

LEVEL 1 — SURDS

Note: Only turn back to page number if you have difficulty

Page

Q1. Simplify the following:

65

$$\begin{array}{lll} \text{(a)} \sqrt{6} \times \sqrt{3} & \text{(b)} \sqrt{15} \div \sqrt{3} & \text{(c)} 2\sqrt{8} \times \sqrt{7} \\ \text{(d)} 3\sqrt{8} \div \sqrt{2} & \text{(e)} 4\sqrt{2} \times 3\sqrt{3} & \text{(f)} 6\sqrt{12} \div 3\sqrt{3} \end{array}$$

Q2. Simplify these surds:

66

$$\begin{array}{lll} \text{(a)} \sqrt{50} & \text{(b)} \sqrt{18} & \text{(c)} \sqrt{45} \\ \text{(e)} \sqrt{12} & \text{(f)} \sqrt{20} & \text{(g)} 4\sqrt{24} \\ & & \text{(h)} 3\sqrt{27} \end{array}$$

Q3. Simplify these expressions:

67

$$\begin{array}{lll} \text{(a)} 5\sqrt{2} - 3\sqrt{2} & \text{(b)} 2\sqrt{5} + 3\sqrt{3} - \sqrt{5} & \text{(c)} 6\sqrt{10} - 4\sqrt{5} - 3\sqrt{10} \\ \text{(d)} 4\sqrt{3} + 2\sqrt{12} & \text{(e)} 9\sqrt{12} - 2\sqrt{75} & \text{(f)} 5\sqrt{80} + 5\sqrt{125} \end{array}$$

Q4. Expand and simplify:

68

$$\begin{array}{lll} \text{(a)} 5(\sqrt{6} + 3) & \text{(b)} \sqrt{2}(\sqrt{3} - 1) & \text{(c)} \sqrt{10}(4 - 2\sqrt{5}) \\ \text{(d)} 2\sqrt{2}(\sqrt{5} + 5) & \text{(e)} \sqrt{7}(2\sqrt{7} + 3) & \text{(f)} 2\sqrt{6}(7 - 3\sqrt{6}) \end{array}$$

Q5. Expand and simplify:

68, 69

$$\begin{array}{lll} \text{(a)} (2 + \sqrt{7})(3 - \sqrt{5}) & \text{(b)} (1 - \sqrt{2})(1 + \sqrt{2}) & \text{(c)} (2\sqrt{2} + 3)(\sqrt{3} - 1) \\ \text{(d)} (\sqrt{6} - 4)^2 & \text{(e)} (2 - \sqrt{5})(4 + 2\sqrt{3}) & \text{(f)} (3\sqrt{2} + 2)(3\sqrt{2} - 2) \end{array}$$

Q6. Express the following with rational denominators:

70

$$\begin{array}{lll} \text{(a)} \frac{1}{\sqrt{2}} & \text{(b)} \frac{5}{\sqrt{5}} & \text{(c)} \frac{10}{2\sqrt{3}} \\ \text{(e)} \frac{7}{2\sqrt{7}} & \text{(f)} \frac{2\sqrt{3}}{3\sqrt{10}} & \text{(g)} \frac{3 - \sqrt{2}}{\sqrt{2}} \end{array} \quad \begin{array}{l} \text{(d)} \frac{\sqrt{2}}{\sqrt{6}} \\ \text{(h)} \frac{\sqrt{5} + 4}{2\sqrt{3}} \end{array}$$

Q7. Rationalise the denominator in each expression:

71

$$\begin{array}{lll} \text{(a)} \frac{1}{1 + \sqrt{2}} & \text{(b)} \frac{5}{6 - \sqrt{3}} & \text{(c)} \frac{\sqrt{5}}{\sqrt{3} + 3} \\ \text{(e)} \frac{\sqrt{3}}{5 - 3\sqrt{3}} & \text{(f)} \frac{2}{\sqrt{5} - \sqrt{3}} & \text{(g)} \frac{10}{2\sqrt{3} - 2\sqrt{2}} \end{array} \quad \begin{array}{l} \text{(d)} \frac{7}{3\sqrt{6} + 2} \\ \text{(h)} \frac{5 + \sqrt{3}}{5 - \sqrt{3}} \end{array}$$

LEVEL 2 — SURDS

Q1. Simplify:

- | | | | |
|-------------------|--------------------------|----------------------------|-------------------|
| (a) $3\sqrt{48}$ | (b) $2\sqrt{54}$ | (c) $4\sqrt{96}$ | (d) $2\sqrt{108}$ |
| (e) $3\sqrt{162}$ | (f) $\sqrt{\frac{3}{4}}$ | (g) $\sqrt{\frac{24}{25}}$ | (h) $\sqrt{x^3}$ |

Q2. Simplify:

- | | | |
|---|--|---|
| (a) $5\sqrt{20} - 2\sqrt{18} - \sqrt{45}$ | (b) $\sqrt{98} + \sqrt{32} - \sqrt{63}$ | (c) $\sqrt{108} - \sqrt{24} + \sqrt{27}$ |
| (d) $\sqrt{500} + 2\sqrt{45} - \sqrt{80}$ | (e) $2\sqrt{4x} + 5\sqrt{9x} - \sqrt{x}$ | (f) $x\sqrt{16y} - \sqrt{x^2y} + 3x\sqrt{9y}$ |

