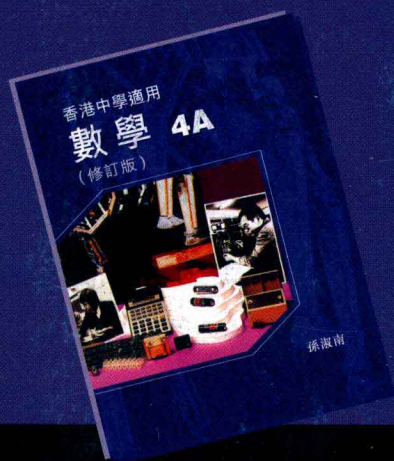


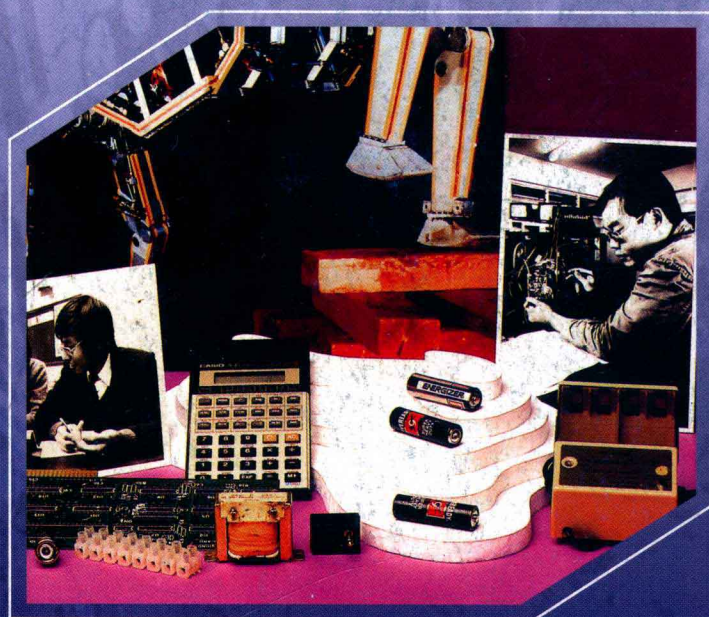


香港中學適用

數學 4A

(修訂版)

學習指引



孫淑南

為課本提供

習題內單數題目的詳細題解

香港中學適用

數學 4A

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學習指引

孫淑南

DISCARDED



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指數、恆等式和對數

練習 (第 5 頁)

1. (a) $4 \cdot 4^5 = 4^{1+5} = \underline{\underline{4^6}}$

(b) $6^3 \cdot 6^2 \cdot 6^{-1} = 6^{3+2-1} = \underline{\underline{6^4}}$

3. (a) $\frac{x^{12}}{x^5} = x^{12-5} = \underline{\underline{x^7}}$

(b) $\frac{3^4 \cdot 3^8}{3^{10}} = 3^{4+8-10} = \underline{\underline{3^2}}$

5. (a) $3x^2 \cdot 2x^{-2} = 3 \cdot 2x^{2-2} = 6x^0 = \underline{\underline{6}}$

(b) $\frac{x^{-2}}{y^{-1}} = \frac{x^{-2}}{\frac{1}{y}} = \underline{\underline{\frac{y}{x^2}}}$

7. (a) $\frac{a}{\sqrt[3]{a}} = \frac{a}{a^{\frac{1}{3}}} = a^{1-\frac{1}{3}} = \underline{\underline{a^{\frac{2}{3}}}}$

(b) $\left(\sqrt[3]{a^3 b}\right)^5 = \left[(a^3 b)^{\frac{1}{3}}\right]^5$
 $= \left(a^{3 \times \frac{1}{3}} b^{\frac{1}{3}}\right)^5$
 $= \left(ab^{\frac{1}{3}}\right)^5$
 $= a^5 b^{\frac{1}{3} \times 5}$
 $= \underline{\underline{a^5 b^{\frac{5}{3}}}}$

9. $4m^{1-2x} \div m^{-2x} = \frac{4m^{1-2x}}{m^{-2x}}$
 $= 4m^{1-2x-(-2x)}$
 $= \underline{\underline{4m}}$

11. $x^{\frac{1}{4}} = 3$
 $\therefore \left(x^{\frac{1}{4}}\right)^4 = 3^4$
 $\therefore x = \underline{\underline{81}}$

13. $7^{2x+1} = 7^3$
 $\therefore 2x+1 = 3$
 $\therefore x = \underline{\underline{1}}$

15. (a) $(-3)^3(-3)^5(-3)^7 = (-3)^{3+5+7}$
 $= (-3)^{15}$
 $= (-1)^{15} \times 3^{15}$
 $= \underline{\underline{-3^{15}}}$

(b) $(-a)^6 \cdot (-a^6) \cdot a^6$
 $= (-1)^6 \cdot a^6 \cdot (-1) \cdot a^6 \cdot a^6$
 $= (-1)^{6+1} a^{6+6+6}$
 $= \underline{\underline{-a^{18}}}$

17. (a) $(-2x^2)^3(3y^3)^2 = (-2)^3(x^2)^3(3)^2(y^3)^2$
 $= (-8)(9)x^6y^6$
 $= \underline{\underline{-72x^6y^6}}$

(b) $[(-2p)^2]^3(-p^2)^0 = [(-2)^2p^2]^3(1)$
 $= (-2)^6p^6$
 $= \underline{\underline{64p^6}}$

練習 I 題解 (續)

$$\begin{aligned}
 19. \quad 3^x \cdot 2^{2x} \cdot (6^x)^{-1} &= 3^x \cdot 2^{2x} \cdot 6^{-x} \\
 &= 3^x \cdot 2^{2x} \cdot (2 \cdot 3)^{-x} \\
 &= 3^x \cdot 2^{2x} \cdot 2^{-x} \cdot 3^{-x} \\
 &= 3^{x-x} \cdot 2^{2x-x} \\
 &= 3^0 \cdot 2^x \\
 &= \underline{\underline{2^x}}
 \end{aligned}$$

$$\begin{aligned}
 21. \quad 4x^{-\frac{1}{3}} &= 64^{\frac{2}{3}} \\
 4x^{-\frac{1}{3}} &= (4^3)^{\frac{2}{3}} \\
 x^{-\frac{1}{3}} &= \left(4^{3 \times \frac{2}{3}}\right) \times \frac{1}{4} \\
 &= 4^2 \times 4^{-1} \\
 &= 4^{2-1} \\
 &= 4 \\
 \therefore \left(x^{-\frac{1}{3}}\right)^{-3} &= 4^{-3} \\
 \therefore x &= \underline{\underline{\frac{1}{64}}}
 \end{aligned}$$

