Let the mind manage the body
Que l'esprit gère le corps

Mauritius Examinations Syndicate

PSAC 2018

MATHEMATICS

Subject Code: P120

Examiners' Report

April 2019

MATHEMATICS

(Subject Code: P120)

Background

The Primary School Achievement Certificate (PSAC) Assessment in Mathematics was introduced in 2017 in the context of the implementation of the Nine-Year Continuous Basic Education (NYCBE) reform. 2018 was the second year in which the PSAC was administered.

The Mathematics assessment paper serves to measure pupils' acquisition of mathematical knowledge as well as the development of understanding and mathematical skills at the end of the primary cycle.

Learners are assessed on three Assessment Objectives (AOs), namely **[1]**:

- **Knowledge and comprehension (40 %)** – questions aimed at showing learners' ability to '*recall specific mathematical facts, concepts, rules and formulae; represent simple mathematical statements or information; perform simple mathematical operations and routine procedures*'.

- **Application (40%)** – questions developed to provide learners with the opportunities to demonstrate their ability to '*identify and apply mathematical concepts, rules and formulae, skills and techniques to solve familiar problems in Mathematics*'.

- **Analysis (20%)** – questions which seek to indicate whether learners can '*break down and interpret multi-faceted information and data into their component parts; recognise and use unstated mathematical assumptions in problem solving; formulate appropriate strategies to solve non-routine problems'*.

While some questions focus mainly on knowledge and comprehension and others on application or analysis, there are some questions assessing more than one of the objectives.

In response to the need to equip learners with the necessary 21st century skills and, in line with the specifications of the *National Curriculum Framework Grades 1-6*, the Mathematics assessment paper also sets forth to reflect the extent of pupils' acquisition of the eight components of mathematical proficiency given in **Table 1** below **[2]**.

Thus, the PSAC Mathematics assessment paper can be regarded as the product of a matrix of three main interconnected elements: the learning outcomes, the assessment objectives and the components of mathematical proficiency.

Components	Learning Aims
Representation	*Use* and *interpret* illustrations of mathematical objects such as graphs, tables, pictorial and schematic diagrams.
Communication	*Read* and *interpret* mathematical statements or information; *explain*, *display* and *discuss* mathematical information.
Conceptual understanding	*Develop understanding* of operations and relations for mathematical concepts; *identify relationships* among different concepts.
Logical reasoning	*Explore* and *link* problem elements from logically embedded thought; *check a given justification* and *provide clarification*.
Procedural fluency	*Perform* mathematical operations flexibly, correctly, competently and appropriately.
Strategic thinking	*Select* or *develop* a mathematical strategy for a situation arising from a task or context.
Modelling	*Interpret mathematical items or information* in relation to the situation represented; *convert real world problem* into a mathematical problem.
Problem solving	*Experience the power and usefulness of mathematics* in everyday life; *apply appropriate skills* in solving routine and non-routine problems in a creative way.

Table 1: Components of Mathematical Proficiency

General Comments

The percentage of school candidates who achieved a numerical grade 5 or better in PSAC Mathematics in 2018 was 80.42% at first sitting, compared to 80.86% in 2017, thus showing that performances were comparable. Nevertheless, that roughly 4000 students were not able to meet the requirements of the PSAC Mathematics assessment in each of its last two editions should be a matter of concern. This examiners' report seeks to provide some guidance to educators in their teaching of certain topics in Mathematics at the upper primary level, with the idea that learning of such topics will be improved and more students will be able to succeed in the assessment in the future.

What follows is primarily based on a quantitative analysis of a sample of examination scripts and on qualitative observations made during the marking exercise. While the report serves principally to illustrate the various types of mistakes and misconceptions, all of which could leave the reader with the impression that performance in the assessment has been particularly poor, it is important to emphasise that a majority of candidates were able to show sound knowledge acquisition and understanding, and to demonstrate that learning has taken place quite satisfactorily. Where descriptive statistics are cited, it should be understood that they are based solely on the sample of scripts analysed.

Figure 1 below shows the distribution of total marks achieved in the sample, with a trendline superposed. About 20% of candidates achieved a minimum of 70 marks, with about 16% of them obtaining the best possible numerical grade 1. Roughly 30% of the candidates in the sample achieved numerical grade 6. The distribution shows two discernible peaks due to a dip in the 20-29 mark range.

In general, questions that set out to assess the learner's knowledge, understanding, recall and basic use of mathematical facts, concepts, familiar rules and simple formulae were mostly well answered by a majority of candidates. In particular, many were proficient at carrying out basic operations involving whole numbers. Many pupils also demonstrated ability in answering typical questions that required them to recall routine procedures.

Candidates' responses to Questions 8, 10, 15, 19, 22, 24, 31, 32 and 35 indicate that many of them managed to develop only a shallow understanding of basic concepts related to fractions, decimals, and operations thereon. These questions did not require high-order thinking skills. Rather, they called for learners to demonstrate their understanding of the foundations of number relations, structures and operations.

In general, candidates showed that they could recall facts, properties (of 2D- and 3D-shapes), and concepts such as perimeter and volume but struggled to apply this knowledge in given contexts as evidenced in, for example, **Questions 34** and **37**. It appears that candidates had difficulty in making important connections among the seemingly disparate sets of knowledge base they had constructed. Consequently, this hindered their ability to decide on the best approaches to go about answering some questions (**Questions 41**, **42**, **44** and **45**). A reason that could potentially explain why learners face these difficulties lies in the way they learn mathematics.

