THE MATH’S BOOK

FLY THROUGH THE SELECTION PROCESS!

ADFMENTORS
Fly through the selection process!
Pre-course Maths Book

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Training and Assessment Cert IV
Statement of Attainment for Apply mathematical skills for further study
Statement of Attainment for Apply calculus concepts
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1. Introduction

Welcome to the ADFmentors ‘Pre-course Maths Book’. This booklet is designed to refresh you on the basic year 8 – 10 maths that you will need to use throughout the Selection Process and during your career as an Officer. It is likely that you have forgotten how to perform the following maths due to the invention of the calculator which eliminates the need to perform mental and written calculations. Unfortunately you won’t have a calculator in the cockpit and likewise you won’t have one for the aptitude tests.

By the end of this booklet you will be back up to speed with: Times tables, subtraction/multiplication/division, decimals, fractions, and basic trigonometry/geometry. All of these skills will be relied on when learning to answer the aptitude test questions in our aptitude training courses, thus make sure you complete ALL of the exercises listed throughout the book.

One final note before we begin is that all answers are to be calculated to no more than 2 decimal places, unless otherwise stated!

Buckle up and get ready to take a ride back to year 8!
2. Times-Tables

Well here they are, the infamous times tables are back to haunt us again. Fortunately for you we have some simple exercises that will help you get back up to speed with our old friends and you should be feeling confident with them in no time (some of you might already feel confident with them, but just to be sure go through and complete this refresher anyway).

2.1 Deck of cards

The simplest way to refresh yourself on the times tables (up to 12) is with a deck of cards. Get yourself a standard deck of cards. Open them. Take out the two jokers and all four kings. Now shuffle them so they are in a completely random order. Now what you are going to do is assign yourself with a number (from 1 -12) for the first round, for this example lets pick the number 7. Now you are going to turn the deck upside down and flip over the first card (let’s say it’s a 4), so you multiply $7 \times 4 = 28$. Then flip over the next card (let’s say it’s a 7), so you multiply $7 \times 7 = 49$. Then flip over the next card (let’s say it’s a 8), so you multiply $7 \times 8 = 56$. And so on. If a picture card flips over they will be assigned with a number, take a look at the following list so you know which card equals which number:

<table>
<thead>
<tr>
<th>Card</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ace</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Jack</td>
<td>11</td>
</tr>
<tr>
<td>Queen</td>
<td>12</td>
</tr>
</tbody>
</table>
So you see that each card has a number!

Continue flipping cards over until you are through the entire deck. Once you finish the entire deck you move onto the next number (for us it would be 8). And follow the same flipping process for this number. Then you move onto the next number and so on. Most people are confident with their 1, 2, 3, 5, 10, and 11 times tables so most likely the only ones you will have to do this for are the 4, 6, 7, 8, 9, and 12 times tables. That’s 6 rounds and should take you a total of about 10 minutes.

For the last round (a 7th round) you will flip over two cards and multiply the two together. For example: You turn the deck of cards upside and flip over the top two, lets say one is a 3 and one is a 7, so you multiply 7 x 3. You do this until the whole deck is finished. This gives the final round a random element and is a good consolidation to each session. We encourage you do this every day until you feel confident with them, and then every second day until your aptitude test preparation course. This is what I did, what our previous students have done and is what all the students on your aptitude test training course will be doing as well!

### 2.2 To be the best

You have chosen to do our training courses because you want to be the best applicant. To do this we encourage you complete this next activity which will set you apart in the Officer interviews when it comes time to doing maths questions:

The exercise is to complete the above activity (deck of cards) with your left hand, whilst pouring water from one cup into another with your right hand (or vica versa if you are left handed). This will test that you know your multiplication tables EXTREMELY well and will develop your multitasking abilities which you will need to use in the cockpit. This exact exercise could be used on you in the Officer interviews!
3. The basic four

The basic four are: Division, multiplication, addition and subtraction. No doubt you will have learnt to complete these by hand up until year 8, however after this our reliance on the calculator takes over and these basic skills are forgotten. Not to worry, the next chapter is designed to refresh you in a mere few hours!

3.1 Division

Short division and Long division is a long lost art. Master this skill and you will give yourself a huge leg up for the aptitude tests, as the majority of people completing them will have forgotten how to. Fortunately it is a million times easier than most people make out!

When it comes to division you must first assess whether you need to use short division or long division (if you don’t know the difference you will in a second) or whether you can mentally perform the calculation. For example if I gave you the problem 70 ÷ 5, mentally you should be able to calculate that the answer is 14. However if I gave you the equation 847 ÷ 5, that’s a whole other story, 99.99% of people can’t work that out in their head and thus we need to resort to short division.

3.1.1 Short and long division

There are two methods when dividing larger numbers together (that you can’t perform mentally), these are known as short division and long division. Short division is generally used when the divisor is a single digit number (for example, 2383 ÷6. The number 6 is the divisor and it is a single digit). When the divisor is more than one digit, short division becomes too complicated and thus we resort to long division (for example 2383 ÷26. The number 26 is the divisor and it is double digit). You will understand why it becomes too complicated to use short division when the divisor is greater than one digit after we do a few examples. Let start with short division first!
3.1.2 Short division

The process for short division is a step by step one that is extremely easy. I will demonstrate it for you below and then I will provide you with a link to a video that will explain it again (to further consolidate the process).

Let’s take the above example: 847 ÷ 5

Step 1: can I calculate it in my head – NO

Step 2: is the divisor single digit – Yes - so short division

Step 3: draw with numbers spaced apart

\[ \begin{array}{c}
5 \\
\hline
8 \ 4 \ 7
\end{array} \]

Step 4: Divide first number. 8 ÷ 5 = 1, remainder 3

\[ \begin{array}{c}
5 \\
\hline
8 \ 4 \ 7
\end{array} \]

Step 5: Write answer above 8, carry remainder (3 over to next number)

\[ \begin{array}{c}
1 \\
\hline
8 \ 3 \ 4 \ 7
\end{array} \]

Step 6: Divide second number. 34 ÷ 5 = 6, remainder 4

\[ \begin{array}{c}
1 \\
\hline
8 \ 3 \ 4 \ 7
\end{array} \]
Step 7: Write answer above 34, carry remainder

\[
\begin{array}{c}
\phantom{5)8}\phantom{447}\\
\phantom{5)8}\phantom{447}\\
\phantom{5)8}\phantom{447}\\
\end{array}
\]

Step 8: Calculate \(47 \div 5 = 9\), remainder 2. Write 9 above 47, and put decimal. Then put decimal after 47. Because there was a remainder it means a decimal will continue, so put a 0 after the decimal behind the 47.

\[
\begin{array}{c}
\phantom{5)8}\phantom{447}\\
\phantom{5)8}\phantom{447}\\
\phantom{5)8}\phantom{447}\\
\phantom{5)8}\phantom{447}\\
\end{array}
\]

Step 9: Carry the 2

\[
\begin{array}{c}
\phantom{5)8}\phantom{447}\\
\phantom{5)8}\phantom{447}\\
\phantom{5)8}\phantom{447}\\
\phantom{5)8}\phantom{447}\\
\end{array}
\]

Step 10: Calculate \(20 \div 5 = 4\), no remainder

\[
\begin{array}{c}
\phantom{5)8}\phantom{447}\\
\phantom{5)8}\phantom{447}\\
\phantom{5)8}\phantom{447}\\
\phantom{5)8}\phantom{447}\\
\end{array}
\]
Video: The above example is also demonstrated in this video. I recommend you take a look as it will consolidate this process before you try some yourself. It also explains the process of continuing with decimal places in short division.

### 3.1.3 Exercise 1 (short division)

Complete the following problems to two decimal places using short division (the answers are at the back of the book):

1. \(482 \div 6\)
2. \(6978 \div 4\)
3. \(1122 \div 8\)
4. \(3621 \div 7\)
5. \(793 \div 9\)

### 3.2 Long division

As mentioned above there are two methods when dividing larger numbers together (that you can’t perform mentally); these are known as short division and long division. Short division has been explained above so now I will cover long division. Long division is used when the divisor is more than one digit in length, this is because short division becomes too complicated (for example 2383 ÷ 26 or 2383 ÷ 124. The number 26 is the divisor in the first problem and 124 in the second problem. You will see that both times the number is more than one digit in length).

The process to demonstrate long division is too long and detailed to outline in a series of steps. Thus the process is explained in this video. If you need a further explanation then click here for another video.
3.2.1 Exercise 2 (long division)

Complete the following problems to two decimal places using long division (the answers are at the back of the book):

1. $676 \div 13$
2. $4973 \div 42$
3. $6112 \div 124$
4. $3224 \div 220$
5. $796 \div 91$

3.3 Multiplication

Now that we have covered long division and short division it is time that we go over multiplication (when I say multiplication I am referring to all of the number outside of your times tables). I’m going to assume that you already know how to do your times tables, seeing as you have been completing the deck of cards exercise in the first chapter!

Multiplication of larger digits should come back to you very quickly therefore I will demonstrate a few examples below and then I will provide a video link. After this you will be required to complete an exercise of 5 questions.
3.3.1 One by two digits

What is 54 x 7?

Step 1: Write it out

\[
\begin{array}{c}
54 \\
\times 7
\end{array}
\]

Step 2: 7 x 4 = 28. Write down the 8, carry the 2

\[
\begin{array}{c}
^2 \underline{54} \\
\times \underline{7} \\
\underline{8}
\end{array}
\]

Step 3: 7 x 5 = 35. 35 + 2 = 37. Write down 37

\[
\begin{array}{c}
^2 \underline{54} \\
\times \underline{7} \\
\underline{378}
\end{array}
\]
3.3.2 Two by two digits

What is 54 x 17?

