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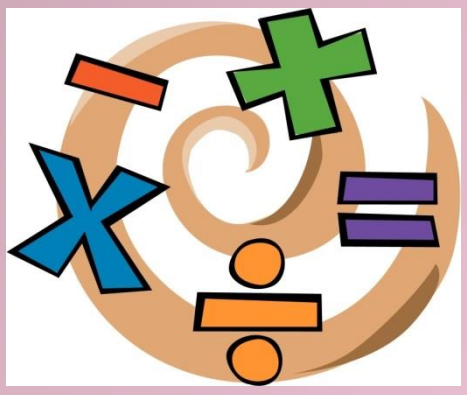

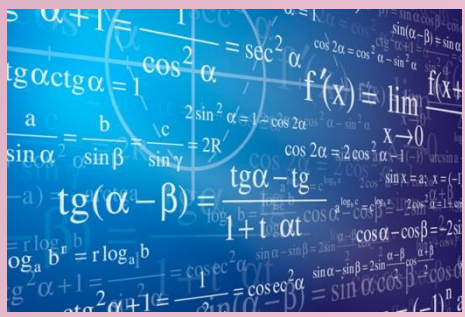

Perform computations

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Unit Resource Manual

Manufacturing Skills Australia Courses

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Aims of the Competency Unit

This unit covers estimating approximate answers to arithmetical problems, carrying out basic calculations involving percentages and proportions, and determining simple ratios and averages. The unit includes producing and interpreting simple charts and graphs and applies in manufacturing, engineering or related environments. It includes the application of the four rules of algebraic expressions, extracting information from drawings, diagrams, graphs and charts and producing simple charts and graphs.

Data may be derived from readings taken or may be computer generated. Applications can include computations associated with pressure, volume, temperature, heat, speed, power, elasticity, density, mass, force etc.

Calculations may be performed using pen and paper or on a calculator.

Unit Hours

36 Hours

Prerequisites:

None

Elements and Performance Criteria

1.	Determine work requirement	1.1	Required outcomes are established from job instructions.
		1.2	Data is obtained from relevant sources and interpreted correctly.
		1.3	Required calculation method is determined to suit the application, including selection of relevant arithmetic operations and/or formulae.
		1.4	Expected results are estimated, including rounding off, as appropriate.
2.	Perform calculations	2.1	Calculation method is applied correctly.
		2.2	Correct answer is obtained.
		2.3	Answer is checked against estimation.
3.	Use two-dimensional geometry to solve practical problems	3.1	Data is transposed accurately to produce charts or graphs.
		3.2	Charts or graphs accurately reflect data on which they are based.

Required Skills and Knowledge

Required skills include:

- performing calculations involving whole numbers using all four basic rules
- performing calculations involving length, perimeter, area and volume
- checking calculated answers for accuracy
- rounding off estimated answers
- expressing information presented in fractional or decimal format as a percentage
- selecting appropriate formulae for the given application
- substituting the correct values for each term in the relevant formulae
- using appropriate mathematical operations
- performing calculations involving ratios or proportions
- determining required information from appropriate charts or graphs
- producing simple charts or graphs from given information or observations made
- selecting appropriate scales and using them in the production of charts and graphs
- marking appropriate limits clearly on the graph or chart
- reading, interpreting and following information on written job instructions, specifications, standard operating procedures, charts, lists, drawings and other applicable reference documents
- planning and sequencing operations
- checking and clarifying task related information
- checking for conformance to specifications
- undertaking numerical operations, geometry and calculations/formulae within the scope of this unit

Required knowledge includes:

- formula applicable to the determination of perimeter, area and volume of simple geometric shapes
- techniques for estimating approximate answers
- reasons for using dimensions with the same units when calculating length, perimeter, area and volume
- concepts of perimeter, area and volume
- procedures for rounding off figures when estimating approximate answers
- mixed numbers, decimals, fractions and whole numbers
- concept of percentage
- procedures to be followed in converting a decimal to a percentage
- procedures for carrying out calculations involving fractions and using each of the four basic rules
- procedures to be followed on converting a fraction to a percentage
- sources of appropriate formulae
- reasons for ensuring that the units of each term are consistent with the formulae selected
- procedures for converting given units to those required for use in formulae
- concepts of ratio and proportion
- given ratios and proportions can be expressed in terms of whole numbers, fractions and decimal fractions
- scales applicable to the axes of the graphs or charts
- three types of charts and/or graphs used in the individual's field of work
- where appropriate, upper and lower limits of acceptability applicable to data

entered on a graph or chart
- where appropriate, the trends indicated by the slope or gradient of a graph
- where appropriate, the action to be taken when given trends occur or set limits are approached on graphs or charts
- procedures for drawing 'lines of best fit'
- the trends indicated by the graphs or charts drawn
- hazards and control measures associated with performing computations, including housekeeping
- safe work practices and procedures