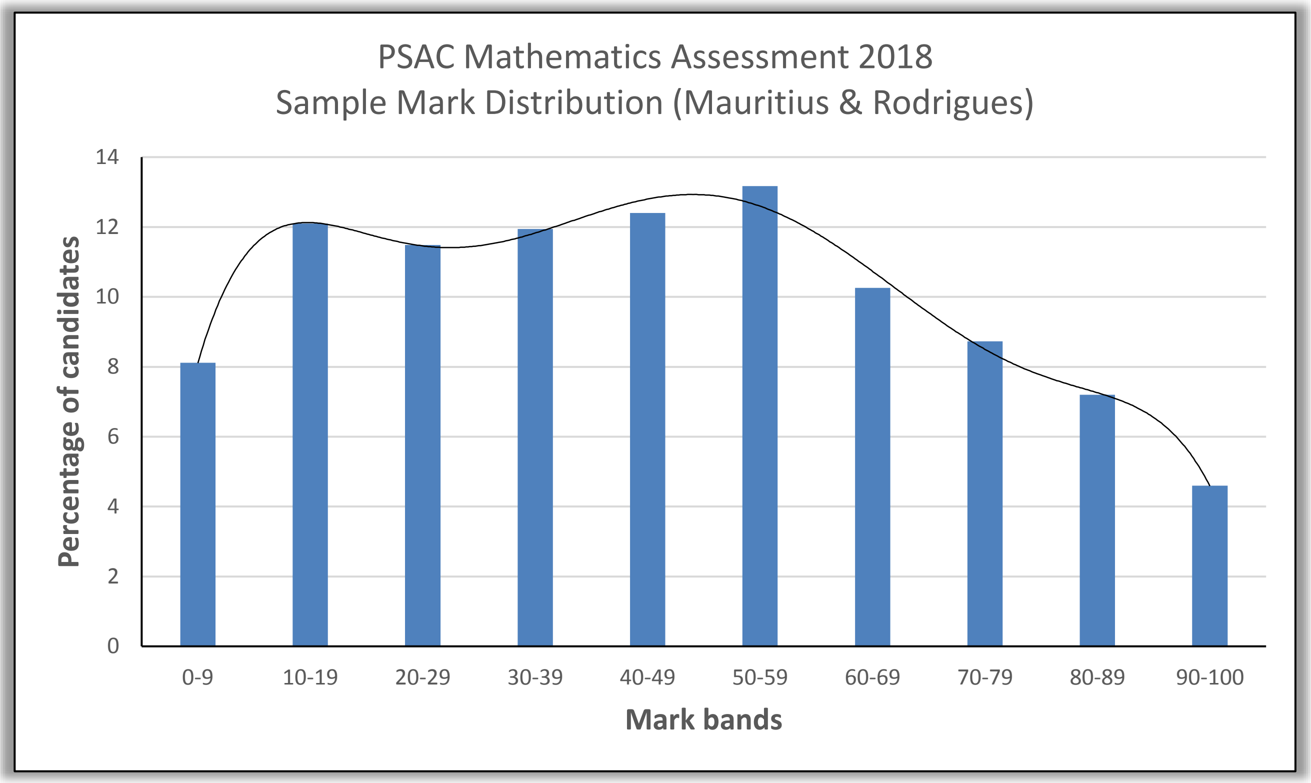


Figure 1: Sample mark distribution

Recommendations

The teaching and learning of mathematics too often happen in a linear and compartmentalised manner. This tends to lead to a reinforcement of the learner's idea that mathematical facts, rules and concepts are quite distinct from each other and even unrelated. While Mathematics can present itself as a subject where concepts fall into certain categories, it is however extremely important that learning mathematics is, to a large extent, geared away from a narrow emphasis on the acquisition of disparate skills towards a focus on deeper understanding of the relationships that exist among concepts to ensure greater success in the future.

Another absolutely key area where improvement is critical has to do with helping the learner build confidence in developing his/her own strategies to solve problems that are unfamiliar to him/her. The use of more open-ended tasks that elicit the learner's thinking and provide him/her with the opportunities to experiment with how to solve a complex task on his/her own, or explore and make general statements, is strongly encouraged. It is by engaging with various types of task that learners become familiar with concepts and develop confidence in their use. This inevitably leads the learner to better appreciate the value of acquiring mathematical knowledge, understanding, and skills.

A major weakness that still remains in general is the learner's limited competence in articulating his/her thinking in a logical manner, and putting this in writing. Too often did we note that some candidate's work was messy or incoherently expressed, which made it difficult to follow. Most of the time, this indicates a lack of conceptual understanding and procedural fluency, and a poor mastery of mathematical language leading to unsurmountable difficulties in communication. It is also felt that this prevented many candidates from developing their thinking.

It is important that pupils are taught how to move from using everyday language to making use of the mathematics register. Educators can do so "*by helping students recognise and use technical language rather than informal language when they are defining and explaining concepts; by working to develop connections between the everyday meanings of words and their mathematical meanings, especially for ambiguous terms, homonyms and similar-sounding words; and by explicitly evaluating students' ability to use technical language appropriately. One way to evaluate this ability is by having students talk about mathematics as they solve problems, encouraging them to articulate patterns and generalisations*". **[3]**

Providing a conducive environment for learners to express (either in writing or verbally) their thought processes when solving a problem in the class may be beneficial in many ways. It not only allows learners to clarify their own understanding but also helps the educator to better grasp what they know, the misconceptions they nurture, and how these might have developed (Resnick, 1988). For this reason, a key message of this report is to make ample room for learners to verbalise their mathematical understanding in class.

Comments on Specific Questions

Knowledge & Comprehension

Question 6

A number of candidates were not able to convert 5 kilograms into grams, indicating that converting units of mass remains problematic at this level. This is a mathematical concept which can rather easily be applied to common life situations and where learners can be encouraged to estimate masses of different objects, vegetables, fruits, etc.

Question 8

Candidates did not fare very well in this question, where they were asked to reduce $\frac{12}{18}$ to its lowest terms. About three out of every five candidates either did not understand what they were expected to do, or were not able to understand how to proceed to reduce the fraction.

Reducing fractions is closely linked to the concept of equivalent fractions, which is introduced at the level of Grade 5. Instead of *multiplying* the numerator and denominator of a fraction by the same number to obtain an equivalent fraction, one divides both by a common factor to obtain an equivalent fraction. Very often, a general confusion arises in understanding the concept of equivalent fractions since the learner is taught that the whole numbers (numerator and denominator) forming a fraction are related to each other, while these same numbers are treated separately when multiplying (or dividing) them by some integer (or common factor). This misunderstanding can lead to further confusion when multiplying or dividing fractions by whole numbers. It is therefore important that particular attention is given to working with fractions. Common wrong answers given by candidates were the not-fully-reduced fractions $\frac{4}{6}$ and $\frac{6}{9}$.

Question 10

Performance in this question was reasonably good. However, it is worth noting that misconceptions related to operations on fractions persist. A common mistake observed was the candidate adding the numerators and denominators independently to obtain $\frac{7}{18}$. Adding and subtracting fractions with the same denominators is introduced at Grade 4 level, and the candidate is expected to be able to demonstrate understanding of the use of this basic algorithm at the end of Grade 6.

Question 13

A significant number of candidates did not manage to find the LCM of 8 and 10. One could find the LCM either by prime-factorising the two numbers, or by identifying multiples of each number and finding the least common one. It appears that candidates still confuse HCF and LCM. It is thus important that the learner understands how the algorithms differ.

Question 15

More than half of the candidates could not identify the prime number from a list of five numbers since they most likely could not recall the definition of a prime number. It is common for pupils to think that all prime numbers are odd numbers, although they are taught that 2, an even number, is prime. Some pupils tend to think that numbers ending with 1 and 7 are very likely to be prime, since 7, 11, 17, 31, 37, 41, 47, 61, 67, 71, 97, etc. are all prime. Consequently, many ended up choosing either 21 or 27 without realising that they are multiples of 3. Educators should be wary of the above misconceptions.

Question 16

The concept of angle is introduced at the level of Grade 4, and by Grade 5, pupils are taught to distinguish between turning through multiples of a quarter turn in a clockwise or anti-clockwise direction. This was what was assessed in this question, but almost two thirds of the candidates were not able to give the direction which Tania would face after making a quarter turn clockwise from her position facing North. Many could not either understand what a quarter turn is (with some wrongly thinking that the angle between the **N** and **NE** directions is a quarter turn), or clockwise direction is.

Question 19

Candidates were required to determine the number of jugs of water needed to fill a container completely, given that the capacity of the jug is 1.25 L and that of the container is 125 L. Many chose options **A** (10) and **C** (1000). It was sufficient to note that one had to move the decimal point by two digits to the right, which meant that one had to multiply 1.25 by 100 to get 125. Mistakes here generally demonstrate partly remembered rules based around '*move the decimal point*' and '*put in some zeros*', rather than an understanding of place value with decimals.

Question 21

Roughly two out of every five students identified the correct option **D** (234°) as the reflex angle. Many low-ability candidates ended up opting for **C** (180°) as answer, and quite a few thought that 72° and 135° were reflex angles. This clearly indicates that distinguishing among types of angles (acute, obtuse and reflex) remains problematic.

Question 22

More than half of the candidates could not express the fraction $\frac{3}{20}$ as a decimal. Many low-to-average ability candidates chose options **A** (0.03) and **C** (0.30), most likely because they saw 3 as the numerator, without realising or knowing that they had to first find the fraction with denominator 100 that is equivalent to $\frac{3}{20}$ by multiplying both the numerator and the denominator by 5, that is $\frac{3}{20} = \frac{15}{100}$.

Question 24

Quite many candidates were not able to answer this basic question correctly. A significant number of below-average students chose option **C** (2 units) since 2 is the last digit of the number, without maybe noticing that the number is actually a decimal, with the decimal point between 5 and 1. This question, again, shows that Grade 5 notions of place value in decimals remain poorly understood by many learners at the end of Grade 6.