Step 1: Write it out

\[ \begin{array}{c}
54 \\
\times 17
\end{array} \]

Step 2: 7 x 4 = 28. Write down the 8, carry the 2

\[ \begin{array}{c}
54 \\
\times 17
\end{array} \]

\[ \begin{array}{r}
378 \\
8
\end{array} \]

Step 7: Add together 8 + 0 = 8.

\[ \begin{array}{c}
54 \\
\times 17
\end{array} \]

\[ \begin{array}{r}
378 \\
540 \\
\hline
8
\end{array} \]

Step 8: Add 7 + 4 = 11. Write down 1, carry the 1

\[ \begin{array}{c}
54 \\
\times 17
\end{array} \]

\[ \begin{array}{r}
378 \\
540 \\
\hline
18
\end{array} \]

Step 3: 7 x 5 = 35. 35 + 2 = 37. Write down 37

\[ \begin{array}{c}
54 \\
\times 17
\end{array} \]

\[ \begin{array}{r}
378 \\
\hline
378
\end{array} \]

Step 4: Add 0 under eight.

\[ \begin{array}{c}
54 \\
\times 17
\end{array} \]

\[ \begin{array}{r}
378 \\
0
\end{array} \]

Step 9: 3 + 5 = 8. 8 + 1 = 9. Write down 9

\[ \begin{array}{c}
54 \\
\times 17
\end{array} \]

\[ \begin{array}{r}
378 \\
540 \\
\hline
918
\end{array} \]

Step 5: 1 x 4 = 4. Write down 4

\[ \begin{array}{c}
54 \\
\times 17
\end{array} \]

\[ \begin{array}{r}
378 \\
40
\end{array} \]

Step 6: 1 x 5 = 5. Write down 5

\[ \begin{array}{c}
54 \\
\times 17
\end{array} \]

\[ \begin{array}{r}
378 \\
540
\end{array} \]
3.3.3 Three by three digits

What is 354 x 117?

Step 1: Write it out

\[
\begin{array}{c}
354 \\
\times 117 \\
\hline
8 \\
\end{array}
\]

Step 2: 7 \times 4 = 28. Write down the 8, carry the 2

\[
\begin{array}{c}
354 \\
\times 117 \\
\hline
2478 \\
3540 \\
\end{array}
\]

Step 3: 7 \times 5 = 35. 35 + 2 = 37. Write down 7, carry the 3.

\[
\begin{array}{c}
354 \\
\times 117 \\
\hline
2478 \\
3540 \\
0 \\
\end{array}
\]


\[
\begin{array}{c}
354 \\
\times 117 \\
\hline
2478 \\
3540 \\
400 \\
\end{array}
\]

Step 5: Add 0 under eight.

\[
\begin{array}{c}
354 \\
\times 117 \\
\hline
2478 \\
3540 \\
5400 \\
\end{array}
\]

Step 6: 1 \times 4 = 4. Write down 4

\[
\begin{array}{c}
354 \\
\times 117 \\
\hline
2478 \\
40 \\
\end{array}
\]

Step 7: 1 \times 5 = 5. Write down 5

\[
\begin{array}{c}
354 \\
\times 117 \\
\hline
2478 \\
540 \\
\end{array}
\]

Step 8: 1 \times 3 = 3. Write down 3

\[
\begin{array}{c}
354 \\
\times 117 \\
\hline
2478 \\
3540 \\
\end{array}
\]

Step 9: Add two 0's under 3540.

\[
\begin{array}{c}
354 \\
\times 117 \\
\hline
2478 \\
3540 \\
0 \\
\end{array}
\]

Step 10: Multiply 1 \times 4 = 4. Write down 4

\[
\begin{array}{c}
354 \\
\times 117 \\
\hline
2478 \\
3540 \\
0 \\
\end{array}
\]

Step 11: Multiply 1 \times 5 = 5. Write down 5

\[
\begin{array}{c}
354 \\
\times 117 \\
\hline
2478 \\
3540 \\
5400 \\
\end{array}
\]

Step 12: Multiply 1 \times 3 = 3. Write down 3

\[
\begin{array}{c}
354 \\
\times 117 \\
\hline
2478 \\
3540 \\
35400 \\
\end{array}
\]
In addition to this example I also recommend you look at [this video](#) before completing the following exercises. It will work as a good consolidation to these examples.

### 3.3.4 Exercise 3 (multiplication)

Complete the following problems using the methods outlined above (the answers are at the back of the book):

1. $7 \times 456$
2. $17 \times 339$
3. $26 \times 126$
4. $129 \times 236$
5. $321 \times 213$
3.4 Addition

Addition is extremely simple. This quick refresher will clear out any cobwebs in your system.

3.4.1 Three digits plus three digits

What is 657 + 296?

Step 1: Draw it out

\[
\begin{array}{c}
657 \\
+296 \\
\hline
\end{array}
\]

Step 2: 7 + 6 = 13. Write the 3, carry the 1.

\[
\begin{array}{c}
6\overline{5}7 \\
+296 \\
\hline
3
\end{array}
\]

Step 3: 5 + 9 + 1 = 15. Write the 5, carry the 1.

\[
\begin{array}{c}
6\overline{5}7 \\
+296 \\
\hline
53
\end{array}
\]


\[
\begin{array}{c}
6\overline{5}7 \\
+296 \\
\hline
953
\end{array}
\]

If you need a further explanation and to see more complicated examples, click to watch this video here.
3.4.2 Exercise 4 (addition)

Complete the following problems using the methods outlined above (the answers are at the back of the book):

1. $198 + 254 + 663$
2. $19882 + 9018$
3. $1223 + 1398$
4. $8927 + 29387 + 387744$
5. $29288 + 19 + 3 + 3207$
3.5 Subtraction

As with addition, subtraction will most likely be fairly easy for you already. However once again I will run through a quick refresher just to be sure!

What is $657 - 296$?

Step 1: Draw it out

\[
\begin{align*}
6 &\;5\;7 \\
- &\;2\;9\;6 \\
\hline
&\;3\;6\;1 \\
\end{align*}
\]

Step 2: $7 - 6 = 1$. Write the 1.

\[
\begin{align*}
6 \;5\;7 \\
- \;2\;9\;6 \\
\hline
1 \\
\end{align*}
\]

Step 3: $5 - 9$ gets a negative number, therefore take one from 6, and add 1 to 5.

\[
\begin{align*}
5 &\;6\;5\;7 \\
- &\;2\;9\;6 \\
\hline
1 \\
\end{align*}
\]


\[
\begin{align*}
5 &\;6\;5\;7 \\
- &\;2\;9\;6 \\
\hline
6 &\;1 \\
\end{align*}
\]

Step 5: $5 - 2 = 3$. Write 3.

\[
\begin{align*}
5 &\;6\;5\;7 \\
- &\;2\;9\;6 \\
\hline
3 &\;6\;1 \\
\end{align*}
\]

For further examples, I highly encourage you to watch this video here.
3.5.1  Exercise 5 (subtraction)

Complete the following problems using the methods outlined above (the answers are at the back of the book):

1. $456 - 235$
2. $5446 - 5940$
3. $7718 - 2201$
4. $9811 - 5699$
5. $4122 - 3695$

3.6  Exercise 6 (all types from the Basic Four)

Complete the following problems using the correct methods outlined in the above sections (the answers are at the back of the book):

1. $556 + 228$
2. $2398 \div 6$
3. $582 \times 64$
4. $6129 \div 43$
5. $9823 - 2212$
6. $3694 + 2241 - 5623$
7. $226 \times 361$
8. $2955 + 14 + 667 + 1423$
9. $1139 \div 9$
10. $1946 - 338$
4. Working with decimals

Throughout the aptitude tests, interviews and especially throughout your career as an Officer (whether that be Ground Defence/Pilot/ACO/ATC or other) you will be required to calculate problems that contain decimals. Once again they are extremely basic to do however it is amazing how quickly we forget these basic skills once we start relying on a calculator. The purpose of this chapter is to bring you back up to speed with dividing, multiplying, adding and subtracting decimals.

4.1 Dividing decimals

The first step in dividing decimals together is to make sure the Divisor (e.g. In 13.125 ÷ 1.85. 1.85 is the divisor) is a whole number. The way you do this is by moving the decimal point on the divisor however many spots to the right until the number is whole. For example: with the previous example ‘13.125 ÷ 1.85’ you would need to move the decimal spot on the divisor two spots to the right in order to make it a whole number of 185. Now because you have moved the decimal point on the divisor two spots to the right you must also do that to the dividend (which is 13.125). Therefore the dividend becomes 1312.5. Now you calculate for 1312.5 ÷ 185. If you type the first equation (13.125 ÷ 1.85) into a calculator and the second equation into the calculator (1312.5 ÷ 185) you will see that the answer comes out to be the same.

Once the divisor is a whole number you put a decimal in the answer right above the decimal in the dividend. Have a look at the example below to see what we mean. Now you can go ahead and do long division EXACTLY the same way as outlined in 3.2.
What is $13.125 \div 1.85$?

**Step one: Write out**

$$1.85 \overline{)13.125}$$

**Step two: Make Divisor a whole number**

$$1,85 \overline{)13,125}$$

**Step three: Put decimal for answer above decimal in dividend**

$$185 \overline{)131.25}$$

**Step Four: Solve as per normal long division**

$$185 \overline{)131.25}$$

If the question was $131.2 \div 1.85$ then you would have to apply a little trick. After you move the decimal two spaces to the right for the divisor you would go to move the decimal two spots to the right for the dividend. However after moving it once to the right you don’t have any more numbers to jump. Therefore what you do is you add a zero and then jump the decimal over that. So the question would now be $13120 \div 185$.

