Exercise 2E

This exercise involves algebraic fractions.

1 Fill in the missing terms.

a $\frac{2c}{ab} = \frac{6c^2}{\square}$ **b** $\frac{2mn}{\square} = \frac{m}{4nt}$ **c** $\frac{3a}{2b} = \frac{\square}{8bc}$ **d** $2ac = \frac{6ace}{\square}$

e $\frac{a-b}{3ab} = \frac{\square}{6a^2b}$ **f** $\frac{3}{17y} = \frac{\square}{51y^2}$ **g** $\frac{4}{13} = \frac{28x}{\square}$

2 Express each of these as a single fraction.

a $\frac{2}{a} + \frac{3}{a}$ **b** $\frac{a}{4} + \frac{a}{3}$ **c** $\frac{6}{x} - \frac{5}{x}$

d $\frac{y}{3} + \frac{y}{4} - \frac{y}{6}$ **e** $\frac{2}{a} - \frac{3}{b}$ **f** $\frac{1}{3x} + \frac{1}{5x}$

g $\frac{1}{4a} - \frac{1}{6a} - 3$ **h** $\frac{b}{4} + \frac{3b}{8} + \frac{1}{2}$ **i** $\frac{x}{4} + \frac{5x}{12} - \frac{x}{3}$

j $\frac{x}{yz} + \frac{z}{xy}$ **k** $\frac{m}{n} + \frac{n}{m}$ **l** $\frac{6a^2}{9a} - \frac{b^2}{a^2}$

m $5 + \frac{31}{3y}$ **n** $\frac{2b}{a} + \frac{a-b}{b}$ **o** $\frac{x}{a-x} - \frac{y}{a-y}$

3 Simplify

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

c $x - \frac{1}{3}(x+3) + \frac{1}{5}(x-2) + 2$ **d** $\frac{3(2x-3y)}{2} - \frac{4(3x+y)}{9} - \frac{3x-17}{18}$

4 Simplify

a $\frac{a}{b} \times \frac{b^2}{a^2}$ **b** $\frac{3x}{2y} \times \frac{6x^2y}{5z}$ **c** $\frac{ab^2}{2} \times 6a$ **d** $3 \times \frac{2x^2}{9}$

e $3 \times \frac{2x^2}{y}$ **f** $3 \times \frac{x^2}{2y}$ **g** $\frac{ab^2}{4c^2d} \times \frac{2cd}{ab}$ **h** $\frac{18ab}{15bc} \times \frac{20ce}{24de}$

i $\frac{mn}{2} \times \frac{2}{mn}$ **j** $\frac{3ab^2}{5b^3c} \times \frac{15b^2c^2}{9a^2b}$ **k** $\frac{a-b}{c} \times \frac{c}{b-a}$ **l** $\frac{6}{a+b} \times \frac{a^2-b^2}{2}$

5 Simplify, expressing as a single fraction

a $\frac{a}{2b} \div \frac{b}{2a}$ **b** $c \div \frac{1}{1-d}$ **c** $\frac{12xy^3}{5xy} \div \frac{2xz}{3xyz}$ **d** $\frac{1}{\frac{x}{y}}$

e $\frac{2}{\frac{a}{b}}$ **f** $\frac{1}{a+\frac{b}{c}}$ **g** $\frac{1}{\frac{x}{y}-z}$ **h** $1 - \frac{1}{a}$

i $\frac{x+1}{1-\frac{1}{x^3}}$ **j** $\frac{\frac{1}{b}+\frac{1}{a}}{\frac{a}{b}-\frac{b}{a}}$

Exercise 2F (Review)

1 Given that $p(x) = 3x + 1$, $q(x) = 2x - 3$, and $r(x) = 5x^2 + x - 7$, find

a $[p(x)]^2$ **b** $[q(x)]^2$ **c** $p(x)q(x)$

d $6p(x) - q(x)$ **e** $p(x)q(x) + r(x)$ **f** $q(x) - r(x)$

g $2r(x) - q(x)$ **h** $r(x) - q(x) - p(x)$

2 Factorise fully.

a $a^2 + 6a + 8$ **b** $a^2 + 5a - 14$ **c** $6a^2 - 11a - 7$

d $a^2 - 9$ **e** $12a^2 - 4a$ **f** $4a^2 - 25$

g $ab + a + b + 1$ **h** $a^3 - 7a^2 + 12a$

3 Given $a = 3$, $b = \frac{1}{4}$, $c = 5$, $d = \frac{2}{7}$ and $e = 2$, find the value of these, giving the answer as simply as possible.