Question 29

This was a generally straightforward question requiring candidates to mention the number of faces, edges and vertices of different 3-D shapes. It was felt that the diagrams as well as the example provided would have helped candidates in answering that question. Yet, about a third of the candidates were unable to answer this question correctly. This may be due to a lack of knowledge and understanding of the mathematics register such as faces, edges and vertices. It is therefore important that educators explicitly teach the mathematics vocabulary and provide varied opportunities for pupils to communicate and make use of this vocabulary during classroom activities.

Question 31

Comparing and ordering fractions on number lines is introduced at Grade 4 level. In part (a) of this question, candidates were asked to order the fractions $\frac{1}{2}$, $\frac{1}{10}$ and $\frac{1}{3}$ between 0 and 1. About one out of every three of them only managed to do so. That the numerator was the same meant that the candidate only had to compare the denominators, and order the fractions from left to right starting with the one with the biggest denominator. Although the method is more tedious, many determined the respective equivalent fractions with denominator 30 (the LCM of 2, 3 and 10), then compared those equivalent fractions to order the original fractions. However, some students ended up filling in the boxes with those equivalent fractions, while they should have used the fractions in the list. Of those who managed to answer part (a) correctly, slightly more than half of them could actually properly explain why they decided to place the fractions in part (b). Many could not explain their thinking process and reasoning coherently in writing. Common mistakes were:

- *The smaller the fraction* [instead of '*denominator*' or '*bottom number*']*, the bigger the number/fraction*.
- $\frac{15}{30}, \frac{3}{30}, \frac{10}{30}$ [no explanation given]

Question 32

Here, candidates had to work out the division of a fraction by another: $\frac{3}{5} \div \frac{5}{8}$. Of course, the algorithm to use is to multiply the first fraction by the reciprocal of the second. Learners often misapply the *invert-and-multiply* procedure. Common mistakes that were noted were:

- Not inverting either fraction and multiplying : $\frac{3}{\cancel{5}} \times \frac{\cancel{5}}{8} = \frac{3}{8}$ or $\frac{3}{5} \times \frac{5}{8} = \frac{15}{40}$;
- Taking the reciprocal of the first fraction and multiplying : $\frac{5}{3} \times \frac{5}{8} = \frac{25}{24}$ or $1\frac{1}{24}$;
- Taking the reciprocal of both fractions and multiplying : $\frac{\cancel{5}}{3} \times \frac{8}{\cancel{5}} = \frac{8}{3}$ or $\frac{5}{3} \times \frac{8}{5} = \frac{40}{15}$;
- Cross-multiplication : $\frac{3}{5} \div \frac{5}{8} = \frac{25}{24}$.

Such errors generally reflect a lack of conceptual understanding of why the invert-and-multiply procedure produces the correct quotient. The invert-and-multiply procedure translates a multi-step calculation into a more efficient procedure.

Yet, of those candidates who used the correct reciprocal, some either:

- did the multiplication incorrectly by using the idea from adding/subtracting fractions of having common denominators and operating on the numerators only : $\frac{3}{5} \times \frac{8}{5} = \frac{24}{5}$; or

- did not replace the division sign by the multiplication sign, but still got the expected correct answer : $\frac{3}{5} \div \frac{8}{5} = \frac{24}{25}$ (mathematically incorrect working leading to a correct answer).

Questions 31 and **32** show that a good conceptual understanding and grasp of fractions appear to be lacking. Research demonstrates that pupils generally have difficulties with understanding fractions as a number and hence placing on the number line can be a challenge for many pupils. See **[4]**.

Question 35

This was the least well answered question under the '*Knowledge & Comprehension*' assessment objective. It is important to remind the reader that candidates were not expected to do any calculation here. Rather, they had to use the information that was provided and relate it to their knowledge and understanding of number operations to deduce the answers. A very similar question (Question 36) was given in the 2017 PSAC Mathematics assessment, but not much improvement, except fewer candidates attempting to perform the calculations, was seen.

35. Josh knows that

$$\boxed{385} \times \boxed{439} = \boxed{169\ 015}$$

Without doing any calculation, help Josh by writing down the missing numbers in the empty boxes below.

(a) $\boxed{169\ 015} \div \boxed{385} = \boxed{}$

(b) $\boxed{38.5} \times \boxed{4.39} = \boxed{}$

(c) $\boxed{385} \times \boxed{} = \boxed{169\ 015} - \boxed{385}$

[3]

In general, candidates found part (a) relatively easier, with the majority being able to deduce that 169 015 divided by 385 would give 439.

Part (b) was relatively less well tackled, with many recognising that the answer would be related to the number 169 015, but then not being able to figure out where the decimal point should be placed. This indicates that those candidates did not understand that multiplying or dividing a number by factors of 10 effectively moves the decimal point in that number.

Part (c) proved most challenging with very few candidates being able to relate the part question to the information given. It appears that most candidates did not actually understand, or failed to recall, what multiplication of one number by another actually means. Many lost precious time by using the method of trial and error unsuccessfully.

Educators are encouraged to make connections while teaching the different arithmetic operations, while talking about the relationships between numbers and operations. In addition, the equal sign should not be seen as an indication that a calculation is required. They can also promote the use of problem solving strategies such as making use of a smaller numbers in the first place.

Application

Question 20

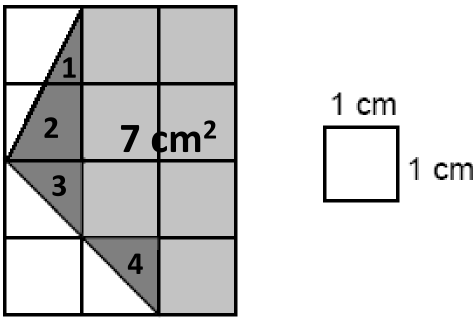
In this question, the candidate was asked to calculate the price at which a shopkeeper should sell an egg he bought at Rs 4.50 if he was to make a profit of Rs 1.75. The concepts of profit and loss are introduced quite comprehensively at Grade 5 level, with percentage profit/loss being taught in Grade 6. More than a third of the candidates did not answer this question correctly, with many choosing option **A** since they mistakenly subtracted the profit from the buying price to get the selling price. It is advised that the concepts of profit and loss be properly reviewed before students are taught how to calculate percentage profit/loss.

Question 25

This question was poorly attempted by a majority of students, with about a third managing to determine the area of the shaded region.

A significant number of low-ability candidates chose either:

- option **A** (8 cm^2), most likely because they counted the 7 squares in light grey in the picture on the left together with the area of regions 3 and 4 only; or
- option **D** (11 cm^2), possibly because they counted 7 squares and the regions 1, 2, 3 and 4 as 11 squares in total.



Question 27

The concept of common and leap years is fairly abstract. Therefore, it is generally not well understood, with the learner being introduced to it only in Grade 6. Performance in this question was poor, with many low-ability candidates choosing option **A** (2008), which is the only year from the list that has the last 2 digits (08) starting with a zero. The meaning of leap years should be taught in connection with the necessity to add an extra day to February every 4 years to cater for the roughly 6 additional hours it takes the Earth to orbit the Sun every 365 days.

Question 28

In this question, the candidate was told that 40 marbles are shared in the ratio 2 : 3, and was asked to find the number of marbles that the "smallest" [sic] share contains. As many as a quarter of mostly below-average candidates chose option **A** (8 marbles) as answer, which is actually the number of marbles in 1 share:

$$\frac{40\,marbles}{5\,shares} = 8\,marbles/share$$

The smaller share would thus contain $2 \times 8 = 16$ marbles, which is the correct option **B**, which was chosen by only about half of the candidates.

