

Fully-Worked Solutions

CHAPTER 2 Factorisation and Algebraic Fractions

UPSKILL 2.1

- 1 (a) $m(2m + 5) = 2m^2 + 5m$
- (b) $3n(n - 4) = 3n^2 - 12n$
- (c) $-5q(2q + 3) = -10q^2 - 15q$
- (d) $-4y(7 - 2y) = -28y + 8y^2$
- 2 (a) $(x + 1)(x + 4) = x^2 + 4x + x + 4$
 $= x^2 + 5x + 4$
- (b) $(2y + 5)(y + 3) = 2y^2 + 6y + 5y + 15$
 $= 2y^2 + 11y + 15$
- (c) $(m - 2)(3m - 4) = 3m^2 - 4m - 6m + 8$
 $= 3m^2 - 10m + 8$
- (d) $(2n - 1)(3n - 5) = 6n^2 - 10n - 3n + 5$
 $= 6n^2 - 13n + 5$
- (e) $(2h + 7)(h - 3) = 2h^2 - 6h + 7h - 21$
 $= 2h^2 + h - 21$
- (f) $(2 - 3k)(5k + 2) = 10k + 4 - 15k^2 - 6k$
 $= -15k^2 + 4k + 4$
- (g) $2(3p + 4)(5 - 2p) = 2(15p - 6p^2 + 20 - 8p)$
 $= 2(-6p^2 + 7p + 20)$
 $= -12p^2 + 14p + 40$
- (h) $-3(4 - 3q)(2q + 7) = -3(8q + 28 - 6q^2 - 21q)$
 $= -3(-6q^2 - 13q + 28)$
 $= 18q^2 + 39q - 84$
- 3 (a) $(2h + k)^2 = 4h^2 + 4hk + k^2$
- (b) $(3x - 4y)^2 = 9x^2 - 24xy + 16y^2$
- (c) $5(2e + f)^2 = 5(4e^2 + 4ef + f^2)$
 $= 20e^2 + 20ef + 5f^2$
- (d) $-5(v - 2w)^2 = -5(v^2 - 4vw + 4w^2)$
 $= -5v^2 + 20vw - 20w^2$
- (e) $3(p - 3q)(p + 3q) = 3(p^2 - 9q^2)$
 $= 3p^2 - 27q^2$
- (f) $-2(4m + 3n)(4m - 3n) = -2(16m^2 - 9n^2)$
 $= -32m^2 + 18n^2$
- 4 (a) $5(b - 2) + 3b = 5b - 10 + 3b$
 $= 8b - 10$
- (b) $8e - 2(3e + 4) = 8e - 6e - 8$
 $= 2e - 8$
- (c) $3x(2x + 5) - 2(x - 3) = 6x^2 + 15x - 2x + 6$
 $= 6x^2 + 13x + 6$
- (d) $9m + 7 - (m + 2)^2 = 9m + 7 - m^2 - 4m - 4$
 $= -m^2 + 5m + 3$
- (e) $3(2a - 1) + 2(a + 2)^2 = 6a - 3 + 2a^2 + 8a + 8$
 $= 2a^2 + 14a + 5$
- (f) $5x^2 - 2(x + 3)(x - 5) + 4x = 5x^2 - 2(x^2 - 2x - 15) + 4x$
 $= 5x^2 - 2x^2 + 4x + 30 + 4x$
 $= 3x^2 + 8x + 30$
- 5 (a) $A = \frac{1}{2}(6x)(4x - 3) = 3x(4x - 3) = 12x^2 - 9x$
- (b) $A = \frac{1}{2}(4x - 8)(3x + 2) = (2x - 4)(3x + 2) = 6x^2 - 8x - 8$
- 6 Number of Science workbooks = $x - 2$
Price of each Science workbook = $18 + 2 = \text{RM}20$

Total cost of workbooks
 $= 18x + 20(x - 2)$
 $= 18x + 20x - 40$
 $= \text{RM}(38x - 40)$