Once again the process of long division is too detailed to write out an example. Instead watch this video here for a practical example of dividing decimals.
4.1.1 Exercise 7 (dividing decimals)

Complete the following problems using the methods outlined above (the answers are at the back of the book):

1. \(32.41 \div 6.2\)
2. \(56.3 \div 17.45\)
3. \(16.7 \div 72\)
4. \(55 \div 18.25\)
5. \(63.16 \div 7.23\)

4.2 Multiplying decimals

The process to multiply decimals is extremely easy. Say for example you wanted to multiply 6.23 x 1.2. What you do is you move the decimal point to the right for the first number until this number becomes whole (so for 6.23, it would be two spots to the right to make 623) and remember the amount of places the decimal spot moved (for 6.23 it was 2). Now you do the same thing for the second number (for 1.2 it would be one spot to the right to make 12) and once again remember the amount of places you moved the decimal point (for 1.2 it was 1). Now you find the total amount of decimal places moved for both numbers by adding the two numbers together (so add 2 + 1 = 3) and remember this number (so remember 3). Now you go ahead and multiply the two whole numbers together using the method outlined in 3.3.2 (623 x 12 = 7476). Once you have the answer (which is 7476) you then insert back into the number (from right to left) the total amount of decimals you took out at the start (which was 3), this is the final answer (7.476, therefore 6.23 x 1.2 = 7.476).
A second example: What is 6.23 x 7.61?

Step 1: Take out decimals and counts places moved – 623 x 761 (4 decimal places)

Step 2: Do the multiplication as per 3.3.3 – 623 x 761 = 474103

Step 3: Insert back in decimal places from the right (4 decimal places) - 47.4103

Step 4: 6.23 x 7.61 = 47.4103

The video here gives a further example of this. In this video they leave the decimal in when doing the calculation however in my opinion it is neater (and less confusing) if you take them out at the start and insert them back in at the end. Either way is fine.

4.2.1 Exercise 8 (multiplying decimals)

Complete the following problems using the methods outlined above (the answers are at the back of the book):

1. 2.4 x 7
2. 3.5 x 4.9
3. 8.24 x 7.2
4. 3.19 x 5.62
5. 7.121 x 7.6
4.3 Adding decimals

In order to add decimals together all you need to do is line the decimal points up, add a decimal point in the answer row and add as per 3.4.4.

First example: What is 3.67 + 2.95?

\[
\begin{array}{c}
3.67 \\
+2.95 \\
\hline
6.62
\end{array}
\]

Step 1: Line up the decimals -

Step 2: Calculate as per 3.4.4 -

Second example: What is 3.67 + 4.2?

\[
\begin{array}{c}
3.67 \\
+4.20 \\
\hline
7.87
\end{array}
\]

Step 1: Line up the decimals -

Step 2: Calculate as per 3.4.4 -

For a final consolidation of adding decimals, ensure you watch this video here.
4.3.1 Exercise 9 (adding decimals)

Complete the following problems using the methods outlined above. Calculate to full decimal places (the answers are at the back of the book):

1. $6.12 + 7.39$
2. $5.112 + .14$
3. $.0012 + 1.013$
4. $.095 + 112.63$
5. $.0111 + 0.111$

4.4 Subtracting decimals

Subtracting decimals follows the same process as adding decimals. First you must line up the decimal places, then you must subtract as per the same method outlined in 3.5.

Example: What is $3.67 - 2.95$?

Step 1: Line up the decimals – \[
\begin{array}{c}
3.67 \\
-2.95 \\
\hline
\end{array}
\]

Step 2: Calculate as per 3.5 – \[
\begin{array}{c}
3.67 \\
-2.95 \\
\hline
0.72
\end{array}
\]

For a further demonstration of subtracting decimals, ensure you watch this video here before attempting the following exercise.
4.4.1 Exercise 10 (subtracting decimals)

Complete the following problems using the methods outlined above. Calculate to full decimal places (the answers are at the back of the book):

1. 7.14 – 2.33
2. 0.154 - .0014
3. 17.221 – 12.12
4. 1.21 – 0.2211
5. 3.92 – 2.823

4.5 Exercise 11 (all types of decimals)

Complete the following problems using the correct methods outlined in the above sections (the answers are at the back of the book):

1. 6.26 x 7.9
2. 4.33 – 1.003
3. 4.66 ÷ 2.12
4. 3.951 + 6.02
5. 0.303 + .129
6. 4.629 – .1302
7. 2.15 x 0.65
8. 71 ÷ 5.66
9. 3.1 x 4.92
10. 66.71 ÷ 16.3
5. Fractions

Working with fractions will become extremely regular for you throughout your career in the military. You must be able to change proper fractions to improper fractions and visa versa. You must also be able to divide, multiply, add and subtract them with relative ease. Because of this, your ability to work with fractions is assessed during the aptitude tests. This next section will refresh you on how to calculate all of the above problems.

5.1 Converting improper fractions to proper fractions and vice versa

Answers are always given as proper fractions! It is important to remember this because sometimes the answer of a question we solve will be an improper and we have to convert this to a proper fraction as the final step.

If you completed a problem and came to an answer of \( \frac{13}{6} \) you should immediately see that this is an improper fraction. An improper fraction is a fraction that has a larger number on top and a smaller number on the bottom (for this example 13 is bigger than 6). To get to the final answer you must convert it to a proper fraction.

The way you covert to a proper fraction is you work out how many times the bottom number will go into the top number (in this case it’s twice, 6 goes into 13 twice), and what the remainder is (in this case it’s 1). Therefore the answer will be how many times the ‘bottom number goes into the top number’ displayed next to the ‘remainder over the bottom number’. The example \( \frac{13}{6} \) would convert to \( 2\frac{1}{6} \) (you can see that the number 2, which is how many times the 6 goes into 13, is on the right. And the number 1, which is the remainder when you divide 13 by 6, is above the 6).

To covert a proper fraction into an improper fraction (which you will need to do when you are dividing, multiplying, adding or subtracting fractions) you must multiply the bottom number by the left number and add the top number, then put this answer on top of the bottom number. For example to convert \( 2\frac{1}{6} \) to an improper fraction you would multiply 6 by 2 \( ( \frac{2 \times 6}{6} ) \) which equals 12. Then you add 1 \( ( \frac{1}{6} ) \) which equals 13. Then you put this answer over the bottom number \( ( \frac{13}{6} ) \) which is 6. Therefore the answer would be \( \frac{13}{6} \). You could then go ahead and divide, multiply, add
or subtract this by other fractions and then once you have the solution convert it back to a proper fraction.

It is much easier to understand the conversion process of proper fractions to improper fractions (and vice versa) when it is practically demonstrated. The videos below provide a good addition to the above explanation (In the video’s they refer to proper fractions as ‘mixed numbers’, they are the same thing). Click this link for a further demonstration of converting proper fractions to improper fractions, and click this link here for converting improper fractions to proper fractions. I highly recommend you watch these before attempting the following exercise.

5.1.1 Exercise 12 (converting fractions - proper to improper and vice versa)

Complete the following problems using the methods outlined above (the answers are at the back of the book):

1. Convert $\frac{15}{6}$ to a proper fraction
2. Convert $\frac{7}{3}$ to a proper fraction
3. Convert $3\frac{1}{4}$ to an improper fraction
4. Convert $5\frac{1}{2}$ to an improper fraction
5. Convert $\frac{3}{2}$ to a proper fraction

5.2 Dividing fractions

You might remember from high school that the technique used for dividing fractions is ‘cross multiplying’. It is very straightforward, and the below example will guide you through the process.

Example: What is $\frac{3}{5} \div \frac{4}{5}$?

Step 1: Cross multiply - $\frac{3}{5} \times \frac{5}{4}$ (red x red, blue x blue)

or

Step 1.1: Invert the second fraction and multiply - $\frac{3}{5} \times \frac{4}{5}$ (you can see that this will
get the same answer as step 1 however now follows the basic principle of multiplying fractions (this
is covered in the next section). It is less confusing because you don’t have to think about diagonally
multiplying therefore it is the one that I recommend).

Step 2: \[ \frac{3 \times 5}{5 \times 4} = \frac{15}{20} \]

Step 3: Simplify - \[ \frac{15}{20} = \frac{3}{4} \] (The common numeral is 5: \( \frac{15 \div 5 = 3}{20 \div 5 = 4} \))

For further examples of dividing fractions watch this video before completing the exercise below! In
these video’s they refer to proper fraction as ‘mixed numbers’, they are the same thing!

5.2.1 Exercise 13 (dividing fractions)

Complete the following problems using the methods outlined above. All answers are to be converted
to proper fractions (the answers are at the back of the book):

1) \( \frac{3}{4} \div \frac{1}{2} \)
2) \( \frac{5}{2} \div \frac{3}{4} \)
3) \( 1 \frac{3}{4} \div 2 \frac{1}{2} \)
4) \( 3 \frac{1}{2} \div 2 \frac{1}{4} \)
5) \( \frac{7}{4} \div 1 \frac{5}{6} \)
5.3 Multiplying fractions

Multiplying fractions are done the same way as the final step of dividing fractions. You simply convert to improper (if you have to) making sure the fractions are one number over another and then multiply in a line.

For example: What is \( \frac{3}{5} \times \frac{1}{4} \)

Step 1: Convert the proper fraction to improper fraction - \( \frac{3}{5} \times \frac{5}{4} \)

Step 2: Multiply the top two number and the bottom two numbers - \( \frac{3 \times 5}{5 \times 4} \) (red x red, blue x blue)

Step 3: Simplify answer - \( \frac{15}{20} = \frac{3}{4} \)

Step 4: The answer is a proper fraction so leave as is!

For a further consolidation of multiplying fractions I recommend watching this video here before completing the next exercise.

