

**AN ASSESSMENT OF NUMBER SENSE AMONG  
SECONDARY SCHOOL STUDENTS**

Parmjit Singh  
MARA University of Technology, Malaysia  
<[parmjit@tm.net.my](mailto:parmjit@tm.net.my)>

Postal address:  
Faculty of Education  
Campus Sec. 17, *University Technology MARA*  
40200 Shah Alam, Selangor  
MALAYSIA

Tel: 603-55227396  
Fax: 603-55227412

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# AN ASSESSMENT OF NUMBER SENSE AMONG SECONDARY SCHOOL STUDENTS

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MARA University of Technology, Malaysia

< [parmjit@tm.net.my](mailto:parmjit@tm.net.my) >

**Abstract.** This paper reports selected findings from a study of number sense proficiency of students aged 13 to 16 years in a state in Malaysia. A total of 1756 students, from thirteen schools in a state in Malaysia participated in this study. A majority (74.9%) of these students obtained an A grade for their respective year-end school examinations. The design for this study was quantitative in nature where the data on student's sense of numbers was collected using Number Sense Test adapted from McIntosh et. al.,(1997). The results from this study indicate that students obtained a low percentage of success rate ranging from 37.3% to 47.7% across the levels. There was no significant difference in the results between Secondary 1 students and Secondary 2 students and also between Secondary 3 students and Secondary 4 students. In terms of gender comparison, although the male students obtained a higher score than their female counterparts, this difference was only significant among the Secondary one student's. It seems that an over reliance on paper and pencil computation at the expense of intuitive understanding of numbers is taking place among these students.

## Background

Learning what numbers mean, how they may be represented, relationships among them and computations with them are central to developing number sense. Number sense refers to a person's general understanding of numbers and operations along with the ability to use this understanding in flexible ways to make mathematical judgments and to develop useful strategies for solving complex problems (Burton, 1993; Reys & Yang, 1998). Kalchman, Moss, and Case (2001) defined number sense:

*The characteristics of good number sense include: a) fluency in estimating and judging magnitude, b) ability to recognize unreasonable results, c) flexibility when mentally computing, [and] d) ability to move among different representations and to use the most appropriate representation (p. 2).*

In other words, it can be said that number sense refers to student's insight with the conceptual world of numbers which includes a sense in their ability to gauge the appropriateness of an answer and solving a problem in a meaningful and adequate manner. Researchers note that number sense develops gradually, and varies as a result of exploring numbers, visualizing them in a variety of contexts, and relating them in ways that are not limited by traditional algorithms (Howden, 1989). The NCTM Standards state that "children must understand numbers if they are to make sense of the ways numbers are used in their everyday world" (NCTM, 1989).

One recurrent component in all operational definitions of number sense is the effect of operation on numbers. Too often, children are expected to regard the numerals and symbols of mathematics merely as objects to manipulate rather than as meaningful symbols that represent ideas. For example, the following examples were cited in Parmjit (2003):  $14 - 5 = ?$  and  $400 - 1 = ?$

$$\begin{array}{r}
 \cancel{1}4 \\
 - \quad 5 \\
 \hline
 9
 \end{array}
 \qquad
 \begin{array}{r}
 3\cancel{9}\cancel{1} \\
 - \quad \quad 1 \\
 \hline
 399
 \end{array}$$

Each of these examples, in different ways, show the result of imposing strategies, emphasizing counting and memorizing without opportunity to make sense of mathematics. Conventional mathematics instruction in the elementary school has memorization and “mastery” of specific procedures or computation as goals. While some children make sense of numbers and learn to compute using procedures prescribed by the teacher, many of them fail to understand what they are doing, become frustrated, anxious and turn away from mathematics because it does not make sense to them. These students have probably not even read the entire problem before setting the pencil-and-paper rules in motion. If the students had actually read and interpreted the symbols before manipulating them, they would have easily calculated the result without wasting their pencil lead! Geary (2004) notes that using inefficient counting strategies is a key indicator of which students are likely to have difficulty learning mathematics.

Another common component in all operational definitions of number sense is the equivalent forms of expression. In representing  $2/5$  in terms of various given representations, students should understand not only that  $2/5$ ,  $40/100$ ,  $0.4$  and  $40$  percent are all representations of the same number but also that these representations may not be equally suitable to use in a particular context. For example, it is typical to represent a sales discount as  $40\%$ , the probability of winning a game as  $2/5$  or a fraction of a Ringgit Malaysia in writing a cheque as  $40/100$ . Students should also have had experience in comparing fractions between  $0$  and  $1$  in relation to such benchmarks as  $0$ ,  $1/4$ ,  $1/2$ ,  $3/4$ , and  $1$ . In the lower secondary, students should build on and extend this experience to become facile in using fractions, decimals, and percents meaningfully.

Students who usually take a mechanical approach to the symbols rarely try to make sense of the symbols and the operations of mathematics and eventually do not recognize when to apply the algorithm in solving a problem. I believe that students who merely manipulate numbers via algorithm have not learned mathematics. This was further pointed out by Pirie (1988) who said:

*An algorithm is not itself knowledge, it is a tool whose use is directed by mathematical knowledge and care must be taken not to confuse evidence of understanding with understanding itself* (p. 4)

Studies have shown that students who score well on standardized tests often are unable to successfully use memorized facts and formulae in real-life application outside the classroom (Parmjit, 2000; Parmjit 2002; Yager, 1991). Resnick (1987) has commented that practical knowledge (common sense) and school knowledge are becoming mutually exclusive. This was echoed by Steffee (1994):

*The current notion of school mathematics is based almost exclusively*

*on formal mathematical procedures and concepts that, of their nature, are very remote from the conceptual world of the children who are to learn them (p. 5).*

In Malaysian school climate, children's natural thinking "becomes gradually replaced by attempts at rote learning, with a disaster as a result" as indicated by Parmjit (2002) that the grades obtained in the national examination for mathematics do not indicate their mathematical knowledge. For many children, school mathematics seems to be an endless sequence of memorizing and forgetting facts and procedures that make little sense to them. I strongly believe that making sense of numbers is the cornerstone for the learning of mathematics. So, the question to be pursued: is number sense taught or caught in students mathematics learning? According to Thorton & Tucker (1989) "number sense develops over time and the development is best if the focus is consistent, day by day, and occurs frequently within each mathematics lesson" (p. 21). This was similarly echoed by Van de Walle and Watkins (1993) when they said that number sense is more of a way of teaching than a topic to be taught. The researcher believes that understanding numbers becomes more essential especially when they proceed to secondary school and the question that arises is that, "Have Malaysian school students mastered number sense well enough so as to be able to grasp the content of secondary school syllabus as vision in national curriculum?".