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Lesson Program:

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Error! Reference source not found.	MEM12024-SP-0201
Topic 3 – Decimals	MEM12024-SP-0301
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Topic 13 – Coordinates & Statistics	MEM12024-SP-1301
Topic 14 – Industrial Applications	MEM12024-SP-1401
Practice Competency Test:	

Solving Maths Problems:

An equation is a combination of math expressions.

Word problems are a series of expressions that fits into an equation.

There are two steps to solving math word problems:

1. Translate the wording into a numeric equation that combines smaller "expressions".
2. Solve the equation!

Suggestions:

- **Read the problem entirely**
  Get a feel for the whole problem
- **List information** and the variables you identify
  Attach units of measure to the variables (gallons, miles, inches, etc.)
- **Define what answer you need**,
  as well as its units of measure
- **Work in an organized manner**
  Working clearly will help you think clearly
- Draw and label all graphs and pictures clearly
- Note or explain each step of your process;
  this will help you track variables and remember their meanings
- **Look for the "key" words (**above**)**
  Certain words indicate certain mathematical operations:

Key words for addition (+) :
increased by; more than; combined together; total of; sum; added to

What is the sum of 8 and *y*?

Express the total weight of the mast (*x*) and antenna (*y*).

Key words for Subtraction (-) **:**
less than, fewer than, reduced by, decreased by, difference of

What is four less than *y.*

What is the difference in the mass of the beams *x* and the columns *y*.

Key words for multiplication (* or ×):
of, times, multiplied by

What is *y* multiplied by 13.

A car drives at 105 kilometres per hour. How far will it go in *x* hours?

Key words for division (÷ or /)
per, a; out of; ratio of, quotient of; percent (divide by 100).

What is the quotient of *x* and 3.

y machines produce a total of 3457. Express their average production

Lesson 1 – The Four Basic Operations:

Required Skills:

- Determine the result of a mathematical expression using addition.
- Determine the result of a mathematical expression using subtraction.
- Determine the result of a mathematical expression by multiplication.
- Determine the result of a mathematical expression by division.
- Calculate the result of a compound mathematical expression consisting of addition, subtraction, multiplication and division

Required Knowledge:

- The difference between a whole number, decimal percentage and fraction.
- Multiplication and division is carried out before addition and subtraction.
- Laying out calculations on paper in a logical manner.

The Four Mathematics Operations:

The basic understanding of the use of arithmetic and mathematics without the aid of mobile phones, calculators and computers is an essential skill required for engineers, technicians, and people working in the trades. The first instinct is to reach for some electronic means to do a simple calculation but what happens if the mobile phone batteries go flat, or worse the phone is dropped in the water or under the wheels of a 150 tonne earth moving machine? The calculations must be worked out in the head or at the very least approximated by applying mathematics learned at school and at College.

The four basic mathematical operations are:

- Addition
- Subtraction
- Multiplication
- Division

To effectively operate in engineering fields, everyone must know the 4 basic operations of addition (+), subtraction (-), multiplication (×) and division (÷), and how they are applied to whole numbers, fractions, and decimals.

Addition:

Addition is a mathematical operation that represents combining collections of objects together into a larger collection. It is signified by the plus sign (+).

Each number being added is called an **addend** while the total, which is the answer to the addition problem, is called the **sum**.

4	addend	9	addend
+3	addend	+4	addend
7	sum	13	sum

Adding numbers with 1 digit is reasonably straightforward. In general, it mentally can be calculated mentally or by the use of fingers. Adding zero to a number never changes the number.

Look at the following problems and select the incorrect answer.

A	B	C	D	E	F	G	H	I
2	7	4	5	5	6	6	7	9
+6	+3	+8	+6	+5	+9	+7	+8	+8
8	10	12	11	10	13	13	15	17

If you selected F you are correct as 6+9=15; NOT 13.

Adding numbers with 2 or more digits is a bit more challenging so when we have to add 57 and 34 together. The result can be determined using the Expanded Notation method or placing the numbers into columns and carrying numbers over.

Expanded Notation:

To calculate the sum the numbers are broken down into basic elements:

57 = 50 (tens) + 7 (ones)

34 = 30 (tens) + 4 (ones)

The ones are totalled first 7 + 4 = 11 or 1 (ten) + 1 (ones).