Question 30

Pupils learn how to tell time to the hour from a clockface as from Grade 3, so they are exposed to the notion of the passage of time and its measurement from a young age. Gradually, as the learner progresses to upper Grade levels, he/she is taught how to draw the minute and hour hands on the clockface to represent time (Grade 4) and how to use time notation (a.m. and p.m.) and read and write time using the 12-hour and 24-hour clocks. (Grade 6). In this question, the candidate was asked to convert the time 18 15 on the 24-hour clock to the equivalent time on the 12-hour clock, and express the time in words. Almost two thirds of the candidates, mostly from the low-ability group, did not manage to correctly answer any part of the question, with only about two out of every five pupils getting both answers right. Examples of common incorrect answers given are:

- "one/a quarter past six in the afternoon" instead of "quarter past six in the afternoon"
- "fifteen past eighteen in the afternoon" (influence from French: "*dix-huit heures quinze*")

A majority of Grade 6 students still struggle to read and convert time.

Question 34

A significant number of candidates were not able to calculate the volume of a cuboid, given its dimensions. Only about half of the candidates managed to answer part (i) correctly. A number of pupils confused the concept of volume with that of surface area, and ended up using the wrong formula to find the volume. Still others ended up wrongly doing the multiplications involved in this simple computation. Response to this question clearly revealed pupils' superficial conceptual understanding of volume.

Part (ii) was poorly attempted. An overwhelming majority of candidates did not recall the method of finding the volume of a cube. In fact, what was expected of the candidate here was for him/her to recall the multiplication table and realise that $4 \times 4 \times 4 = 64$, and that the length of the cube is thus 4 cm.

Question 36

The concept of percentage remains abstract for the vast majority of learners. A third of the candidates answered this question successfully. In general, they were mostly from the above average ability group.

Language seemed to be a major barrier to average and below-average candidates. Not being able to make out what was being asked, they randomly carried operations with the figures given in the question. This explains the lack of logical reasoning in the work presented. The most common wrong answer obtained was Rs 432 as many set out to calculate $\frac{12}{100}$ of Rs 3600, without realising that they have only calculated the increase in the price. Some candidates wrongly equated 112% with Rs 3600, and worked out $\frac{\text{Rs } 3600}{112} \times 100$ to find the new price.

Method 1	**Method 2**
$\frac{12}{100} \times \text{Rs } 3600$ = Rs 432 Rs (3600 + 432) = Rs 4032	(100 + 12)% = 112% $\frac{112}{100} \times \text{Rs } 3600$ = Rs 4032

Question 37

This was one of the least well answered questions in this assessment.

Candidates were expected to first deduce, in part (i), that the length of **BC** plus the length of **DE** was equal to the length of **AF**, that is 17 cm. Only about a quarter of the candidates answered this part correctly, while many low-ability candidates just added the two given lengths to obtain 29 cm.

37. A **rectangular** sheet of paper has length 17 cm and width 12 cm.
A square piece is cut out of the sheet of paper, and the shape below is obtained.

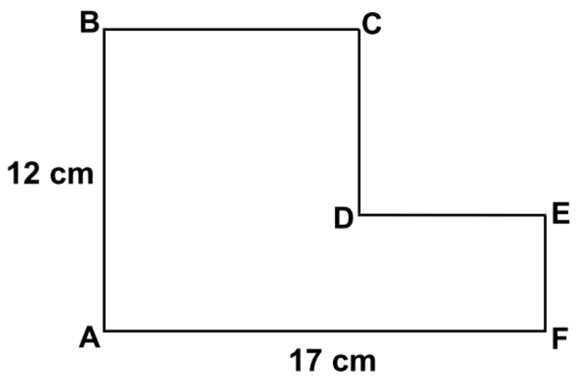


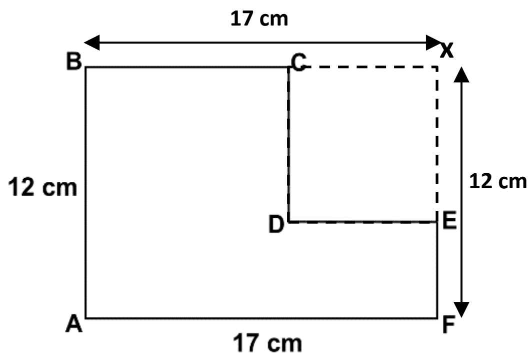
Diagram not to scale

Most of those who managed to deduce the correct length in part (i) were able to extend the reasoning to find that the length of **CD** plus the length of **EF** as being equal to 12 cm.

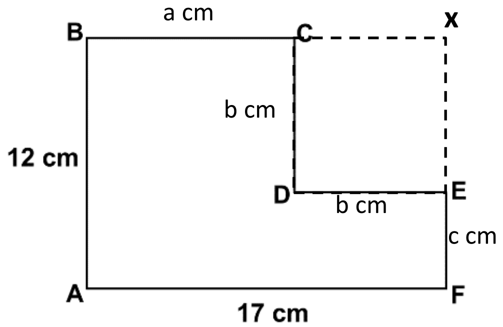
As long as **CD** and **DE** are parallel to **AB** and **AF** respectively, one could vary the lengths of **CD** and **DE,** and one would still end up with the same perimeter for the shape **ABCDEF** since (i) |**BC**| + |**DE**| = 17 cm and (ii) |**CD**| + |**EF**| = 12 cm, always. In this problem, however, it was clearly mentioned that a square piece (i.e. |**CD**| = |**DE**|) was cut out; candidates who worked out the perimeter assuming |**CD**| ≠ |**DE**| (but with relations (i) and (ii) still holding) were penalised.

So, either:

(i) the candidate extended sides **BC** and **EF** to meet at **X** so that the perimeter of shape **ABCDEF** would be obtained by adding the lengths |**AB**|+|**BX**|+|**XF**|+|**FA**| = (12 + 17 +12 +17) cm = 58 cm; or



(ii) the candidate chose |**CD**|=|**DE**|= b < 12 cm (since the removed part is a square), and let |**BC**|= (17 – b) cm = a cm and |**EF**| = (12 – b) cm = c cm.



The perimeter of shape **ABCDEF** would then be (12 + a + b + b + c + 17) cm = (12 + (17 – b) + b + b + (12 – b) + 17) cm = (12 + 17 + 12 +17) cm = 58 cm.
Both methods obviously lead to the same answer. About one of every ten candidates managed to answer part (ii) right.