The second part of this study was to explore gender differences in the Number Sense Test. This exploration process was taken as this issue of gender differences in mathematics learning are still a source of concern for many mathematics educators (Isiksal & Cakiroglu, 2008; Ercikan, McCreith, & Lapointe, 2005; Awang & Ismail, 2003; Alkhateeb' 2001; Leder, 1992). Various studies have indicated that males tend to outperform their female counterpart in standardized tests of mathematics (Gallagher and Kaufman, 2005; Cleary, 1992) whereas recent studies has indicated that either there is no difference or female tend to outperform their male counterparts (Isiksal & Cakiroglu, 2008; Hyde and Linn, 2006; Ma, 2004; Awang & Ismail, 2003; Alkhateeb, 2001). The rationale for this exploration is that issues of gender differences are a phenomenon that rarely garnered attention in the Malaysian context as compared to the western counterparts.

### **Objective of Study**

The improvement of mathematics education for all students requires effective mathematics teaching in all classrooms. Assessing students' understanding of numbers, ways of representing numbers, relationships among numbers, and number systems are focus areas for this research. Determining what experience might be important to foster this understanding requires a thorough analysis of a student's number sense in various mathematical strands. The objective of this study is to:

1. Assess students' achievement in the Number Sense test across levels and in the strands of: a) number concepts b) multiple representation c) effect of operations d) equivalent expression e) counting and computation

- Analyze if there is difference between male and female students achievement in the Number Sense Test?

### **Research Methodology**

The methodology that was utilized in this study encompassed the quantitative method where the data provided a bearing on how students respond to a given set of problem tasks in Number Sense.

*Subjects.* The subjects for this study comprised 1756 students from the levels of Form One, Form Two, Form Three and Form Four (ages ranged from 13 to 16 years old) from 13 schools in a state in Malaysia. The students selected were from the top two classes for each of these levels. The compositions of the samples are shown in table 1.

Table 1: Demographics of respondents by grade level and gender

| <b>Gender</b> | <b>Form1</b>   | <b>Form 2</b>  | <b>Form 3</b>  | <b>Form 4</b>  | <b>Total</b> |
|---------------|----------------|----------------|----------------|----------------|--------------|
| Male          | 200            | 211            | 105            | 107            | 623 (35.5%)  |
| Female        | 356            | 377            | 144            | 256            | 1133 (64.5)  |
| Total         | 556<br>(31.7%) | 588<br>(33.5%) | 249<br>(14.2%) | 363<br>(20.7%) | 1756         |

The compositions of the samples are 31.7 % in Form 1, 33.5% in Form 2, 14.2% in Form 3 and 20.7% in Form 4. From this total, 35.5% of them are male students as compared to 64.5 % as female.

Table 2 indicates the Math grades obtained in their respective school year-end examination.

Table 2. Demographics of respondents by examination grades

| <b>Grade</b> | <b>Frequency</b> | <b>Percent</b> |
|--------------|------------------|----------------|
| A            | 1243             | 70.8           |
| B            | 340              | 19.4           |
| C            | 74               | 4.2            |
| D            | 3                | .2             |
| Missing      | 96               | 5.5            |
| Total        | 1756             | 100.0          |

From these samples (1660 as 96 were indicates as missing data) majority (74.9%) obtained an A grade for their respective year-end examinations. This was followed by 20.5%, 4.5% and 0.2% respectively for grades B, C and D. In other words, approximately 90% of the total samples were above average students in mathematics based on these year-end examination results.

*Instrument and Administration of the Instrument.* All students were given a 50-item paper and pencil test on number sense. The test items were adapted from a number sense test

published by McIntosh (McIntosh et al., 1997), which comprised of five number sense strands in their framework, as shown in table 3.

Table 3. Items according to the strands

| <b>Strand</b>               | <b>No. of Items</b> |
|-----------------------------|---------------------|
| 1: Number Concepts          | 14                  |
| 2: Multiple representation  | 7                   |
| 3: Effect of operations     | 10                  |
| 4: Equivalent Expression    | 8                   |
| 5: Counting and Computation | 11                  |
| <b>Total</b>                | <b>50</b>           |

From the pilot study, glaring weaknesses in the methodology that was to be applied for this research was noted, based on the methodology used by McIntosh et. al (1997). Firstly, it was noted that the time allocated for each item in the number sense (45 seconds) was too long for each student. They had time to do the working for each item. Secondly, as the students were told to proceed to the following question after the 45 seconds allocated for each item, they were still busy doing the computation of the previous item. This was because the items were in the worksheet and they did not heed the instruction of the researchers. These episodes were against the purpose of this study, which was to comprehend students' mental prowess rather than their written computation. These pitfalls were acknowledged and the following actions were taken to overcome these shortcomings.

- a) Each item was allocated 30 seconds
- b) Students were provided with a worksheet providing the multiple-choice responses without the questions. The questions were displayed using an Over Head Projector (OHP) and after 30 seconds, the following question was posed and students did not have the luxury of working (doing computation) on the previous item.

### **Analysis and Results**

The following sections detail the findings of students' performance based on the Number Sense test.

#### **Analysis of Number Sense Test across Levels**

On each of the test items in the Number Sense test, a score of one is given for a correct answer while a zero score is awarded for an incorrect answer. As such, the total score for each of the Strands 1, 2, 3, 4 and 5 are 14, 7, 10, 8 and 11 respectively. Hence, the total score for the Number Sense test is 50. Table 4 shows that the mean score on the test increases with age (and grade level). The percentage of correct responses for the Number Sense Test is less than 50% across all levels. The lowest percentage of average score on this test is 37.3% (Form 1) and the highest is 47.7% (Form 4) which means that these students' received a score of less than 50% achievement in the Number Sense Test. The highest increase (8.1%) in the percentage of correct responses is in the transition from Form 2 (38.6%) to Form 3 (46.7%). This score was also similarly represented in the

Table 4: Descriptive Statistics for Number Sense Test by Grade Levels

| Level  | N   | Mean<br>(Max. 50) | Percentage<br>Correct | Std.<br>Deviation |
|--------|-----|-------------------|-----------------------|-------------------|
| Form 1 | 556 | 18.65             | 37.3%                 | 6.01              |
| Form 2 | 588 | 19.32             | 38.6%                 | 7.06              |
| Form 3 | 249 | 23.37             | 46.7%                 | 6.16              |
| Form 4 | 363 | 23.83             | 47.7%                 | 6.58              |

mean score where the Form 4 students obtained the highest mean (23.83) followed by the Form 3 (23.37), Form 2 (19.32) and Form 1 (18.65) students respectively.

### Difference in Mean Score for Number Sense Test

A review of Table 4 showed that there was a difference in the mean score between levels in the Number Sense test. In order to analyze whether the mean difference was statistically significant, an F test was done as shown in table 5.