$$\begin{aligned}
 23. \quad 4^{3x+2} &= 256(8^{1-x}) \\
 2^{6x+4} &= 2^8(2^3)^{1-x} \\
 2^{6x+4} &= 2^{8+3(1-x)} \\
 2^{6x+4} &= 2^{11-3x} \\
 \therefore 6x+4 &= 11-3x \\
 9x &= 7 \\
 \therefore x &= \underline{\underline{\frac{7}{9}}}
 \end{aligned}$$

$$\begin{aligned}
 25. \quad 2^{x+2} - 6 \cdot 2^{x-1} - 8 &= 0 \\
 2^2 \cdot 2^x - 6 \cdot 2^{-1} \cdot 2^x - 8 &= 0 \\
 4 \cdot 2^x - 3 \cdot 2^x - 8 &= 0 \\
 2^x &= 8 \\
 2^x &= 2^3 \\
 \therefore x &= \underline{\underline{3}}
 \end{aligned}$$

練習 (第 9 頁)

$$\begin{aligned}
 1. \quad (a) \quad x^2 - 144y^2 &= x^2 - (12y)^2 \\
 &= \underline{\underline{(x+12y)(x-12y)}}
 \end{aligned}$$

$$\begin{aligned}
 (b) \quad 225z^2 - 9 &= 9(25z^2 - 1) \\
 &= 9[(5z)^2 - 1^2] \\
 &= \underline{\underline{9(5z+1)(5z-1)}}
 \end{aligned}$$

$$\begin{aligned}
 3. \quad (a) \quad (2x+1)^2 &= (2x)^2 + 2(2x)(1) + 1^2 \\
 &= \underline{\underline{4x^2 + 4x + 1}}
 \end{aligned}$$

$$\begin{aligned}
 (b) \quad (1-5y)^2 &= 1^2 - 2(1)(5y) + (5y)^2 \\
 &= \underline{\underline{1 - 10y + 25y^2}}
 \end{aligned}$$

$$\begin{aligned}
 5. \quad (a) \quad 25x^2 - 10xy + y^2 &= (5x)^2 - 2(5x)(y) + y^2 \\
 &= \underline{\underline{(5x-y)^2}}
 \end{aligned}$$

$$\begin{aligned}
 (b) \quad 16u^2 + 72uv + 81v^2 \\
 &= (4u)^2 + 2(4u)(9v) + (9v)^2 \\
 &= \underline{\underline{(4u+9v)^2}}
 \end{aligned}$$

$$\begin{aligned}
 7. \quad (a) \quad 18m^2 - 12mn + 2n^2 \\
 &= 2(9m^2 - 6mn + n^2) \\
 &= 2[(3m)^2 - 2(3m)(n) + n^2] \\
 &= \underline{\underline{2(3m-n)^2}}
 \end{aligned}$$

$$\begin{aligned}
 (b) \quad x + 8x^2 + 16x^3 \\
 &= x(16x^2 + 8x + 1) \\
 &= x[(4x)^2 + 2(4x)(1) + 1^2] \\
 &= \underline{\underline{x(4x+1)^2}}
 \end{aligned}$$

$$\begin{aligned}
 9. \quad (a) \quad 4x^2 - 25(y-z)^2 \\
 &= (2x)^2 - [5(y-z)]^2 \\
 &= [2x+5(y-z)][2x-5(y-z)] \\
 &= \underline{\underline{(2x+5y-5z)(2x-5y+5z)}}
 \end{aligned}$$

練習 II 題解 (續)

$$\begin{aligned}
 \text{(b)} \quad & 6(a+b)^2 - 96(a-b)^2 \\
 &= 6[(a+b)^2 - 16(a-b)^2] \\
 &= 6\{(a+b)^2 - [4(a-b)]^2\} \\
 &= 6[a+b+4(a-b)][a+b-4(a-b)] \\
 &= \underline{\underline{6(5a-3b)(5b-3a)}}
 \end{aligned}$$

$$\begin{aligned}
 11. \text{ (a)} \quad & \left(\frac{3}{m} - \frac{m}{3}\right)^2 = \left(\frac{3}{m}\right)^2 - 2\left(\frac{3}{m}\right)\left(\frac{m}{3}\right) + \left(\frac{m}{3}\right)^2 \\
 &= \underline{\underline{\frac{9}{m^2} - 2 + \frac{m^2}{9}}}
 \end{aligned}$$

$$\begin{aligned}
 \text{(b)} \quad & x^2\left(2x - \frac{1}{2x}\right)^2 \\
 &= x^2\left[(2x)^2 - 2(2x)\left(\frac{1}{2x}\right) + \left(\frac{1}{2x}\right)^2\right] \\
 &= x^2\left[4x^2 - 2 + \frac{1}{4x^2}\right] \\
 &= \underline{\underline{4x^4 - 2x^2 + \frac{1}{4}}}
 \end{aligned}$$

$$\begin{aligned}
 13. \text{ (a)} \quad & \frac{x^2}{4} + \frac{4}{x^2} + 2 = \left(\frac{x}{2}\right)^2 + 2\left(\frac{x}{2}\right)\left(\frac{2}{x}\right) + \left(\frac{2}{x}\right)^2 \\
 &= \underline{\underline{\left(\frac{x}{2} + \frac{2}{x}\right)^2}}
 \end{aligned}$$

$$\begin{aligned}
 \text{(b)} \quad & 2m^4 - 8m + \frac{8}{m^2} \\
 &= 2\left(m^4 - 4m + \frac{4}{m^2}\right) \\
 &= 2\left[(m^2)^2 - 2(m^2)\left(\frac{2}{m}\right) + \left(\frac{2}{m}\right)^2\right] \\
 &= \underline{\underline{2\left(m^2 - \frac{2}{m}\right)^2}}
 \end{aligned}$$