5.3.1 Exercise 14 (multiplying fractions)

Complete the following problems using the methods outlined above. All answers are to be converted to proper fractions (the answers are at the back of the book):

1. \( \frac{2}{5} \times \frac{1}{4} \)
2. \( \frac{4}{7} \times 1\frac{2}{3} \)
3. \( 1\frac{3}{5} \times 1\frac{5}{6} \)
4. \( \frac{1}{3} \times \frac{13}{2} \)
5. \( 2\frac{3}{4} \times \frac{1}{2} \)
5.4 Adding fractions

Adding fraction requires the ability to make the denominator (the bottom number) of both fractions the same, then adding the two top numbers together, and then finally simplifying to get an answer. You must first convert to an improper fraction if required, so each fraction has only one number over another.

For example: What is $\frac{1}{2} + \frac{3}{7}$?

Step 1: Find the lowest common denominator. In this case it is 14. ($2 \times 7 = 14$ and $7 \times 2 = 14$) - $\frac{1}{14} + \frac{3}{14}$

Step 2: Multiply the numerators (top number of the fractions) by the same number you multiplied the bottom number by to get the lowest common denominators (14) -

Step 3: Add the numerators (the top numbers together) and put over the lowest common denominator ($7 + 6$) - $\frac{13}{14}$

Step 4: Simplify - $\frac{13}{14}$ cannot be simplified any-more

For a number of further examples and to see the process in action, watch this video [here](#)!
5.4.1 Exercise 15 (adding fractions)

Complete the following problems using the methods outlined above. All answers are to be converted to proper fractions (the answers are at the back of the book):

1. What is $\frac{1}{2} + \frac{1}{3}$
2. What is $\frac{5}{6} + \frac{1}{4}$
3. What is $1\frac{4}{5} + \frac{2}{3}$
4. What is $3\frac{1}{2} + \frac{1}{7}$
5. What is $\frac{9}{2} + 1\frac{1}{9}$
5.5 Subtracting Fractions

Subtracting fractions follows the same process as adding fractions. The only difference is the last step (before you simplify) where you subtract the second numerator from the first numerator instead of add.

For example: What is \( \frac{1}{2} - \frac{3}{7} \)?

**Step 1:** Find the lowest common denominator. In this case it is 14. (2 x 7 = 14 and 7 x 2 = 14) - \( \frac{1}{14} - \frac{3}{14} \)

**Step 2:** Multiply the numerators (top number of the fractions) by the same number you multiplied the bottom number by to get the lowest common denominator (14) -

\[
\begin{align*}
\frac{1}{2} & \quad \times \quad 7 \\
\frac{3}{7} & \quad \times \quad 2 \\
\frac{7}{14} & \quad - \quad \frac{6}{14}
\end{align*}
\]

**Step 3:** Subtract the second numerator from the first numerator (the top numbers) and put over the lowest common denominator (7 - 6) – \( \frac{1}{14} \)

**Step 4:** Simplify – \( \frac{1}{14} \) cannot be simplified any-more

For a number of further examples and to see the process in action, watch this video [here](#)!
5.5.1 Exercise 16 (subtracting fractions)

Complete the following problems using the methods outlined above. All answers are to be converted to proper fractions (the answers are at the back of the book):

1. What is \( \frac{1}{2} - \frac{1}{3} \)
2. What is \( \frac{5}{6} - \frac{1}{4} \)
3. What is \( 1\frac{4}{5} - \frac{2}{3} \)
4. What is \( 3\frac{1}{2} - \frac{1}{7} \)
5. What is \( \frac{9}{2} - 1\frac{1}{9} \)

5.6 Exercise 17 (all types of fractions)

Complete the following problems using the correct methods outlined in the above sections. Ensure all answers are displayed as proper fractions (the answers are at the back of the book):

1. What is \( \frac{5}{6} \times \frac{1}{4} \)
2. What is \( \frac{7}{3} - \frac{1}{3} \)
3. What is \( 1\frac{5}{6} \div \frac{5}{6} \)
4. What is \( 3\frac{2}{3} + \frac{1}{4} \)
5. What is \( \frac{5}{5} - \frac{1}{5} \)
6. What is \( \frac{5}{3} \times \frac{2}{3} \)
7. What is \( \frac{1}{6} + 2\frac{1}{9} \)
8. What is \( \frac{2}{2} + \frac{6}{5} \)
9. What is \( 2 - \frac{1}{9} \)
10. What is \( \frac{7}{9} + 1\frac{1}{9} \)
6. Converting fractions to decimals

There will be times throughout your career as an Officer that you will be required to convert fractions into decimals, and as such some of the aptitude tests assess your ability to do this. There are also a variety of fractions that you must be able to quickly identify as decimals and vice versa. This next segment will show you how to convert a fraction into a decimal and then outline the most common fractions and decimals that you will learn to convert immediately.

6.1 Fractions to decimals

Converting a fraction to a decimal is done by using short division or long division (depending on the size of the denominator. If the denominator is greater than two digits it is easier to use long division. E.g. $\frac{1}{24}$). It is literally exactly the same as the process outlined in 3.1.2 or 3.2, because when you think about it, a fraction is really just one number divided by another (for example $\frac{1}{4}$ is just $1 \div 4$).

It would be extremely pedantic to write down another example of how to do short or long division, especially considering it is already outlined in an above chapter. In case you would like a refresher, this video here explains the process extremely well using many examples with fractions.

6.1.1 Exercise 18 (convert fractions to decimals via long/short division)

Complete the following problems using the correct methods outlined in the above sections. Complete answers to two decimal places (the answers are at the back of the book):

1. Convert $\frac{1}{16}$ to a decimal
2. Convert $\frac{2}{5}$ to a decimal
3. Convert $\frac{3}{24}$ to a decimal
4. Convert $\frac{7}{15}$ to a decimal
5. Convert $\frac{5}{67}$ to a decimal
6.2 Important decimals to fractions (and vice versa quickly)

There are a number of decimals that you must immediately be able to recognise and convert to fractions and vice versa. These particular decimals will come up quite regularly in the testing conducted throughout the Selection Process and you shouldn’t need to perform long/short division to solve them (you won’t have the time). There are some easy ways to remember how to do these conversions quickly, however some of them you will just have to memorise through repetition. An example of one of the questions where converting these decimals to fractions will come in handy was one of the questions in our ‘free practice tests’ on our website:

E.g. $0.56 ÷ \frac{4}{7} \times 16 = \text{a) 14 b) 17.5 c) 18.4 d) 16}$

Once you memorize the chart on the next page (the important decimals you must be able to convert immediately to fractions) you will quickly realise that $\frac{4}{7}$ equals 0.56. Now (in the above example) you should be able to see that ‘$0.56 ÷ \frac{4}{7}$’ = 1, and $1 \times 16 = 16$. Quick and easy! As a matter of fact once you know these quick decimal conversions these questions become some of the easiest in the exams!

So below are the decimals you must immediately be able to recognise and convert to fractions and vice versa. After the chart I will break down for you an easy way to remember how to convert some of these.
6.3 Fractions table

Below is the list of fractions that you will need to learn to convert over (instantaneously) to decimals and vice versa.

\(\frac{1}{2} = 0.5\)

\(\frac{1}{3} = 0.333\), \(\frac{2}{3} = 0.666\)

\(\frac{1}{4} = 0.25\), \(\frac{2}{4} = 0.5\), \(\frac{3}{4} = 0.75\)

\(\frac{1}{5} = 0.2\), \(\frac{2}{5} = 0.4\), \(\frac{3}{5} = 0.6\), \(\frac{4}{5} = 0.8\)

\(\frac{1}{6} = 0.17\), \(\frac{2}{6} = 0.333\), \(\frac{3}{6} = 0.5\), \(\frac{4}{6} = 0.666\), \(\frac{5}{6} = 0.83\)

\(\frac{1}{7} = 0.14\), \(\frac{2}{7} = 0.28\), \(\frac{3}{7} = 0.42\), \(\frac{4}{7} = 0.56\), \(\frac{5}{7} = 0.7\), \(\frac{6}{7} = 0.84\)

\(\frac{1}{8} = 0.125\), \(\frac{2}{8} = 0.25\), \(\frac{3}{8} = 0.375\), \(\frac{4}{8} = 0.5\), \(\frac{5}{8} = 0.625\), \(\frac{6}{8} = 0.75\), \(\frac{7}{8} = 0.875\)

\(\frac{1}{9} = 0.111\), \(\frac{2}{9} = 0.222\), \(\frac{3}{9} = 0.333\), \(\frac{4}{9} = 0.444\), \(\frac{5}{9} = 0.555\), \(\frac{6}{9} = 0.666\), \(\frac{7}{9} = 0.777\), \(\frac{8}{9} = 0.888\)

\(\frac{1}{10} = 0.1\), \(\frac{1}{20} = 0.05\), \(\frac{1}{25} = 0.04\), \(\frac{1}{50} = 0.02\), \(\frac{1}{100} = 0.01\)
There are some simple tricks that you can use to convert these decimals over to fractions and vice versa. For starters let’s eliminate the ones that you should already know and are easy to remember!

Below I have highlighted in green the ones that you should already know or are easy to remember, and I have highlighted in red the ones that you probably don’t already know (I will teach you some tricks for these after the chart).