Table 5. Comparison of Means between Levels in Number Sense Test

|                | Sum of<br>Squares | df   | Mean Square | F      | Sig.  |
|----------------|-------------------|------|-------------|--------|-------|
| Between Groups | 8789.608          | 3    | 2929.869    | 69.034 | 0.000 |
| Within Groups  | 74356.399         | 1752 | 42.441      |        |       |
| Total          | 83146.007         | 1755 |             |        |       |

The F test to compare mean scores on the Number Sense test between levels indicates a significant difference with an F-value of 69.034 (p-value 0.000) as shown in table 5.

Multiple comparisons using Scheffe's multiple comparisons tests as shown in table 6, indicates that there is a significant difference in mean scores on the Number Sense Test at the 0.05 level between students of all forms except between Form 1 and Form 2 students as well as between Form 3 and Form 4 students.

Table 6. Multiple Comparisons of Means between Levels on Number Sense

| Dependent Variable | Form (I) | Form (J) | Mean Difference<br>(I - J) | Std. Error | Sig.  |
|--------------------|----------|----------|----------------------------|------------|-------|
| Number Sense Test  | 1        | 2        | -0.666                     | 0.385      | 0.084 |
|                    |          | 3        | -4.720*                    | 0.497      | 0.000 |
|                    |          | 4        | -5.184*                    | 0.440      | 0.000 |
|                    | 2        | 1        | 0.666                      | 0.385      | 0.084 |
|                    |          | 3        | -4.054*                    | 0.493      | 0.000 |
|                    |          | 4        | -4.518*                    | 0.435      | 0.000 |
|                    | 3        | 1        | 4.720*                     | 0.497      | 0.000 |
|                    |          | 2        | 4.054*                     | 0.493      | 0.000 |
|                    |          | 4        | -0.464                     | 0.536      | 0.387 |

## Descriptive Analysis for Number Sense Strands across Levels

The followings section details an analysis of students responses across the five strands utilized in the Number Sense Test. Strand 1 – Number Concepts; Strand 2 - Multiple Representations; Strand 3 - Effect of Operations; Strand 4 - Equivalent Expression Strand 5 - Counting and Computation. The items in the test were analyzed, with respect to each strand, to find the percentages of correct responses for the items across levels.

### Strand 1 – Number Concepts

Strand 1 which deals with making sense of number concepts posed great difficulty to students as indicated with the average low percentage score shown (31.6%) in table 7. All the items in this strand posed great difficulty for all levels in terms of its low average percentage score except for item 4 (80.2%) and item 29 (65.5%).

Table 7. Item analysis for Strand 1 across Levels

|                 | Item    | % Correct |       |       |       |         |
|-----------------|---------|-----------|-------|-------|-------|---------|
|                 |         | Form1     | Form2 | Form3 | Form4 | Average |
| <b>Strand 1</b> | 1       | 25.7      | 27.4  | 31.3  | 25.1  | 27.4    |
|                 | 3       | 7.0       | 10.2  | 28.1  | 22.6  | 17.0    |
|                 | 4       | 73.7      | 74.7  | 83.1  | 89.3  | 80.2    |
|                 | 6       | 3.8       | 6.5   | 8.0   | 12.9  | 7.8     |
|                 | 9       | 6.8       | 3.9   | 20.5  | 6.9   | 9.5     |
|                 | 10      | 8.8       | 11.1  | 31.7  | 25.3  | 19.2    |
|                 | 15      | 16.2      | 18.7  | 16.9  | 19.3  | 17.8    |
|                 | 18      | 24.8      | 31.8  | 33.7  | 27.5  | 29.5    |
|                 | 19      | 11.5      | 14.5  | 20.9  | 18.2  | 16.3    |
|                 | 22      | 42.4      | 45.1  | 43.4  | 48.8  | 44.9    |
|                 | 25      | 29.0      | 29.3  | 34.9  | 52.3  | 36.4    |
|                 | 29      | 69.1      | 63.1  | 65.1  | 64.5  | 65.5    |
|                 | 36      | 28.4      | 28.7  | 34.9  | 54.5  | 36.6    |
|                 | 39      | 25.2      | 26.9  | 44.6  | 41.6  | 34.6    |
|                 | Average | 26.6%     | 28.0% | 35.5% | 36.3% | 31.6%   |

In comparing the responses of items between Form 3 and Form 4 students, the percentage of correct answers for item 1, item 3, item 9, item 10, item 18, item 19, item 29 and item 39 for Form 4 students is surprisingly lower than the percentage score obtained by the Form 3 students. This trend was also prevalent in item 9 and item 29 between Form 1 and Form 2 students. One would have expected the reverse given the maturity level as one moves up the ladder from one level to another. Several examples are given to investigate the source of difficulty for the respective items that posed problems to students

Item 6: How many fractions are there between  $\frac{2}{5}$  and  $\frac{3}{5}$ ? For this item, it seems that the majority of the students do not understand the densely packed nature of rational numbers. It seems to indicate from the worksheet that most of the students believed there was no fraction between  $\frac{2}{5}$  and  $\frac{3}{5}$ . Similarly for item 3 (How many decimal fraction numbers are there between 1.52 and 1.53?), approximately 75% - 90% (across levels) of the students faced difficulty in understating the nature of number concepts in decimal.

Based on the work sheet responses, students reasoning seemed to indicate that there were no decimal fractions between 1.52 and 1.53.

In item 36, (on the placement of the decimal point for the sum of  $715.347 + 589.2 + 4.553$ ) the percentage of correct answers was less than 40% for all levels except for Form 4 (54.5%). From their worksheet responses, it was noticed that more than half of the students who answered it correctly actually worked out the sum, and then placed the decimal point correctly, without using estimation. The over reliance on algorithm and rules was evident, with little or no reliance on estimation and making sense.

## Strand 2 - Multiple Representations

Table 8 gives the item analysis for strand 2 (Multiple Representation) across levels. It shows that more than 50% of the students gave correct responses for items 7, 30 and 31 across all levels whereas less than 25% obtained correct responses for item 13 and item 40. At a glance, there is not much difference in the percentage of correct responses for items 8, 13, 14 and 40 among the four levels. If we analyze the average percentage score, it shows that it increases with age. However surprisingly, there is a slight drop in the percentage score from 47.8 to 47.5 as student's transit from Form 3 to Form 4.

Table 8. Item analysis for Strand 2 across Levels

| Item            | % Correct |       |       |       |         |
|-----------------|-----------|-------|-------|-------|---------|
|                 | Form1     | Form2 | Form3 | Form4 | Average |
| <b>Strand 2</b> |           |       |       |       |         |
| 7               | 68.5      | 63.6  | 77.9  | 73.6  | 70.9    |
| 8               | 29.3      | 27.4  | 26.5  | 23.4  | 26.7    |
| 13              | 13.3      | 16.7  | 24.5  | 11.6  | 16.5    |
| 14              | 30.4      | 32.1  | 37.3  | 39.9  | 34.9    |
| 30              | 68.5      | 70.4  | 74.7  | 85.4  | 74.8    |
| 31              | 62.1      | 67.9  | 69.1  | 84.6  | 70.9    |
| 40              | 11.9      | 8.0   | 24.5  | 13.8  | 14.6    |
| Average         | 40.6%     | 40.9% | 47.8% | 47.5% | 44.2%   |

Generally, we can deduce that students performed better in strand 2 as compared to strand 1. Several examples are appended to investigate the source of difficulty for the respective items that posed problems to students.