練習 (第 12 頁)

$$\begin{aligned}
 1. \text{ (a)} \quad & x^3 + 27 = x^3 + 3^3 \\
 &= \underline{\underline{(x+3)(x^2-3x+9)}}
 \end{aligned}$$

$$\begin{aligned}
 \text{(b)} \quad & 125 + y^3 = 5^3 + y^3 \\
 &= \underline{\underline{(5+y)(25-5y+y^2)}}
 \end{aligned}$$

$$\begin{aligned}
 3. \text{ (a)} \quad & a^3b^3 - 1 = (ab)^3 - 1^3 \\
 &= \underline{\underline{(ab-1)(a^2b^2+ab+1)}}
 \end{aligned}$$

$$\begin{aligned}
 \text{(b)} \quad & -p^3 - q^3 = -(p^3 + q^3) \\
 &= \underline{\underline{-(p+q)(p^2-pq+q^2)}}
 \end{aligned}$$

$$\begin{aligned}
 5. \text{ (a)} \quad & a^3b^3 - 125c^3 \\
 &= (ab)^3 - (5c)^3 \\
 &= (ab-5c)[(ab)^2 + (ab)(5c) + (5c)^2] \\
 &= \underline{\underline{(ab-5c)(a^2b^2+5abc+25c^2)}}
 \end{aligned}$$

$$\begin{aligned}
 \text{(b)} \quad & a^4b^4 - ab = ab(a^3b^3 - 1) \\
 &= ab[(ab)^3 - 1^3] \\
 &= \underline{\underline{ab(ab-1)(a^2b^2+ab+1)}}
 \end{aligned}$$

$$\begin{aligned}
 7. \text{ (a)} \quad & 8 - \frac{1}{m^3} = 2^3 - \left(\frac{1}{m}\right)^3 \\
 &= \underline{\underline{\left(2 - \frac{1}{m}\right)\left(4 + \frac{2}{m} + \frac{1}{m^2}\right)}}
 \end{aligned}$$

$$\begin{aligned}
 \text{(b)} \quad & 3n^3 + \frac{1}{9} = 3\left(n^3 + \frac{1}{27}\right) \\
 &= 3\left[n^3 + \left(\frac{1}{3}\right)^3\right] \\
 &= \underline{\underline{3\left(n + \frac{1}{3}\right)\left(n^2 - \frac{1}{3}n + \frac{1}{9}\right)}}
 \end{aligned}$$

$$\begin{aligned}
 9. \text{ (a)} \quad & a^3(b+2)^3 + a^3b^3 \\
 &= a^3[(b+2)^3 + b^3] \\
 &= a^3[(b+2)+b][(b+2)^2 - (b+2)b + b^2] \\
 &= a^3(2b+2)[b^2+4b+4-b^2-2b+b^2] \\
 &= \underline{\underline{2a^3(b+1)(b^2+2b+4)}}
 \end{aligned}$$

練習 III 題解 (續)

$$\begin{aligned}
 \text{(b)} \quad & (a+b)^3 - (a-b)^3 \\
 &= [(a+b) - (a-b)][(a+b)^2 + \\
 &\quad (a+b)(a-b) + (a-b)^2] \\
 &= 2b[(a^2 + 2ab + b^2) + (a^2 - b^2) + \\
 &\quad (a^2 - 2ab + b^2)] \\
 &= \underline{\underline{2b(3a^2 + b^2)}}
 \end{aligned}$$

練習 IV (第 14 頁)

$$\begin{aligned}
 \text{1. (a)} \quad & \log 100 - \log 10 = 2 - 1 \\
 &= \underline{\underline{1}}
 \end{aligned}$$

$$\begin{aligned}
 \text{(b)} \quad & \log 25 + \log 40 = \log (25 \times 40) \\
 &= \log 1\,000 \\
 &= \underline{\underline{3}}
 \end{aligned}$$

$$\begin{aligned}
 \text{3.} \quad & \log (10x)^3 + \log \frac{1}{x^3} = \log \left[(10x)^3 \cdot \frac{1}{x^3} \right] \\
 &= \log 1\,000 \\
 &= \underline{\underline{3}}
 \end{aligned}$$

$$\begin{aligned}
 \text{5.} \quad & \log \frac{x}{\sqrt{x}} - \frac{1}{2} \log x = \log x^{\frac{1}{2}} - \log x^{\frac{1}{2}} \\
 &= \underline{\underline{0}}
 \end{aligned}$$

$$\begin{aligned}
 \text{7.} \quad & \log 3^6 + \log \left(\frac{1}{9}\right)^3 = \log \left[3^6 \cdot \left(\frac{1}{9}\right)^3 \right] \\
 &= \log 1 \\
 &= \underline{\underline{0}}
 \end{aligned}$$

$$\begin{aligned}
 \text{9.} \quad & 3 \log 5 - 2 \log \frac{5}{2} + \log 50 \\
 &= \log 5^3 - \log \left(\frac{5}{2}\right)^2 + \log 50 \\
 &= \log \left[\frac{5^3 \times 50}{\left(\frac{5}{2}\right)^2} \right] \\
 &= \log 1\,000 \\
 &= \underline{\underline{3}}
 \end{aligned}$$

$$\begin{aligned}
 \text{11.} \quad & \frac{2 \log x - \log \frac{1}{x}}{\log x^3 + 4 \log x} = \frac{2 \log x + \log x}{3 \log x + 4 \log x} \\
 &= \frac{3 \log x}{7 \log x} \\
 &= \underline{\underline{\frac{3}{7}}}
 \end{aligned}$$

練習 V (第 16 頁)

$$\text{1.} \quad \log x = 3 \log y + \log 2$$

$$\log x = \log y^3 + \log 2$$

$$\log x = \log (2y^3)$$

$$\therefore x = \underline{\underline{2y^3}}$$

$$\text{3.} \quad \log (2x - 3) = 0$$

$$\therefore 2x - 3 = 1$$

$$x = \underline{\underline{2}}$$

$$\text{5.} \quad 4^x = 13$$

$$\log 4^x = \log 13$$

$$x \log 4 = \log 13$$

$$x = \frac{\log 13}{\log 4}$$

$$= \underline{\underline{1.85}} \text{ (準確至二位小數)}$$

$$\text{7.} \quad 4(9^{4+x}) = 15$$

$$9^{4+x} = \frac{15}{4}$$

$$\log 9^{4+x} = \log \frac{15}{4}$$

$$(4+x) \log 9 = \log \frac{15}{4}$$

$$4+x = \frac{\log \frac{15}{4}}{\log 9}$$

$$x = \frac{\log \frac{15}{4}}{\log 9} - 4$$

$$= \underline{\underline{-3.40}} \text{ (準確至二位小數)}$$

練習 V 題解 (續)

$$9. \log(x+y) = \log(x+1) - 1$$

$$\log(x+y) = \log(x+1) - \log 10$$

$$\log(x+y) = \log \frac{x+1}{10}$$

$$\therefore x+y = \frac{x+1}{10}$$

$$10x + 10y = x + 1$$

$$9x = 1 - 10y$$

$$x = \frac{1-10y}{9}$$

$$11. \log \sqrt{1+\frac{x}{2}} = \frac{1}{2}$$

$$\log \left(1+\frac{x}{2}\right)^{\frac{1}{2}} = \frac{1}{2}$$

$$\frac{1}{2} \log \left(1+\frac{x}{2}\right) = \frac{1}{2}$$

$$\log \left(1+\frac{x}{2}\right) = 1$$

$$\therefore 1+\frac{x}{2} = 10$$

$$\frac{x}{2} = 9$$

$$x = \underline{\underline{18}}$$

$$13. \quad 5^{2x-1} = 7^{3x+1}$$

$$\log 5^{2x-1} = \log 7^{3x+1}$$

$$(2x-1) \log 5 = (3x+1) \log 7$$

$$2x \log 5 - \log 5 = 3x \log 7 + \log 7$$

$$x(2 \log 5 - 3 \log 7) = \log 7 + \log 5$$

$$x = \frac{\log 7 + \log 5}{2 \log 5 - 3 \log 7}$$

$$= \underline{\underline{-1.36}} \text{ (準確至二位小數)}$$

15.