UPSKILL 2.2

- 1 (a) $9x - 21 = 3(3x - 7)$
- (b) $14h + 21k = 7(2h + 3k)$
- (c) $4m^2 - 6m = 2m(2m - 3)$
- (d) $6vw + 8wx = 2w(3v + 4x)$
- 2 (a) $b^2 - 64 = b^2 - 8^2$
 $= (b + 8)(b - 8)$
- (b) $4m^2 - 25 = (2m)^2 - 5^2$
 $= (2m + 5)(2m - 5)$
- (c) $a^2 - 9x^2 = a^2 - (3x)^2$
 $= (a + 3x)(a - 3x)$
- (d) $5x^2 - 20y^2 = 5(x^2 - 4y^2)$
 $= 5[x^2 - (2y)^2]$
 $= 5(x + 2y)(x - 2y)$
- 3 (a) $x^2 + 7x + 12 = (x + 3)(x + 4)$
- (b) $m^2 - 11m + 30 = (m - 6)(m - 5)$
- (c) $w^2 + 5w - 14 = (w + 7)(w - 2)$
- (d) $3a^2 - 2a - 8 = (3a + 4)(a - 2)$
- (e) $b^2 + 14b + 49 = (b + 7)^2$
- (f) $4x^2 - 20x + 25 = (2x - 5)^2$
- 4 (a) $2hx + 3ky + kx + 6hy = 2hx + kx + 3ky + 6hy$
 $= x(2h + k) + 3y(k + 2h)$
 $= (x + 3y)(2h + k)$
- (b) $3a^2 + 10mn - 5am - 6an = 3a^2 - 5am + 10mn - 6an$
 $= a(3a - 5m) + 2n(5m - 3a)$
 $= a(3a - 5m) - 2n(3a - 5m)$
 $= (a - 2n)(3a - 5m)$
- 5 $A = \frac{1}{2}(x + 1)(3x + 6 + x + 2) + \frac{1}{2}(x + 2)(4x)$
 $= \frac{1}{2}(x + 1)(4x + 8) + 2x(x + 2)$
 $= 2(x + 1)(x + 2) + 2x(x + 2)$
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$$\begin{aligned}
(b) \quad & \frac{1}{2x} + \frac{2}{x+1} = \frac{(x+1) + 4x}{2x(x+1)} \\
&= \frac{5x+1}{2x(x+1)}
\end{aligned}$$

$$\begin{aligned}
(c) \quad & \frac{3}{y+2} + \frac{2}{y-3} = \frac{3(y-3) + 2(y+2)}{(y+2)(y-3)} \\
&= \frac{3y-9+2y+4}{(y+2)(y-3)} \\
&= \frac{5y-5}{(y+2)(y-3)}
\end{aligned}$$

$$\begin{aligned}
(d) \quad & \frac{5w}{w+3} + \frac{w-1}{w-3} = \frac{5w(w-3) - (w-1)(w+3)}{(w+3)(w-3)} \\
&= \frac{5w^2 - 15w - (w^2 + 2w - 3)}{(w+3)(w-3)} \\
&= \frac{4w^2 - 17w + 3}{w^2 - 9}
\end{aligned}$$

$$\begin{aligned}
(e) \quad & \frac{4n+1}{3n(n-5)} - \frac{5}{6n} = \frac{2(4n+1) - 5(n-5)}{6n(n-5)} \\
&= \frac{8n+2 - 5n+25}{6n(n-5)} \\
&= \frac{3n+27}{6n(n-5)}
\end{aligned}$$

$$\begin{aligned}
(f) \quad & \frac{2b^2}{(b-4)(b+3)} + \frac{b+1}{b+3} = \frac{2b^2 + (b+1)(b-4)}{(b-4)(b+3)} \\
&= \frac{2b^2 + b^2 - 3b - 4}{(b-4)(b+3)} \\
&= \frac{3b^2 - 3b - 4}{(b-4)(b+3)}
\end{aligned}$$

$$\begin{aligned}
(g) \quad & \frac{4a+5}{a^2-9} - \frac{a-3}{a+3} = \frac{(4a+5) - (a-3)(a-3)}{(a+3)(a-3)} \\
&= \frac{4a+5 - (a^2 - 6a + 9)}{a^2 - 9} \\
&= \frac{-a^2 + 10a - 4}{a^2 - 9} \\
&= \frac{a^2 - 10a + 4}{9 - a^2}
\end{aligned}$$

