8 Fractions and decimals

This work will help you

- revise ordering, adding and subtracting fractions
- multiply and divide a whole number by a fraction
- convert between fractions and decimals, including recurring decimals

A Simplifying and comparing fractions

A1 Copy and complete these pairs of equivalent fractions.

(a) $\frac{4}{5} = \frac{?}{20}$ (b) $\frac{12}{40} = \frac{?}{10}$ (c) $\frac{3}{8} = \frac{?}{24}$ (d) $\frac{2}{5} = \frac{10}{?}$ (e) $\frac{16}{30} = \frac{?}{90}$

(f) $\frac{2}{7} = \frac{10}{?}$ (g) $\frac{8}{9} = \frac{32}{?}$ (h) $\frac{4}{11} = \frac{32}{?}$ (i) $\frac{12}{20} = \frac{?}{5}$ (j) $\frac{1}{5} = \frac{?}{25}$

A2 Simplify these fractions as far as possible.

(a) $\frac{18}{20}$ (b) $\frac{9}{21}$ (c) $\frac{25}{45}$ (d) $\frac{18}{48}$ (e) $\frac{24}{80}$

(f) $\frac{24}{60}$ (g) $\frac{8}{32}$ (h) $\frac{20}{90}$ (i) $\frac{36}{84}$ (j) $\frac{30}{56}$

To compare fractions, change them to the same denominator.

Example Which is greater, $\frac{3}{5}$ or $\frac{5}{8}$?

$\frac{3}{5} = \frac{24}{40}$ $\frac{5}{8} = \frac{25}{40}$ So $\frac{5}{8}$ is greater.

A3 Which fraction in each pair is greater?

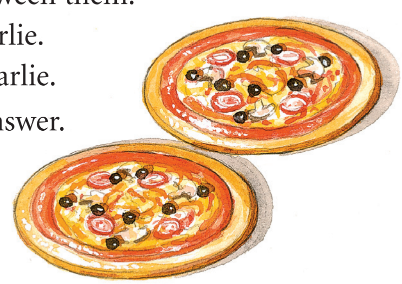
(a) $\frac{3}{4}$ or $\frac{11}{12}$ (b) $\frac{3}{4}$ or $\frac{7}{9}$ (c) $\frac{5}{7}$ or $\frac{7}{10}$ (d) $\frac{3}{8}$ or $\frac{5}{12}$ (e) $\frac{9}{11}$ or $\frac{5}{6}$

(f) $\frac{5}{8}$ or $\frac{2}{3}$ (g) $\frac{3}{10}$ or $\frac{2}{7}$ (h) $\frac{4}{5}$ or $\frac{7}{9}$ (i) $\frac{3}{5}$ or $\frac{2}{3}$ (j) $\frac{11}{16}$ or $\frac{2}{3}$

A4 Albert, Bess and Charlie share two identical pizzas between them.
Albert has $\frac{3}{5}$ of the first pizza and gives the rest to Charlie.
Bess has $\frac{2}{3}$ of the second pizza and gives the rest to Charlie.

(a) Who has most pizza? Explain how you get your answer.

(b) Who has least? Explain your answer.



B Adding and subtracting fractions

B1 Work these out. Simplify the result where possible.

(a) $\frac{3}{4} - \frac{2}{3}$ (b) $\frac{1}{12} + \frac{2}{3}$ (c) $\frac{3}{5} - \frac{1}{5}$ (d) $\frac{3}{8} + \frac{1}{5}$ (e) $\frac{5}{6} - \frac{1}{4}$

(f) $\frac{5}{6} - \frac{3}{5}$ (g) $\frac{1}{8} + \frac{1}{5}$ (h) $\frac{3}{5} + \frac{1}{4}$ (i) $\frac{7}{8} - \frac{2}{3}$ (j) $\frac{5}{12} - \frac{1}{4}$

B2 Work these out.