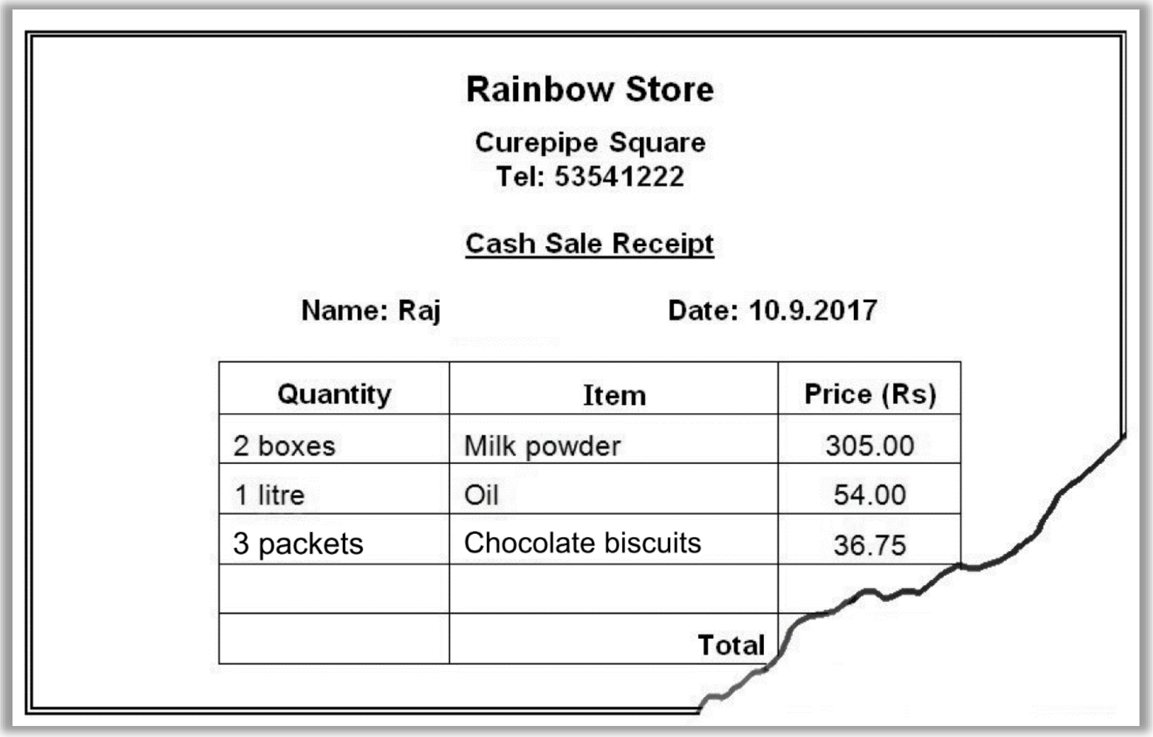
Question 38

Here, the candidate was given a graph with three vertices (**P**, **Q** and **S**) of a rhombus **PQRS** plotted. In part (a), the candidate was asked to plot point **R** and write down its coordinates. More than a third of students did not know how to plot point **R**, indicating that they either did not know the properties of a rhombus (sides of equal length, with equal opposite angles), or did not understand the instruction. On the other hand, a majority of those who managed to plot point **R** correctly were not able to read the coordinates in the right way, and wrote (8,4) instead of (4,8) for the coordinates of **R**.

In part (b), the candidate was expected to identify the two lines of symmetry of rhombus **PQRS**, locate their intersection point **T**, and write down its coordinates. Those pupils who were not able to do part (a) right would not be able to identify the two lines of symmetry (if they marked point **R** anywhere but at coordinates (4,8)), so that they would inevitably be unable to find **T**. Those students who incorrectly read the coordinates of **R** as (8,4) would give the coordinates of **T** as (5,4) instead of (4,5).
Only about a third of candidates managed to answer the whole question correctly.

Question 39

Here, the candidate was given a shopping problem. These types of questions are normally set at Grade 5 level. The pupil is meant to carefully study a torn receipt of the purchase of some items from a store, where the price given for each item is the total price for that item. This was a generally straightforward problem which is placed in a meaningful context for candidates.



Rainbow Store

Curepipe Square
Tel: 53541222

Cash Sale Receipt

Name: Raj **Date: 10.9.2017**

Quantity	Item	Price (Rs)
2 boxes	Milk powder	305.00
1 litre	Oil	54.00
3 packets	Chocolate biscuits	36.75
	Total	

In part (a), the pupil was asked to calculate the price of one packet of chocolate biscuits. A significant number of candidates were not able to understand what they were expected to do here. Many of them mistook Rs 36.75 to be the price of 1 packet of biscuits. Similarly, they took the price of 1 box of milk powder to be Rs 305.00. This indicates that candidates had difficulties in reading and interpreting the receipt. A number of pupils who understood that they had to do the division $\frac{\text{Rs } 36.75}{3}$ ended up finding the division of a decimal number by a whole number difficult. Roughly half of the candidates managed to answer this part correctly.

The candidate was then expected to calculate the total cost of all items bought by summing up the prices shown to get Rs 395.75 as correct answer. Some of the students who took the prices to be unit prices ended up adding Rs (2 × 305.00 + 54.00 + 3 × 36.75) to get a total expense of Rs 774.25. Many candidates struggled to operate on the decimal numbers, with some candidates even going so far as to ignore the 75 cents in Rs 36.75 to simplify their addition: Rs (305 + 54 + 36) = Rs 395. Others removed the decimal points in the prices before adding them up, but forgot to put the decimal point back in the answer:

$$\begin{array}{r} 305\ 00 \\ +\quad 54\ 00 \\ 36\ 75 \\ \hline 395\ 75 \\ \hline \end{array}$$

Although this was a simple problem in addition, only about two thirds of the candidates managed to do it correctly.

In part (c), the candidate was asked to calculate how much change Raj would receive if he paid his bill with a one-thousand rupee note. Some of those who obtained Rs 774.25 in part (b) wound up with Rs 225.75 as answer. In general, almost half of the candidates were not able to arrive at the correct answer here, with most finding it difficult to subtract 395.75 from 1000 mainly because there were multiple borrowings in the calculation, and "borrowing from 0" is problematic.

Question 44

About half of the candidates did not manage to score any mark in this question on distance, time and speed. A majority had difficulty in understanding the context, most likely due to language problems. The question was set in such a way as to assess the candidate's ability to break down and interpret information. The different parts of the question were related to each other, and provided a narrative which many pupils did not end up understanding.

A fairly small number of candidates answered part (i) related to speed correctly. Mistakes were mostly related to lack of recall or misuse of the formula: speed = $\frac{\text{distance}}{\text{time}}$. Some pupils converted 2 hours into 120 minutes, and calculated $\frac{24\text{ km}}{120\text{ min}}$ to end up getting an average speed of $\frac{1}{5}$ or 0.2 km/min, while they were expected to get the equivalent speed of $\frac{24\text{ km}}{12\text{ h}}$ = 12 km/h. The concept of speed is introduced at Grade 6, and it is recommended that it be introduced through proportion which may make more sense to pupils than a mere recall of formula.

In part (ii), the candidate was told that Axel spends 30 minutes in the park before running back home. Some pupils converted the 2 hours into 120 minutes and added

$$\begin{array}{rl} 09\ 25 & \\ +\ \ 1\ 20 & \longleftarrow \text{2 hours converted into minutes} \\ 30 & \\ \hline 10\ 75 & \quad \text{i.e.}\ \ 11.15\text{ a.m. (wrong answer!)} \\ \hline \end{array}$$

without realising that time 09 25 is in hours and minutes, so the conversion was not necessary, and actually led to a wrong answer.

The candidate was then asked to find the time at which Axel reaches his home given that he runs at an average speed of 10 km/h, covering the same distance, i.e. 24 km. A majority of candidates did not perform well in part (iii). Common mistakes were:

- candidates calculating the amount of time it takes Axel to reach home, and giving this as answer, without realising, because of careless reading of the question, that they were asked to find the **time** at which he reaches home.

- candidates erroneously assuming that, since Axel is running the same distance, so it would take him the same amount of time as in part (i), i.e. 2 hours, to run back.

- candidates correctly finding the time it takes Axel to run back in decimal form, i.e. 2.4 hours, but then adding the time as 2 hours 40 minutes instead of converting the 0.4 hours to 24 minutes to get:

$$\begin{array}{r} 11\ 55 \\ +\ \ 2\ 40 \\ \hline 13\ 95 \\ \hline \end{array} \quad \text{i.e. } 14\ 35 \text{ or } 2.35 \text{ p.m. (wrong answer!)}$$

- candidates correctly finding the time it takes Axel to run back, but then converting the time into minutes and adding those to the time calculated in part (ii):

$$\frac{24 \text{ km}}{10 \text{ km/h}} = 2\frac{2}{5} \text{ hours} = 144 \text{ minutes}$$

$$\begin{array}{r} 11\ 55 \\ +\ \ 1\ 44 \\ \hline 12\ 99 \\ \hline \end{array} \quad \text{i.e. } 13\ 39 \text{ or } 1.39 \text{ p.m. (wrong answer!)}$$

Some candidates first proceeded with converting 10 km/h into km/min:

$$\frac{10 \text{ km}}{60 \text{ min}} = \frac{1}{6} \text{ km/min}$$

then calculated the amount of time:

$$\frac{24 \text{ km}}{\frac{1}{6} \text{ km/min}} = 24 \times 6 = 144 \text{ minutes}$$

and then converted this time into hours and minutes to 2 hours and 24 minutes. These back-and-forth conversions are not necessary have led some candidates to make mistakes.

