

# SUMS, INVOICES & SCIENTIFIC NOTATION

$$\begin{aligned} 1. \sqrt{50} &= \sqrt{25} \sqrt{2} \\ &= \underline{5\sqrt{2}} \quad \checkmark \end{aligned}$$
$$\begin{aligned} 2. \frac{\sqrt{72}}{\sqrt{3}} &= \sqrt{\frac{72}{3}} \quad \checkmark \text{ or } \frac{\sqrt{72}}{\sqrt{3}} = \frac{\sqrt{72}}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} \quad \checkmark \\ &= \sqrt{24} \\ &= \sqrt{4} \sqrt{6} \\ &= \underline{2\sqrt{6}} \quad \checkmark \cdot 2 \end{aligned}$$
$$\begin{aligned} &= \frac{\sqrt{36} \sqrt{2} \sqrt{3}}{3} \\ &= \frac{6\sqrt{6}}{3} \\ &= \underline{2\sqrt{6}} \quad \checkmark \cdot 2 \end{aligned}$$

$$\begin{aligned} 3. \sqrt{48} - 3\sqrt{3} &= \sqrt{16 \times 3} - 3\sqrt{3} \\ &= \sqrt{16} \sqrt{3} - 3\sqrt{3} \\ &= 4\sqrt{3} - 3\sqrt{3} \\ &= \underline{\sqrt{3}} \quad \checkmark \cdot 2 \end{aligned}$$
$$\begin{aligned} 4. \sqrt{32} - \sqrt{2} &= \sqrt{16 \times 2} - \sqrt{2} \\ &= \sqrt{16} \sqrt{2} - \sqrt{2} \\ &= 4\sqrt{2} - \sqrt{2} \quad \checkmark \\ &= \underline{3\sqrt{2}} \quad \checkmark \cdot 2 \end{aligned}$$

$$\begin{aligned} 5. \sqrt{72} - \sqrt{2} + \sqrt{50} &= \sqrt{36 \times 2} - \sqrt{2} + \sqrt{25 \times 2} \\ &= \sqrt{36} \sqrt{2} - \sqrt{2} + \sqrt{25} \sqrt{2} \\ &= 6\sqrt{2} - \sqrt{2} + 5\sqrt{2} \quad \checkmark \\ &= \underline{10\sqrt{2}} \quad \checkmark \cdot 3 \end{aligned}$$

$$\begin{aligned} 6. \sqrt{32} + \sqrt{8} &= \sqrt{16 \times 2} + \sqrt{4 \times 2} \\ &= \sqrt{16} \sqrt{2} + \sqrt{4} \sqrt{2} \\ &= 4\sqrt{2} + 2\sqrt{2} \quad \checkmark \\ &= \underline{6\sqrt{2}} \quad \checkmark \cdot 3 \end{aligned}$$
$$\begin{aligned} 7. \sqrt{2}(\sqrt{6} - \sqrt{2}) &= \sqrt{2}\sqrt{6} - \sqrt{2}\sqrt{2} \quad \checkmark \\ &= \sqrt{12} - \sqrt{4} \\ &= \sqrt{4}\sqrt{3} - 2 \\ &= \underline{2\sqrt{3} - 2} \quad \checkmark \cdot 2 \end{aligned}$$

$$\begin{aligned} 8. \frac{3}{\sqrt{5}} &= \frac{3}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} \quad \checkmark \\ &= \frac{3\sqrt{5}}{\underline{5}} \quad \checkmark \cdot 2 \end{aligned}$$

$$\begin{aligned} 9. \frac{\sqrt{3}}{\sqrt{24}} &= \frac{\sqrt{3}}{\sqrt{24}} \times \frac{\sqrt{24}}{\sqrt{24}} \quad \checkmark \\ &= \frac{\sqrt{3} \sqrt{24}}{24} \\ &= \frac{\sqrt{72}}{24} \\ &= \frac{\sqrt{36} \sqrt{2}}{24} \quad \checkmark \\ &= \frac{6\sqrt{2}}{24} \\ &= \frac{\sqrt{2}}{4} \quad \checkmark \cdot 3 \end{aligned}$$