(a) $\frac{1}{4} + \frac{1}{5} + \frac{1}{6}$ (b) $\frac{1}{3} + \frac{1}{5} + \frac{1}{8}$ (c) $\frac{1}{3} + \frac{1}{5} - \frac{1}{6}$ (d) $\frac{1}{4} - \frac{1}{5} + \frac{1}{6}$

B3 Which two of these fractions do you add together to get the largest possible result? Explain your answer.

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

B4 What fraction is missing in each of these?

(a) $\frac{1}{5} + \textbf{?} = \frac{3}{4}$ (b) $\textbf{?} + \frac{1}{6} = \frac{3}{8}$ (c) $\textbf{?} - \frac{1}{5} = \frac{1}{6}$ (d) $\frac{1}{4} - \textbf{?} = \frac{1}{6}$

B5 (a) Work out $\frac{3}{5} + \frac{1}{4}$. (b) Hence work out $2\frac{3}{5} + 1\frac{1}{4}$.

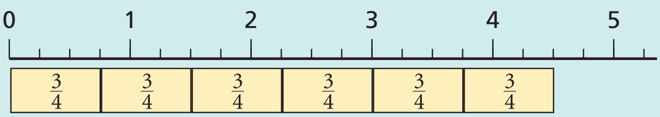
B6 (a) Work out $\frac{3}{4} - \frac{1}{3}$. (b) Hence work out $4\frac{3}{4} - 2\frac{1}{3}$.

B7 Work these out. Simplify the result where possible.

(a) $3\frac{2}{3} + 1\frac{1}{6}$ (b) $3\frac{2}{3} - 1\frac{1}{6}$ (c) $4\frac{3}{4} + 1\frac{1}{8}$ (d) $1\frac{1}{3} - \frac{3}{4}$ (e) $1\frac{1}{4} - \frac{4}{5}$

C Multiplying a whole number by a fraction

T



$6 \times \frac{3}{4}$

$6 \times \frac{3}{4} = \frac{18}{4} = \frac{9}{2} = \mathbf{4\frac{1}{2}}$

$\frac{3}{4} \times 6$

$\frac{3}{\cancel{4}_2} \times \cancel{6}^3 = \frac{9}{2} = \mathbf{4\frac{1}{2}}$

$\frac{3}{4}$ of 6

$\frac{1}{2}$ of 6 = 3

So $\frac{1}{4}$ of 6 = $1\frac{1}{2}$

So $\frac{3}{4}$ of 6 = $\mathbf{4\frac{1}{2}}$

C1 Work these out.

(a) $10 \times \frac{1}{2}$ (b) $\frac{1}{2} \times 15$ (c) $12 \times \frac{1}{4}$ (d) $\frac{1}{4} \times 9$ (e) $2 \times \frac{3}{8}$

(f) $5 \times \frac{2}{3}$ (g) $\frac{3}{4} \times 14$ (h) $8 \times \frac{2}{5}$ (i) $\frac{5}{6} \times 15$ (j) $12 \times \frac{5}{8}$

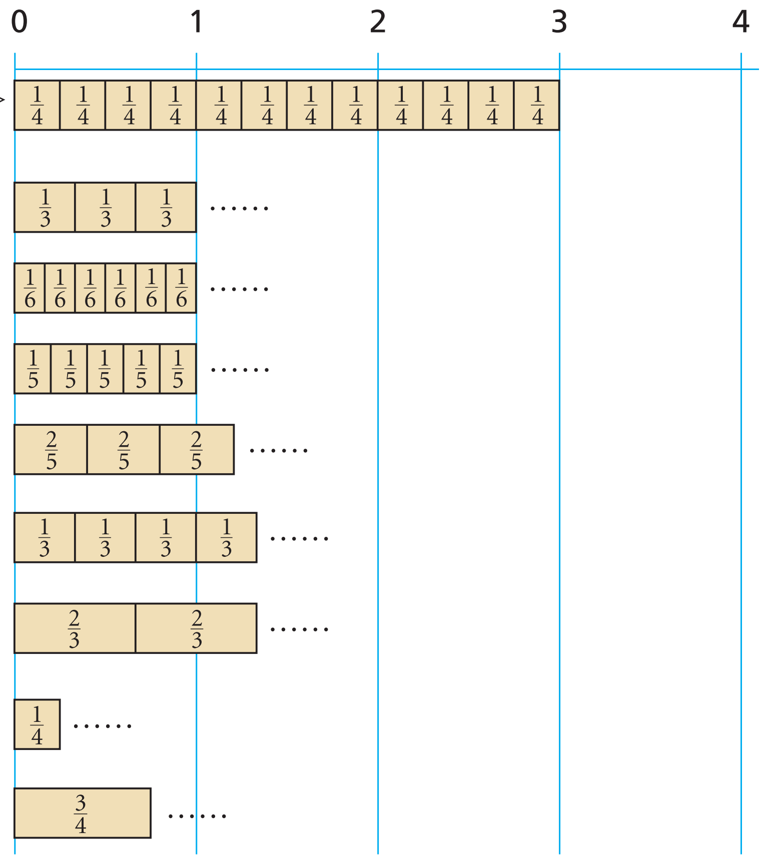
C2 Work these out.