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Decimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>0.5</td>
</tr>
<tr>
<td>1/3</td>
<td>0.333</td>
</tr>
<tr>
<td>2/3</td>
<td>0.666</td>
</tr>
<tr>
<td>1/4</td>
<td>0.25</td>
</tr>
<tr>
<td>2/4</td>
<td>0.5</td>
</tr>
<tr>
<td>3/4</td>
<td>0.75</td>
</tr>
<tr>
<td>1/5</td>
<td>0.2</td>
</tr>
<tr>
<td>2/5</td>
<td>0.4</td>
</tr>
<tr>
<td>3/5</td>
<td>0.6</td>
</tr>
<tr>
<td>4/5</td>
<td>0.8</td>
</tr>
<tr>
<td>1/6</td>
<td>0.17</td>
</tr>
<tr>
<td>5/6</td>
<td>0.83</td>
</tr>
<tr>
<td>1/7</td>
<td>0.14</td>
</tr>
<tr>
<td>2/7</td>
<td>0.28</td>
</tr>
<tr>
<td>3/7</td>
<td>0.42</td>
</tr>
<tr>
<td>4/7</td>
<td>0.56</td>
</tr>
<tr>
<td>5/7</td>
<td>0.7</td>
</tr>
<tr>
<td>6/7</td>
<td>0.84</td>
</tr>
<tr>
<td>1/8</td>
<td>0.125</td>
</tr>
<tr>
<td>3/8</td>
<td>0.375</td>
</tr>
<tr>
<td>5/8</td>
<td>0.625</td>
</tr>
<tr>
<td>7/8</td>
<td>0.875</td>
</tr>
<tr>
<td>1/9</td>
<td>0.111</td>
</tr>
<tr>
<td>2/9</td>
<td>0.222</td>
</tr>
<tr>
<td>4/9</td>
<td>0.444</td>
</tr>
<tr>
<td>5/9</td>
<td>0.555</td>
</tr>
<tr>
<td>7/9</td>
<td>0.777</td>
</tr>
<tr>
<td>8/9</td>
<td>0.888</td>
</tr>
<tr>
<td>1/10</td>
<td>0.1</td>
</tr>
<tr>
<td>1/20</td>
<td>0.05</td>
</tr>
<tr>
<td>1/25</td>
<td>0.04</td>
</tr>
<tr>
<td>1/50</td>
<td>0.02</td>
</tr>
<tr>
<td>1/100</td>
<td>0.01</td>
</tr>
</tbody>
</table>
Once they are highlighted like this you can see that there really aren’t that many to learn (the ones in red)! And as for them, I am about to teach you some tricks which will help.

\[
\frac{1}{7} = 0.14 \quad \frac{2}{7} = 0.28 \quad \frac{3}{7} = 0.42 \quad \frac{4}{7} = 0.56 \quad \frac{5}{7} = 0.70 \quad \frac{6}{7} = 0.84
\] – These fractions are probably ones that you can’t yet convert quickly. This trick should help you: Pick any of the “7th” fractions, I’ll pick \(\frac{3}{7}\) for this example. Multiple the numerator (top number) by 2: \(3 \times 2 = 6\). Then multiply that number by 7 (the denominator): \(6 \times 7 = 42\). Now check above and see that \(\frac{3}{7} = 0.42\).

I’ve illustrated the above example in the box below:

<table>
<thead>
<tr>
<th>3</th>
<th>x 2</th>
<th>= 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>x</td>
<td>= 42 - put decimal in front - 0.42</td>
</tr>
</tbody>
</table>

Let’s try another one, this time I’ll pick \(\frac{5}{7}\): \(5 \times 2 = 10\). \(10 \times 7 = 70\). Now check above and see that \(\frac{5}{7} = 0.70\). Once again I have illustrated the example in the box below:

<table>
<thead>
<tr>
<th>5</th>
<th>x 2</th>
<th>= 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>x</td>
<td>= 70 - put decimal in front of it - 0.70</td>
</tr>
</tbody>
</table>

You try some and see if you get the correct answer!

\[
\frac{1}{8} = 0.125 \quad \frac{2}{8} = 0.25 \quad \frac{3}{8} = 0.375 \quad \frac{4}{8} = 0.5 \quad \frac{5}{8} = 0.625 \quad \frac{6}{8} = 0.75 \quad \frac{7}{8} = 0.875
\] –

Unfortunately for these ones there is no easy way to convert them. You will just have to memorize them! But hey, there are only 4 and exercise 19 should help you!
\[ \frac{1}{6} = 0.17 \quad \frac{2}{6} = 0.333 \quad \frac{3}{6} = 0.5 \quad \frac{4}{6} = 0.666 \quad \frac{5}{6} = 0.83 \] – The same with these 2, you will just have to memorize them. An easy way to remember them is if you see \( \frac{5}{6} \) remember that \( \frac{4}{6} = 0.666 \) therefore the answer must be greater than 0.666! Once again exercise 19 should help you!

So now that you know the trick with the ‘7th’ fractions, in total you only need to memorize 6 fractions:

\[ \frac{1}{8} = 0.125 \quad \frac{3}{8} = 0.375 \quad \frac{5}{8} = 0.625 \quad \frac{7}{8} = 0.875 \quad \frac{1}{6} = 0.17 \quad \frac{5}{6} = 0.83 \] - Not bad from a list of 41!

For the following exercises (19 and 20) I recommend you print them out and complete them as many times as you have to until all of these fractions and decimals are stuck in your memory! Should only take about 3-4 attempts!
6.3.1 Exercise 19 (Fill in the decimals)

*Answers in above charts

\[
\frac{1}{2} = \\
\frac{1}{3} = \frac{2}{3} = \\
\frac{1}{4} = \frac{2}{4} = \frac{3}{4} = \\
\frac{1}{5} = \frac{2}{5} = \frac{3}{5} = \frac{4}{5} = \\
\frac{1}{6} = \frac{2}{6} = \frac{3}{6} = \frac{4}{6} = \frac{5}{6} = \\
\frac{1}{7} = \frac{2}{7} = \frac{3}{7} = \frac{4}{7} = \frac{5}{7} = \frac{6}{7} = \\
\frac{1}{8} = \frac{2}{8} = \frac{3}{8} = \frac{4}{8} = \frac{5}{8} = \frac{6}{8} = \frac{7}{8} = \\
\frac{1}{9} = \frac{2}{9} = \frac{3}{9} = \frac{4}{9} = \frac{5}{9} = \frac{6}{9} = \frac{7}{9} = \frac{8}{9} = \\
\frac{1}{10} = \frac{1}{20} = \frac{1}{25} = \frac{1}{50} = \frac{1}{100} =
\]
### 6.3.2 Exercise 20 (Fill in the fractions)

*Answers in above charts*

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Decimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>0.5</td>
</tr>
<tr>
<td>1/3</td>
<td>0.333</td>
</tr>
<tr>
<td>2/3</td>
<td>0.666</td>
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<tr>
<td>1/4</td>
<td>0.25</td>
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<td>2/4</td>
<td>0.5</td>
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<td>3/4</td>
<td>0.75</td>
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</tr>
<tr>
<td>5/10</td>
<td>0.01</td>
</tr>
</tbody>
</table>

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* All Rights Reserved     Page 45 of 76
7. Trigonometry & Geometry

For this stage of your basic maths refresher I will cover the basics of trigonometry. This will be required throughout a number of the tests during the Selection Process! There are four principles which you need to know:

Principle 1: All angles in a triangle equal $180^\circ$

Principle 2: The side of a triangle $- a^2 = b^2 + c^2$

Principle 3: SOH CAH TOA

Principle 4: Basic geometry equations –

a) Circumference of circle = $2\pi r$

b) Area of a circle = $\pi r^2$

c) Arc length of a circle = $\frac{\theta}{360} \times 2\pi r$ (which is the same as saying ‘the full circumference of the circle’ $(2\pi r) \times \text{the percentage of the arc}$ $\frac{\theta}{360}$)

d) Volume of a cube = $s \times s \times s$

I will now break down these principles for you one by one.
7.1 All angles in triangle = 180°

This principle is pretty straightforward. Basically it means that when you add up all the angles in a triangle they MUST equal 180°.

For the below triangle θ must equal 60°. As 180 – (30 + 90) = 60°:

Moving forward from this we must then apply the 180° principle to different types of triangles. There are 3 special names given to triangles, they are: Equilateral, Isosceles and Scalene. The different names of the triangles tell us how many sides (or angles) are equal.

There can be 3, 2 or no equal sides/angles:
Triangles can also have names that tell you what **type of angle** is inside:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Triangle</td>
<td>All angles are less than 90°</td>
</tr>
<tr>
<td>Right Triangle</td>
<td>Has a right angle (90°)</td>
</tr>
<tr>
<td>Obtuse Triangle</td>
<td>Has an angle more than 90°</td>
</tr>
</tbody>
</table>

Regardless of what type of triangle it is, in all cases the angles of a triangle must add up to equal 180°.

The 180° principle is so straightforward that there are no exercises for this component.
7.2 The side of a triangle – Pythagoras theorem: \( a^2 + b^2 = c^2 \)

Once again this should come back to you quite quickly. Pythagoras theorem is \( a^2 + b^2 = c^2 \) and is used to find the side of a right angle triangle (if the other two sides are known). ‘\( c^2 \)’ always refers to the longest side of the triangle (which in a right angle triangle is always the hypotenuse)! The below diagram will demonstrate what Pythagoras theorem is and how to use it:

‘If the triangle had a right angle (90°) ...... and you made a square on each of the three sides, then ... the biggest square had the exact same area as the other two squares put together!’

![Pythagoras Theorem Diagram](image)

Note: \( c \) is the longest side of the triangle. \( a \) and \( b \) are the other two sides!

When you have ‘\( a \)’ and ‘\( b \)’ and are trying to calculate ‘\( c \)’ the formula works quite easily like this:

E.g. what is the length of side \( x \)?

\[
\begin{align*}
\quad a^2 + b^2 &= c^2 \\
\quad c^2 &= 10^2 + 5^2 \\
\quad c^2 &= 100 + 25 \\
\quad c^2 &= 125 \\
\quad c &= \sqrt{125} \\
\quad x &= 11.18 & \text{In the test the answer would be left as } \sqrt{125} \text{ because the final stage is too hard to calculate without the use of a calculator.}
\end{align*}
\]
When you are trying to work out the length of ‘a’ or ‘b’ the calculation is performed slightly different:

E.g. what is the length of side x?

\[ a^2 + b^2 = c^2 \]

\[ 10^2 = 5^2 + b^2 \]

\[ 100 = 25 + b^2 \]

*Difference - Minus 25 from both sides

\[ b^2 = 75 \]

\[ b = \sqrt{75} \]

\[ x = 8.66 – \text{In the test the answer would be left as } \sqrt{75} \text{ because the final stage is too hard to calculate without the use of a calculator.} \]
7.2.1 Exercise 21 \((a^2 + b^2 = c^2)\)

Calculate the answer to the ‘square root’ stage. Answers are at the back of the book.