For example in item 13 as shown in figure 1, students were asked: Which letter in the number line shows a fraction where the numerator is slightly more than the denominator? It was graded based on correct or incorrect responses. The percentages of correct responses across levels are summarized in table 9. The percentage range from 11.6% to 16.7% with an average score of 15.7%. Surprisingly, Form 4 students score was the lowest as compared with the other levels.

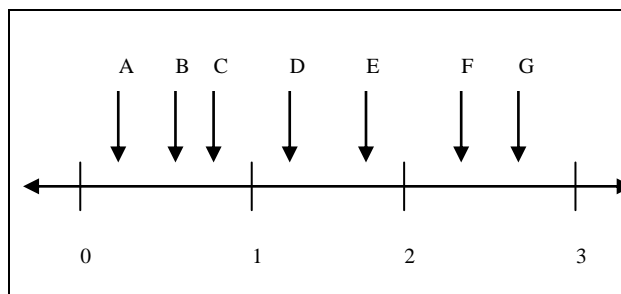


Figure 1

Table 9. Percentage of correct responses across levels for Item 13

|                                 | Form 1 | Form 2 | Form 3 | Form 4 | Overall |
|---------------------------------|--------|--------|--------|--------|---------|
| Percentage of correct responses | 13.3   | 16.7   | 24.5   | 11.6   | 15.7    |

This seems to indicate that students faced difficulty in determining the value of a fraction based on numerator and denominator values and determining it on a line graph.

Item 40: Arrange the following numbers in ascending order.  $0.595$  ;  $3/5$  ;  $61\%$  ;  $0.3$  ;  $30.5\%$ . Table 11 shows percentage of correct responses.

Table 10. Percentage of correct responses across levels for Item 40

|                                 | Form 1 | Form 2 | Form 3 | Form 4 | Overall |
|---------------------------------|--------|--------|--------|--------|---------|
| Percentage of correct responses | 11.9   | 8      | 24.5   | 13.8   | 12.8    |

This item was graded based on correct and incorrect responses. The percentage of correct responses range from a low of 8% to 24.5% with an average percentage score of 12.8%. Form 2 students obtained the lowest correct percentage (8%), followed by Form 1 (11.9%), Form 4 (13.8%) and Form 3 (24.5%). There is also a decline among form 2 students performance as compared to form 1 students and this was also prevalent between the from 3 and form 4 students where the former had a lower score compared to the latter. Based on the overall percentage of correct responses in strand 2, this item seems to be the most difficult for these students. They were not able to differentiate a fraction to a decimal and percentage, which is the essence in multiple representations of numbers. One can conclude from this strand that these students faced great difficulty in representing numbers into different representations.

### Strand 3 - Effect of Operations

Table 11 shows the item analysis for strand 3 (Effect of Operations) across levels. Generally, students performed much better in strand 3 as compared to the former two strands. In this strand, student's correct responses ranged from 43.1% to 55.8% across levels with an average percentage of 48.7%.

Items with an average percentage score of less than 50% is in item 16, 20, 21, 27, 28 and 49. For items 16, 20, 27, 28, 38, 48 and 49, the difference in the percentage of correct

answers between Form 1 and Form 2 students was less than 3%. In contrast, the difference in the percentage of correct responses for items 16, 17, 24, 27, 38, 48 and 49 between Form 3 students and Form 4 students was less than 7%. There was also a similar trend as in strand 2 where form 2 students percentage score (43.1%) was lower as compared to form one students (44.7%).

Table 11 : Item analysis for Strand 3 across Levels

|                 | Item    | % Correct |       |       |       | Average |
|-----------------|---------|-----------|-------|-------|-------|---------|
|                 |         | Form1     | Form2 | Form3 | Form4 |         |
| <b>Strand 3</b> | 16      | 38.8      | 39.6  | 54.2  | 58.4  | 47.8    |
|                 | 17      | 55.6      | 50.3  | 58.2  | 60.1  | 56.1    |
|                 | 20      | 38.7      | 35.4  | 49.0  | 58.1  | 45.3    |
|                 | 21      | 14.4      | 19.9  | 27.8  | 44.4  | 26.6    |
|                 | 24      | 49.8      | 57.5  | 60.6  | 63.4  | 57.8    |
|                 | 27      | 26.3      | 26.7  | 35.3  | 31.7  | 30.0    |
|                 | 28      | 25.4      | 28.2  | 36.9  | 49.3  | 35.0    |
|                 | 38      | 79.3      | 78.4  | 84.7  | 90.9  | 83.3    |
|                 | 48      | 47.8      | 50.7  | 58.2  | 59.2  | 54.0    |
|                 | 49      | 42.4      | 44.6  | 48.2  | 42.4  | 44.4    |
|                 | Average | 44.7      | 43.1  | 51.3  | 55.8  | 48.7    |

Several examples are exemplified to investigate the source of difficulty for the respective items that posed problems to students.

Item 21. Without calculating the exact answer, circle the best estimate for:

$$54 \div 0.09$$

- A. A lot less than 54                      B. A little less than 54.  
 C. A little more than 54.                D. Very much more than 54.

The correct answer to this item is D. The data in table 12 shows that the percent of correct responses were 14.4%, 19.9%, 27.8% and 44.4% for Form 1, Form 2, Form 3 and Form 4 students. Choice A seems to be the item distractor as the majority of students (44.2%, 46.7%, 36.7% and 33.1% respectively) responded by giving A as the answer.

Table 12. Percentage of correct responses across levels for Item 21

| Item 21 | Form 1      | Form 2      | Form 3      | Form4       |
|---------|-------------|-------------|-------------|-------------|
| A       | <b>44.2</b> | <b>46.7</b> | <b>36.7</b> | 33.1        |
| B       | 28.9        | 22.5        | 21.4        | 12.8        |
| C       | 12.4        | 10.8        | 14.1        | 9.7         |
| D       | 14.4        | 19.9        | 27.8        | <b>44.4</b> |

Item 28: Without calculating the exact answer, circle the best estimate for  $29 \div 0.8$

- A. Less than 29                              B. Equal to 29  
 C. More than 29                              D. Impossible to tell without calculating

The correct response for this item is C. However, as found in item 21, students seem to face difficulty when posed with problems that have a divisor less than 1. Majority of the students across forms responded by giving A as the answer. As table 13 shows, an alarming 61.1%, 56.8%, 51% and 46% of Form 1, Form 2, Form 3 and Form 4 students respectively gave A as the answer. In comparing with lower (Form 1 and Form 2) and upper secondary (Form 3 and Form 4), a high 59% and 48.5% of these levels respectively responded A as the answer.