$$3(5^{1-x}) - 4(6^{2-3x}) = 0$$

$$3(5^{1-x}) = 4(6^{2-3x})$$

$$\log [3(5^{1-x})] = \log [4(6^{2-3x})]$$

$$\log 3 + \log 5^{1-x} = \log 4 + \log 6^{2-3x}$$

$$\log 3 + (1-x) \log 5 = \log 4 + (2-3x) \log 6$$

$$\log 3 + \log 5 - x \log 5 = \log 4 + 2 \log 6 - 3x \log 6$$

$$(3 \log 6 - \log 5)x = \log 4 + 2 \log 6 - \log 3 -$$

$$\log 5$$

$$x = \frac{\log 4 + 2 \log 6 - \log 3 - \log 5}{3 \log 6 - \log 5}$$

$$= \underline{\underline{0.60}} \text{ (準確至二位小數)}$$

補充練習 (第 17 頁)

$$1. (a) 3(3^{-2})^{-\frac{1}{2}} = 3 \left[3^{(-2) \times \left(-\frac{1}{2}\right)} \right]$$

$$= 3 \cdot 3$$

$$= 3^{1+1}$$

$$= \underline{\underline{3^2}}$$

$$(b) \left(4x^{\frac{1}{6}}\right) \left(\frac{1}{8}x^{\frac{1}{3}}\right) = 4 \cdot \frac{1}{8} \cdot x^{\frac{1}{6}} \cdot x^{\frac{1}{3}}$$

$$= \frac{1}{2} x^{\frac{1}{6} + \frac{1}{3}}$$

$$= \underline{\underline{\frac{1}{2} x^{\frac{1}{2}}}}$$

$$3. (a) \frac{9^k \cdot 2^{-3k}}{3^{-k} \cdot 4^k} = \frac{(3^2)^k \cdot 2^{-3k}}{3^{-k} \cdot (2^2)^k}$$

$$= \frac{3^{2k} \cdot 2^{-3k}}{3^{-k} \cdot 2^{2k}}$$

$$= 3^{2k - (-k)} \cdot 2^{-3k - 2k}$$

$$= \underline{\underline{2^{-5k} \cdot 3^{3k}}}$$

$$(b) \left(\frac{a}{\sqrt[n]{a}}\right)^n \cdot a = \left(\frac{a}{a^{\frac{1}{n}}}\right)^n \cdot a$$

$$= \left(a^{1-\frac{1}{n}}\right)^n \cdot a$$

$$= a^{\left(1-\frac{1}{n}\right) \times n} \cdot a$$

$$= a^{n-1} \cdot a$$

$$= a^{n-1+1}$$

$$= \underline{\underline{a^n}}$$

補充練習 0 題解 (續)

$$\begin{aligned}
 5. \quad & 27^{2x-1} \cdot 243^{2x-2} = 81^{3x+1} \\
 & 3^{3(2x-1)} \cdot 3^{5(2x-2)} = 3^{4(3x+1)} \\
 & 3^{6x-3} \cdot 3^{10x-10} = 3^{12x+4} \\
 & 3^{(6x-3)+(10x-10)} = 3^{12x+4} \\
 & 3^{16x-13} = 3^{12x+4} \\
 \therefore \quad & 16x-13 = 12x+4 \\
 & 4x = 17 \\
 & x = \frac{17}{4}
 \end{aligned}$$

$$\begin{aligned}
 7. \quad & (4x+3)^{-\frac{5}{3}} = -\frac{1}{32} \\
 & (4x+3)^{-\frac{5}{3}} = -2^{-5} \\
 & \left[(4x+3)^{-\frac{5}{3}}\right]^{-\frac{3}{5}} = [(-1)^{-5}2^{-5}]^{-\frac{3}{5}} \\
 & 4x+3 = (-1)^{-5\left(-\frac{3}{5}\right)}2^{-5\left(-\frac{3}{5}\right)} \\
 & 4x+3 = (-1)^32^3 \\
 & 4x+3 = -8 \\
 & x = -\frac{11}{4}
 \end{aligned}$$

$$\begin{aligned}
 9. \quad (a) \quad & \sqrt[7]{a\sqrt{a}\sqrt[3]{a}} = \left[a\left(a \cdot a^{\frac{1}{2}}\right)^{\frac{1}{2}}\right]^{\frac{1}{7}} \\
 & = \left[a\left(a^{1+\frac{1}{2}}\right)^{\frac{1}{2}}\right]^{\frac{1}{7}} \\
 & = \left[a\left(a^{\frac{3}{2}}\right)^{\frac{1}{2}}\right]^{\frac{1}{7}} \\
 & = \left[a^{1+\frac{3}{4}}\right]^{\frac{1}{7}} \\
 & = \left[a^{\frac{7}{4}}\right]^{\frac{1}{7}} \\
 & = \underline{\underline{a^{\frac{1}{4}}}}
 \end{aligned}$$

$$(b) \quad \sqrt[7]{a\sqrt{a}\sqrt[3]{a}} = 2$$

$$a^{\frac{1}{4}} = 2$$

[根據 (a)]

$$\left(a^{\frac{1}{4}}\right)^4 = 2^4$$

$$a = \underline{\underline{16}}$$

$$\begin{aligned}
 11. \quad (a) \quad & 81x^4 - 16y^4 \\
 & = (9x^2)^2 - (4y^2)^2 \\
 & = (9x^2 + 4y^2)(9x^2 - 4y^2) \\
 & = (9x^2 + 4y^2)[(3x)^2 - (2y)^2] \\
 & = \underline{\underline{(9x^2 + 4y^2)(3x + 2y)(3x - 2y)}}
 \end{aligned}$$