1. Find the length of \(x\) -

2. Find the length of \(x\) -

3. Find the length of \(x\) -

4. Find the length of \(x\) -

5. Find the length of \(x\) -
7.3 SOH CAH TOA

You will no doubt remember SOH CAH TOA from your days back in year 9 and 10. Well it’s making an appearance again! It’s quite straightforward, so let’s get into it.

SOH CAH TOA:

\[
\sin \theta = \frac{\text{opp}}{\text{hyp}} \\
\cos \theta = \frac{\text{adj}}{\text{hyp}} \\
\tan \theta = \frac{\text{opp}}{\text{adj}}
\]

‘Hypotenuse’ is always opposite the right angle. ‘Opposite’ is always opposite the angle in question. And ‘adjacent’ is the remaining side.

Depending on the values you have regarding a right angle triangle (SOH CAH TOA only works with right angle triangles), you will use one of the above equations to calculate the side of a right angle triangle (using an angle and a side) or an angle of a right angle triangle (using a side and a side).

All you have to do for these questions is determine which values you have and choose the appropriate part of SOH CAH TOA to apply.

The example on the next page will demonstrate what I mean:
Pre-course Maths Book

Chapter 7: Trigonometry & Geometry

Example 1

Find the value of $\theta$ -

Stage 1: Work out what part of ‘SOH CAH TOA’ to use:

- We have the values for ‘opp’ and ‘adj’.

So: $\tan \theta = \frac{opp}{adj}$

Stage 2: $\tan \theta = \frac{4}{12}$

Stage 3: Simplify to $\tan \theta = \frac{1}{3}$

- This is how the answer would appear in the test. Or alternatively it will appear as how you enter it into the calculator as $\tan^{-1}(\frac{1}{3})$. You might remember that when you enter the above expression into the calculator you have to enter the inverse of tan (which is displayed as $\tan^{-1}$). This is ONLY when you have two sides and from that are working out an angle.
Now using a side and an angle to work out a side:

Example 2

Find the value of $x$ -

Stage 1: Work out what part of ‘SOH CAH TOA’ to use:

- We have the values for ‘opp’ and ‘hyp’.

So: $\sin \theta = \frac{\text{opp}}{\text{hyp}}$

Stage 2: Calculate $\sin 30 = \frac{x}{12}$

$x = 12 \times \sin 30$ or $12 \sin 30$ - this is what the answer will appear as in the aptitude tests as it is too hard to calculate this without the use of a calculator!

I recognise that SOH CAH TOA is hard to grasp from just a few written examples. Therefore if you view this link here (for finding the missing angle, used in ‘example 1’ above) and this link here (for finding the length of a side, used in ‘example 2’ above), you will be taken to a great video which gives a further explanation!
7.3.1 Exercise 22 (SOH CAH TOA)

1. Find the value of \( x \) –

2. Find the value of \( x \) –

3. Find the value of \( x \) –

4. Find the value of \( x \) –

5. Find the value of \( x \) –
7.4 Basic geometry equations

The final bits of basic maths that you will need to know are some basic geometry equations. They include:

a) Circumference of circle = 2πr
b) Area of a circle = πr²
c) Arc length of a circle = \( \frac{\theta}{360} \times 2\pi r \) (which is the same as saying ‘the full circumference of the circle’ (2πr) x ‘the percentage of the arc’ - \( \frac{\theta}{360} \))
d) Volume of a cube = s x s x s

* Before we start on these four points I would like to refresh you that there are 2π radians in every 360°, which means there is 1π radian in 180°. If this is confusing to you please watch this video before moving on!

I will quickly break down each point for you and then you will go through and complete an exercise.

a) Circumference of circle = 2πr

Note: For these questions it is important to remember that π = 3.14

1) The radius of a circle is 5 m, what is the circumference (x) of the circle?

\[ x = 2 \times \pi \times 5 \]
\[ = 2 \times 3.14 \times 5 \]
\[ = 6.28 \times 5 \]
\[ = 31.4 \text{ m} \]
b) **Area of a circle = \( \pi r^2 \)**

1) What is the area of the circle?

\[
\text{Area} = \pi r^2 \\
\pi \times 5^2 \\
3.14 \times 25 \\
= 78.5 \text{ m}^2
\]

---

**c) Arc length of a circle = \( \frac{\theta}{360} \times 2\pi r \)**

1) What is the length of the arc (x) in the following circle?

\[
x = \left( \frac{\theta}{360} \right) \times 2\pi r \\
= \left( \frac{30}{360} \right) \times (2\pi \times 5) \\
= \left( \frac{1}{12} \right) \times (6.28 \times 5) \\
= \left( \frac{1}{12} \right) \times (31.4) \\
= \frac{31.4}{12} \\
= 2.62 \text{ m}
\]
When you’re tested on arc lengths you may have to calculate the angles of a triangle in a semi-circle in order to get the angle you will use to calculate the arc length. The angle I’m referring to is this angle here:

\[ x = \frac{\theta}{360} \times 2\pi r \]

Let me step you through the process of how to calculate the angles of a triangle in a semi-circle now.

We will be using a theory known as Thales Theory. Basically what it states is that if you use the whole diameter of the semi-circle as one of the sides of the triangle, the angle of the point of the triangle that touches the outside of the circle must be equal to 90°. You will see in the next picture that this is the case for all three triangles drawn even though the bottom two angles have changed (the top angle is always 90°).

Because we know this rule to be true we can then move forward with it and use it to our advantage.

If I gave you the question:

*In the following diagram, if \( ab = 7 \) meters, what does the arc length \( bc = ? \)*

'ab' refers to the line from 'a' to 'b' (which is the radius of the circle). And the arc length 'bc' refers to the arc of the circle from 'a' to 'b' (indicated in red below). The diagram below illustrates what the question has provided and asked us:
In order to calculate the arc length we need to first calculate $\theta$, as we have all of the other necessary components for the arc length formula (we know the radius is 7 meters and we know $\pi = 3.14$):

$$x = \frac{\theta}{360} \times 2\pi$$

So in order to calculate $\theta$ we will refer to Thales Theory. First we recognise that all of the angles inside the triangle must equal 180. Therefore, because we have the angle of $35^\circ$ (which can also be referred to as angle ‘acb’), we only need to work out the top angle (also known as angle ‘abc’) and we can then calculate $\theta$ using those two (the below picture indicates which angles I’m referring to).

This is where Thales Theory comes in handy. If we draw in a third line ‘BD’, then we have a right angled triangle and certain principles help us out:

We know that the lines $AB$=AD=AC therefore the triangle ABC and ABD are isosceles triangles. We know this because in chapter 7.1 we learnt that an isosceles triangle has two equal sides and two equal angles. Therefore, because we know that there are two equal sides in triangle ‘ABC’, the angles $\beta$ must be the same. This is the same for triangle ‘ABD’, if two sides are equal then the angles $\alpha$ must be the same.
If we refer this back to the original question it is now very easy to work out.

*In the following diagram, if \( ab = 7 \) meters, what does the arc length \( bc \) = ?*

Well, because of Thales Theory we know that angle ABC = 35° as this is an isosceles triangle.

Therefore, because all angles in a triangle must = 180° we know that \( \theta = 180 - (35 + 35) = 110° \). The problem now looks like this:

\[
\text{So } bc = \frac{\theta}{360} \times 2\pi r \\
= \frac{110}{360} \times (2 \times 3.14 \times 7) \\
= \frac{11}{36} \times 43.96 \\
= 0.30 \times 43.96 \\
bc = 13.2 \text{ meters}
\]

Therefore the arc length ‘bc’ is equal to 13.2 meters.
If you were ever asked the same question like this:

*In the following diagram, if \( ac = 14 \) meters, what does the arc length \( bc = ? \)

Then using Thales Theory you could quickly add in the other components and convert it to the below diagram to calculate the answer:

The relationship between angles in a triangle will definitely come in handy for your math tests with Defence. Especially the following diagram illustrating Thales Theory. It is in your best interest to learn the relationships so you can use them on the day!
d) **Volume of a cube** = $s \times s \times s$

Note: The volume of a cube is one up from the area of a square ($s \times s$) and a rectangle follows the same principle as a square (length $\times$ breadth).

1) What is the volume of the following cube?

Volume = $s \times s \times s$

\[
= 5 \times 5 \times 5 \\
= 25 \times 5 \\
= 125 \text{ m}^3
\]
7.4.1 Exercise 23 (Basic geometry)

1. What is the circumference of this circle?

2. What is the area of that same circle?

3. What is the length of the arc in this circle?

4. What is the volume of this cube?

5. What is the length of the arc (x) in this circle?

6. In the following diagram; if ab = 12 meters and abc = 40°, what is the arc length of bc?
7.5  Exercise 24 (all types from chapter 7)

1. What is the value of x?

![Diagram of a triangle with sides 4 in, 2 in, and x.]

2. What is the length of the arc (x) in the following circle?

![Diagram of a circle with an arc labeled x and a central angle of 90 degrees.]

3. What is the value of x?

![Diagram of a right triangle with sides x, 5 m, and 4 m.]

4. What is the area of this rectangle?

![Diagram of a rectangle with dimensions 6 m by 3 m.]

5. What is the value of x?

![Diagram of a right triangle with sides x, 4 m, and 3 m.]