(a) $\frac{1}{3} \times 8$ (b) $9 \times \frac{2}{3}$ (c) $\frac{3}{8} \times 20$ (d) $16 \times \frac{5}{8}$ (e) $7 \times \frac{1}{3}$

(f) $10 \times \frac{2}{5}$ (g) $3 \times \frac{3}{4}$ (h) $\frac{7}{10} \times 5$ (i) $15 \times \frac{2}{5}$ (j) $\frac{5}{6} \times 7$

D Dividing a whole number by a fraction

$3 \div \frac{1}{4}$
means 'how many $\frac{1}{4}$s in 3'.
So $3 \div \frac{1}{4} = \mathbf{12}$



D1 What is $2 \div \frac{1}{3}$?

D2 What is $3 \div \frac{1}{6}$?

D3 What is $4 \div \frac{1}{5}$?

D4 What is $4 \div \frac{2}{5}$?

D5 What is $4 \div \frac{1}{3}$?

D6 What is $4 \div \frac{2}{3}$?

D7 What is $6 \div \frac{1}{4}$?

D8 What is $6 \div \frac{3}{4}$?

You can do these in a similar way, by imagining the diagrams.

D9 (a) $9 \div \frac{1}{4}$ (b) $9 \div \frac{3}{4}$ (c) $6 \div \frac{1}{3}$ (d) $6 \div \frac{2}{3}$ (e) $10 \div \frac{1}{8}$ (f) $10 \div \frac{5}{8}$

D10 (a) $6 \div \frac{1}{5}$ (b) $6 \div \frac{2}{5}$ (c) $6 \div \frac{3}{5}$

D11 (a) Perry writes down a rule for dividing a whole number by a fraction.
It starts like this.

> Example: $4 \div \frac{2}{3}$
>
> First multiply the whole number by the denominator of the fraction: 4 x 3 = 12.
> Then

Finish the rule.

(b) What do you get if you use the rule for $2 \div \frac{3}{4}$?
Draw a diagram to show that the result is correct.

D12 Work these out.

(a) $8 \div \frac{1}{4}$ (b) $\frac{1}{4} \times 8$ (c) $12 \times \frac{2}{3}$ (d) $12 \div \frac{2}{3}$ (e) $7 \times \frac{1}{8}$ (f) $7 \div \frac{1}{8}$

T

E Changing fractions to decimals

To change a fraction to a decimal, you divide the numerator by the denominator.

For example, $\frac{5}{8} = 5 \div 8$
$= \mathbf{0.625}$

$$\begin{array}{r} 0.6\ 2\ 5 \\ 8\overline{)5.0^{2}0^{4}0} \end{array}$$

When you change $\frac{1}{3}$ to a decimal, the calculation goes on forever.

0.3333… is called a **recurring** decimal.

$$\begin{array}{r} 0.3\ 3\ 3\ 3\ 3\ \ldots \\ 3\overline{)1.0^{1}0^{1}0^{1}0^{1}0\ \ldots} \end{array}$$

E1 Change $\frac{2}{3}$ to a recurring decimal.