$$\begin{aligned}
(h) \quad & \frac{2x^2 + 4x - 3}{50 - 8x^2} + \frac{3x - 5}{2x - 5} \\
&= \frac{2x^2 + 4x - 3}{2(25 - 4x^2)} + \frac{3x - 5}{2x - 5} \\
&= \frac{2x^2 + 4x - 3}{2(5 - 2x)(5 + 2x)} + \frac{5 - 3x}{5 - 2x} \\
&= \frac{2x^2 + 4x - 3 + 2(5 + 2x)(5 - 3x)}{2(5 - 2x)(5 + 2x)} \\
&= \frac{2x^2 + 4x - 3 + 2(25 - 5x - 6x^2)}{2(5 - 2x)(5 + 2x)} \\
&= \frac{2x^2 + 4x - 3 + 50 - 10x - 12x^2}{2(5 - 2x)(5 + 2x)} \\
&= \frac{-10x^2 - 6x + 47}{2(5 - 2x)(5 + 2x)}
\end{aligned}$$

$$\begin{aligned}
3 \quad (a) \quad & 4(w-2) \times 3(w+3) = 12(w-2)(w+3) \\
&= 12(w^2 + w - 6) \\
&= 12w^2 + 12w - 72
\end{aligned}$$

$$\begin{aligned}
(b) \quad & -3(2x+5) \times 4(3-x) = -12(2x+5)(3-x) \\
&= -12(15+x-2x^2) \\
&= 24x^2 - 12x - 180
\end{aligned}$$

$$\begin{aligned}
(c) \quad & 8(5-3x) \times \frac{3}{4}(x+2) = 6(10-x-3x^2) \\
&= 60 - 6x - 18x^2
\end{aligned}$$

$$\begin{aligned}
(d) \quad & \frac{9}{8}(2y+3) \times \frac{16}{3}(3y-2) = 6(6y^2 + 5y - 6) \\
&= 36y^2 + 30y - 36
\end{aligned}$$

$$\begin{aligned}
4 \quad (a) \quad & (3p+2) \div (3p^2 - 7p - 6) = \frac{3p+2}{(3p+2)(p-3)} \\
&= \frac{1}{p-3}
\end{aligned}$$

$$\begin{aligned}
(b) \quad & (6x^2 - x - 15) \div 7x(2x+3) = \frac{(3x-5)(2x+3)}{(7x)(2x+3)} \\
&= \frac{3x-5}{7x}
\end{aligned}$$

$$\begin{aligned}
(c) \quad & \frac{mx - my - nx + ny}{x^2 - xy} = \frac{x(m-n) - y(m-n)}{x(x-y)} \\
&= \frac{(x-y)(m-n)}{x(x-y)} \\
&= \frac{m-n}{x}
\end{aligned}$$

$$\begin{aligned}
(d) \quad & \frac{2x^2 + 3x - 4ax - 6a}{6x + 9} = \frac{x(2x+3) - 2a(2x+3)}{3(2x+3)} \\
&= \frac{(x-2a)(2x+3)}{3(2x+3)} \\
&= \frac{x-2a}{3}
\end{aligned}$$

$$\begin{aligned}
5 \quad (a) \quad & \frac{3m+6n}{10m^2-15m} \times \frac{m^2-3mn}{6m+12n} = \frac{3(m+2n)}{5m(2m-3)} \times \frac{m(m-3n)}{6(m+2n)} \\
&= \frac{m-3n}{10(2m-3)}
\end{aligned}$$

$$\begin{aligned}
(b) \quad & \frac{15p^2 - 10pq}{(p-3q)^2} \times \frac{p^2 - 9q^2}{6p - 4q} \\
&= \frac{5p(3p-2q)}{(p-3q)^2} \times \frac{(p+3q)(p-3q)}{2(3p-2q)} \\
&= \frac{5p(p+3q)}{2(p-3q)}
\end{aligned}$$

$$\begin{aligned}
(c) \quad & \frac{15abc^2}{6a-8b} \div \frac{9a^3b}{3a^2-4ab} = \frac{15abc^2}{2(3a-4b)} \times \frac{a(3a-4b)}{9a^3b} \\
&= \frac{5c^2}{6a}
\end{aligned}$$

