# 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** $A = \frac{1}{2}(x + 1)(3x + 6 + x + 2) + \frac{1}{2}(x + 2)(4x)$
$= \frac{1}{2}(x + 1)(4x + 8) + 2x(x + 2)$
$= 2(x + 1)(x + 2) + 2x(x + 2)$
$= 2(x + 2)(x + 1 + x)$
$= 2(x + 2)(2x + 1)\ \text{cm}^2$

### UPSKILL 2.3

**1** (a) $2y(y + 3) - (y + 3) = 2y^2 + 6y - y - 3$
$= 2y^2 + 5y - 3$
$= (2y - 1)(y + 3)$

(b) $x(x + 6) + (6 - x) = x^2 + 6x + 6 - x$
$= x^2 + 5x + 6$
$= (x + 2)(x + 3)$

(c) $(p + 3)(p - 3) - 2(p^2 - 17) = p^2 - 9 - 2p^2 + 34$
$= 25 - p^2$
$= (5 + p)(5 - p)$

(d) $(3n - 1)(n + 2) - 4(n + 2) = 3n^2 + 5n - 2 - 4n - 8$
$= 3n^2 + n - 10$
$= (3n - 5)(n + 2)$

**2** (a) $\frac{5}{2m} - \frac{6}{5m} = \frac{25 - 12}{10m} = \frac{13}{10m}$

(b) $\frac{1}{2x} + \frac{2}{x+1} = \frac{(x+1)+4x}{2x(x+1)}$

$= \frac{5x+1}{2x(x+1)}$

(c) $\frac{3}{y+2} + \frac{2}{y-3} = \frac{3(y-3)+2(y+2)}{(y+2)(y-3)}$

$= \frac{3y-9+2y+4}{(y+2)(y-3)}$

$= \frac{5y-5}{(y+2)(y-3)}$

(d) $\frac{5w}{w+3} + \frac{w-1}{w-3} = \frac{5w(w-3)-(w-1)(w+3)}{(w+3)(w-3)}$

$= \frac{5w^2-15w-(w^2+2w-3)}{(w+3)(w-3)}$

$= \frac{4w^2-17w+3}{w^2-9}$

(e) $\frac{4n+1}{3n(n-5)} - \frac{5}{6n} = \frac{2(4n+1)-5(n-5)}{6n(n-5)}$

$= \frac{8n+2-5n+25}{6n(n-5)}$

$= \frac{3n+27}{6n(n-5)}$

(f) $\frac{2b^2}{(b-4)(b+3)} + \frac{b+1}{b+3} = \frac{2b^2+(b+1)(b-4)}{(b-4)(b+3)}$

$= \frac{2b^2+b^2-3b-4}{(b-4)(b+3)}$

$= \frac{3b^2-3b-4}{(b-4)(b+3)}$

(g) $\frac{4a+5}{a^2-9} - \frac{a-3}{a+3} = \frac{(4a+5)-(a-3)(a-3)}{(a+3)(a-3)}$