E2 (a) Work out $\frac{1}{9}$ as a recurring decimal.
(b) Repeat for $\frac{2}{9}$, $\frac{3}{9}$, … and so on.

E3 (a) $\frac{1}{6}$ is half of $\frac{1}{3}$, or $\frac{1}{3}$ divided by 2.
Starting from the recurring decimal for $\frac{1}{3}$, work out the recurring decimal for $\frac{1}{6}$.
(b) Use the result for $\frac{1}{6}$ to find the recurring decimal for $\frac{1}{12}$.

E4 When you work out $\frac{1}{7}$ as a recurring decimal, a whole group of figures recurs:

$$\begin{array}{r} 0.\overbrace{1\ 4\ 2\ 8\ 5\ 7}\ \overbrace{1\ 4\ 2\ 8\ 5\ 7}\ 1\ \ldots \\ 7\overline{)1.0^{3}0^{2}0^{6}0^{4}0^{5}0^{1}0^{3}0^{2}0^{6}0^{4}0^{5}0^{1}0\ \ldots} \end{array}$$

Work out the recurring decimals for $\frac{2}{7}$, $\frac{3}{7}$, … What do you notice?

E5 Find the recurring decimal for
(a) $\frac{1}{13}$ (b) $\frac{1}{17}$

$$\begin{array}{r} 0.076 \\ 13\overline{)1.0000000000000\ \ldots} \\ \underline{91} \\ 90 \\ \underline{78} \end{array}$$

Investigation

- Add some more fractions to each of these lists.

Fractions leading to recurring decimals	$\frac{1}{3}$	$\frac{1}{6}$	$\frac{1}{7}$	$\frac{1}{9}$	$\frac{1}{12}$		
Fractions leading to terminating decimals	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{5}$	$\frac{1}{8}$	$\frac{1}{10}$	$\frac{1}{20}$	$\frac{1}{25}$

- Try to find a rule to tell you when a fraction will lead to a recurring decimal.
- Test your rule on these fractions.

$\frac{1}{21}$ $\frac{1}{30}$ $\frac{1}{11}$ $\frac{1}{15}$ $\frac{1}{40}$ $\frac{1}{16}$ $\frac{1}{80}$ $\frac{1}{36}$ $\frac{1}{52}$ $\frac{1}{64}$

F Mixed questions

F1 During one term, Prakesh had 14 music lessons of $\frac{1}{4}$ hour each, 9 lessons of $\frac{1}{2}$ hour and 7 lessons of $\frac{3}{4}$ hour.

How many hours was this altogether?

F2 Carol cuts a cake into three pieces. She gives $\frac{1}{3}$ to Debbie, $\frac{1}{4}$ to Elly and keeps the rest for herself.

(a) What fraction of the cake does Carol get?

(b) What is the difference between Carol's fraction and Debbie's?

(c) What is the difference between Carol's fraction and Elly's?

F3 Gail is weaving rugs, which are all identical.
In $\frac{1}{4}$ hour she weaves $\frac{2}{3}$ of a rug.
How many rugs will she weave in 4 hours, if she works at the same rate?

F4 (a) From the facts that $\frac{1}{3} = 0.3333\ldots$ and $\frac{1}{2} = 0.5$, it follows that $\frac{1}{3} + \frac{1}{2} =$

$$\begin{array}{r} 0.33333\ldots \\ +\ 0.5 \\ \hline 0.83333\ldots \\ \hline \end{array}$$

What fraction is equivalent to the recurring decimal 0.83333… ?

(b) Work out $\frac{1}{3} + \frac{1}{4}$ (i) as a fraction (ii) as a recurring decimal

Egyptian fractions

The ancient Egyptians used only 'unit fractions' like $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, … (but they did allow $\frac{2}{3}$).

They expressed other fractions by adding unit fractions together.

For example, $\frac{5}{6} = \frac{1}{2} + \frac{1}{3}$ $\frac{19}{20} = \frac{1}{2} + \frac{1}{4} + \frac{1}{5}$

(They didn't repeat the same unit fraction, so $\frac{1}{3} + \frac{1}{3} + \frac{1}{5}$, for example, would not be allowed.)