a $\frac{a+c}{e}$ **b** $\frac{a+b}{c}$ **c** $\frac{a+c}{b}$

d $3d$ **e** $\frac{a+3b}{2d}$ **f** $\frac{b}{d}$

g $\frac{a-c}{c-a}$ **h** $12bcd$ **i** $b \div e$

j $7(b+d)$ **k** $a+b+ab$ **l** $10b^2$

m $\frac{12}{d^2}$ **n** $\frac{c-e}{e-c}$ **o** $\frac{(2b)^2}{3d}$

p $\sqrt{a-3b}$

4 Given $a = x + 1$, $b = x^2$, $c = \frac{3}{x}$ and $d = 4 - \frac{1}{x}$, find, giving the answer as simply as possible,

a bc **b** bd **c** bd^2

d $4a - d$ **e** $c + d$ **f** $\frac{c}{d}$

g $c(a^2 - b - 1)$ **h** bc^2 **i** $\sqrt{b + 2a - 1}$

j $\frac{d}{c^2}$ **k** $\frac{c+3d}{3c+d}$ **l** $\frac{1-b}{a}$

10 **a** $(t-3)(t+2)$
b $(2t+5)(3t-2)$
c $(7-2t)(1+6t)$
d $(2t-r)(3t-2r)$
e $(3t-4)(4t-3)$
g $(2t-3u)(3t+5u)$
h $12(t+1)(t-2)$
i $(4t+3)(6t-5)$
j $(3t+4)(8t-3)$
k $(1-x)(1+6x)$
l $(2t-3)(3t-4)$
m $(4-3t)(5t+2)$
n $7(1+2c)(1-2c)$
o $4(3t^2-13t-2)$
p $(3t+1)(4t-9)$
q $(t-6)(4t+1)$
r $(2t-3)^2$
s $(t-3)(4t-5)$
t $(t-15)(4t+1)$
u $4(5t+1)(5t-1)$

11 **a** $n^2(n+3)(n-3)$
b $\pi(R+r)(R-r)$
c $(a+b)(x^2+2)$
d $(e^2+1)(e^2+3)$
e $(2-d)(3+d)$
f $(x^3+2)(2x-1)$
g $(c+2d)(c-2d)$
i $(a+b)(2x+y)$
j $3(4t^2-6t-3)$
k $4(t-1)^2$
m $l(1-3l)(1+l)$
n $(x+7)(x-8)$
o $6(2+x)(1-x)$

12 **a** $-3(x+2)$
b $-(x+3)$
c $4x$
d $(x+1)(x+2)(2x+9)$
e $(N+1)^2(N+2)^2$
f $(a+b)(a^2-ab+b^2)$
g $x(x+7)(3x^2+19x-7)$
h $12(x+2)$
i $(x+2)(5x+12)$
j $x(5x+14)$

Exercise 2E (p. 38)

1 **a** $3abc$ **b** $8n^2t$ **c** $12ac$
d $3e$ **e** $2a(a-b)$
f $9y$ **g** $91x$

2 **a** $\frac{5}{a}$ **b** $\frac{7a}{12}$
c $\frac{1}{x}$ **d** $\frac{5y}{12}$
e $\frac{2b-3a}{ab}$ **f** $\frac{8}{15x}$
g $\frac{1-36a}{12a}$ **h** $\frac{5b+4}{8}$
i $\frac{x}{3}$ **j** $\frac{x^2+z^2}{xyz}$
k $\frac{m^2+n^2}{mn}$ **l** $\frac{2a^3-3b^2}{3a^2}$
m $\frac{15y+31}{3y}$ **n** $\frac{2b^2+a^2-ab}{ab}$
o $\frac{ax-ay}{(a-x)(a-y)}$

3 **a** $\frac{56b-33c}{24}$ **b** $\frac{68-9x}{20}$
c $\frac{13x+9}{15}$ **d** $\frac{27x-89y+17}{18}$

4 **a** $\frac{b}{a}$ **b** $\frac{9x^3}{5z}$ **c** $3a^2b^2$
d $\frac{2x^2}{3}$ **e** $\frac{6x^2}{y}$ **f** $\frac{3x^2}{2y}$
g $\frac{b}{2c}$ **h** $\frac{a}{d}$ **i** 1
j $\frac{c}{a}$ **k** -1 **l** $3(a-b)$

5 **a** $\frac{a^2}{b^2}$ **b** $c(1-d)$ **c** $\frac{18y^3}{5}$
d $\frac{y}{x}$ **e** $\frac{2b}{a}$
f $\frac{c}{ac+b}$ **g** $\frac{y}{x-yz}$
h $\frac{a-1}{a}$ **i** $\frac{x^4+x^3}{x^3-1}$
j $\frac{1}{a-b}$

Exercise 2F Review (p. 39)

1 **a** $9x^2+6x+1$
b $4x^2-12x+9$
c $6x^2-7x-3$
d $16x+9$
e $11x^2-6x-10$
f $4+x-5x^2$
g $10x^2-11$
h $5x^2-4x-5$