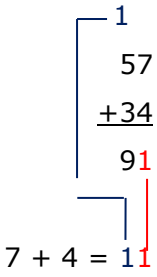
The tens are totalled next, 50 + 30 + 10 = 90 or 90 (tens) + 1 (ones) = 91.

Columns:

The same result can be achieved by arranging the numbers into columns where the ones, tens, hundreds are lined vertically below each other.

57
+34
91

The one (right) column is totalled first, then the tens (next left), then the hundreds (3rd column from the right) and so on. Where the ones column totals more then 10, the number 0 to 9 is placed in the answer line and the ten number carried over to the ten column.



Subtraction:

Subtraction is one of the four basic arithmetic operations; it is the inverse of addition meaning that if we start with any number and add any number and then subtract the same number we added, we return to the number we started with. Subtraction is denoted by a minus (-).

Instead of adding 2 numbers to get a sum, one number is removed from the other to get the difference. The following are simple subtractions:

9	8	6	11	16
-4	-7	-2	-3	-6
5	1	4	8	10

In the first example, if 9 – 4 = 5 is related to money, if you had $9 and bought an item for $4 you would have $5 left.

Subtractions with one digit are fairly simple however subtractions with 2 or more digits can become more complicated especially when a digit being subtracted is larger than the other digit; eg. 93 – 6.

As in addition the result can be determined using the expanded notation or column methods.

Expanded Notation:
As with additions, the numbers are broken down into basic elements:

93	=	9 tens + 3 ones	or	8 tens + 13 ones
-6	=	6 ones		-6 ones
				8 tens + 7 ones
				= 87

In the above example, the 9-10's is reduced to 8-10's and the 3-1's is increased to 13-1's. The ones can then be subtracted (13 – 6 = 7) and added to the 8-10's to give 87.

Columns:
Since 6 can not be subtracted from 3, 10 is borrowed from the 10's column and then paid back.

$$\begin{array}{rr} & 13 \\ 9 & \cancel{3} \\ -\ 1 & 6 \\ \hline 8 & 7 \end{array}$$

In the above example, 10 is borrowed from the 9 to turn the 3 into 13 therefore 13–6=7; the 10 is then paid back to the tens column, 9 – 1 = 8. The final answer is 87.

Multiplication:

Multiplication is the mathematical operation of scaling one number by another. It is one of the four basic operations in elementary arithmetic. The multiplication is denoted by the symbol (x).

Numbers being multiplied are called **Factors**, while the result or answer to the multiplied figures is called the **Product**. A solid knowledge of the multiplication tables is recommended to successfully multiply.

3	factor	8	factor
×2	factor	×3	factor
6	product	24	product

The easiest multiplication we can perform is the one with one digit because all we need is a good remembrance of a multiplication table.

8	9	6	10	5
×4	×3	×1	×0	×5
32	27	6	0	25

Multiplying a two-digit number by a one-digit number is a little bit more fun but can easily be calculated using the Expanded Notation method.

Let's look at 53x7 using the Expanded Notation and Columns methods.

Expanded Notation:

53 = 5 tens and 3 ones

×7 = × 7 ones

35 tens and 21 ones

35+2 tens and 1 one

371

The 21 ones break down to 2 tens and 1 one with the 2 tens being added to the 35 tens to give 37 tens and 1 one or 371.

Columns:

As with addition and subtraction, multiplication can be done by laying the calculation out in column form.

Method 1:

53 factor

×7 factor

21 Ones - 3 × 7

350 Tens - 5 × 70

371 product

Method 2:

2 carry over

53 factor

×7 factor

371 product

3x7=21 1 is placed on the answer line and 2 is carried over to the tens column. 7x5=35+2=37 and is placed next to the 1.

Keep the columns neat and carry over numbers clear and neat.

Dividing Whole Numbers:

Dividing whole numbers is the opposite of multiplying whole numbers. It is the process by which we try to find out how many times a number (divisor) is contained in another number (dividend). The resulting answer is called the quotient. The symbol used to designate divide is ÷.

6 quotient

5)30 dividend

divisor

Long Division:

At times when the number or dividend is too long to simply divide, the Long Division method should be used to calculate the answer or quotient. The division is laid out in the same manner but there are several lines under breaking up the long number into shorter sections.

Example 1-1:
Divide 1645 by 7 or 1645 ÷ 7

Step 1:

$$7\ )\overline{1645}$$

Lay the division out as shown.