6. What is the value of x?

![Diagram of a right triangle with sides x, 5 m, and 2 m.]

7. What is the circumference of this circle?

![Diagram of a circle with a radius of 5 m and circumference labeled x.]

8. What is the value of $x$?

9. In the following diagram; if $ac = 8$ meters and $acb = 50^\circ$, what is the arc length of $bc$?

10. What is the area of this circle?

11. What is the value of $x$?
8. Square roots

During the mathematical aptitude test you may be required to answer a number of square root problems, whether that be simplifying them or fully completing them. This chapter will provide a refresher on how to do that. Instructions in written format for square roots would be far too complicated to follow thus we have isolated a number of YouTube videos that explain the process extremely well and will be using those for demonstrations.

8.1 Terminology

Some terms I will cover before you watch the demonstrations are:

- Radical – A radical is just another way of referring to a square root.
- Prime number - A prime number is a whole number greater than 1 that has no positive divisors other than 1 and itself.
- Prime factors- In the demonstrations they refer to prime factors a number of times. Please watch this video for an explanation of what a prime factor is.
- Integer – An integer is a number which is not a fraction; a whole number.

8.2 Demonstrations

Please watch the videos from 1 through to 7, making sure you watch ALL of the videos as each video introduces a further concept or provides further consolidation. Don’t be fooled by the use of a ‘dot’ instead of a multiplication sign, a ‘dot’ is just a faster way of writing the multiplication sign ‘x’.

The first video covers what a square root is:

1. A square root

This second video demonstrates how to simplify or calculate the answer to a square root (or radical).

2. Simplifying a square root (or radical)

This third video shows you how to simplify a square root (or radical) in a shorter method – sometimes you might find the method in the above video easier. If that is the case just use the above method. However the better you get at these you might find it easier to follow this slightly shorter method.

3. Simplifying square roots (shorter method)

Further simplification of square roots (more examples)

4. Further square root examples
It is EXTREMELY important that you watch this video containing radicals with higher roots which expands on previous concepts!

5. **Simplifying radicals with higher roots**

And then finally these two videos delve into more complicated square roots containing variables.

6. **Square roots containing variables - 1**
7. **Square roots containing variables - 2**

### 8.2.1 Exercise 25 (simplifying square roots)

Complete the following questions using the concepts that were demonstrated in the above videos.

Simplify the following radicals or square roots:

1) \( \sqrt{96} \)  
2) \( \sqrt{216} \)

3) \( \sqrt{98} \)  
4) \( \sqrt{18} \)

5) \( \sqrt{72} \)  
6) \( \sqrt{144} \)

7) \( \sqrt{45} \)  
8) \( \sqrt{175} \)
9) $\sqrt{343}$

10) $\sqrt{12}$

11) $10\sqrt{96}$

12) $9\sqrt{245}$

13) $7\sqrt{600}$

14) $5\sqrt{45}$

15) $5\sqrt{180}$

16) $3\sqrt{405}$

17) $2\sqrt{36}$

18) $9\sqrt{125}$

19) $8\sqrt{27}$

20) $12\sqrt{1764}$
8.2.2 Exercise 26 (simplifying radicals with variables)

Complete the following questions using the concepts that were demonstrated in the above videos.

Simplify the following radicals or square roots:

1) $\sqrt{125n}$
2) $\sqrt{216v}$

3) $\sqrt{512k^2}$
4) $\sqrt{512m^3}$

5) $\sqrt{216k^4}$
6) $\sqrt{100v^3}$

7) $\sqrt{80p^3}$
8) $\sqrt{45p^2}$

9) $\sqrt{147m^2n^2}$
10) $\sqrt{200m^4n}$
11) $\sqrt{75x^2y}$

12) $\sqrt{64m^3n^3}$

13) $\sqrt{16u^4v^3}$

14) $\sqrt{28x^3y^3}$

15) $\sqrt{36x^2y^3}$

16) $\sqrt{384x^4y^3}$

17) $7\sqrt{96m^3}$

18) $6\sqrt{72x^2}$

19) $-6\sqrt{150r}$

20) $5\sqrt{80a^2}$
8.2.3 Exercise 27 (Simplifying radicals with higher roots)

Complete the following questions using the concepts that were demonstrated in the above videos.

Simplify the following radicals or square roots:

1) \( \sqrt[4]{24} \) 
2) \( \sqrt[3]{1000} \)

3) \( \sqrt[3]{-162} \) 
4) \( \sqrt{512} \)

5) \( \sqrt[4]{128n^8} \) 
6) \( \sqrt[3]{98k} \)

7) \( \sqrt[5]{224r^7} \) 
8) \( \sqrt[3]{24m^3} \)

9) \( \sqrt[4]{405x^3y^2} \) 
10) \( \sqrt[3]{-16a^3b^8} \)

11) \( \sqrt[3]{16xy} \) 
12) \( \sqrt[3]{56x^5y} \)
9. Conclusion

Congratulations on completing the ‘Pre-course Maths Book’. You are now ready to undertake ADFmentors training presentations. Feel free to go back through and complete the exercises contained within to stay fresh before your training course date. We look forward to meeting you and teaching you all of the skills and techniques you will use to excel throughout the ADF aptitude tests!

Keep your head in the books,

Nick Moller

(Managing Director and Head Instructor – ADFmentors)
10. Answers

Exercise 1 (short division):
1. $482 \div 6 = 80.33$
2. $6978 \div 4 = 1744.5$
3. $1122 \div 8 = 140.25$
4. $3621 \div 7 = 517.29$
5. $793 \div 9 = 88.11$

Exercise 2 (long division):
1. $676 \div 13 = 52$
2. $4973 \div 42 = 118.40$
3. $6112 \div 124 = 49.29$
4. $3224 \div 220 = 14.65$
5. $796 \div 91 = 8.75$

Exercise 3 (multiplication):
1. $7 \times 456 = 3192$
2. $17 \times 339 = 5763$
3. $26 \times 126 = 3276$
4. $129 \times 126 = 3276$
5. $321 \times 213 = 68373$

Exercise 4 (addition):
1. $198 + 254 + 663 = 1115$
2. $19882 + 9018 = 28900$
3. $1223 + 1398 = 2621$
4. $8927 + 29387 + 387744 = 426058$
5. $29288 + 19 + 3 + 3207 = 32517$

Exercise 5 (subtraction):
1. $456 - 235 = 221$
2. $5446-5940 = -494$
3. $7718-2201 = 5517$
4. $9811-5699 = 4112$
5. $4122-3695 = 427$

Exercise 6 (all types from the Basic Four):
1. $556 + 228 = 784$
2. $2398 + 6 = 399.66$
3. $582 \times 64 = 37248$
4. $6129 \div 43 = 142.53$
5. $9823 - 2212 = 7611$
6. $3694 + 2241 - 5623 = 312$
7. $226 \times 361 = 81586$
8. $2955 + 14 + 667 + 1423 = 5059$
9. $1139 \div 9 = 126.55$
10. $1946 - 338 = 1608$

Exercise 7 (dividing decimals):
1. $32.41 \div 6.2 = 5.23$
2. $56.3 \div 17.45 = 3.23$
3. $16.7 \div 72 = 0.23$
4. $55 \div 18.25 = 3.01$
5. $63.16 \div 7.23 = 8.74$

Exercise 8 (multiplying decimals):
1. $2.4 \times 7 = 16.8$
2. $3.5 \times 4.9 = 17.15$
3. $8.24 \times 7.2 = 59.33$
4. $3.19 \times 5.62 = 17.93$
5. $7.121 \times 7.6 = 54.12$

Exercise 9 (adding decimals):
1. $6.12 + 7.39 = 13.51$
2. $5.112 + .14 = 5.252$
3. $.0012 + 1.013 = 1.0142$
4. $.095 + 112.63 = 112.725$
5. $.0111 + 0.111 = 0.1221$

