days of a week However, some of them failed to find the number of days of an activity from the calendar, according to given conditions.<br>• Most students were capable of telling the time on a clock face and a digital clock. Many students could use the '24-hour time' to express the time appropriately.<br>• For the length of objects, most students were capable of using suitable tools to measure and appropriate units to record.<br>• The majority of students were capable of measuring the weight of objects using 'gram' (g) or 'kilogram' (kg), and showed improvement when comparing weights of objects.<br>• The majority of students could measure and compare the capacity of containers, but few could not use appropriate units. | • P.6 students could write the correct dates and apply the '24-hour time'.<br>• P.6 students were capable of recording the length, weight and capacity with appropriate units.<br>• P.6 students were capable of measuring and comparing the capacity of containers.<br>• P.6 students could calculate the perimeters and areas of simple 2-D shapes as well as the volume of solids.<br>• P.6 students were capable of applying the formula of circumference.<br>• P.6 students could solve simple problems related to speed. | • Students could choose an appropriate unit and the degree of accuracy for real-life measurements, however, they were not able to choose the appropriate measuring technique.<br>• Students could calculate arc lengths, areas of sectors, volumes of spheres and curved surface areas of cones.<br>• Performance of students was quite good in calculating circumferences and areas of circles. They could also find the total surface areas of triangular prisms and volumes of cylinders.<br>• Quite a number of students could estimate measures and give reasonable explanations.<br>• Students were weak in abstract concepts (such as using relationship of similar figures to find measures). |

| Level / Dimension | P.3 | P.6 | S.3 |
|---|---|---|---|
| **Shape and Space** | • P.3 students could recognize cones/pyramids, cylinders/prisms and spheres.<br>• P.3 students were capable of identifying different 2-D shapes.<br>• P.3 students were capable of identifying straight lines, curves, parallel lines and perpendicular lines.<br>• P.3 students could recognize right angles and compare the size of angles.<br>• P.3 students could recognize the four directions, namely north, east, south and west. | • P.6 students could recognize the characteristics of cones, pyramids, cylinders, prisms and spheres.<br>• P.6 students were capable of identifying 2-D shapes in different orientations.<br>• P.6 students could recognize the eight main directions and apply the knowledge of direction to solve problems. | • Students could not demonstrate recognition of some common terms in geometry (e.g. regular polygons, adjacent angles).<br>• Students could identify the relation between simple 3-D solids and their corresponding 2-D figures. They could also sketch simple solids.<br>• Students could deal with simple symmetry and transformation.<br>• Some students confused the reasons for congruent triangles with that for similar triangles.<br>• Students had good knowledge of the rectangular coordinate system. However, their performance was fair only when they had to find areas of simple figures.<br>• Students performed satisfactorily in solving problems by using trigonometry.<br>• Some students could not identify the angle between a line and a plane.<br>• Students performed quite well in writing proofs by using the conditions for congruent and similar triangles. When angles and lines were related, many students could not correctly provide reasons or complete the proofs. |

| Level / Dimension | P.3 | P.6 | S.3 |
|---|---|---|---|
| **Data Handling** | • P.3 students performed well at reading simple pictograms with one-to-one representation. They could answer straightforward questions by retrieving data given in the pictogram.<br>• Many students were able to interpret the data given in pictograms when answering open-ended questions.<br>• P.3 students could construct pictograms using one-to-one representation and give a suitable title.<br>• A small proportion of P.3 students mistakenly added a 'frequency axis' to a pictogram. | • P.6 students performed well at reading pictograms and bar charts, including those of greater frequency counts.<br>• P.6 students could extract the relevant information from given statistical graphs.<br>• P.6 students could construct statistical graphs from tabulated data, though a small number of them confused pictograms with bar charts or mistakenly added a 'frequency axis' to a pictogram.<br>• P.6 students were capable of finding the average of a group of data and solving simple problems of averages. | • Students recognized the basic procedures of statistical work and the data collection methods.<br>• Some students could not distinguish discrete and continuous data.<br>• Students could interpret simple statistical charts and choose appropriate diagrams / graphs to present a set of data.<br>• Some students could not construct stem-and-leaf diagrams and compare the presentations of the same set of data by using statistical charts.<br>• Some students could not identify sources of deception in misleading graphs or in cases of misuse of averages.<br>• Some students could not calculate mean from grouped data, but they performed well in the cases of ungrouped data.<br>• Students could calculate the theoretical probability by listing. However, performance in calculating the empirical probability was fair. |