Step 2:

$$\begin{array}{r} \mathbf{2} \\ \hline 7\ )1645 \end{array}$$

7 will go into 16, twice so 2 is placed above the line.

Step 3:

$$\begin{array}{r} 2 \\ \hline 7\ )1645 \\ \hline \mathbf{14} \end{array}$$

2×7=14; 14 is placed below the 16.

Step 4:

$$\begin{array}{r} 2 \\ \hline 7\ )1645 \\ \hline 14 \\ \hline \mathbf{2} \end{array}$$

Subtract 14 from 16 = 2

Step 5:

$$\begin{array}{r} 2 \\ \hline 7\ )1645 \\ \hline 14 \\ \hline 2\mathbf{4} \end{array}$$

Cary the 4 down next to the 2 to give a figure of 24.

Step 6:

$$\begin{array}{r} 2\mathbf{3} \\ \hline 7\ )1645 \\ \hline 14 \\ \hline 24 \end{array}$$

24 ÷ 7 is 3 so 3 is placed in the quotient next to 2.

Step 7:

$$\begin{array}{r} 23 \\ \hline 7\ )1645 \\ \hline 14 \\ \hline 24 \\ \mathbf{21} \end{array}$$

3×7=21; 21 is placed below the 24.

Step 8:

```
      23
7 )1645
   14
    24
    21
     3
```

Subtract 21 from 24 = 3.

Step 9:

```
      23
7 )1645
   14
    24
    21
     35
```

Cary the 5 down next to the 3 to give a figure of 35.

Step 10:

```
      235
7 )1645
   14
    24
    21
     35
```

35 ÷ 7 is 5, so 5 is placed in the quotient next to 23.

Step 11:

```
      235
7 )1645
   14
    24
    21
     35
     35
      0
```

5×7=35; 35 is placed below the 35 and when subtracted leaves 0.

The final answer is 235.

Order of Operations:

Since the early days of ancient Egypt, Greece and Rome, Mathematicians have agreed on a definite order of doing the 4 operations (+, – , ×, ÷) otherwise confusion would occur.

Working from left to right, Multiplication and Division are calculated before additions and subtractions.

- ✓ First: Work out any grouping of symbols or brackets.
- ✓ Second: Work out any multiplication and division as they occur from left to right.
- ✓ Third: Work out any addition and subtraction as they occur from left to right.

From the following example, which is the correct answer; A or B?

A $5 + 3 \times 4 = 17$

B $5 + 3 \times 4 = 32$

As any multiplication must be done before any addition, then the answer would be 5+12=17 as answer A is correct. For B to be correct

The agreed Order of Operations is often remembered as **B O D M A S** or **B**rackets **O**f **D**ivision **M**ultiplication **A**ddition **S**ubtraction.

Skill Practice Exercise: MEM12024-SP-0101:

1. Determine the following answers:

a. 7+4 b. 17+24 c. 34+58 d. 62+74 e. 53+96

f. 85+65 g. 105+89 h. 186+178 i. 275+349 j. 597+627

k. 1017+527 l. 297+2489 m. 2481+92 n. 1579+6982 o. 8715+2547

2. Determine the following answers:

a. 6-4 b. 12-8 c. 84-24 d. 98-72 e. 53-7

f. 85-36 g. 207-104 h. 179-36 i. 285-147 j. 987-321

k. 1489 -268 l. 2478- 1587 m. 2481- 1478 n. 2579 -1587 o. 8715 -2547

3. Determine the following answers:

a. 5×4 b. 3×9 c. 8×7 d. 9×6 e. 12×8

f. 7×8 g. 14×6 h. 85×24 i. 96×48 j. 57×57

k. 118×47 l. 249×58 m. 758×68 n. 1485×69 o. 1479×247

4. Determine the following answers:

a. 15 ÷ 3 b. 48 ÷ 8 c. 16 ÷ 4 d. 81 ÷ 9 e. 12 ÷ 6

f. 8) 448 g. 6) 252 h. 7) 868 i. 4) 116

j. 9)3132 k. 3) 501 l. 10)1000 m. 12) 2904

5. Determine the following answers:

a. 8 × 6 + 4 b. 4 x 7 – 9 c. 4 + 7 × 8

d. 12 × 3 + 5 x 6 e. 36 – 4 × 8 f. 28 × 2 ÷ 8

g. 46 + 24 ÷ 4 h. 6 × 8 + 4 × 3 i. 15 × 5 + 25 ÷ 5

6. Name the 4 major operations in Mathematics.