Exercise 10 (subtracting decimals):
1. $7.14 - 2.33 = 4.81$
2. $0.154 - .0014 = 0.1526$
3. $17.221 - 12.12 = 5.101$
4. $1.21 - 0.2211 = 0.9889$
5. $3.92 - 2.823 = 1.097$
<table>
<thead>
<tr>
<th>Exercise 11 (all types of decimals)</th>
<th>Exercise 15 (adding fractions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (6.26 \times 7.9 = 49.45)</td>
<td>1. What is (\frac{1}{2} + \frac{1}{3} = \frac{5}{6})</td>
</tr>
<tr>
<td>2. (4.33 - 1.003 = 3.327)</td>
<td>2. What is (-\frac{5}{6} + \frac{1}{4} = 1 \frac{1}{12})</td>
</tr>
<tr>
<td>3. (4.66 \div 2.12 = 2.19)</td>
<td>3. What is (1 \frac{1}{5} + \frac{2}{3} = 2 \frac{7}{15})</td>
</tr>
<tr>
<td>4. (3.951 + 6.02 = 9.971)</td>
<td>4. What is (3 \frac{1}{2} + \frac{1}{7} = 3 \frac{9}{14})</td>
</tr>
<tr>
<td>5. (0.303 + .129 = 0.432)</td>
<td>5. What is (-\frac{9}{2} + 1 \frac{1}{9} = 5 \frac{11}{18})</td>
</tr>
<tr>
<td>6. (4.629 - \frac{1}{3} = 4.4988|</td>
<td></td>
</tr>
<tr>
<td>7. (71 \div 5.66 = 12.54)</td>
<td>Exercise 16 (subtracting fractions)</td>
</tr>
<tr>
<td>8. (951 + 6.02 = 9.971)</td>
<td>1. What is (\frac{1}{2} - \frac{1}{3} = \frac{1}{6})</td>
</tr>
<tr>
<td>9. (0.303 + \frac{1}{9} = 0.432|</td>
<td></td>
</tr>
<tr>
<td>10. (4.629 - \frac{1}{3} = 4.4988|</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exercise 12 (converting fractions - proper to improper and vice versa)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (2 \frac{1}{2})</td>
<td>1. (\frac{1}{2} - \frac{1}{3} = \frac{1}{6})</td>
</tr>
<tr>
<td>2. (2 \frac{1}{3})</td>
<td>2. What is (\frac{5}{6} - \frac{1}{4} = \frac{7}{12})</td>
</tr>
<tr>
<td>3. (\frac{13}{4})</td>
<td>3. What is (1 \frac{4}{5} - \frac{2}{3} = 1 \frac{2}{15})</td>
</tr>
<tr>
<td>4. (\frac{11}{2})</td>
<td>4. What is (3 \frac{1}{2} + \frac{1}{7} = 3 \frac{5}{14})</td>
</tr>
<tr>
<td>5. (1 \frac{1}{2})</td>
<td>5. What is (\frac{9}{2} + 1 \frac{1}{9} = 3 \frac{7}{18})</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exercise 13 (dividing fractions)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (\frac{3}{4} \div \frac{1}{2} = 1 \frac{1}{2})</td>
<td>1. (\frac{5}{6} \times \frac{1}{4} = \frac{5}{24})</td>
</tr>
<tr>
<td>2. (\frac{5}{2} \div \frac{3}{4} = 3 \frac{1}{3})</td>
<td>2. (\frac{7}{3} - \frac{1}{3} = 2)</td>
</tr>
<tr>
<td>3. (1 \frac{3}{4} \div 2 \frac{1}{2} = \frac{7}{10})</td>
<td>3. What is (1 \frac{5}{6} + \frac{5}{6} = 2 \frac{1}{5})</td>
</tr>
<tr>
<td>4. (3 \frac{1}{2} \div 2 \frac{1}{4} = 1 \frac{5}{9})</td>
<td>4. What is (3 \frac{2}{3} + \frac{1}{4} = 3 \frac{11}{12})</td>
</tr>
<tr>
<td>5. (\frac{7}{4} \div 1 \frac{5}{6} = \frac{21}{22})</td>
<td>5. What is (\frac{5}{5} - \frac{1}{5} = \frac{4}{5})</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exercise 14 (multiplying fractions)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (\frac{2}{5} \times \frac{1}{4} = \frac{1}{10})</td>
<td>1. (\frac{5}{6} \times \frac{1}{4} = \frac{5}{24})</td>
</tr>
<tr>
<td>2. (\frac{4}{7} \times 1 \frac{2}{3} = \frac{20}{21})</td>
<td>2. (\frac{7}{3} - \frac{1}{3} = 2)</td>
</tr>
<tr>
<td>3. (\frac{3}{5} \times 1 \frac{5}{6} = 2 \frac{14}{15})</td>
<td>3. What is (1 \frac{5}{6} + \frac{5}{6} = 2 \frac{1}{5})</td>
</tr>
<tr>
<td>4. (\frac{1}{3} \times \frac{13}{2} = 2 \frac{1}{6})</td>
<td>4. What is (3 \frac{2}{3} + \frac{1}{4} = 3 \frac{11}{12})</td>
</tr>
<tr>
<td>5. (2 \frac{3}{4} \times \frac{1}{2} = 1 \frac{3}{8})</td>
<td>5. What is (\frac{5}{5} - \frac{1}{5} = \frac{4}{5})</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exercise 17 (all types of fractions)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (\frac{5}{6} \times \frac{1}{4} = \frac{5}{24})</td>
<td>1. (\frac{5}{6} \times \frac{1}{4} = \frac{5}{24})</td>
</tr>
<tr>
<td>2. (\frac{7}{3} - \frac{1}{3} = 2)</td>
<td>2. (\frac{7}{3} - \frac{1}{3} = 2)</td>
</tr>
<tr>
<td>3. What is (1 \frac{5}{6} + \frac{5}{6} = 2 \frac{1}{5})</td>
<td>3. What is (1 \frac{5}{6} + \frac{5}{6} = 2 \frac{1}{5})</td>
</tr>
<tr>
<td>4. What is (3 \frac{2}{3} + \frac{1}{4} = 3 \frac{11}{12})</td>
<td>4. What is (3 \frac{2}{3} + \frac{1}{4} = 3 \frac{11}{12})</td>
</tr>
<tr>
<td>5. What is (\frac{5}{5} - \frac{1}{5} = \frac{4}{5})</td>
<td>5. What is (\frac{5}{5} - \frac{1}{5} = \frac{4}{5})</td>
</tr>
<tr>
<td>6. What is (\frac{5}{3} \times \frac{2}{3} = 1 \frac{1}{9})</td>
<td>6. What is (\frac{5}{3} \times \frac{2}{3} = 1 \frac{1}{9})</td>
</tr>
<tr>
<td>7. What is (\frac{1}{6} + 2 \frac{1}{9} = 2 \frac{5}{18})</td>
<td>7. What is (\frac{1}{6} + 2 \frac{1}{9} = 2 \frac{5}{18})</td>
</tr>
<tr>
<td>8. What is (\frac{9}{2} \div \frac{6}{5} = 3 \frac{3}{18})</td>
<td>8. What is (\frac{9}{2} \times \frac{2}{3} = 3 \frac{3}{18})</td>
</tr>
<tr>
<td>9. What is (2 - \frac{1}{9} = 1 \frac{8}{9})</td>
<td>9. What is (2 - \frac{1}{9} = 1 \frac{8}{9})</td>
</tr>
<tr>
<td>10. What is (\frac{7}{9} \times 1 \frac{1}{9} = \frac{7}{10})</td>
<td>10. What is (\frac{7}{9} \times 1 \frac{1}{9} = \frac{7}{10})</td>
</tr>
</tbody>
</table>
Exercise 18 (convert fractions to decimals via long/short division)

1. Convert $\frac{1}{16}$ to a decimal = 0.06
2. Convert $\frac{2}{5}$ to a decimal = 0.4
3. Convert $\frac{3}{24}$ to a decimal = 0.12
4. Convert $\frac{7}{15}$ to a decimal = 0.46
5. Convert $\frac{2}{67}$ to a decimal = 0.03

Exercise 21 ($a^2 + b^2 = c^2$)

1. $\sqrt{29}$
2. $\sqrt{45}$
3. $\sqrt{65}$
4. $\sqrt{32}$
5. $\sqrt{27}$

Exercise 22 (SOH CAH TOA)

1. $6\sin30$
2. $\cos x = \frac{4}{5}$
3. $X = \frac{3}{\sin 40}$
4. $\tan x = \frac{3}{2}$
5. $x = 8\cos55$

Exercise 23 (Basic geometry)

1. 43.96m
2. 153.86m²
3. 18.31m
4. 252m³
5. $\text{Arc} = \frac{1}{6} \times 50.25$
   = 9.07 m
6. 20.93m

Exercise 24 (all types from chapter 7)

1. $\sqrt{12} $
2. 4.89m
3. $X = \frac{5}{\sin 40}$
4. 18m²
5. 50°
6. $\cos x = \frac{2}{5}$
7. 75.36m³
8. $X = 7\cos55$
9. 11.16m
10. 452.16m³
11. $X = \frac{10}{\tan 25}$

Exercise 25 (Simplifying square roots)

1) $\sqrt{96}$  2) $\sqrt{216}$  3) $\sqrt{98}$  4) $\sqrt{18}$  5) $\sqrt{72}$  6) $\sqrt{144}$  7) $\sqrt{45}$  8) $\sqrt{175}$  9) $\sqrt{343}$  10) $\sqrt{12}$  11) $10\sqrt{96}$  12) $9\sqrt{245}$  13) $7\sqrt{600}$  14) $5\sqrt{45}$  15) $5\sqrt{180}$  16) $3\sqrt{405}$  17) $2\sqrt{36}$  18) $9\sqrt{125}$  19) $8\sqrt{27}$  20) $12\sqrt{1764}$  21) $24\sqrt{3}$  22) 504
### Exercise 26 (radicals with variables)

1. \(\sqrt[5]{125n}\)
2. \(\sqrt[6]{216v}\)
3. \(\sqrt[16k]{512}\)
4. \(\sqrt{512n^3}\)
5. \(\sqrt[6]{216k^4}\)
6. \(\sqrt[10]{100v^3}\)
7. \(\sqrt[4]{80p^5}\)
8. \(\sqrt[3]{45p^7}\)
9. \(\sqrt[7]{147m^3n^3}\)
10. \(\sqrt[10]{200m^4n}\)
11. \(\sqrt[5]{75x^2y}\)
12. \(\sqrt[8]{64m^3n^7}\)
13. \(\sqrt[4]{16x^4v^3}\)
14. \(\sqrt[2]{28x^3y^3}\)
15. \(\sqrt[6]{36x^3y^3}\)
16. \(\sqrt[8]{384x^4y^3}\)
17. \(\sqrt[28m\sqrt{6m}]\)
18. \(6\sqrt[36]{72x^2}\)
19. \(-6\sqrt{150r}\)
20. \(5\sqrt[20\alpha^2]{80a^2}\)

### Exercise 27 (radicals with high roots)

1. \(\sqrt[2]{24}\)
2. \(\sqrt[1000]{10}\)
3. \(\sqrt[3]{162}\)
4. \(\sqrt[3]{512}\)
5. \(\sqrt[2]{128n^3}\)
6. \(\sqrt[2]{98k}\)
7. \(\sqrt[224r^3]{7}\)
8. \(\sqrt[24m^3]{3}\)
9. \(\sqrt[405x^3y^2]{3}\)
10. \(\sqrt[16a^2b^8]{-2ab}\)
11. \(\sqrt[16xy]{2}\)
12. \(\sqrt[2\sqrt{2xy}]{56x^5y}\)

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