$$\begin{aligned}
 (b) \quad & 5u^4v - 125u^2v^3 = 5u^2v(u^2 - 25v^2) \\
 & = 5u^2v[u^2 - (5v)^2] \\
 & = \underline{\underline{5u^2v(u + 5v)(u - 5v)}}
 \end{aligned}$$

$$\begin{aligned}
 13. \quad (a) \quad & 25x^4 - 30x^2y + 9y^2 \\
 & = (5x^2)^2 - 2(5x^2)(3y) + (3y)^2 \\
 & = \underline{\underline{(5x^2 - 3y)^2}}
 \end{aligned}$$

$$\begin{aligned}
 (b) \quad & 16a^2b^2 + 56abc + 49c^2 \\
 & = (4ab)^2 + 2(4ab)(7c) + (7c)^2 \\
 & = \underline{\underline{(4ab + 7c)^2}}
 \end{aligned}$$

$$\begin{aligned}
 15. \quad (a) \quad & \left(\sqrt{x} - \frac{1}{\sqrt{x}}\right)^2 \\
 & = (\sqrt{x})^2 - 2(\sqrt{x})\left(\frac{1}{\sqrt{x}}\right) + \left(\frac{1}{\sqrt{x}}\right)^2 \\
 & = \underline{\underline{x - 2 + \frac{1}{x}}}
 \end{aligned}$$

$$\begin{aligned}
 (b) \quad (i) \quad & \sqrt{x} - \frac{1}{\sqrt{x}} = \sqrt{2} \\
 & \left(\sqrt{x} - \frac{1}{\sqrt{x}}\right)^2 = (\sqrt{2})^2
 \end{aligned}$$

$$x - 2 + \frac{1}{x} = 2$$

[根據 (a)]

$$\therefore \quad x + \frac{1}{x} = \underline{\underline{4}}$$

補充練習 0 題解 (續)

(ii) 根據 (b)(i),

$$\begin{aligned}\left(x + \frac{1}{x}\right)^2 &= 4^2 \\ x^2 + 2(x)\left(\frac{1}{x}\right) + \left(\frac{1}{x}\right)^2 &= 16 \\ x^2 + 2 + \frac{1}{x^2} &= 16 \\ \therefore x^2 + \frac{1}{x^2} &= \underline{\underline{14}}\end{aligned}$$

(iii) 根據 (b)(ii),

$$\begin{aligned}\left(x^2 + \frac{1}{x^2}\right)^2 &= 14^2 \\ (x^2)^2 + 2(x^2)\left(\frac{1}{x^2}\right) + \left(\frac{1}{x^2}\right)^2 &= 196 \\ x^4 + 2 + \frac{1}{x^4} &= 196 \\ \therefore x^4 + \frac{1}{x^4} &= \underline{\underline{194}}\end{aligned}$$

$$\begin{aligned}17. (a) \quad 4x^3 - 32y^3 &= 4(x^3 - 8y^3) \\ &= 4[x^3 - (2y)^3] \\ &= 4(x - 2y)[x^2 + (x)(2y) + (2y)^2] \\ &= \underline{\underline{4(x - 2y)(x^2 + 2xy + 4y^2)}}$$

$$\begin{aligned}(b) \quad 16x - \frac{x^4}{4} &= \frac{1}{4}x(64 - x^3) \\ &= \frac{1}{4}x(4^3 - x^3) \\ &= \frac{1}{4}x(4 - x)(16 + 4x + x^2) \\ &= \underline{\underline{\frac{1}{4}x(4 - x)(16 + 4x + x^2)}}$$

$$\begin{aligned}19. (a) \quad 8^n + x^{6n} &= (2^3)^n + (x^{2n})^3 \\ &= (2^n)^3 + (x^{2n})^3 \\ &= (2^n + x^{2n})[(2^n)^2 - (2^n)(x^{2n}) + (x^{2n})^2] \\ &= \underline{\underline{(2^n + x^{2n})(2^{2n} - 2^n x^{2n} + x^{4n})}}\end{aligned}$$

$$\begin{aligned}(b) \quad 8x^{6n} - y^{3n+9} &= (2x^{2n})^3 - (y^{n+3})^3 \\ &= \underline{\underline{(2x^{2n} - y^{n+3})(4x^{4n} + 2x^{2n}y^{n+3} + y^{2n+6})}}\end{aligned}$$

$$\begin{aligned}21. (a) \quad \log \sqrt{625} + 2 \log 2 &= \log 25 + \log 2^2 \\ &= \log (25 \cdot 2^2) \\ &= \log 100 \\ &= \underline{\underline{2}}\end{aligned}$$

$$\begin{aligned}(b) \quad \left(\log 1.6 - \log \frac{4}{25}\right)^2 &= \left[\log \left(\frac{1.6}{\frac{4}{25}}\right)\right]^2 \\ &= [\log 10]^2 \\ &= 1^2 \\ &= \underline{\underline{1}}\end{aligned}$$

$$\begin{aligned}23. \quad \because 10^a &= 5 \quad \text{及} \quad 10^b = 3 \\ \therefore a &= \log 5 \quad \text{及} \quad b = \log 3\end{aligned}$$

$$\begin{aligned}(a) \quad \log 600 &= \log (3 \times 2 \times 100) \\ &= \log 3 + \log 2 + \log 100 \\ &= \log 3 + \log \frac{10}{5} + 2 \\ &= \log 3 + (\log 10 - \log 5) + 2 \\ &= b + 1 - a + 2 \\ \therefore \log 600 &= \underline{\underline{b - a + 3}}\end{aligned}$$

$$\begin{aligned}(b) \quad \log 40.5 &= \log \frac{81}{2} \\ &= \log 81 - \log 2 \\ &= \log 3^4 - \log \frac{10}{5} \\ &= 4 \log 3 - (\log 10 - \log 5) \\ &= 4b - (1 - a) \\ \therefore \log 40.5 &= \underline{\underline{4b + a - 1}}\end{aligned}$$

$$\begin{aligned}25. (a) \quad 2 \log x &= 3 - \log y \\ \log x^2 &= \log 10^3 - \log y \\ \log x^2 &= \log \left(\frac{1000}{y}\right) \\ \therefore x^2 &= \frac{1000}{y} \\ \therefore y &= \underline{\underline{\frac{1000}{x^2}}}\end{aligned}$$

補充練習 0 題解 (續)

(b) 根據 (a), $x^2 = \frac{1\,000}{y}$

$$\therefore x = 10\sqrt{\frac{10}{y}} \quad \text{或} \quad -10\sqrt{\frac{10}{y}} \quad (\text{捨去})$$