Analysis

Question 40

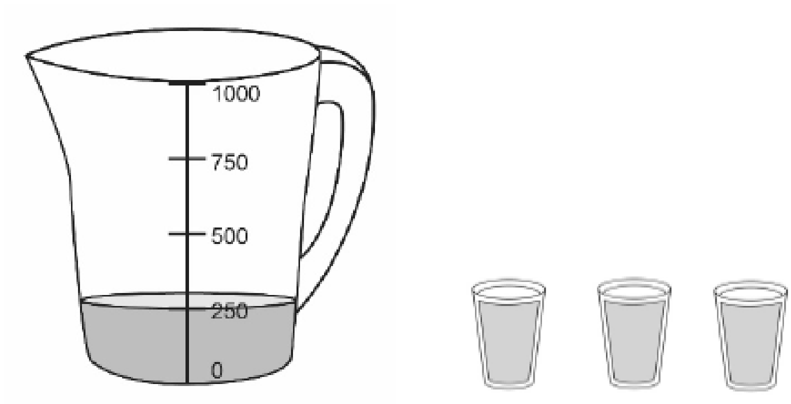
A considerable number of candidates across all ability groups found it difficult to read, break down, and make sense of the information given in this question. Diagrams of a jug of capacity 1000 mL containing 250 mL of orange juice with three glasses containing equal amounts of apple juice were provided to aid the pupil in better understanding the context and in finding the right strategy to solve the problem. However, only about a quarter of the candidates managed to answer the question correctly.

A jug has a capacity of **one litre**.

It contains 250 mL of orange juice.

480 mL of water are poured into the jug.

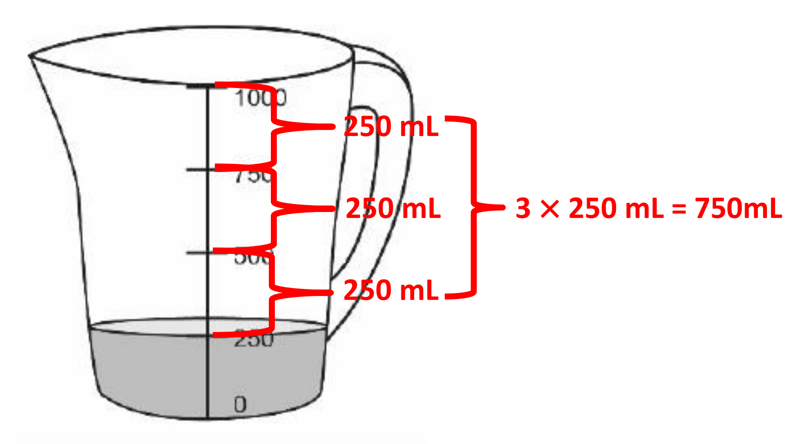
Three glasses containing equal amounts of apple juice are then poured into the jug. The jug is now full.



Most candidates managed to understand that they had to add the two volumes to get 730 mL. They were then required to convert 1 L into 1000 mL, which many were not able to recall even though converting units of volume/capacity from one to another is a Grade 5 learning outcome. From the fact that the jug was full after pouring three glasses containing equal amounts of apple juice, the candidate should have deduced that the amount of apple juice would be equal to the difference in the capacity of the jug (1000 mL) and the amount 730 mL, i.e. (1000-730) mL = 270 mL. Since this amount was contained in equal proportions in 3 glasses, then each glass would contain 270 ÷ 3 = 90 mL of apple juice. A rather common mistake was to leave 270 mL as the answer, without the candidate realising that he/she had to divide by 3.

Other equivalent ways of answering the question are as follows (**Method 1** being the one described above):

Method 2



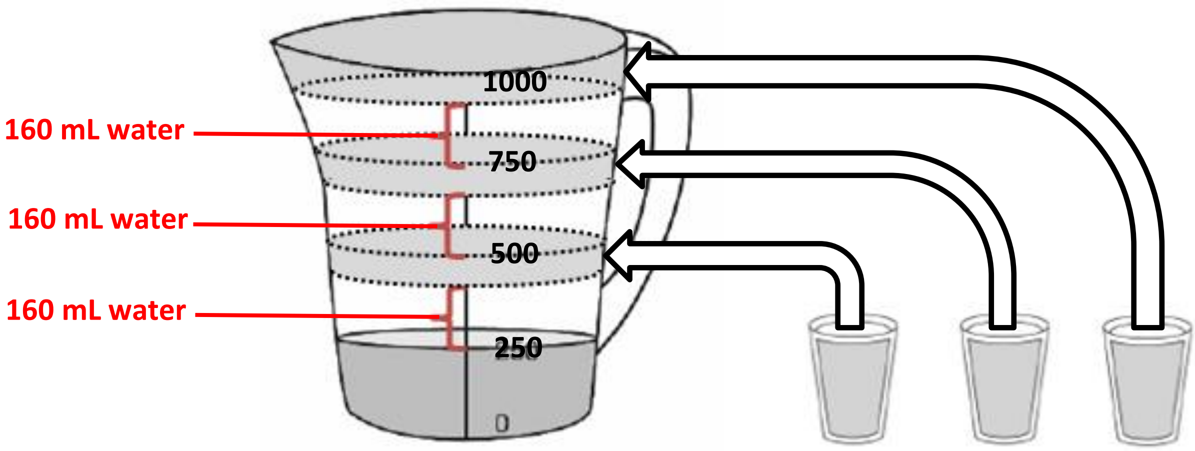
Step 1: Unoccupied volume in jug = 250 mL × 3 = 750 mL (or alternatively (1000 – 250) mL = 750 mL)

Step 2: Unoccupied volume in jug after water is poured = (750 – 480) mL = 270 mL, which is equal to volume of apple juice poured.

Step 3: Therefore, amount of apple juice contained in each glass = $\frac{270 \text{ mL}}{3}$ = 90 mL.

This method is similar to **Method 1**, but here the candidate subtracts the amounts of orange juice and water from 1000 mL separately (**steps 1** & **2**), instead of adding the amounts and then subtracting the answer from 1000 mL. A similar method involves swapping **steps 1** and **2**.

Method 3



Some of the high-ability candidates realised that **three** quarters of the jug are unoccupied, and that after pouring **three** glasses of apple juice, the jug is full. There was then a correspondence between the number of empty quarters of the jug and the number of glasses of apple juice. This meant that, when the jug is full, each of the three quarters would be filled with a glass of apple juice, and the rest of each quarter would contain water, as shown in the diagram above. The amount of water in each of the 3 quarters would then be equal to $\frac{480 \text{ mL}}{3}$ = 160 mL. Thus, in each of the 3 quarters, there would be (250-160) mL = 90 mL of apple juice, which is the amount of apple juice contained in each glass. This is actually the quickest method to arrive at the answer.

Question 41

This question assessed the ability of the candidate to read and interpret data represented on a pie chart, and solve routine word problems, which are Grade 6 learning outcomes. More than half of the candidates did not manage to score any mark here.

Barely one out of every five candidates managed to answer part (a) correctly. Here, it is given that Ben spent Rs 8 000 on Food, which is represented by a sector with angle 90° (right angle). Thus, one could easily find the total amount of money spent as follows:

$$90^\circ \text{ or } \frac{1}{4} \longrightarrow \text{Rs } 8\,000$$

$$360^\circ \text{ or } 1 \longrightarrow \frac{\text{Rs } 8\,000}{90^\circ} \times 360^\circ \quad \text{or} \quad \text{Rs } 8000 \times 4$$

$$= \text{Rs } 32\,000$$

Many did not find the first correspondence, so were unable to answer this part. A number of candidates went as far as evaluating the money spent on each item in the pie chart, and then adding them all up to find the total amount spent. This was an unnecessary and lengthy method, which sometimes proved to be error-prone as those pupils ended up leaving mistakes in their calculations.