- Find a way to write each of these fractions in the Egyptian way.
  (You may be able to find more than one way for some of them.)

  $\frac{5}{8}$ $\frac{7}{8}$ $\frac{7}{12}$ $\frac{9}{10}$ $\frac{17}{30}$

What progress have you made?

Statement	Evidence
I can multiply a whole number by a fraction.	**1** Work out (a) $15 \times \frac{3}{4}$ (b) $\frac{5}{8} \times 20$
I can divide a whole number by a fraction.	**2** Work out (a) $12 \div \frac{1}{6}$ (b) $8 \div \frac{2}{3}$
I can change fractions to decimals, including recurring decimals.	**3** Change each of these to a decimal. (a) $\frac{7}{20}$ (b) $\frac{1}{11}$ (c) $\frac{7}{11}$

8 Fractions and decimals

p 55 **A** Simplifying and comparing fractions

p 56 **B** Adding and subtracting fractions

p 56 **C** Multiplying a whole number by a fraction

p 57 **D** Dividing a whole number by a fraction

p 58 **E** Changing fractions to decimals

p 59 **F** Mixed questions

Practice booklet pages 27 to 29

A Simplifying and comparing fractions (p 55)

B Adding and subtracting fractions (p 56)

C Multiplying a whole number by a fraction (p 56)

T

◊ '6 lots of $\frac{3}{4}$' and '$\frac{3}{4}$ of 6' do not 'feel' the same, even though they give the same result. You may need to spend some time dealing with different ways of understanding 'fraction × whole number' (or vice versa).

For example, pupils may find it helpful to see that $6 \times \frac{3}{4}$ is equivalent to $6 \times 3 \div 4$ and that $\frac{3}{4}$ of 6 is equivalent to $6 \div 4 \times 3$. As the order of '× 3' and '÷ 4' doesn't matter, the two expressions reduce to the same calculation.

The number line diagram shows that '6 lots of $\frac{3}{4}$' is 18 quarters, which make 4 whole ones and 2 quarters, or $4\frac{1}{2}$.

◊ This is a good point to introduce or revise cancelling common factors, because the fact that the result is as expected helps to convince pupils that the process is legitimate.

D Dividing a whole number by a fraction (p 57)

◊ Ordinary language is no help here. Someone who says 'Divide 10 by $\frac{1}{2}$' usually means 'Halve 10'.

You may need to give several whole-number examples to establish that A ÷ B can be thought of as 'How many Bs in A?'. For example, 15 ÷ 3 can mean 'How many 3s in 15?'.

◊ It will also help if you start with a number such as 12 and divide by smaller and smaller numbers. As the number you divide by gets smaller, the result gets larger. So pupils should expect $12 \div \frac{1}{2}$ to be greater than $12 \div 1$.

E Changing fractions to decimals (p 58)

T

◊ Some pupils may be fascinated by the idea of a never-ending process leading to a number which can never be completely written out (in decimal notation).

The mystery deepens when you ask them to multiply 0.3333… by 3. The result, as a decimal, is 0.9999… However, we know that $3 \times \frac{1}{3} = 1$, from which it follows that 0.9999… = 1.

Pupils may find the following argument helpful.

Let $u = 0.9999\ldots$
Then $10u = 9.9999\ldots$

Subtract: $9u = 9$

So $u = 1$

Some pupils may insist that 0.9999… is not equal to 1, that it differs from 1 by a tiny amount. Try asking how big this amount is.

Investigation

The fractions which lead to terminating decimals are those whose denominators have only 2 and/or 5 as prime factors. In other words their denominators are of the form $2^m \times 5^n$ (where either m or n could be 0).

Extension 1 Recurring decimals with a calculator

Pupils will have seen that the recurring digits in the decimals for $\frac{1}{7}, \frac{2}{7}, \ldots$ are cyclic. Although the pattern may be more complex in other cases, the cyclic property opens up a way of using a calculator to investigate recurring decimals.