$$\begin{aligned}
(d) \quad & \frac{9x^2 - 25y^2}{12xy - 3xz} \div \frac{3x^2 - 2xy - 5y^2}{4y^2 - yz} \\
&= \frac{(3x+5y)(3x-5y)}{3x(4y-z)} \times \frac{y(4y-z)}{(3x-5y)(x+y)} \\
&= \frac{y(3x+5y)}{3x(x+y)}
\end{aligned}$$

$$\begin{aligned}
6 \quad (a) \quad & (6x+5y)(2x-3y) - (2x-3y)^2 \\
&= (2x-3y)(6x+5y-2x+3y) \\
&= (2x-3y)(4x+8y) \\
&= 4(2x-3y)(x+2y)
\end{aligned}$$

$$\begin{aligned}
(b) \quad & (5n^2 + 10n) \div (n^2 - 4) - (3 - 2n) \\
&= \frac{5n(n+2)}{(n+2)(n-2)} - (3 - 2n) \\
&= \frac{5n - (3 - 2n)(n-2)}{n-2} \\
&= \frac{5n - (-2n^2 + 7n - 6)}{n-2} \\
&= \frac{2n^2 - 2n + 6}{n-2} \\
&= \frac{2(n^2 - 2n + 3)}{n-2}
\end{aligned}$$

$$\begin{aligned}
(c) \quad & 3(2y-3) - (3y^2 + 10y - 8) \div (2 - 3y) \\
&= 3(2y-3) - \frac{(3y-2)(y+4)}{2-3y} \\
&= 3(2y-3) + \frac{(2-3y)(y+4)}{2-3y} \\
&= 6y - 9 + y + 4 \\
&= 7y - 5
\end{aligned}$$

$$\begin{aligned}
(d) \quad & (m^3 + 5m^2 - 14m) \div (m^2 - 4) \times (3m^2 + 2m - 8) \\
&= m(m^2 + 5m - 14) \times \frac{1}{(m+2)(m-2)} \times (3m-4)(m+2) \\
&= m(m+7)(m-2) \times \frac{3m-4}{m-2} \\
&= m(m+7)(3m-4)
\end{aligned}$$

Summative Practice 2

Section A

1 $3m - 4 - 10 + 5m = 8m - 14$

Answer: D

2 $15 - (3x^2 + 4x - 15) = 30 - 4x - 3x^2$

Answer: C

3 $(e-f)^2 = e^2 + f^2 - 2ef = 24 - 2(-8) = 40$

Answer: C

$$\begin{aligned}
4 \quad (h+2k)^2 - 8hk &= h^2 + 4k^2 + 4hk - 8hk \\
&= h^2 + 4k^2 - 4hk \\
&= (h-2k)^2
\end{aligned}$$

Answer: B

$$\begin{aligned}
5 \quad 3x - 2 - 3(y-x) &= 3x - 2 - 3y + 3x \\
&= 6x - 3y - 2 \\
&= 3(2x-y) - 2 \\
&= 3(12) - 2 \\
&= 34
\end{aligned}$$

Answer: D

6 $h^2 - k^2 = (h+k)(h-k)$
 $40 = 8(h-k)$

$h-k = 5$

Answer: A

7 $2(11x-4) + (6x+1)(x-2)$
 $= 22x - 8 + 6x^2 - 11x - 2$
 $= 6x^2 + 11x - 10$
 $= (3x-2)(2x+5)$

Answer: A

8 $(2x^2 - 7x - 1)(x-2) - 3(x-2)$
 $= (x-2)(2x^2 - 7x - 1 - 3)$
 $= (x-2)(2x^2 - 7x - 4)$
 $= (x-2)(2x+1)(x-4)$

Answer: B

9 A $\frac{x^2}{x^2+1}$
B $\frac{x^2+x}{x^2-1} = \frac{x(x+1)}{(x+1)(x-1)} = \frac{x}{x-1}$
C $\frac{x^2-x}{x^2-1} = \frac{x(x-1)}{(x-1)(x+1)} = \frac{x}{x+1}$
D $\frac{2x}{2x+1}$