In part (b), the candidate was told that Ben spent twice as much on Transport as on Clothing, and was asked to calculate the size of angle ***x*** representing Clothing on the pie chart. More than three-quarter of the candidates were not able to answer this question correctly, with most of them wrongly interpreting “twice as much” to mean that the size of the angle ***x*** is twice that of the angle representing Transport, hence giving the incorrect answer 36° × 2 = 72°. This erroneous interpretation keeps being an issue year in year out.

In part (c), the candidate was asked to calculate how much Ben spent on Rent, which is represented on the pie chart by a sector with angle of size 144°. The pupil could either use the answer to part (a), that is the total amount of money spent, or use the fact that Ben spent Rs 8000 on Food, that is:

either $360° \longrightarrow \text{Rs } 32\,000$ **or** $90° \longrightarrow \text{Rs } 8\,000$

$$144° \longrightarrow \frac{\text{Rs } 32\,000}{360°} \times 144° \qquad\qquad 144° \longrightarrow \frac{\text{Rs } 8\,000}{90°} \times 144°$$

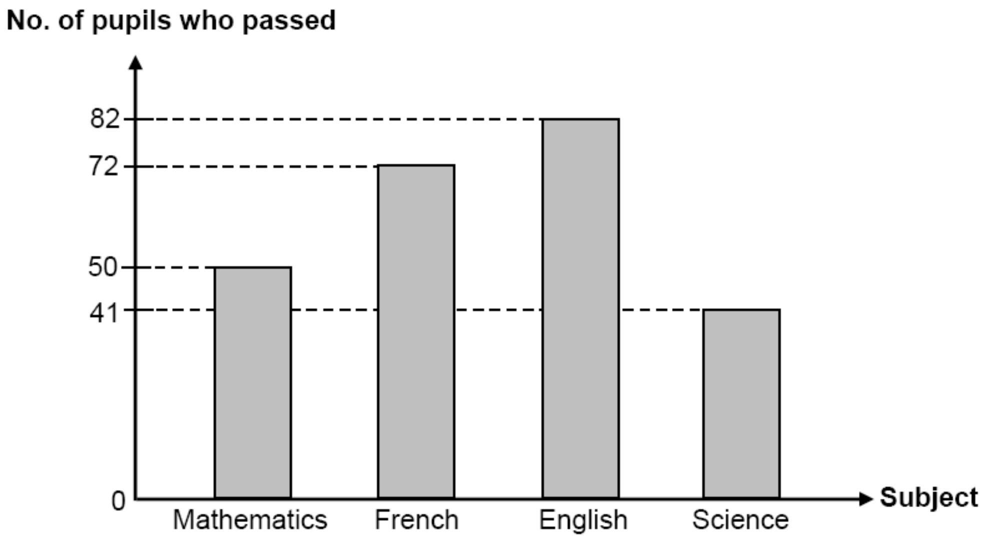
$$= \text{Rs } 12\,800 \qquad\qquad = \text{Rs } 12\,800$$

More than half of the candidates did not manage to answer this part correctly.

Question 42

This was meant to be an accessible question considering that learners are generally good at interpreting bar charts. However, performance here revealed that learners rarely encounter situations where they need to go beyond mere observation and to think more deeply about the type of information presented in a bar chart.

The bar chart below shows the number of Grade 6 pupils who passed in Mathematics, French, English and Science.

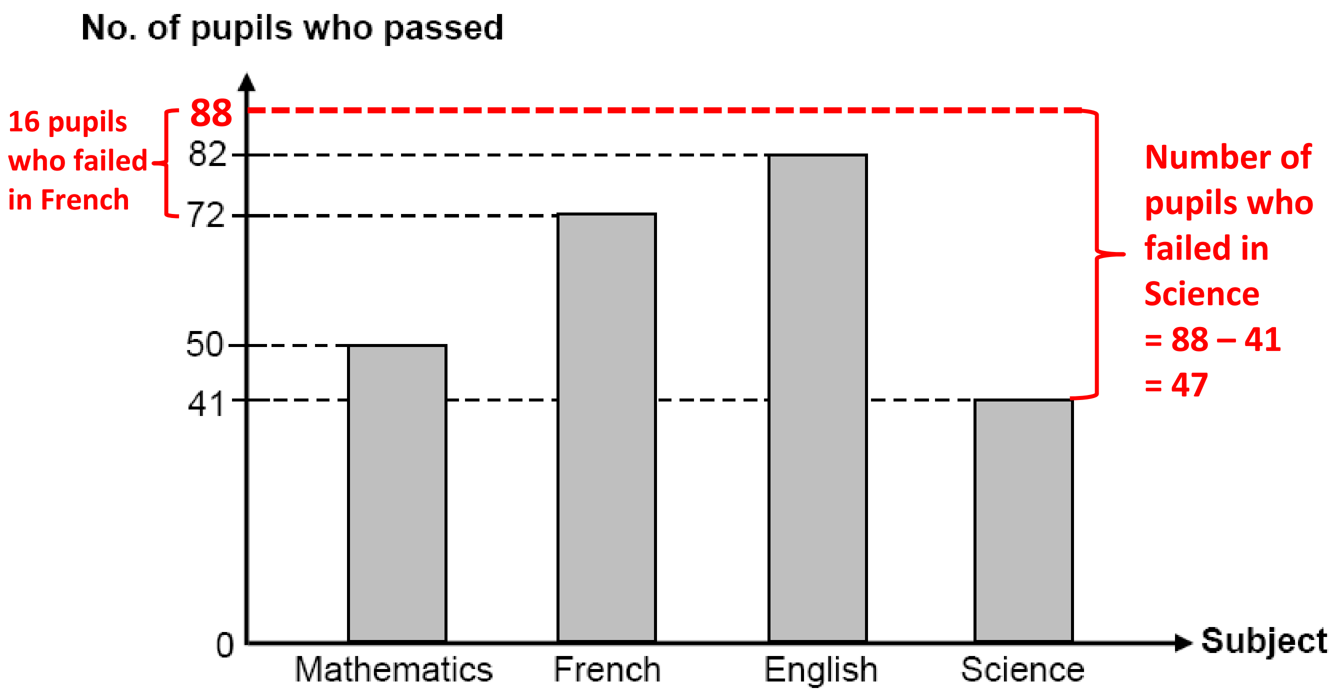


A bar chart showing the number of Grade 6 pupils who passed in Mathematics, French, English and Science was given.