For example, for $\frac{1}{17}$ a 10-digit calculator shows 0.058823529.

For $\frac{2}{17}$ it shows 0.117647058.

Because the group 058 occurs in both, it suggests that the decimal for $\frac{2}{17}$ continues like this: 0.117647058823529.

If we try $\frac{3}{17}$, we get 0.176470588, which does not help.

$\frac{4}{17}$ gives 0.235294117, which suggests the complete cycle in the decimal for $\frac{1}{17}$ is 0588235294117647.

(There may be a problem when the calculator automatically rounds up the last displayed digit if the next one is 5 or more.)

Sometimes there is no single cycle of digits but two or more separate cycles.

Extension 2 How many recurring digits are there?

The number of recurring figures is interesting but more difficult to generalise about. In the division process the recurrence starts when the same remainder appears twice. For example, when we divide 1 by 7, the remainders are 1, then 3, 2, 6, 4, 5, then 1 again:

$$\begin{array}{r} 0.\,1\,4\,2\,8\,5\,7 \\ 7\overline{)\,1\,.\,{}^{1}0\,{}^{3}0\,{}^{2}0\,{}^{6}0\,{}^{4}0\,{}^{5}0\,{}^{1}0\,\ldots} \end{array}$$

There are only six possible remainders (1, 2, 3, 4, 5, 6) and they are all used up in this process. If we are dividing by 13, there are 12 possible remainders; so the number of recurring figures cannot be more than 12. In fact, the process recurs after only six of the remainders are used. In the case of division by 17, all of the 16 remainders are used and there are thus 16 recurring figures.

F Mixed questions (p 59)

A Simplifying and comparing fractions (p 55)

A1 (a) $\frac{4}{5} = \frac{\mathbf{16}}{20}$ (b) $\frac{12}{40} = \frac{\mathbf{3}}{10}$

(c) $\frac{3}{8} = \frac{\mathbf{9}}{24}$ (d) $\frac{2}{5} = \frac{10}{\mathbf{25}}$

(e) $\frac{16}{30} = \frac{\mathbf{48}}{90}$ (f) $\frac{2}{7} = \frac{10}{\mathbf{35}}$

(g) $\frac{8}{9} = \frac{32}{\mathbf{36}}$ (h) $\frac{4}{11} = \frac{32}{\mathbf{88}}$

(i) $\frac{12}{20} = \frac{\mathbf{3}}{5}$ (j) $\frac{1}{5} = \frac{\mathbf{5}}{25}$

A2 (a) $\frac{9}{10}$ (b) $\frac{3}{7}$ (c) $\frac{5}{9}$ (d) $\frac{3}{8}$
(e) $\frac{3}{10}$ (f) $\frac{2}{5}$ (g) $\frac{1}{4}$ (h) $\frac{2}{9}$
(i) $\frac{3}{7}$ (j) $\frac{15}{28}$

A3 (a) $\frac{11}{12}$ (b) $\frac{7}{9}$ (c) $\frac{5}{7}$ (d) $\frac{5}{12}$
(e) $\frac{5}{6}$ (f) $\frac{2}{3}$ (g) $\frac{3}{10}$ (h) $\frac{4}{5}$
(i) $\frac{2}{3}$ (j) $\frac{11}{16}$

A4 (a) Albert has $\frac{9}{15}$ of a pizza, Bess has $\frac{10}{15}$ of a pizza. So Charlie has $\frac{11}{15}$ of a pizza (because $\frac{30}{15} - \frac{9}{15} - \frac{10}{15} = \frac{11}{15}$). Charlie has most.

(b) Albert has least.