Answer: C

10 $\frac{2}{y-2} - \frac{4}{y+5} = \frac{2(y+5) - 4(y-2)}{(y-2)(y+5)}$
 $= \frac{2y+10 - 4y+8}{(y-2)(y+5)}$
 $= \frac{18-2y}{(y-2)(y+5)}$

Answer: D

11 $\frac{5x+1}{4x^2-9} - \frac{2}{2x-3} = \frac{5x+1-2(2x+3)}{4x^2-9}$
 $= \frac{5x+1-4x-6}{4x^2-9}$
 $= \frac{x-5}{4x^2-9}$

Answer: B

$$\begin{aligned}
12 \quad & \frac{4w^2-1}{w^2} \times \frac{2w}{6w+3} = \frac{(2w+1)(2w-1)}{w^2} \times \frac{2w}{3(2w+1)} \\
&= \frac{2(2w-1)}{3w}
\end{aligned}$$

Answer: C

$$\begin{aligned}
13 \quad (15m^2n^3 - 24mn^4) \div 27m^3n &= \frac{3mn^3(5m-8n)}{27m^3n} \\
&= \frac{n^2(5m-8n)}{9m^2}
\end{aligned}$$

Answer: A

$$\begin{aligned}
14 \quad & \frac{x^2+xy-6y^2}{6xy} \div \frac{x^2-9y^2}{2x} \\
&= \frac{(x+3y)(x-2y)}{6xy} \times \frac{2x}{(x+3y)(x-3y)} \\
&= \frac{x-2y}{3y(x-3y)}
\end{aligned}$$

Answer: A

Section B

1 (a) $5(3-w) = 15 - 5w$
(b) $2x(3x-2) = 6x^2 - 4x$
(c) $-3y(4-5y) = -12y + 15y^2$
(d) $4(x-1) - (3-x) = 4x - 4 - 3 + x$
 $= 5x - 7$

2 (a) $A - B = 1 + p - (1-p)$
 $= 1 + p - 1 + p$
 $= 2p$
 $AB = (1-p)(1+p)$
 $= 1 - p^2$

(b) $6a^2 - ab - 12b^2 = (2a-3b)(3a+4b)$

3

Statements	TRUE or FALSE
(a) $3(h+7) - k(h+7) = (h+7)(3-k)$	FALSE
(b) $25h^2 - 81k^2 = (5h)^2 - (9k)^2$ $= (5h-9k)(5h+9k)$	FALSE
(c) $9a^2 - (b+c)^2$ $= (3a)^2 - (b+c)^2$ $= (3a+b+c)(3a-b-c)$	TRUE
(d) $\frac{2}{x+3} - \frac{3}{2(x+3)} = \frac{4}{2(x+3)} - \frac{3}{2(x+3)}$ $= \frac{1}{2(x+3)}$	TRUE

4 (a) $(m+n)^2 = m^2 + n^2 + 2mn$
 $= 113 + 2(56)$
 $= 113 + 112$
 $= 225$

(b) $(m-n)^2 = m^2 + n^2 - 2mn$
 $= 113 - 2(56)$
 $= 113 - 112$
 $= 1$

(c) $m^2 - n^2 = (m+n)(m-n)$
 $= (\sqrt{225})(\sqrt{1})$
 $= 15$

(d) $m^3n - mn^3 = mn(m^2 - n^2)$
 $= 56(15)$
 $= 840$

Section C

1 (a) (i) $x(2x-5) - 3(2x-5) = (2x-5)(x-3)$
(ii) $x(b-c) - y(c-b) = (b-c)(x+y)$

$$\begin{aligned} \text{(iii)} \quad & 3ac - 2ad + 9bc - 6bd = 3c(a + 3b) - 2d(a + 3b) \\ & = (a + 3b)(3c - 2d) \end{aligned}$$

$$\begin{aligned} \text{(b) (i) Perimeter} &= 2[(5x + 2) + (4x - 3)] \\ &= 2(9x - 1) = (18x - 2) \text{ cm} \end{aligned}$$

$$\text{(ii) Area} = (5x + 2)(4x - 3) = (20x^2 - 7x - 6) \text{ cm}^2$$

$$\begin{aligned} \text{(c) Area} &= \frac{1}{2}(4x - 2)(3x + 5) \\ &= (2x - 1)(3x + 5) \\ &= (6x^2 + 7x - 5) \text{ cm}^2 \end{aligned}$$