2 **a** $(a+4)(a+2)$
b $(a+7)(a-2)$
c $(3a-7)(2a+1)$
d $(a+3)(a-3)$
e $4a(3a-1)$
f $(2a-5)(2a+5)$
g $(a+1)(b+1)$
h $a(a-4)(a-3)$

3 **a** 4 **b** $\frac{13}{20}$ **c** 32 **d** $\frac{6}{7}$
e $\frac{105}{16}$ **f** $\frac{7}{8}$ **g** -1 **h** $\frac{30}{7}$
i $\frac{1}{8}$ **j** $\frac{15}{4}$ **k** 4 **l** $\frac{5}{8}$
m 147 **n** -1 **o** $\frac{7}{24}$ **p** $\frac{3}{2}$

4 **a** $3x$ **b** $x(4x-1)$
c $(4x-1)^2$ **d** $4x+\frac{1}{x}$
e $4+\frac{2}{x}$ **f** $\frac{3}{4x-1}$
g 6 **h** 9
i $x+1$ **j** $\frac{x(4x-1)}{9}$
k $\frac{3x}{x+2}$ **l** $1-x$

3 Equations and quadratic functions

Exercise 3A (p. 46)

1 **a** $x=-\frac{5}{7}$ **b** $x=\frac{2}{3}$ **c** $x=3$
d $x=\frac{1}{2}$ **e** $x=\frac{1}{3}$ **f** $x=1$
g $x=2$ **h** $y=-\frac{1}{2}$ **i** $a=5$
j $b=0$ **k** $c=7\frac{2}{3}$ **l** $d=5\frac{1}{2}$
m $e=0$ **n** $m=3$ **o** $v=-2$
p $x=2\frac{3}{5}$ **q** $k=\frac{1}{4}$

2 **a** $a=48$ **b** $x=1\frac{11}{16}$
c $a=24$ **d** $x=2$
e $x=-1\frac{4}{5}$ **f** $x=5$
g $y=-16\frac{2}{3}$ **h** $x=3$
i $y=\frac{1}{2}$ **j** $x=1\frac{2}{3}$
k $x=1\frac{1}{2}$ **l** $x=2$
m $x=15$ **n** $x=\frac{1}{7}$
o $x=5$ **p** $x=4$
q $x=0.5$ **r** $x=2$
s $x=17$ **t** $a=5$
u $x=-12$ **v** $x=4$
w $x=\frac{2}{3}$ **x** $x=7$
y $x=-4$ **z** $x=\frac{7}{11}$

3 8.5 m

4 23 balls

5 $x=32$

6 $-2\,\mathrm{m\,s^{-2}}$

Exercise 3B (p. 55)

1 **a** $x=2, x=-\frac{1}{2}$ **b** $x=3, x=4$
c $y=2, y=3$ **d** $y=\pm 4$
e $x=0, x=9$ **f** $x=0, x=1\frac{2}{3}$
g $x=-3, x=7$ **h** $x=-4, x=3$
i $x=3$ **j** $x=-3, x=-2$
k $x=1\frac{1}{2}, x=2$ **l** $e=-2, e=\frac{2}{3}$
m $d=-1, d=2\frac{2}{3}$ **n** $e=2, e=-\frac{2}{3}$
o $f=-\frac{2}{3}, f=\frac{3}{4}$ **p** $g=-6, g=\frac{1}{5}$
q $y=\pm 7$ **r** $x=\pm\frac{3}{5}$
s $x=0, x=6$ **t** $x=\pm\frac{2}{3}$
u $y=\pm 5$

2 **a** $a=\frac{2}{3}, a=1$ **b** $b=1, b=1\frac{1}{2}$
c $c=\frac{1}{2}, c=3$ **d** $d=1, d=2\frac{1}{2}$
e $e=-2, e=-\frac{1}{3}$ **f** $f=-\frac{1}{2}, f=2$
g $g=-2, g=1\frac{1}{2}$ **h** $h=0, h=1$
i $k=-2\frac{1}{3}, k=2\frac{1}{2}$
j $l=-2, l=0$ **k** $m=0, m=4$
l $t=0, t=\pm 10$ **m** $u=0, u=7$
n $w=\pm 1$ **o** $x=1, x=2$
p $y=1$ **q** $k=-\frac{3}{2}, k=\frac{1}{9}$
r $x=-4, x=\frac{2}{5}$

3 **a** $x=-1\pm\sqrt{6}$ **b** $x=2\pm\sqrt{11}$
c $t=5\pm 3\sqrt{3}$ **d** $s=-3\pm 2\sqrt{3}$
e $r=-\frac{5}{2}\pm\frac{\sqrt{29}}{2}$ **f** $t=\frac{3}{2}\pm\frac{\sqrt{37}}{2}$