Table 13. Percentage of correct responses across levels for Item 28

| Item 28 | Form 1      | Form 2      | Form 3    | Form4     |
|---------|-------------|-------------|-----------|-----------|
| A       | <b>61.1</b> | <b>56.8</b> | <b>51</b> | <b>46</b> |
| B       | 3.3         | 2.8         | 5.6       | 1.9       |
| C       | 26          | 28.8        | 36.9      | 49.6      |
| D       | 9           | 11.6        | 6.4       | 2.5       |

Item 16: Circle the correct estimate for  $29 \times 0.98$

A. More than 29    B. Less than 29    C. Impossible to estimate without computing

Item 20: Circle the correct estimate for  $87 \times 0.09$

A. Very much less than 87                      B. Slightly less than 87  
 C. Slightly more than 87                        D. Very much more than 87

Choosing the correct answer to items 16, 20, 21 and 28 without calculating, requires an understanding of the numbers involved and the effect of the operations of multiplication or division on these numbers. Answers to items 16 and 20, seemed to indicate the common misconception that multiplication results in a larger number. Similarly, item 21 and 28 also indicate the common misconceptions that division results in a smaller number. If given enough time, most students would have been able to compute these items correctly.

#### Strand 4 - Equivalent Expression

Table 14 indicates that student's percentage of correct responses range from 44.7% to 69.2% across levels in strand 4 (Equivalent Expression). As shown in the table it was evident that students of all levels find difficulty in answering items 11, 23, 26, 33 and 34 as the percentage of correct responses was less than 50%.

The trend of lower levels outperforming the higher level was prevalent in item 23 (form 1 & 2 and form 3 & 4), item 32 (form 1 & 2), item 33 (form 1 & 2), item 34 (form 3 & 4), and item 42 (form 1 & 2 and form 3 & 4).

Table 14. Item analysis for Strand 4 across Levels

| Item            | % Correct |       |       |       |         |      |
|-----------------|-----------|-------|-------|-------|---------|------|
|                 | Form1     | Form2 | Form3 | Form4 | Average |      |
| <b>Strand 4</b> | 11        | 33.1  | 35.9  | 35.7  | 39.4    | 36.0 |
|                 | 23        | 38.7  | 38.6  | 50.2  | 50.1    | 44.4 |
|                 | 26        | 32.2  | 36.2  | 47.8  | 52.9    | 42.3 |

|         |      |      |      |      |      |
|---------|------|------|------|------|------|
| 32      | 84.2 | 73.3 | 83.5 | 83.5 | 81.1 |
| 33      | 17.6 | 15.3 | 27.7 | 47.9 | 27.1 |
| 34      | 36.9 | 42.3 | 50.6 | 32.8 | 40.7 |
| 37      | 67.3 | 68.9 | 65.9 | 71.6 | 68.4 |
| 42      | 75.0 | 70.7 | 83.5 | 77.7 | 69.2 |
| 45      | 47.8 | 50.3 | 52.2 | 52.6 | 50.7 |
| Average | 44.7 | 45.1 | 51.7 | 69.2 | 52.7 |

The following examples are given to exemplify student's low proficiency of number sense in equivalent expressions.

Item 33. Circle the number, which can be put in both boxes to make this sentence true.

$$243 \times \square = \square \times 24.3$$

- A. 0            B. 0.1            C. 1            D. 10

The answer to this question is A. Students correct percentage responses for the respective forms were 17.6%, 15.3%, 27.7% and 47.9%. Surprisingly, approximately 50% of the students from the respective levels (except Form 4) chose B as the answer, as indicated in table 15.

Table 15. Percentage of correct responses across levels for Item 33

| Item 33 | Form 1      | Form 2      | Form 3      | Form4     |
|---------|-------------|-------------|-------------|-----------|
| A       | 18.3        | 15.7        | 28.5        | <b>49</b> |
| B       | <b>53.7</b> | <b>58.6</b> | <b>49.2</b> | 39.4      |
| C       | 3.9         | 5.9         | 4.5         | 4.2       |
| D       | 24.1        | 19.7        | 17.8        | 7.3       |

In item 11,  $0.5 \times 840$  equals:

- A.  $840 \div 2$     B.  $5 \times 840$     C.  $5 \times 8400$     D.  $840 + 2$     E.  $0.50 \times 84$ .

Approximately 60% of the students were unable to choose an equivalent expression to the given decimal expression. From the answer sheets, it was noticed that they tried to compute for  $0.5 \times 840$  and similarly computed for each of the choices given.

### Strand 5 - Counting and Computation

The average percentage score for this strand is 46.0 as shown in table 16. Items 5 and item 43 posed the greatest difficulty with low average percentage scores of 13.9 and 6.6 respectively. The range of low scores for these two items is from 5% to 18% across each level. In this strand, there is also a drop in the percentage score from 52.5 to 50.3, as student's transit from Form 3 to Form 4.

Table 16. Item analysis for strand 5 across Levels

| Item     | % Correct |       |       |       |         |      |
|----------|-----------|-------|-------|-------|---------|------|
|          | Form1     | Form2 | Form3 | Form4 | Average |      |
| Strand 5 | 2         | 72.5  | 74.7  | 87.1  | 81.3    | 78.9 |
|          | 5         | 7.6   | 11.7  | 18.1  | 18.2    | 13.9 |
|          | 12        | 48.7  | 45.2  | 53    | 32.2    | 44.8 |
|          | 35        | 25.0  | 36.7  | 60.2  | 50.1    | 43.0 |
|          | 41        | 42.8  | 48.8  | 60.2  | 67.8    | 54.9 |
|          | 42        | 75.0  | 70.7  | 83.5  | 77.7    | 76.7 |
|          | 43        | 5.0   | 6.6   | 7.2   | 7.7     | 6.6  |
|          | 44        | 30.0  | 29.3  | 44.6  | 49      | 38.2 |
|          | 46        | 50.9  | 51.2  | 60.6  | 57.3    | 55.0 |
|          | 47        | 36.3  | 45.9  | 45.0  | 60.1    | 46.8 |
|          | 50        | 38.1  | 40.5  | 58.2  | 52.1    | 47.2 |
| Average  | 39.3      | 41.9  | 52.5  | 50.3  | 46.0    |      |

Following examples are given to exemplify student’s low proficiency of number sense in Counting and Computation.