27. $2 \log \sqrt{2x-3} - \log 10 = \log 1$

$$\log \left[(2x-3)^{\frac{1}{2}} \right]^2 - \log 10 = \log 1$$

$$\log \left(\frac{2x-3}{10} \right) = \log 1$$

$$\therefore \frac{2x-3}{10} = 1$$

$$x = \underline{\underline{\frac{13}{2}}}$$

29. $7^x \cdot 3^{2x+1} = 7$

$$3^{2x+1} = 7^{1-x}$$

$$\log 3^{2x+1} = \log 7^{1-x}$$

$$(2x+1) \log 3 = (1-x) \log 7$$

$$2x \log 3 + \log 3 = \log 7 - x \log 7$$

$$x(2 \log 3 + \log 7) = \log 7 - \log 3$$

$$x = \frac{\log 7 - \log 3}{2 \log 3 + \log 7}$$

$$= \underline{\underline{0.205}} \quad (\text{準確至三位有效數字})$$

31. $\left(\frac{7}{3}\right)^{2x-1} \cdot \frac{1}{4^x} = 2.8$

$$\left(\frac{7}{3}\right)^{2x-1} \cdot 4^{-x} = 2.8$$

$$\log \left[\left(\frac{7}{3}\right)^{2x-1} \cdot 4^{-x} \right] = \log 2.8$$

$$\log \left(\frac{7}{3}\right)^{2x-1} + \log 4^{-x} = \log 2.8$$

$$(2x-1) \log \frac{7}{3} - x \log 4 = \log 2.8$$

$$2x \log \frac{7}{3} - \log \frac{7}{3} - x \log 4 = \log 2.8$$

$$x \left(2 \log \frac{7}{3} - \log 4 \right) = \log 2.8 + \log \frac{7}{3}$$

$$x = \frac{\log 2.8 + \log \frac{7}{3}}{2 \log \frac{7}{3} - \log 4}$$

$$= \underline{\underline{6.09}} \quad (\text{準確至三位有效數字})$$

33. (a) $\left(\frac{2a^{-1}b^{-\frac{1}{2}}}{4^{\frac{1}{2}}a^{\frac{1}{2}}b^{-2}} \right)^{-\frac{2}{3}} = \left[\frac{2a^{-1}b^{-\frac{1}{2}}}{(2^2)^{\frac{1}{2}}a^{\frac{1}{2}}b^{-2}} \right]^{-\frac{2}{3}}$

$$= \left[2^{1-4} a^{-1-\frac{1}{2}} b^{-\frac{1}{2}-(-2)} \right]^{-\frac{2}{3}}$$

$$= \left(2^{-3} a^{-\frac{3}{2}} b^{\frac{3}{2}} \right)^{-\frac{2}{3}}$$

$$= 2^2 ab^{-1}$$

$$= \underline{\underline{\frac{4a}{b}}}$$

(b) $\frac{7^0 \sqrt{p} \sqrt[3]{q}}{7p^2 \cdot \sqrt[4]{q^3}} = \frac{p^{\frac{1}{2}} q^{\frac{1}{3}}}{7p^2 q^{\frac{3}{4}}}$

$$= \frac{1}{7p^{2-\frac{1}{2}} q^{\frac{3}{4}-\frac{1}{3}}}$$

$$= \frac{1}{7p^{\frac{3}{2}} q^{\frac{5}{12}}}$$

35. $6(\sqrt{2x-1})^{-\frac{5}{3}} = 12 \times 2^{-6}$

$$\left[(2x-1)^{\frac{1}{2}} \right]^{-\frac{5}{3}} = 2 \times 2^{-6}$$

$$(2x-1)^{-\frac{5}{6}} = 2^{-5}$$

$$\left[(2x-1)^{-\frac{5}{6}} \right]^{-\frac{6}{5}} = (2^{-5})^{-\frac{6}{5}}$$

$$2x-1 = 2^6$$

$$2x-1 = 64$$

$$x = \underline{\underline{\frac{65}{2}}}$$

37. (a) $\left(a - \frac{b}{2}\right)^2 = a^2 - 2(a)\left(\frac{b}{2}\right) + \left(\frac{b}{2}\right)^2$

$$= \underline{\underline{a^2 - ab + \frac{b^2}{4}}}$$

補充練習 0 題解 (續)

$$\begin{aligned}
 \text{(b)} \quad & (a-1)(a+1) + \frac{1}{4}b(b-4a) \\
 &= a^2 - 1 + \frac{1}{4}b^2 - ab \\
 &= \left(a^2 - ab + \frac{b^2}{4}\right) - 1 \\
 &= \left(a - \frac{b}{2}\right)^2 - 1 \\
 &= \left(a - \frac{b}{2} + 1\right)\left(a - \frac{b}{2} - 1\right)
 \end{aligned}$$

[根據 (a)]

$$\begin{aligned}
 39. \text{(a)} \quad & 2^{3x+3} = 81 \\
 & 2^{3x} \cdot 2^3 = 3^4 \\
 & 2^{3x} = \frac{3^4}{2^3} \\
 & (2^{3x})^{\frac{1}{3}} = \left(\frac{3^4}{2^3}\right)^{\frac{1}{3}} \\
 & 2^x = \frac{1}{2} \left(\frac{3^4}{2^3}\right)
 \end{aligned}$$

$$\begin{aligned}
 \text{(b)} \quad & 2^{3x+3} = 81 \\
 & 2^{3x} = \frac{81}{8} \\
 & \frac{1}{2^{3x}} = \frac{8}{81} \\
 \therefore \quad & \left(\frac{1}{8}\right)^x = \frac{8}{81}
 \end{aligned}$$

$$\begin{aligned}
 41. \text{(a)} \quad & (mx)^{-\frac{3}{2}} = n \\
 & \left[(mx)^{-\frac{3}{2}}\right]^{\frac{2}{3}} = n^{\frac{2}{3}} \\
 & (mx)^{-1} = m \\
 & \frac{1}{mx} = m \\
 & x = \frac{1}{m^2}
 \end{aligned}$$