B Adding and subtracting fractions (p 56)

B1 (a) $\frac{1}{12}$ (b) $\frac{3}{4}$ (c) $\frac{2}{5}$ (d) $\frac{23}{40}$
(e) $\frac{7}{12}$ (f) $\frac{7}{30}$ (g) $\frac{13}{40}$ (h) $\frac{17}{20}$
(i) $\frac{5}{24}$ (j) $\frac{1}{6}$

B2 (a) $\frac{37}{60}$ (b) $\frac{79}{120}$ (c) $\frac{11}{30}$ (d) $\frac{13}{60}$

B3 $\frac{3}{4}$ and $\frac{7}{10}$, because these are the largest two fractions.
($\frac{3}{4} = \frac{30}{40}, \frac{3}{5} = \frac{24}{40}, \frac{5}{8} = \frac{25}{40}, \frac{7}{10} = \frac{28}{40}$)

B4 (a) $\frac{11}{20}$ (b) $\frac{5}{24}$ (c) $\frac{11}{30}$ (d) $\frac{1}{12}$

B5 (a) $\frac{17}{20}$ (b) $3\frac{17}{20}$

B6 (a) $\frac{5}{12}$ (b) $2\frac{5}{12}$

B7 (a) $4\frac{5}{6}$ (b) $2\frac{1}{2}$ (c) $5\frac{7}{8}$ (d) $\frac{7}{12}$
(e) $\frac{9}{20}$

C Multiplying a whole number by a fraction (p 56)

C1 (a) 5 (b) $7\frac{1}{2}$ (c) 3 (d) $2\frac{1}{4}$
(e) $\frac{3}{4}$ (f) $3\frac{1}{3}$ (g) $10\frac{1}{2}$ (h) $3\frac{1}{5}$
(i) $12\frac{1}{2}$ (j) $7\frac{1}{2}$

C2 (a) $2\frac{2}{3}$ (b) 6 (c) $7\frac{1}{2}$ (d) 10
(e) $2\frac{1}{3}$ (f) 4 (g) $2\frac{1}{4}$ (h) $3\frac{1}{2}$
(i) 6 (j) $5\frac{5}{6}$

D Dividing a whole number by a fraction (p 57)

D1 6

D2 18

D3 20

D4 10

D5 12

D6 6

D7 24

D8 8

D9 (a) 36 (b) 12 (c) 18
(d) 9 (e) 80 (f) 16

D10 (a) 30 (b) 15 (c) 10

D11 (a) … divide by the numerator of the fraction.
(b) $2\frac{2}{3}$; the pupil's diagram

D12 (a) 32 (b) 2 (c) 8
(d) 18 (e) $\frac{7}{8}$ (f) 56

E Changing fractions to decimals (p 58)

E1 0.666…

E2 (a) 0.1111…
(b) $\frac{2}{9}$ = 0.2222…, $\frac{3}{9}$ = 0.3333…, up to $\frac{8}{9}$ = 0.8888…

E3 (a) 0.16666… (b) 0.083333…

E4 $\frac{2}{7}$ = 0.285714285714…
$\frac{3}{7}$ = 0.428571428571…
$\frac{4}{7}$ = 0.571428571428…
$\frac{5}{7}$ = 0.714285714285…
$\frac{6}{7}$ = 0.857142857142…
The figures 2, 8, 5, 7, 1, 4 are always in the same order, but the starting figure is different.

E5 (a) 0.076923076923…
(b) $0.\underbrace{0588235294117647}_{\text{recurs}}$

Investigation

A fraction leads to a recurring decimal when the prime factors of its denominator include numbers other than 2, 5. These are recurring:

$\frac{1}{21}$ $\frac{1}{30}$ $\frac{1}{11}$ $\frac{1}{15}$ $\frac{1}{36}$ $\frac{1}{52}$

F Mixed questions (p 59)

F1 $13\frac{1}{4}$ hours

F2 (a) $\frac{5}{12}$ (b) $\frac{1}{12}$ (c) $\frac{1}{6}$

F3 $10\frac{2}{3}$ rugs

F4 (a) $\frac{5}{6}$
(b) (i) $\frac{7}{12}$ (ii) 0.583333…

Egyptian fractions

Here is one way for each given fraction.