Item 5:

|  |   |
|--|---|
| Use two of the numbers below<br>3 , 4 , 9 , 12 ,<br>to make a fraction as close as possible to $\frac{1}{2}$ . | Answer: $\frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}}$ |
|--|---|

The analysis of the percentage of correct responses by levels for item 5 as summarized in table 17 indicates that form 2 students performed better than Form 1 and there was not much difference in performance between students in Form 3 and Form 4. The answer for this item is based on correct and incorrect responses. Overall, only 12.6% gave the correct response, which is among the lowest percentage item in the Number Sense Test.

Table 17. Percentage of correct responses across levels for Item 5

|                                 | Form 1 | Form 2 | Form 3 | Form 4 | Overall |
|---------------------------------|--------|--------|--------|--------|---------|
| Percentage of correct responses | 7.6    | 11.7   | 18.1   | 18.2   | 12.6    |

Item 43 and the question is stated below.

|  |               |
|--|---------------|
| <i>A journey to Town A takes 5 hours with an average speed of 80km/hr. The journey to return back takes 3 hours. What is the average speed of the whole journey?</i> | Answer: _____ |
|--|---------------|

The analysis of the percentage of correct responses by forms is summarized as follows.

Table 17. Percentage of correct responses across levels for Item 43

|                                 | Form 1 | Form 2 | Form 3 | Form 4 | Overall |
|---------------------------------|--------|--------|--------|--------|---------|
| Percentage of correct responses | 5      | 6.6    | 7.2    | 7.7    | 6.4     |

This item does not furnish respondents with possible answers. The overall average percentage of 6.4% is the lowest score obtained in the number sense test.

Item 12: Approximately how many days have you lived? Circle the nearest answer:  
 A. 450      B. 4500      C. 45 000      D. 450 000

In this item, about 45% got it correct. But closer examination from students answer sheets revealed that more than half of them actually computed their age in days by multiplying, and then rounded it down or up as the case may be. Once again, then, only very few of them used estimation to arrive at the correct answer; thereby revealing that the majority of these students were not using mental arithmetic or efficient strategies for managing numerical situations.

### Comparison of Number Sense Test by Gender Across Levels

An analysis was done to compare the difference in the number sense test scores between genders by the respective levels, namely Form 1, Form 2, Form 3 and Form 4 students respectively. Table 18 summarizes the result for the number sense test.

The mean score on the number sense test is higher for male students as compared to that of female students across the four levels as shown in Table 18. However, an independent samples t-test as shown in table 19 revealed that the significant differences in mean score on number sense tests between male and female students exists only among Form 1 students ( $t = 3.003$ ,  $p = .003$ ) at the 0.05 level.

Table 18. Summary Statistics for Number Sense by Gender and Levels

| Level  | Gender | N   | Mean  | Standard Deviation |
|--------|--------|-----|-------|--------------------|
| Form 1 | Male   | 200 | 19.66 | 6.08               |
|        | Female | 356 | 18.08 | 5.91               |
| Form 2 | Male   | 211 | 19.58 | 7.36               |
|        | Female | 377 | 19.16 | 5.92               |
| Form 3 | Male   | 105 | 24.08 | 6.41               |
|        | Female | 144 | 22.85 | 5.92               |
| Form 4 | Male   | 107 | 24.43 | 6.30               |
|        | Female | 256 | 23.58 | 6.69               |

Table 19. Independent Samples t-test for Number Sense by Levels

| <b>t-test for equality of means between gender (male – female)</b> |          |                       |                        |                              |
|--|----------|-----------------------|------------------------|------------------------------|
| <b>Level</b>   | <b>t</b> | <b>Sig.(2-tailed)</b> | <b>Mean Difference</b> | <b>Std. Error Difference</b> |
| Form 1   | 3.003*   | 0.003                 | 1.58                   | .53                          |
| Form 2   | 0.686    | 0.493                 | 0.42                   | .61                          |
| Form 3   | 1.561    | 0.120                 | 1.23                   | .79                          |
| Form 4   | 1.125    | 0.261                 | 0.85                   | .76                          |

\* The mean difference is significant at the .05 level.

### **Discussion and Conclusion**

The result reported in this study reveals a cause for concern. Firstly, it indicates students from ages 13 (form 1) to 16 (Form 4) faced great difficulty in making sense with numbers. Given that these items in the Number Sense Test needed very little computation, with more of making sense of numbers, it is troubling that the percentage of correct responses ranged only from 37.3% to 47.7% (refer to table 4) and the mean score from 18.65 to 23.38 (with a maximum of 50) across the levels.

Previous studies conducted by researcher's (Reys, et. al., 1999; Ghazali and Zanzali, 1999) reveals similar findings indicating that students faced great difficulties in understanding basic concepts in number sense. These findings were similar to the study conducted by Reys, et. al (1999) when they said:

*Although the performance levels on the number sense items varied (sometimes greatly) across countries, it was the consistently low performance of students across all countries which reminded us of the common international challenges this topic provides (p. 1).*

Secondly, students performance on this number sense test did not increase dramatically as one would expect from form 1 to form 4 and the level of performance leaves much to be desired. There was no significant difference in the mean scores between students in form 1 and form 2 and also between form 3 and form 4. One would expect that as students move up to a higher level (especially Form 4 students) they should become facile in working with fractions, decimals, and percents meaningfully. However, this was not the case in this study. So, this was not surprising when Reys et. al. (1999) with a similar finding stated that:

*a major impression left by the study is that, while the mathematics curriculum is still heavily weighted toward the development of computational algorithms and procedures, students' number sense does not develop hand in hand with their computational skills growth (p. 2).*

Results from this study shows that these students faced great difficulty in understanding basic number concepts as shown with the low scores (approximately 50% or less) in all the five strands namely : number concepts (31.6%); multiple representation (44.2%); effect of operations (48.7%); equivalent expression (52.7%) and counting and computation (46%)

Thirdly, male students seemed to perform better than their female counterparts across the ages (all levels) although the difference was only significant among the 13 year old students (Form 1). This result does not concur with the findings of recent research (Isiksal & Cakiroglu, 2008; Hyde and Linn, 2006; Ma, 2004; Awang & Ismail, 2003). However, previous research (Fennema & Carpenter, 1981; Walden and Walkerdine, 1982; Battista, 1990) has indicated that males were deemed to do better at mathematics when spatial ability is required and this conforms with their findings since number sense is involved quite heavily in visualizing and spatial ability. Similarly, Walden and Walkerdine (1982) also reported that male students were perceived to be better at mathematics when spatial ability is required, whereas algebra is the only area in which girls had a higher success rate.