(b) 將 $m = \sqrt[3]{n^2}$ 代入 (a) 的結果,

$$\begin{aligned}
 x &= \frac{1}{(\sqrt[3]{n^2})^2} \\
 &= \frac{1}{\left(n^{\frac{2}{3}}\right)^2} \\
 \therefore x &= \frac{1}{\frac{n^{\frac{4}{3}}}{n^{\frac{4}{3}}}}
 \end{aligned}$$

$$\begin{aligned}
 43. \quad & \frac{1}{2} \log(x+y) = \log \sqrt{\frac{x}{y}} + 1 \\
 & \frac{1}{2} \log(x+y) = \log \sqrt{\frac{x}{y}} + \log 10 \\
 & \log(x+y)^{\frac{1}{2}} = \log \left(10 \sqrt{\frac{x}{y}}\right) \\
 \therefore \quad & (x+y)^{\frac{1}{2}} = 10 \sqrt{\frac{x}{y}} \\
 & \left[(x+y)^{\frac{1}{2}}\right]^2 = \left(10 \sqrt{\frac{x}{y}}\right)^2 \\
 & x+y = 100 \left(\frac{x}{y}\right) \\
 & xy + y^2 = 100x \\
 & y^2 = 100x - xy \\
 & y^2 = x(100 - y) \\
 & x = \frac{y^2}{100 - y}
 \end{aligned}$$

$$\begin{aligned}
 45. \text{(a)} \quad & \log \frac{3}{2} = \log 3 - \log 2 \\
 & = \log 9^{\frac{1}{2}} - \log 2 \\
 & = \frac{1}{2} \log 9 - \log 2 \\
 \therefore \quad & \log \frac{3}{2} = \frac{1}{2} b - a
 \end{aligned}$$

補充練習 0 題解 (續)

$$\begin{aligned}
 \text{(b)} \quad \log 54 &= \log (27 \times 2) \\
 &= \log 27 + \log 2 \\
 &= \log 3^3 + \log 2 \\
 &= \log 9^{\frac{3}{2}} + \log 2 \\
 &= \frac{3}{2} \log 9 + \log 2
 \end{aligned}$$

$$\therefore \log 54 = \frac{3}{2}b + a$$

$$\begin{aligned}
 \text{(c)} \quad \log 0.12 &= \log \frac{12}{100} \\
 &= \log 12 - \log 100 \\
 &= \log (4 \times 3) - 2 \\
 &= \log 4 + \log 3 - 2 \\
 &= \log 2^2 + \log 9^{\frac{1}{2}} - 2 \\
 &= 2 \log 2 + \frac{1}{2} \log 9 - 2
 \end{aligned}$$

$$\therefore \log 0.12 = 2a + \frac{1}{2}b - 2$$

$$\begin{aligned}
 47. \text{(a)} \quad x^{3n} + y^{9n} &= (x^n)^3 + (y^{3n})^3 \\
 &= \underline{\underline{(x^n + y^{3n})(x^{2n} - x^n y^{3n} + y^{6n})}}
 \end{aligned}$$

$$\begin{aligned}
 \text{(b)} \quad &\frac{x^{3n} + y^{9n}}{x^n + y^{3n}} \\
 &= \frac{(x^n + y^{3n})(x^{2n} - x^n y^{3n} + y^{6n})}{x^n + y^{3n}} \quad [\text{根據 (a)}] \\
 &= (x^{2n} - x^n y^{3n} + y^{6n}) \\
 &= x^{2n} - (x^{2n})^{\frac{1}{2}} (y^{6n})^{\frac{1}{2}} + y^{6n} \\
 &= 4 - 4^{\frac{1}{2}} \cdot 9^{\frac{1}{2}} + 9 \\
 &= \underline{\underline{7}}
 \end{aligned}$$

$$49. \quad \frac{2(3^{-x} \cdot 4^{2-x}) - 5}{13} = 1$$

$$2(3^{-x} \cdot 4^{2-x}) - 5 = 13$$

$$3^{-x} \cdot 4^{2-x} = 9$$

$$3^{-x} \cdot 4^{2-x} = 3^2$$

$$4^{2-x} = 3^{2+x}$$

$$\log 4^{2-x} = \log 3^{2+x}$$

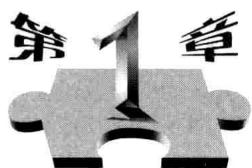
$$(2-x) \log 4 = (2+x) \log 3$$

$$2 \log 4 - x \log 4 = 2 \log 3 + x \log 3$$

$$2(\log 4 - \log 3) = x(\log 3 + \log 4)$$

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

$$= \underline{\underline{0.23}} \quad (\text{準確至二位小數})$$



數系和根式

習題 1A (第 28 頁)

1. (a) 自然數：5, 1, 253
 (b) 整數：5, -5, 1, 0, -1 000, 253
 (c) 小數：0.5, -3.174
 (d) 分數： $\frac{2}{3}, -\frac{5}{4}, 100\frac{7}{9}, \frac{8}{6}$

3. (a) $\frac{2}{3} = 0.666\ 666\cdots = 0.\dot{6}$

$\therefore \frac{2}{3}$ 可化成循環小數。

(b) $\frac{3}{5} = 0.6$

$\therefore \frac{3}{5}$ 可化成有盡小數。

(c) $\frac{3}{12} = 0.25$

$\therefore \frac{3}{12}$ 可化成有盡小數。

5. $\sqrt{25} = 5$

$\sqrt{3} = \sqrt{3}$

$\sqrt[3]{27} = 3$

$\sqrt[3]{5} = \sqrt[3]{5}$

$\sqrt[4]{81} = 3$

$\sqrt[3]{-8} = -2$

	(a)	(b)
$\sqrt{25}$	是	否
$\sqrt{3}$	否	是
$\sqrt[3]{27}$	是	否
$\sqrt[3]{5}$	否	是
$\sqrt[4]{81}$	是	否
$\sqrt[3]{-8}$	是	否

7. (a) $\sqrt{9} = \underline{\underline{3}}$

$0.\dot{2} = \frac{2}{9}$

$\cos 60^\circ = \frac{1}{2}$

$\tan 30^\circ = \frac{\sqrt{3}}{3}$

(b)

	(i)	(ii)	(iii)	(iv)
$\sqrt{9}$	是	否	否	是
$0.\dot{2}$	否	否	是	是
$\cos 60^\circ$	否	否	是	是
$\tan 30^\circ$	否	是	否	是

習題 1B (第 34 頁)

1. (a) $\sqrt{196} = \sqrt{14 \times 14} = \underline{\underline{14}}$

(b) $\sqrt{288} = \sqrt{144 \times 2} = \sqrt{144} \times \sqrt{2} = \underline{\underline{12\sqrt{2}}}$

3. (a) $4\sqrt{3} + 15\sqrt{3} = \underline{\underline{19\sqrt{3}}}$

(b) $\sqrt{8} + 7\sqrt{2} = \sqrt{4 \times 2} + 7\sqrt{2} = 2\sqrt{2} + 7\sqrt{2}$
 $= \underline{\underline{9\sqrt{2}}}$