$$1. 27^{\frac{2}{3}} = (\sqrt[3]{27})^2 \checkmark$$

$$= 3^2$$

$$= \underline{9} \checkmark \cdot 2$$

$$2. y^{10} \times (y^4)^{-2} = y^{10} \times y^{-8} \checkmark$$

$$= y^{10-8}$$

$$= \underline{y^2} \checkmark \cdot 2$$

$$3. a^3(a^{-7}+5) = a^{3-7} + 5a^3 \checkmark$$

$$= a^{-4} + 5a^3 \checkmark$$

$$\left( = \underline{\frac{1}{a^4} + 5a^3} \right) \cdot 2$$

$$4. \frac{3y^5 \times 4y^{-1}}{6y} = \frac{12y^{5-1}}{6y^1} \checkmark$$

$$= \frac{12y^4}{6y^1} \checkmark$$

$$= \underline{2y^3} \checkmark \cdot 3$$

$$5. \frac{y^4 \times y}{y^{-2}} = \frac{y^{4+1}}{y^{-2}} \checkmark$$

$$= \frac{y^5}{y^{-2}} \checkmark$$

$$= y^{5-(-2)} \checkmark$$

$$= \underline{y^7} \checkmark \cdot 2$$

$$6. \frac{b^{\frac{1}{2}} \times b^{\frac{3}{2}}}{b} = \frac{b^{\frac{1}{2}+\frac{3}{2}}}{b^1} \checkmark$$

$$= \frac{b^2}{b^1} \checkmark$$

$$= \underline{b} \checkmark \cdot 2$$

$$7. b^{\frac{1}{2}}(b^{\frac{1}{2}}+b^{-\frac{1}{2}}) = b^{\frac{1}{2}+\frac{1}{2}} + b^{\frac{1}{2}-\frac{1}{2}} \checkmark$$

$$= b^1 + b^0 \checkmark$$

$$= \underline{b+1} \checkmark \cdot 3$$

$$8. a^{\frac{1}{2}}(a+\frac{1}{a}) = a^{\frac{1}{2}}(a^1+a^{-1}) \checkmark$$

$$= a^{\frac{1}{2}+1} + a^{\frac{1}{2}-1} \checkmark$$

$$= a^{\frac{3}{2}} + a^{-\frac{1}{2}} \checkmark \cdot 2$$

$$\left( = \underline{\sqrt{a^3} + \frac{1}{\sqrt{a}}} \right)$$

$$9. 8 \times 4.80 \times 10^8 = 3840000000 \checkmark$$

$$= \underline{3.84 \times 10^9} \text{ L} \checkmark \cdot 2$$

$$10. 1.8 \times 10^3 \times 9.11 \times 10^{-31} = 1.6398 \times 10^{-27} \checkmark$$

$$= \underline{1.6 \times 10^{-27}} \text{ kg (2sf)} \checkmark \cdot 2$$

$$11. 50,000,000 \times 9.46 \times 10^{12} = \underline{4.73 \times 10^{20}} \text{ km} \checkmark \cdot 2$$

# Algebra

$$1. \quad 4(3x-2) - 5(4x+1) = \sqrt{12x-8} - \sqrt{20x+5}$$
$$= \underline{-8x-13} \quad \checkmark \quad \cdot 3$$

$$2. \quad (3a-b)(2a-5b) = 6a^2 - 15ab - 2ab + 5b^2 \quad \checkmark$$
$$= \underline{6a^2 - 17ab + 5b^2} \quad \checkmark \quad \cdot 2$$

$$3. \quad (2x-1)(x+3) + (x-4)^2 = (2x-1)(x+3) + (x-4)(x-4) \quad \checkmark$$
$$= \sqrt{2x^2+6x-x-3} + \sqrt{x^2-4x-4x+16}$$
$$= 2x^2+5x-3+x^2-8x+16 \quad \checkmark$$
$$= \underline{3x^2-3x+13} \quad \checkmark \quad \cdot 4$$

$$4. \quad (3x-4)^2 = (3x-4)(3x-4)$$
$$= 9x^2 - 12x - 12x + 16 \quad \checkmark$$
$$= \underline{9x^2 - 24x + 16} \quad \checkmark$$

$$5. \quad (2x-3)(3x^2+4x-1) = 6x^3 + 8x^2 - 2x$$
$$\quad \quad \quad - 9x^2 - 12x + 3 \quad \checkmark$$
$$= \underline{6x^3 - x^2 - 14x + 3} \quad \checkmark \quad \cdot 3$$

$$7. \quad c^2 - 9 = (c+3)(c-3) \quad \checkmark \quad \cdot 1$$
$$8. \quad v^2 - 81 = (v+9)(v-9) \quad \checkmark \quad \cdot 1$$