The result of this study seems to indicate an existence of a gap between the ability to do paper-and-pencil calculations and intuitive understanding. Majority of the students (74.9%) involved in this study obtained an A grade for their year-end school examination but there seems to be a vast disparity between the grade scores and the Number Sense test, as the low score indicates. The probable reason for this is the inadequate mathematical instructions in schools and this results in many students having inadequate understanding of number sense of mathematical concepts. Previous studies (Ghazali and Zanzali, 1999; Parmjit, 2003; Parmjit, 2007) have indicated that Malaysian students are good at computational skills and once they understand these procedures, 'practice' will help them become confident and competent in using them. However, research indicates that if students memorize mathematical procedures without understanding, it is difficult for them to go back later and build intuitive understanding (Resnick and Omanson 1987; Wearne and Hiebert 1988). When students memorize without understanding, they may confuse methods or forget steps (Kamii and Dominick 1998) and I believe that is the scenario among students of this study and there is a cause for concern as to the direction of these students mathematics learning process in schools.

I believe that the current practice that places emphasis on algorithmic mastery in arithmetic learning in schools is misguided. The students that are being "trained" or "practice" under this environment failed to develop an understanding of the underlying mathematics, and in fact soon lose their grasp on the very skills that were intended to be the focus of their education. Does practice make perfect in mathematics learning? Brownell (1987) found that under certain condition, practice can be harmful. Premature demands for speed, for example, caused many children simply to become quicker at immature approaches. The place of practice in school mathematics is much disputed. I

believe that the right conclusion is that premature practice can be detrimental but that properly managed practice is essential in the development of expertise.

To address this problem, changes in direction and emphasis in both curriculum and pedagogy ought to be undertaken. These changes are often presented as a way to help students develop number sense that will eventually have a positive development in the learning of mathematics. To answer the One million Dollar question, *how can number sense be developed?* Greeno (1991) suggests "it may be more fruitful to view number sense as a by-product of other learning than as a goal of direct instruction" (p. 173). Howden (1989) expresses the view that number sense "develops gradually as a result of exploring numbers, visualizing them in a variety of contexts, and relating them in ways that are not limited by traditional algorithms" (p. 11). The development of number sense requires an environment that fosters curiosity and exploration at all grade levels. For teachers to provide the best learning environment for their students, they must understand each student's current number sense and address their own teaching to make sure that their students understand mathematical concepts and procedures. If teachers never find out what students can do, they cannot give them appropriate tasks to challenge them. They need to know the ideas with which students often have difficulty and ways to help bridge common misunderstandings. We must focus on how students learn and understand mathematics and base instructional decisions on this knowledge. This study provides a detailed sense of numbers among Form 1, Form 2, Form 3 and Form 4 students and teachers should take it from here to the next step in bridging the gap in student's intuitive understanding in making sense of numbers.

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# APPENDIX

## Number Sense Test

Name: ..... School: .....  
.....  
Form: ..... Sex: ..... Age: .....  
.....  
Mathematics Grade obtained in the UPSR/PMR examination: .....  
Mathematics **marks** obtained in your latest school mathematics examination: .....

### Practice Questions:

- Without counting exactly, about how many children are there in your class?  
A. 3                      B. 30                      C. 300                      D. 3000
- What number goes in the box to make this statement true?  
 $30 + \underline{\quad} = 50$   
Answer: \_\_\_\_\_

DO NOT turn over the page until you are told to do so.

DO NOT write anything except your answer.

There are 50 questions in this paper. You will have 25 seconds for each question.

### Test Question:

- Rahman ran 100 meters in 15.52 seconds. Chong took 2 tenths of a second longer. How long did it take Chong to run 100 meters?  
A. 34.52 seconds    B. 16.52 seconds    C. 14.72 seconds    D. 14.54 seconds  
E. 14.50 seconds
- Ten bottles of orange juice cost a total of RM 7.95 at one shop. I can get 5 bottles of the same juice for a total of RM 4.15 at another shop. Where is a bottle of orange juice cheaper, at the first shop or the second shop?  
A. First shop    B. Second shop  
Tell how you decided:  
\_\_\_\_\_  
\_\_\_\_\_

- How many different decimal are there between 1.52 and 1.53? Circle your answer and then fill in the blank.  
A. None. Why? \_\_\_\_\_  
B. One. What is it? \_\_\_\_\_  
C. A few. Give two examples. \_\_\_\_\_ and \_\_\_\_\_  
D. Many. Give two examples. \_\_\_\_\_ and \_\_\_\_\_
- Circle the fraction which represents the largest amount:  
A.  $\frac{5}{6}$                       C.  $\frac{5}{8}$   
B.  $\frac{5}{7}$                       D.  $\frac{5}{9}$

5. Use two of the number below to make a fraction as close as possible to  $\frac{1}{2}$

**3, 4, 9, 12**

Answer: \_\_\_\_\_

6. How many different fraction are there between  $\frac{2}{5}$  and  $\frac{3}{5}$ ? Circle your answer and then fill in the blanks.

- A. None. Why? \_\_\_\_\_
- B. One. What is it? \_\_\_\_\_
- C. A few. Give two examples. \_\_\_\_\_ and \_\_\_\_\_
- D. Many. Give two examples. \_\_\_\_\_ and \_\_\_\_\_

7. Circle all the statements that are true about the number  $\frac{2}{5}$ .

- A. It is greater than  $\frac{1}{2}$
- B. It is the same as 2.5
- C. It is equivalent to 0.4
- D. It is greater than  $\frac{1}{3}$

8. Circle the decimal which best represents the amount of the box shaded.



- A. 0.018
- B. 0.15
- C. 0.4
- D. 0.801
- E. 0.52

9. In the fraction  $\frac{1}{8}$ , the numerator is 1. Fill in the boxes with numbers to make a fraction between 0

and  $\frac{1}{10}$  whose numerator is **NOT** 1.

Answer:  $\frac{\square}{\square}$

10. Write a number in the box to make a fraction which represents a number between 2 and 3.

Answer:  $\frac{\square}{\square}$   
8

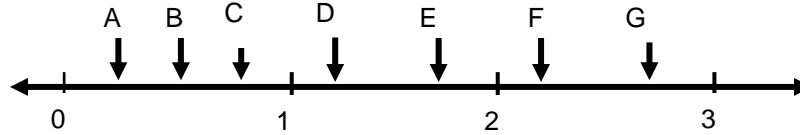
11.  $0.5 \times 840$  is the same as :

- A.  $840 \div 2$
- B.  $840 + 2$
- C.  $5 \times 8400$
- D.  $5 \times 840$
- E.  $0.50 \times 84$

12. About how many days are you lived? (Circle the nearest answer)

- A. 450
- B. 4500
- C. 45 000
- D. 450 000

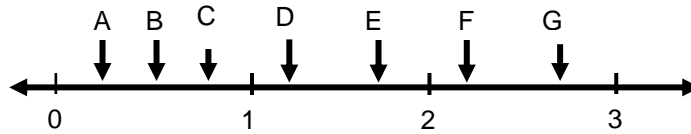
13.



Which letter in the number line above shows a fraction where the numerator is nearly twice the denominator?

Answer: \_\_\_\_\_

14.



Which letter in the number line above shows a fraction where the numerator is nearly twice the denominator?