$$\begin{aligned} \text{2 (a) (i)} \quad & (6m^2 - 7m - 20) \div (2m - 5) = \frac{(3m + 4)(2m - 5)}{2m - 5} \\ & = 3m + 4 \end{aligned}$$

$$\begin{aligned} \text{(ii)} \quad & \frac{2h^3 + h^2 - 10h}{mk} \div \frac{3h^3 - 6h^2}{2m^2} - \frac{10m}{3hk} \\ &= \frac{h(2h^2 + h - 10)}{mk} \times \frac{2m^2}{3h^2(h - 2)} - \frac{10m}{3hk} \\ &= \frac{(2h + 5)(h - 2)}{k} \times \frac{2m}{3h(h - 2)} - \frac{10m}{3hk} \\ &= \frac{2m(2h + 5)}{3hk} - \frac{10m}{3hk} \\ &= \frac{4mh + 10m - 10m}{3hk} \\ &= \frac{4mh}{3hk} \\ &= \frac{4m}{3k} \end{aligned}$$

$$\begin{aligned} \text{(b) } 10x^2 + 5ax - 6x - 3a &= 10x^2 - 6x + 5ax - 3a \\ &= 2x(5x - 3) + a(5x - 3) \\ &= (5x - 3)(2x + a) \end{aligned}$$

Area of rectangle = length × width

Since the length is $(5x - 3)$ cm, therefore the width is $(2x + a)$ cm.

(c) Total area

$$\begin{aligned} &= \frac{1}{2}(4x + 1)(2x - 6) + \frac{1}{2}(2x - 7)(2x + 9 + 2x + 1) \\ &= (4x + 1)(x - 3) + (2x - 7)(2x + 5) \\ &= 4x^2 - 11x - 3 + 4x^2 - 4x - 35 \\ &= (8x^2 - 15x - 38) \text{ cm}^2 \end{aligned}$$

$$\begin{aligned} \text{3 (a) (i)} \quad & \frac{3n}{2m} - \frac{5n^2 - 8}{6mn} = \frac{3n(3n) - 5n^2 + 8}{6mn} \\ &= \frac{9n^2 - 5n^2 + 8}{6mn} \\ &= \frac{4n^2 + 8}{6mn} \\ &= \frac{2n^2 + 4}{3mn} \end{aligned}$$

$$\begin{aligned} \text{(ii)} \quad & \frac{6x}{x^2 - y^2} - \frac{3}{x + y} = \frac{6x}{x^2 - y^2} - \frac{3(x - y)}{(x + y)(x - y)} \\ &= \frac{6x - 3x + 3y}{x^2 - y^2} \\ &= \frac{3(x + y)}{(x + y)(x - y)} \\ &= \frac{3}{x - y} \end{aligned}$$

$$\text{(b) (i)} \quad \frac{12e^5 + 18e^3f^2}{30e^4f} = \frac{6e^3(2e^2 + 3f^2)}{30e^4f} = \frac{2e^2 + 3f^2}{5ef}$$

$$\begin{aligned} \text{(ii)} \quad & \frac{10hk^4 \times 3(h + k)}{12(h^2 + hk)^2 \div 2(h^5 - h^3k^2)} \\ &= \frac{10hk^4 \times 3(h + k)}{12h^2(h + k)^2} \times 2h^3(h^2 - k^2) \\ &= \left(\frac{10 \times 3 \times 2}{12}\right) \times \frac{hk^4 \times h^3}{h^2} \times \frac{(h + k) \times (h + k)(h - k)}{(h + k)(h + k)} \\ &= 5h^2k^4 (h - k) \end{aligned}$$

(c) Area of unshaded region

$$\begin{aligned} &= (3x + 1)(4x - 1) - \frac{1}{2}(2x - 4)(x + 5) \\ &= 12x^2 + x - 1 - (x - 2)(x + 5) \\ &= 12x^2 + x - 1 - (x^2 + 3x - 10) \\ &= 12x^2 + x - 1 - x^2 - 3x + 10 \\ &= (11x^2 - 2x + 9) \text{ cm}^2 \end{aligned}$$