$$9. \quad m^2 - 6m + 9 = (m-3)(m-3) \quad \checkmark \quad \cdot 2$$
$$10. \quad t^2 - 13t + 30 = (t-3)(t-10) \quad \checkmark \quad \cdot 2$$

$$11. \quad w^2 - w - 72 = (w+8)(w-9) \quad \cdot 2$$

$$12. \quad 6x^2 - 9x = \underline{3x(2x-3)} \quad \cdot 2$$
$$13. \quad 4a^2 - 9b^2 = (2a)^2 - (3b)^2$$
$$= \underline{(2a+3)(2a-3)} \quad \cdot 2$$

$$14. 2a^2 - 3a - 2 = \underline{(2a+1)(a-2)} \cdot 2$$

$$\begin{array}{r} 2 \cancel{1} 2 \\ 1 \cancel{2} 1 \end{array}$$

$$15. 3x^2 - 13x - 10 = \underline{(3x+2)(x-5)} \cdot 2$$

$$\begin{array}{r} 3 \cancel{2} 5 10 1 \\ 1 \cancel{15} 2 1 10 \end{array}$$

$$\begin{aligned} 16. x^2 + 8x + 24 &= (x+4)^2 - (4)^2 + 24 \\ &= (x+4)^2 - 16 + 24 \\ &= \underline{(x+4)^2 + 8} \cdot 2 \end{aligned}$$

$$\begin{aligned} 17. x^2 - 2x + 8 &= (x-1)^2 - (1)^2 + 8 \\ &= (x-1)^2 - 1 + 8 \\ &= \underline{(x-1)^2 + 7} \cdot 2 \end{aligned}$$

$$\begin{aligned} 18. x^2 - 8x + 20 &= (x-4)^2 - (4)^2 + 20 \\ &= (x-4)^2 - 16 + 20 \\ &= \underline{(x-4)^2 + 4} \cdot 2 \end{aligned}$$

$$\begin{aligned} 19. x^2 + 10x + 35 &= (x+5)^2 - (5)^2 + 35 \\ &= (x+5)^2 - 25 + 35 \\ &= \underline{(x+5)^2 + 10} \end{aligned}$$

# Algebraic Fractions

$$1. i) 2x^2 - 6x = \underline{2x(x-3)} \checkmark \cdot 1$$

$$ii) \frac{2x^2 - 6x}{x^2 - 9} = \frac{\underline{2x(x-3)}}{(x+3)(x-3)} \checkmark \\ = \frac{\underline{2x}}{x+3} \checkmark \cdot 2$$

$$3. a) a^2 - 9b^2 = a^2 - (3b)^2 \\ = \underline{(a+3b)(a-3b)} \checkmark \cdot 1$$

$$b) \frac{a^2 - 9b^2}{2a + 6b} = \frac{(a+3b)(a-3b)}{2(a+3b)} \checkmark \\ = \frac{a-3b}{2} \checkmark \\ = \underline{\frac{1}{2}(a-3b)} \checkmark \cdot 2$$

$$2. a) 9x^2 - y^2 = (3x)^2 - y^2 \\ = \underline{(3x+y)(3x-y)} \checkmark \cdot 1$$

$$b) \frac{6x+2y}{9x^2-y^2} = \frac{2(3x+y)}{(3x+y)(3x-y)} \checkmark \\ = \frac{2}{3x-y} \checkmark \cdot 2$$

$$4. a) x^2 - 9 = \underline{(x+3)(x-3)} \checkmark \cdot 1$$

$$b) \frac{4(5x+3)}{25x^2-9} = \frac{4(5x+3)}{(5x)^2-9} \\ = \frac{4(5x+3)}{(5x+3)(5x-3)} \checkmark \\ = \underline{\frac{4}{5x-3}} \checkmark \cdot 2$$

$$5. \frac{15x-20}{9x^2-16} = \frac{5(3x-4)}{(3x)^2-16} \\ = \frac{5(3x-4)}{(3x+4)(3x-4)} \checkmark \\ = \frac{5}{3x+4} \checkmark \cdot 3$$

$$6. \frac{1}{2x} - \frac{1}{3x} = \frac{3x-2x}{(3x)(2x)} \checkmark \\ = \frac{x}{6x^2} \\ = \underline{\frac{1}{6x}} \checkmark \cdot 2$$

$$7. \frac{3}{x} + \frac{2-x}{x^2} = \frac{3x^2 + x(2-x)}{x(x^2)} \checkmark \\ = \frac{3x^2 + 2x - x^2}{x^3} \\ = \frac{2x^2 + 2x}{x^3} \\ = \frac{x(2x+2)}{x^3} \checkmark \\ = \underline{\frac{2x+2}{x^2}} \checkmark \cdot 3$$

$$8. \frac{5}{x} - \frac{3}{x-2} = \frac{5(x-2) - 3x}{x(x-2)} \checkmark \\ = \frac{5x - 10 - 3x}{x(x-2)} \\ = \frac{2x - 10}{x(x-2)} \checkmark \cdot 3 \\ = \underline{\left( \frac{2(x-5)}{x(x-2)} \right)}$$