$\frac{5}{8} = \frac{1}{2} + \frac{1}{8}$ $\frac{7}{8} = \frac{1}{2} + \frac{1}{4} + \frac{1}{8}$ $\frac{7}{12} = \frac{1}{2} + \frac{1}{12}$
$\frac{9}{10} = \frac{1}{2} + \frac{1}{3} + \frac{1}{15}$ $\frac{17}{30} = \frac{1}{2} + \frac{1}{15}$

What progress have you made? (p 58)

1 (a) $11\frac{1}{4}$ (b) $12\frac{1}{2}$

2 (a) 72 (b) 12

3 (a) 0.35 (b) 0.09090909…
(c) 0.63636363…

Practice booklet

Sections A and B (p 27)

1 (a) $\frac{6}{9}, \frac{8}{12}$ $\frac{2}{4}, \frac{5}{10}$ $\frac{8}{10}, \frac{12}{15}$

(b) $\frac{5}{15}, \frac{2}{6}$ $\frac{18}{24}, \frac{6}{8}$ $\frac{10}{12}, \frac{5}{6}$

(c) $\frac{15}{40}, \frac{9}{24}$ $\frac{8}{32}, \frac{3}{12}$ $\frac{2}{6}, \frac{4}{12}$

(d) $\frac{12}{30}, \frac{6}{15}$ $\frac{1}{6}, \frac{4}{24}$ $\frac{3}{12}, \frac{5}{20}$

2 (a) $\frac{240}{360} = \frac{48}{72} = \frac{6}{9} = \frac{2}{3}$

(b) $\frac{360}{480} = \frac{90}{120} = \frac{30}{40} = \frac{3}{4}$

3 (a) $\frac{1}{4}$ (b) $\frac{15}{21}$ (c) $\frac{9}{10}$ (d) $\frac{5}{12}$

4 (a) $\frac{11}{12}$ (b) $\frac{11}{20}$ (c) $\frac{11}{15}$ (d) $\frac{7}{15}$

(e) $\frac{5}{18}$ (f) $1\frac{17}{18}$ (g) $\frac{15}{16}$ (h) $\frac{19}{24}$

(i) $6\frac{7}{24}$ (j) $8\frac{47}{80}$

5 (a) $\frac{3}{4}, \frac{7}{8}, \frac{15}{16}$; next terms $\frac{31}{32}, \frac{63}{64}$

6 (a) $\frac{1}{4}, \frac{3}{8}, \frac{5}{16}$; next terms $\frac{7}{32}, \frac{9}{64}$

(b) $\frac{3}{6}, \frac{7}{12}, \frac{15}{24}$; next terms $\frac{31}{48}, \frac{63}{96}$

(c) $\frac{1}{6}, \frac{3}{12}, \frac{5}{24}$; next terms $\frac{7}{48}, \frac{9}{96}$

Sections C and D (p 28)

1 (a) 2 (b) $2\frac{1}{4}$ (c) $5\frac{1}{2}$ (d) $2\frac{2}{5}$

(e) $1\frac{2}{3}$ (f) $5\frac{1}{3}$ (g) $5\frac{3}{5}$ (h) $4\frac{1}{2}$

(i) 15 (j) $3\frac{3}{5}$ (k) $1\frac{5}{7}$ (l) $5\frac{5}{8}$

2 (a) 15 (b) 10 (c) 15 (d) 10

3 (a) 12 (b) 12 (c) 15 (d) 50

4 (a) $13\frac{1}{2}$ (b) 8 (c) 8 (d) 30

5 $4\frac{1}{2}$; the pupil's diagram

6 (a) $6\frac{3}{4}$ (b) 12 (c) 12 (d) $8\frac{1}{3}$

Sections E and F (p 29)

1 (a) 0.06666… and working
(b) 0.03333…

2 (a) 0.28 (b) 0.83333…
(c) 0.375 (d) 0.77777…
(e) 0.025 (f) 0.27272…

3 (a) $\frac{1}{6}$ (b) 4 hours

4 (a) $6\frac{3}{4}$ hours (b) $\frac{1}{2}$ hour more

5 (a) (i) $\frac{2}{3}$ (ii) 0.66666…

(b) (i) $\frac{8}{15}$ (ii) 0.53333…