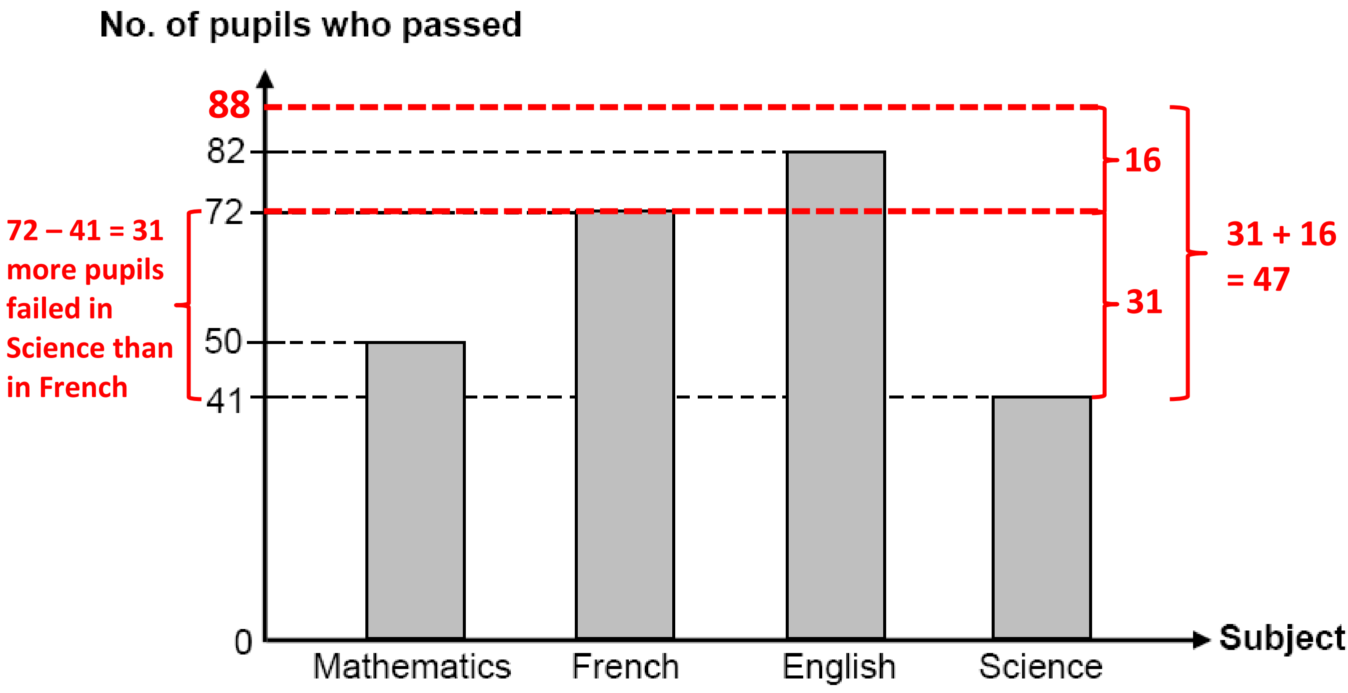
In part (a), the candidate was expected to read the bar chart to know the number of students who passed in English, then deduce in which subject half as many pupils passed. Around half of the candidates were not able to understand the question and interpret "*half the number of pupils*".

More than half of the candidates managed to figure out how many more pupils passed in French than in Mathematics in part (b). They understood that there was a subtraction involved, and knew that they had to read the number of pupils who passed in both subjects, and subtract the smaller number from the larger.

Part (c) was an unfamiliar type of question, where the candidate was expected to interpret hidden information from the bar chart. Indeed, the pupil was told that all Grade 6 pupils took part in all four examinations, that is the same number of pupils took part in each examination. So, if they were told that 16 pupils failed in French, and knowing that 72 pupils actually passed in French, then they should have deduced that 72 + 16 = 88 pupils took the French examination, as well as the other examinations. Hence, the number of pupils who failed in Science would be 88 – 41 = 47 (see below).



Another way would be, first, to find how many more pupils passed in French than in Science, or equivalently how many more pupils failed in Science than in French, i.e. 72 – 41 = 31. Then, one would simply add this to the number of pupils who failed in French to get the number of pupils who failed in Science: 31 + 16 = 47 (see below).



Only one out of every five candidates managed to answer this question correctly.

Question 43

This question was poorly attempted by candidates, with almost two thirds of them not scoring any mark. The pupil was told that soft drinks are sold in packs of 6 cans and packs of 8 cans, with a pack of 6 cans and a pack of 8 cans costing Rs 145 and Rs 197 respectively. He/she was then asked to find the lowest price at which one could buy 24 cans of soft drink.

Some candidates wrongly assumed that the cost of one can from a pack of 8 would cost less than one from a pack of 6. Thus, these candidates would simply calculate

$$\frac{\text{Rs } 197}{8} \times 24 = \text{Rs } 591$$

and give this as answer, without checking that their intuition was right or wrong by computing

$$\frac{\text{Rs } 145}{6} \times 24 = \text{Rs } 580.$$

Thus, these pupils ended up being wrong. Educators can encourage their pupils to check the reasonableness of their answer or in this case, check their intuition

Many candidates tried to evaluate the cost of one can in each pack:

$$\frac{\text{Rs } 145}{6} \quad \text{and} \quad \frac{\text{Rs } 197}{8}$$

and had difficulty in writing the answers in decimal form so that they could then multiply each by 24 to find the lowest price. The best strategy was to leave them as fractions and multiply by 24 since both 6 and 8 divide 24 exactly:

$$\frac{\text{Rs } 145}{\cancel{6}} \times \overset{4}{\cancel{24}} = \text{Rs } 580 \qquad \text{and} \qquad \frac{\text{Rs } 197}{\cancel{8}} \times \overset{3}{\cancel{24}} = \text{Rs } 591$$

Thus, the lowest price would be Rs 580.

Question 45

This was another question which assessed the candidate's ability to make sense of complex information. The challenge here was to interpret the information that each pen cost three times as much as a pencil, and make use of it. This meant that one could buy three pencils for the price of a pen. Using this information, one could either find the cost of 9 + (7 × 3) = 30 pencils then find the cost of 1 pen, or find the cost of 9 ÷ 3 + 7 = 10 pens directly.

Method 1

$$\begin{aligned} &\text{30 pencils} \longrightarrow \text{Rs } 180 \\ &\text{1 pencil} \longrightarrow \text{Rs } 180 / 30 = \text{Rs } 6 \\ &\text{1 pen} = \text{Rs } 6 \times 3 \\ &\qquad = \text{Rs } 18 \end{aligned}$$

Method 2

$$\begin{aligned} &\text{10 pens} \longrightarrow \text{Rs } 180 \\ &\text{1 pen} \longrightarrow \text{Rs } 180 / 10 = \text{Rs } 18 \end{aligned}$$

Some candidates used trial and error to find the cost of a pen. Most of those who did so started with Rs 4 as the price of a pencil:

$$\left.\begin{aligned} \text{9 pencils} &= \text{Rs } 4 \times 9 = \text{Rs } 36 \\ \text{7 pens} &= \text{Rs } 12 \times 7 = \text{Rs } 84 \end{aligned}\right\} \text{Total} = \text{Rs } 120 \neq \text{Rs } 180$$

then tried Rs 5 instead:

$$\left.\begin{array}{r}9 \text{ pencils} = \text{Rs } 5 \times 9 = \text{Rs } 45\\ 7 \text{ pens} = \text{Rs } 15 \times 7 = \text{Rs } 105\end{array}\right\} \text{Total} = \text{Rs } 150 \neq \text{Rs } 180$$

and finally tried Rs 6:

$$\left.\begin{array}{r}9 \text{ pencils} = \text{Rs } 6 \times 9 = \text{Rs } 54\\ 7 \text{ pens} = \underline{\textbf{Rs 18}} \times 7 = \text{Rs } 126\end{array}\right\} \text{Total} = \underline{\textbf{Rs 180}}$$

A common mistake was that a significant number of candidates were confused between the number and the price of the items. Many pupils wrote the following:

pencils	:	pens	
9	:	7	16
1	:	3	4

then proceeded to divide Rs 180 by 4 to get

Rs 45 : Rs 135

which meant that 9 pencils would cost Rs 45 (i.e. cost of 1 pencil = $\frac{\text{Rs } 45}{9}$ = Rs 5) and 7 pens would cost Rs 135 (i.e. cost of 1 pen = $\frac{\text{Rs } 135}{7}$ = Rs $19\frac{2}{7}$). Those pupils, however, did not check that the price of 1 pen is not actually three times that of a pencil. More than three-quarter of the candidates were not able to answer part (i) correctly.

Part (ii) was relatively straightforward once the candidate was able to find the cost of a pen in part (i).

References

[1] Mauritius Examinations Syndicate (2017). *Annual Programme for the Primary School Achievement Certificate (PSAC) Assessment 2018*.

[2] Mauritius Institute of Education (2015). *National Curriculum Framework Grades 1-6*.

[3] Adams, T. (2003). *Reading mathematics: More than words can say*. The Reading Teacher, 58 (8), 219-234.

[4] Gabriel, F., Coche, F., Szűcs, D., Carette, V., Rey, B. and Content, A. (2015). *"I hate fractions!" Children's Difficulties When Learning Fractions.*