# Gradient, Area & Volume

1.  $A(0, 4) B(12, 40)$

$$\begin{aligned} m_{AB} &= \frac{40-4}{12-0} \\ &= \frac{36}{12} \\ &= \underline{3} \quad \checkmark \quad \cdot 1 \end{aligned}$$

2.  $F(0, 40) P(4, 100)$

$$\begin{aligned} m_{FP} &= \frac{100-40}{4-0} \\ &= \frac{60}{4} \\ &= \underline{15} \quad \checkmark \quad \cdot 1 \end{aligned}$$

3.  $A = \frac{40}{360} \times \pi \times 15^2 \quad \checkmark$

$$\begin{aligned} &= 25\pi \\ &= 78.5398 \\ &= \underline{78.5 \text{ cm}^2} \quad \checkmark \quad \cdot 2 \end{aligned}$$

4.  $A = \frac{\theta}{360} \times \pi r^2$        $L = \frac{101.859}{360} \times \pi \times 30$

$$\begin{aligned} 200 &= \frac{\theta}{360} \times \pi \times 15^2 && = 26.6666 \\ \theta &= \frac{200 \times 360}{\pi \times 15^2} && = \underline{26 \frac{2}{3} \text{ m}} \quad \checkmark \quad \cdot 4 \\ &= 101.859 \quad \checkmark \end{aligned}$$

5.  $A = \frac{310}{360} \times \pi \times 1.2^2 \quad \checkmark$

$$\begin{aligned} &= \frac{31\pi}{25} \\ &= 3.8955 \\ &= \underline{3.90 \text{ m}^2} \quad \checkmark \quad \cdot 4 \end{aligned}$$

6. a)  $V = 6 \times 10 \times 15 \quad \checkmark$

$$\begin{aligned} &= 900 \\ &= 900 \text{ cm}^3 \end{aligned}$$

The carton is  $1000 \text{ cm}^3$  short, it only holds 900ml not 1L  $\cdot 2$

b)  $V = \pi r^2 h$

$$\begin{aligned} 900 &= \pi \times 6^2 \times \frac{1}{2} h \quad \checkmark \\ 900 &= \pi \times 18 h \\ h &= \frac{900}{18\pi} \quad \checkmark \\ &= 15.915 \quad \checkmark \\ &= \underline{15.9 \text{ cm}} \quad \checkmark \quad \cdot 4 \end{aligned}$$

$$\begin{aligned}
 7. a) V &= \pi \times 3^2 \times 4 \quad \checkmark \\
 &= 36\pi \\
 &= 113.097 \\
 &= \underline{113} \text{ cm}^3 \quad \checkmark \cdot 2
 \end{aligned}$$

$$\begin{aligned}
 b) V &= \frac{2}{3} \pi r^3 \\
 113 &= \frac{2}{3} \times \pi \times r^3 \quad \checkmark \\
 r^3 &= \frac{113 \times 3}{2\pi} \\
 &= 54 \quad \checkmark \\
 r &= \sqrt[3]{54} \\
 &= 3.7797 \\
 &= \underline{3.78} \text{ cm} \quad \checkmark \cdot 3
 \end{aligned}$$

$$\begin{aligned}
 8. V_{\text{sphere}} &= \frac{4}{3} \pi r^3 \\
 &= \frac{4}{3} \times \pi \times 7^3 \quad \checkmark \\
 &= 1436.755 \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 V_{\text{cone}} &= \frac{1}{3} \pi r^2 h \\
 1436 &= \frac{1}{3} \times \pi \times r^2 \times 24 \quad \checkmark \\
 &= 8\pi \times r^2 \\
 r^2 &= \frac{1436}{8\pi} \\
 &= 57.1666 \quad \checkmark \\
 r &= \sqrt{57.1666} \\
 &= 7.56086 \\
 &= \underline{7.56} \text{ cm (3sf)} \quad \checkmark \cdot 5
 \end{aligned}$$