$= \frac{4a+5-(a^2-6a+9)}{a^2-9}$

$= \frac{-a^2+10a-4}{a^2-9}$

$= \frac{a^2-10a+4}{9-a^2}$

(h) $\frac{2x^2+4x-3}{50-8x^2} + \frac{3x-5}{2x-5}$

$= \frac{2x^2+4x-3}{2(25-4x^2)} + \frac{3x-5}{2x-5}$

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

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

$= \frac{2x^2+4x-3+2(25-5x-6x^2)}{2(5-2x)(5+2x)}$

$= \frac{2x^2+4x-3+50-10x-12x^2}{2(5-2x)(5+2x)}$

$= \frac{-10x^2-6x+47}{2(5-2x)(5+2x)}$

**3** (a) $4(w-2) \times 3(w+3) = 12(w-2)(w+3)$

$= 12(w^2+w-6)$

$= 12w^2+12w-72$

(b) $-3(2x+5) \times 4(3-x) = -12(2x+5)(3-x)$

$= -12(15+x-2x^2)$

$= 24x^2-12x-180$

(c) $8(5-3x) \times \frac{3}{4}(x+2) = 6(10-x-3x^2)$

$= 60-6x-18x^2$

(d) $\frac{9}{8}(2y+3) \times \frac{16}{3}(3y-2) = 6(6y^2+5y-6)$

$= 36y^2+30y-36$

**4** (a) $(3p+2) \div (3p^2-7p-6) = \frac{3p+2}{(3p+2)(p-3)}$

$= \frac{1}{p-3}$

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

$= \frac{3x-5}{7x}$

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

$= \frac{(x-y)(m-n)}{x(x-y)}$

$= \frac{m-n}{x}$

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

$= \frac{(x-2a)(2x+3)}{3(2x+3)}$

$= \frac{x-2a}{3}$

**5** (a) $\frac{3m+6n}{10m^2-15m} \times \frac{m^2-3mn}{6m+12n} = \frac{3(m+2n)}{5m(2m-3)} \times \frac{m(m-3n)}{6(m+2n)}$