5. (a) $\sqrt{8} \times \sqrt{12} = \sqrt{4 \times 2} \times \sqrt{4 \times 3}$
 $= 2 \times \sqrt{2} \times 2 \times \sqrt{3}$
 $= 2 \times 2 \times \sqrt{2} \times \sqrt{3}$
 $= \underline{\underline{4\sqrt{6}}}$

習題 1B 題解 (續)

$$\begin{aligned}
 \text{(b)} \quad \sqrt{18} \times \sqrt{72} &= \sqrt{9 \times 2} \times \sqrt{36 \times 2} \\
 &= 3 \times \sqrt{2} \times 6 \times \sqrt{2} \\
 &= 3 \times 6 \times \sqrt{2} \times \sqrt{2} \\
 &= \underline{\underline{36}}
 \end{aligned}$$

$$\begin{aligned}
 7. \text{ (a)} \quad \sqrt{2}(\sqrt{8} + \sqrt{32}) &= \sqrt{2}(\sqrt{4 \times 2} + \sqrt{16 \times 2}) \\
 &= \sqrt{2}(2\sqrt{2} + 4\sqrt{2}) \\
 &= \sqrt{2}(6\sqrt{2}) \\
 &= \underline{\underline{12}}
 \end{aligned}$$

$$\begin{aligned}
 \text{(b)} \quad (1 + \sqrt{8})(1 + \sqrt{2}) &= (1 + \sqrt{4 \times 2})(1 + \sqrt{2}) \\
 &= (1 + 2\sqrt{2})(1 + \sqrt{2}) \\
 &= 1 + \sqrt{2} + 2\sqrt{2} + 4 \\
 &= \underline{\underline{5 + 3\sqrt{2}}}
 \end{aligned}$$

$$\begin{aligned}
 9. \text{ (a)} \quad (1 + \sqrt{3})^2 &= 1 + 2(1)(\sqrt{3}) + (\sqrt{3})^2 \\
 &= 1 + 2\sqrt{3} + 3 \\
 &= \underline{\underline{4 + 2\sqrt{3}}}
 \end{aligned}$$

$$\begin{aligned}
 \text{(b)} \quad \sqrt{3}(1 + \sqrt{3})^2 &= \sqrt{3}(4 + 2\sqrt{3}) \quad [\text{根據 (a)}] \\
 &= \underline{\underline{6 + 4\sqrt{3}}}
 \end{aligned}$$

$$\begin{aligned}
 11. \text{ (a)} \quad \frac{2}{3}\sqrt{\frac{504}{8}} &= \frac{2}{3}\sqrt{63} \\
 &= \frac{2}{3}\sqrt{9 \times 7} \\
 &= \frac{2}{3}(3\sqrt{7}) \\
 &= \underline{\underline{2\sqrt{7}}}
 \end{aligned}$$

$$\begin{aligned}
 \text{(b)} \quad -\frac{3}{2}\sqrt{\frac{30}{1.6}} &= -\frac{3}{2}\sqrt{\frac{300}{16}} \\
 &= -\frac{3}{2}\sqrt{\frac{75}{4}} \\
 &= -\frac{3}{2}\left(\frac{\sqrt{25 \times 3}}{\sqrt{4}}\right) \\
 &= -\frac{3}{2}\left(\frac{5\sqrt{3}}{2}\right) \\
 &= \underline{\underline{-\frac{15\sqrt{3}}{4}}}
 \end{aligned}$$

$$\begin{aligned}
 13. \text{ (a)} \quad \sqrt{48} + \sqrt{\frac{3}{25}} &= \sqrt{16 \times 3} + \frac{\sqrt{3}}{\sqrt{25}} \\
 &= 4\sqrt{3} + \frac{\sqrt{3}}{5} \\
 &= \underline{\underline{\frac{21\sqrt{3}}{5}}}
 \end{aligned}$$

$$\begin{aligned}
 \text{(b)} \quad \sqrt{\frac{75}{4}} - \sqrt{\frac{27}{4}} &= \frac{\sqrt{25 \times 3}}{\sqrt{4}} - \frac{\sqrt{9 \times 3}}{\sqrt{4}} \\
 &= \frac{5\sqrt{3}}{2} - \frac{3\sqrt{3}}{2} \\
 &= \underline{\underline{\sqrt{3}}}
 \end{aligned}$$

$$\begin{aligned}
 15. \text{ (a)} \quad \sqrt{12} - \sqrt{48} + \sqrt{75} - 2\sqrt{27} \\
 &= \sqrt{4 \times 3} - \sqrt{16 \times 3} + \sqrt{25 \times 3} - 2\sqrt{9 \times 3} \\
 &= 2\sqrt{3} - 4\sqrt{3} + 5\sqrt{3} - 6\sqrt{3} \\
 &= \underline{\underline{-3\sqrt{3}}}
 \end{aligned}$$

$$\begin{aligned}
 \text{(b)} \quad 3\sqrt{32} - 2\sqrt{20} + \sqrt{50} + 4\sqrt{5} \\
 &= 3\sqrt{16 \times 2} - 2\sqrt{4 \times 5} + \sqrt{25 \times 2} + 4\sqrt{5} \\
 &= 12\sqrt{2} - 4\sqrt{5} + 5\sqrt{2} + 4\sqrt{5} \\
 &= \underline{\underline{17\sqrt{2}}}
 \end{aligned}$$

$$\begin{aligned}
 17. \text{ (a)} \quad (\sqrt{2} - \sqrt{3})(\sqrt{2} + \sqrt{6}) \\
 &= (\sqrt{2})^2 + (\sqrt{2})(\sqrt{6}) - (\sqrt{3})(\sqrt{2}) - \\
 &\quad (\sqrt{3})(\sqrt{6}) \\
 &= 2 + \sqrt{12} - \sqrt{6} - \sqrt{18} \\
 &= 2 + \sqrt{4 \times 3} - \sqrt{6} - \sqrt{9 \times 2} \\
 &= \underline{\underline{2 + 2\sqrt{3} - \sqrt{6} - 3\sqrt{2}}}
 \end{aligned}$$

$$\begin{aligned}
 \text{(b)} \quad (2\sqrt{5} - \sqrt{3})(3\sqrt{3} + \sqrt{5}) \\
 &= 6(\sqrt{5})(\sqrt{3}) + 2(\sqrt{5})^2 - 3(\sqrt{3})^2 - \\
 &\quad (\sqrt{3})(\sqrt{5}) \\
 &= 6\sqrt{15} + 2(5) - 3(3) - \sqrt{15} \\
 &= 5\sqrt{15} + 10 - 9 \\
 &= \underline{\underline{5\sqrt{15} + 1}}
 \end{aligned}$$