

Instructions:

You must show ALL your work in ALL questions. You will be graded on your methods, not just your answers. Use only the space provided for each question. Any usage of calculators is prohibited during the exam.

You will have EXACTLY 50 minutes for the exam, which consists of problems numbered 1 – 9. Request a new copy of the exam if any of the problems are missing or hard to read.

1) Fill in the blanks using the correct terminology in their full form:

- a) (4 points) The two special cases of the any-order property are:
the commutative property and the associative property.
- b) (4 points) In the division problem $20 \div 4 = 5$,
the number 20 is called the dividend, the number 5 is called the quotient.
- c) (3 points) The three interpretations of subtraction are:
part-whole, take-away, comparison
- d) (2 points) The number “Two hundred thirty one” in Egyptian numerals is eeennn.
- e) (1 point) Multiplication of whole numbers is defined as repeated addition.
- f) (1 point) Division is defined from multiplication using the concept of missing factor.
- g) (1 point) The most useful model for teaching the commutative property in multiplication is:
the rectangular array.
- h) (1 point) When $18 \div 6$ is presented as finding the size of each of the 6 equal segments that add up to a segment of size 18, one is using the partitive interpretation of division.

2) (1 point each) State the name of the arithmetic property or thinking strategy being used:

- a) $723 + 0 = 723$ The Additive Identity Property ①
- b) $(70 + 14) \div 7 = (70 \div 7) + (14 \div 7)$ The Distributive Property ①
- c) $19 + 26 = 20 + 25$ Compensation ①

Abbreviations:

PV: Place Value

AO: Any-order

CS: compensation

CN: Compatible Numbers

DP: Distributive Property

3) (3 points each) Show (clearly but briefly) how to compute the following using Mental Math. Write down the intermediate steps, and state the properties/techniques used.

a) $28 + 19 + 1272 = (28 + 1272) + 19 = (28 + 72 + 1200) + 19 = 100 + 1200 + 19 = 1319$
 AO ① PV ① CN ① PV

b) $25 \times 98 = 25 \times (100 - 2) = (25 \times 100) - (25 \times 2) = 2500 - 50 = 2450$
 PV ① DP ① PV ① PV

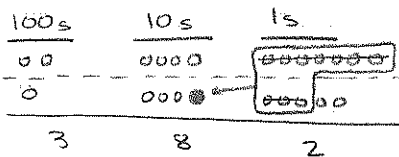
c) $132 \div 12 = (120 + 12) \div 12 = (120 \div 12) + (12 \div 12) = 10 + 1 = 11$
 PV ① DP ① PV ① PV

d) $280 \div 5 = 560 \div 10 = 56$
 (x2) (x2) CS ① PV ①

e) $220 - 191 = 229 - 200 = 29$
 (+9) (+9) CS ① PV ①

4) (5 points each) Illustrate the following calculations using chip diagrams:

a) $247 + 135 = 382$

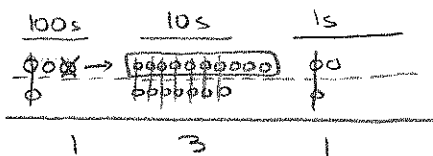


For both:

Diagram & rewording } 4pts

Calculation: 1pt

b) $302 - 171 = 131$



5) (5 points) Using 2 or 3 sentences or bullet points, clearly and completely explain why $0 \div 0$ is undefined.

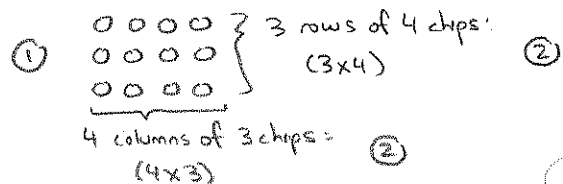
→ $0 \div 0 = ?$ means $0 \times ? = 0$. ①

→ But any number multiplied by 0 would give 0. So there are infinitely many answers. ②

→ So $0 \div 0$ is undefined since there isn't a unique answer. ③

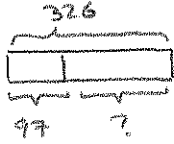
6) (5 points) Illustrate the equality $4 \times 3 = 3 \times 4$:

Draw a diagram -with labels indicating both sides of the equality are visible- that shows that the equality is not coincidental.



7) (10 points each) Give **Teacher Solutions with Diagrams** for the following word problems. Remember such a solution includes clear diagrams with complete labels, question marks marking unknowns, brief computations using units, answer statements.

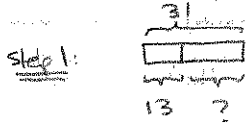
a) There were 326 people at a play. 97 of them were kids. How many were adults?



adults: $326 - 97 = 329 - 100 = 229$ (3)
 (+3) (+3)

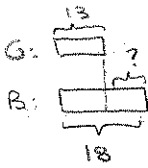
There were 229 adults at the play (3)

b) There are 31 children in a classroom. 13 of them are girls. How many more boys than girls are there?



boys: $31 - 13 = 38 - 20 = 18$ (2)
 (+7) (+7)

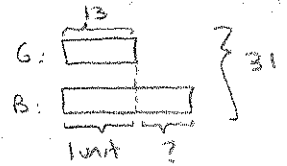
Step 2:



difference: $18 - 3 = 15$ (2)

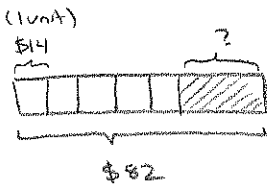
There are 5 more boys than girls. (2)

A. Much Clearer Method



1 unit = 13
 total #: $2 \text{ units} + ? = 31$
 $26 + ? = 31$
 etc.

c) Laura had \$82. She bought 5 books at \$14 each. How much money does she have left?



1 unit = \$14

Amount spent: $5 \text{ units} = 5 \times 14 = 10 \times 7 = 70$ (2)
 (x2) (÷2)

Amount left: $82 - 70 = 12$ (2)

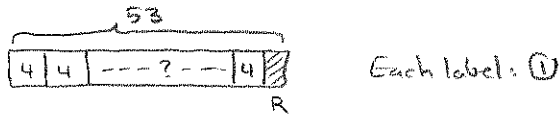
She has \$12 left. (2)

- 8) (6 points) Make up a first grade word problem using measurement division for $53 \div 4$. Illustrate your problem by using an appropriate bar diagram.

53 marbles are divided equally among a group of kids. } ①
 Each kid gets 4 marbles.

How many kids are there? ①

How many marbles are left? ①



- 9) a) (1 point) In the decimal system, "place value" refers to the fact that the value of a digit is specified by its position within a numeral. ①

- a) (4 points) Write down the steps of the place value process in their full form.

- (i) Form bundles of 1, 10, 100, --- (powers of 10) ①
 (ii) If necessary, rebundle to ensure there's at most 9 bundles of each denomination ②
 (iii) Count & record the number of each type of bundle in its appropriate position ①

- b) (2 points) Using 2-digit numbers, give an example of an addition which does not use *step (ii)*.

$$\begin{array}{r} 13 \\ 24 \\ \hline 37 \end{array} \quad \left. \begin{array}{l} \textcircled{1} \\ \textcircled{1} \end{array} \right\}$$

- c) (2 points) Using 2-digit numbers, give an example of an addition which uses *step (ii)*.

$$\begin{array}{r} \textcircled{1} \\ 17 \\ 24 \\ \hline 41 \end{array} \quad \left. \begin{array}{l} \textcircled{1} \\ \textcircled{1} \end{array} \right\}$$