Answer: \_\_\_\_\_

15. Circle all the fractions listed here which are greater than  $\frac{3}{4}$  but less than 1.

- $\frac{3}{4}$      $\frac{5}{8}$      $\frac{4}{5}$      $\frac{7}{10}$      $\frac{4}{3}$

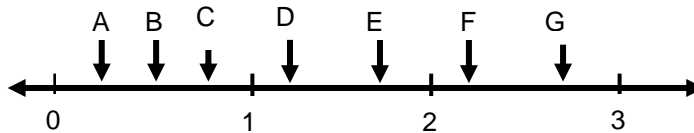
16. Without calculating the exact answer, circle the best estimate for:  
 $29 \times 0.98$

- A. More than 29      B. Less than 29      C. Impossible to tell without working it out

17. When a 2 – digit number is multiplied by a 2 –digit number, the result is: (Circle the correct answer).

- A. always a 3 – digit number      C. either a 3 or 4 – digit number  
 B. always a 4 – digit number      D. sometimes a 5 – digit number

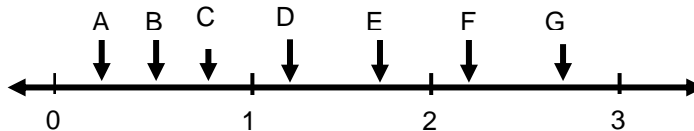
18.



On the number line above, which letter best represents the following:  
 $D \times G$

Answer: \_\_\_\_\_

19.



On the number line above, which letter best represents the following:  
 $E \div F$

Answer: \_\_\_\_\_

20. Without calculating the exact answer circle the best estimate for :

$$87 \times 0.09$$

- A. Very much less than 87                      C. A little more than 87  
 B. A little less than 87                         D. Very much more than 87

21. Without calculating the exact answer circle the best estimate for:

$$54 \div 0.09$$

- A. A lot less than 54                             C. A little more than 54  
 B. A little less than 54                         D. Very much more than 54

22. Without calculating, which total is more than 1? (Circle the correct answer)

- A.  $\frac{2}{5} + \frac{3}{7}$      C.  $\frac{3}{8} + \frac{2}{11}$   
 B.  $\frac{1}{2} + \frac{4}{9}$      D.  $\frac{4}{7} + \frac{1}{2}$

23. Write “ is greater than”, “is equal to” or “ is less than” to make this a true statement:

$$5 \times 7\frac{1}{2} \text{ _____ } 35 \div \frac{1}{2}$$

24. Aminah had RM 426 and spent 0.9 of the money on the clothes. Without calculating an exact answer circle the statement that best described how much she spent.

- A. Slightly less than RM 426                      C. Slightly more than RM 426  
 B. Very much less than RM 426                      D. Impossible to tell without calculating.

25. Circle the correct statement.

$$\frac{4}{5} \times \frac{7}{6}$$

- A. Is less than  $\frac{7}{6}$                                      B. Is equal to  $\frac{7}{6}$                                      C. Is greater than  $\frac{7}{6}$

26. A four digit number is represented by # # # #. If # # # #  $\div$  30  $\square$ , then which of these statement is true?

- A.  $30 \times 40 \square$  # # # #                             B.  $30 \times$  # # # #  $\square$  40  
 B.  $30 \times 40 \square$  # # # #                             C.  $40 \times$  # # # #  $\square$  30

27. Without calculating decide which one of these answer is reasonable, and circle it:

- A.  $45 \times 1.05 = 39.65$                              C.  $87 \times 1.076 = 93.61$   
 B.  $4.5 \times 6.5 = 292.5$                              D.  $589 \times 0.95 = 595.45$

28. Without calculating the exact answer, circle the best estimate for:

$$29 \div 0.8$$

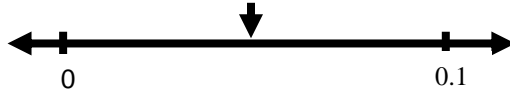
- A. Less than 29                                     C. Greater than 29  
 B. Equal to 29                                     D. Impossible to tell without calculating

29. Without calculating the exact answer, circle the best estimate for:

$$\frac{2}{3} \times \frac{5}{4}$$

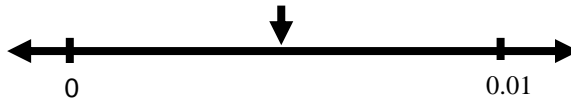
- A. Less than  $\frac{2}{3}$                       C. Greater than  $\frac{2}{3}$   
B. Equal to  $\frac{2}{3}$                       D. Impossible to tell without calculating

30. Estimate the decimal number shown by the arrow on the number line:



Answer: \_\_\_\_\_

31. Estimate the decimal number shown by the arrow on the number line:



Answer: \_\_\_\_\_

32. Without calculating circle the expression which represents the larger amount.

- A.  $145 \times 4$                       B.  $144 + 146 + 148 + 150$

33. Circle the number which can be put in both boxes to make this sentence true:

$$243 \times \square = \square \times 24.3$$

- A. 0                      C. 1  
B. 0.1                      D. 10

34.  $93 \times 134$  is equal to 12 462. Use this to write the answer to the following:

$$93 \times 135$$

Answer: \_\_\_\_\_

35.  $93 \times 134$  is equal to 12 462. Use this to write the answer to the following:

$$12462 \div 930$$

Answer: \_\_\_\_\_

36. Circle the number you can put in the box to make this sentence true:

$$\frac{1}{2} \times \square = \frac{3}{6}$$

- A.  $\frac{2}{4}$                       C. 1  
B.  $\frac{2}{3}$                       D. 3



46. All books in a bookshop are being sold at a discount of 15%. The discounted price of a book that normally costs RM 40 is:
- |          |          |
|----------|----------|
| A. RM 25 | C. RM 36 |
| B. RM 34 | D. RM 29 |
47. Without calculating the exact answer circle the best estimate for  
 $[6 \times 347] \div 43$
- |             |              |
|-------------|--------------|
| A. About 30 | C. About 80  |
| B. About 50 | D. About 100 |
48. A meter of a uniform wooden beam weighs about 2.1 kilograms. About how much do 13.8 meters of this wooden beam weigh? The answer in kilograms is closest to, (Circle the best estimate)
- |                    |       |
|--------------------|-------|
| A. $16\frac{1}{2}$ | C. 26 |
| B. 17              | D. 28 |
49. Without calculating the exact answer circle the best estimate for  
 $424 \times 0.76$
- |        |        |
|--------|--------|
| A. 280 | C. 320 |
| B. 300 | D. 340 |
50. 75% of the tomatoes in a basket were good. There were 48 tomatoes in the basket. How many were good?

Answer: \_\_\_\_\_

**This test items were adapted from a number sense test constructed by published by McIntosh, A.,Reys, B., Reys, R. E., Bana, J., & Farrell, B. (1997).**