$= \frac{m-3n}{10(2m-3)}$

(b) $\frac{15p^2-10pq}{(p-3q)^2} \times \frac{p^2-9q^2}{6p-4q}$

$= \frac{5p(3p-2q)}{(p-3q)^2} \times \frac{(p+3q)(p-3q)}{2(3p-2q)}$

$= \frac{5p(p+3q)}{2(p-3q)}$

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

$= \frac{5c^2}{6a}$

(d) $\frac{9x^2-25y^2}{12xy-3xz} \div \frac{3x^2-2xy-5y^2}{4y^2-yz}$

$= \frac{(3x+5y)(3x-5y)}{3x(4y-z)} \times \frac{y(4y-z)}{(3x-5y)(x+y)}$

$= \frac{y(3x+5y)}{3x(x+y)}$

**6** (a) $(6x+5y)(2x-3y)-(2x-3y)^2$

$= (2x-3y)(6x+5y-2x+3y)$

$= (2x-3y)(4x+8y)$

$= 4(2x-3y)(x+2y)$

(b) $(5n^2+10n) \div (n^2-4) - (3-2n)$

$= \frac{5n(n+2)}{(n+2)(n-2)} - (3-2n)$

$= \frac{5n-(3-2n)(n-2)}{n-2}$

$= \frac{5n-(-2n^2+7n-6)}{n-2}$

$= \frac{2n^2-2n+6}{n-2}$

$= \frac{2(n^2-2n+3)}{n-2}$

(c) $3(2y-3)-(3y^2+10y-8) \div (2-3y)$

$= 3(2y-3) - \frac{(3y-2)(y+4)}{2-3y}$

$= 3(2y-3) + \frac{(2-3y)(y+4)}{2-3y}$

$= 6y-9+y+4$

$= 7y-5$

(d) $(m^3 + 5m^2 - 14m) \div (m^2 - 4) \times (3m^2 + 2m - 8)$

$= m(m^2 + 5m - 14) \times \dfrac{1}{(m + 2)(m - 2)} \times (3m - 4)(m + 2)$

$= m(m + 7)(m - 2) \times \dfrac{3m - 4}{m - 2}$

$= m(m + 7)(3m - 4)$

## 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**

**4** $(h + 2k)^2 - 8hk = h^2 + 4k^2 + 4hk - 8hk$

$= h^2 + 4k^2 - 4hk$

$= (h - 2k)^2$

*Answer*: **B**

**5** $3x - 2 - 3(y - x) = 3x - 2 - 3y + 3x$

$= 6x - 3y - 2$

$= 3(2x - y) - 2$

$= 3(12) - 2$

$= 34$

*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** $\dfrac{x^2}{x^2 + 1}$

**B** $\dfrac{x^2 + x}{x^2 - 1} = \dfrac{x(x + 1)}{(x + 1)(x - 1)} = \dfrac{x}{x - 1}$

**C** $\dfrac{x^2 - x}{x^2 - 1} = \dfrac{x(x - 1)}{(x - 1)(x + 1)} = \dfrac{x}{x + 1}$

**D** $\dfrac{2x}{2x + 1}$

*Answer*: **C**

**10** $\dfrac{2}{y - 2} - \dfrac{4}{y + 5} = \dfrac{2(y + 5) - 4(y - 2)}{(y - 2)(y + 5)}$

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

$= \dfrac{18 - 2y}{(y - 2)(y + 5)}$

*Answer*: **D**

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

$= \dfrac{5x + 1 - 4x - 6}{4x^2 - 9}$

$= \dfrac{x - 5}{4x^2 - 9}$

*Answer*: **B**

**12** $\dfrac{4w^2 - 1}{w^2} \times \dfrac{2w}{6w + 3} = \dfrac{(2w + 1)(2w - 1)}{w^2} \times \dfrac{2w}{3(2w + 1)}$

$= \dfrac{2(2w - 1)}{3w}$

*Answer*: **C**

**13** $(15m^2n^3 - 24mn^4) \div 27m^3n = \dfrac{3mn^3(5m - 8n)}{27m^3n}$

$= \dfrac{n^2(5m - 8n)}{9m^2}$

*Answer*: **A**

**14** $\dfrac{x^2 + xy - 6y^2}{6xy} \div \dfrac{x^2 - 9y^2}{2x}$

$= \dfrac{(x + 3y)(x - 2y)}{6xy} \times \dfrac{2x}{(x + 3y)(x - 3y)}$

$= \dfrac{x - 2y}{3y(x - 3y)}$

*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) $\dfrac{2}{x + 3} - \dfrac{3}{2(x + 3)} = \dfrac{4}{2(x + 3)} - \dfrac{3}{2(x + 3)}$ $= \dfrac{1}{2(x + 3)}$ | 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) $x(b - c) - y(c - b) = (b - c)(x + y)$

(iii) $3ac - 2ad + 9bc - 6bd = 3c(a + 3b) - 2d(a + 3b)$
$= (a + 3b)(3c - 2d)$

(b) (i) Perimeter $= 2[(5x + 2) + (4x - 3)]$
$= 2(9x - 1) = (18x - 2)$ cm

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

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

**2** (a) (i) $(6m^2 - 7m - 20) \div (2m - 5) = \frac{(3m + 4)(2m - 5)}{2m - 5}$
$= 3m + 4$

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

(b) $10x^2 + 5ax - 6x - 3a = 10x^2 - 6x + 5ax - 3a$
$= 2x(5x - 3) + a(5x - 3)$
$= (5x - 3)(2x + a)$

Area of rectangle = length × width

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

(c) Total area
$= \frac{1}{2}(4x + 1)(2x - 6) + \frac{1}{2}(2x - 7)(2x + 9 + 2x + 1)$
$= (4x + 1)(x - 3) + (2x - 7)(2x + 5)$
$= 4x^2 - 11x - 3 + 4x^2 - 4x - 35$
$= (8x^2 - 15x - 38)$ cm$^2$

**3** (a) (i) $\frac{3n}{2m} - \frac{5n^2 - 8}{6mn} = \frac{3n(3n) - 5n^2 + 8}{6mn}$
$= \frac{9n^2 - 5n^2 + 8}{6mn}$
$= \frac{4n^2 + 8}{6mn}$
$= \frac{2n^2 + 4}{3mn}$

(ii) $\frac{6x}{x^2 - y^2} - \frac{3}{x + y} = \frac{6x}{x^2 - y^2} - \frac{3(x - y)}{(x + y)(x - y)}$
$= \frac{6x - 3x + 3y}{x^2 - y^2}$
$= \frac{3(x + y)}{(x + y)(x - y)}$
$= \frac{3}{x - y}$

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

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

(c) Area of unshaded region
$= (3x + 1)(4x - 1) - \frac{1}{2}(2x - 4)(x + 5)$
$= 12x^2 + x - 1 - (x - 2)(x + 5)$
$= 12x^2 + x - 1 - (x^2 + 3x - 10)$
$= 12x^2 + x - 1 - x^2 - 3x + 10$
$= (11x^2 - 2x + 9)$ cm$^2$