Q3. Expand and simplify:

- | | |
|--|--|
| (a) $(2\sqrt{5} + 3\sqrt{3})^2$ | (b) $(2\sqrt{3} + \sqrt{6})(3\sqrt{2} - \sqrt{3})$ |
| (c) $(4\sqrt{2} - 2\sqrt{3})(4\sqrt{2} + 2\sqrt{3})$ | (d) $(3\sqrt{6} - 2\sqrt{7})(2\sqrt{6} - 3\sqrt{3})$ |
| (e) $x\sqrt{y}(6\sqrt{x} - 2\sqrt{y})$ | (f) $(x\sqrt{x} - y\sqrt{y})(x\sqrt{x} + y\sqrt{y})$ |

Q4. Express the following with rational denominators:

- | | | |
|---|---|---|
| (a) $\frac{\sqrt{3} - \sqrt{5}}{3\sqrt{5} + 2\sqrt{3}}$ | (b) $\frac{\sqrt{6} - \sqrt{2}}{2\sqrt{6} - 4\sqrt{2}}$ | (c) $\frac{2\sqrt{5} - 3\sqrt{3}}{2\sqrt{5} + 3\sqrt{3}}$ |
| (d) $\frac{3}{2\sqrt{x} - 3\sqrt{y}}$ | (e) $\frac{2 - \sqrt{5}}{3\sqrt{x} + 4\sqrt{y}}$ | (f) $\frac{\sqrt{x} + \sqrt{y}}{4\sqrt{x} - 2\sqrt{y}}$ |

Q5. Express the following as single fractions with rational denominators:

- | | | |
|---|---|--|
| (a) $\frac{1}{2\sqrt{5}} + \frac{1}{5\sqrt{2}}$ | (b) $\frac{\sqrt{3}}{\sqrt{2}} - \frac{\sqrt{2}}{\sqrt{3}}$ | (c) $\frac{\sqrt{5}}{2\sqrt{6}} + \frac{\sqrt{5}}{\sqrt{7}}$ |
| (d) $\frac{1}{\sqrt{3} + 2} - \frac{1}{\sqrt{3} - 2}$ | (e) $\frac{3}{\sqrt{6} - 2} + \frac{3}{\sqrt{6} + 3}$ | (f) $\frac{2}{2\sqrt{2} + 3} - \frac{1}{5\sqrt{2} + 3}$ |

Q6. If $x = \frac{1}{\sqrt{2} + \sqrt{5}}$ evaluate $x^2 + \frac{1}{x^2}$

Q7. Simplify: $\frac{x\sqrt{x} \times \sqrt{x^3}}{2\sqrt{x} \times \sqrt{2x}}$ (Express answer with a rational denominator)

Q8. Expand and simplify: $(3\sqrt{2} + \sqrt{3})^2 - (3\sqrt{2} - \sqrt{3})^2$

Q9. Show that $\frac{2\sqrt{3} - 2\sqrt{2}}{3\sqrt{3} - 3\sqrt{2}}$ is a rational number.

Level 2 — Equations

- Q1. (a) $x = -4$ (b) $p = 9$ (c) $x = \frac{2}{5}$ (d) $a = 1\frac{1}{4}$ (e) $b = \frac{2}{3}$ (f) $a = -4$
 (g) $x = -5$ (h) $m = 8$ (i) $y = \frac{5}{9}$
- Q2. (a) $x = 24$ (b) $x = 3\frac{1}{3}$ (c) $x = -3$ (d) $x = 4$ (e) $x = 0$ (f) $x = -\frac{3}{10}$
- Q3. (a) $x < 18$ (b) $x > 6$ (c) $x \leq \frac{3}{4}$ (d) $x < 5$ (e) $x < -\frac{1}{2}$ (f) $x \leq -\frac{4}{15}$
- Q4. (a) 24 years and 48 years (b) 1100 mL
- Q5. (a) $X = 9$ (b) $x = \pm \frac{2}{9}$ (c) $y = \frac{2}{3}$
- Q6. (a) $z = y - x$ (b) $A = \frac{3V}{h}$ (c) $x_2 = 2x - x_1$ (d) $a = \frac{v^2 - u^2}{2S}$
 (e) $x = \frac{2A}{h} - y$ (f) $r = \pm \sqrt{\frac{A}{4\pi}}$
- Q7. (a) $M = 6m + 4.2$ (b) $M = \frac{3m + 1}{2}$

Level 3 — Equations

- Q1. (a) $x = 1\frac{3}{4}$ (b) $x = -15$ (c) $x = -7$ (d) $x = 22$ (e) $x = \frac{5}{6}$ (f) $x = 5$
 (g) $x = -11\frac{2}{3}$ (h) $x = 2\frac{5}{18}$ (i) $x = \pm 2$
- Q2. (a) $x > 5$ (b) $x > 4\frac{1}{2}$ (c) $x \geq -6\frac{3}{4}$ (d) $-2 < x \leq 1\frac{1}{3}$ (e) $x \leq 1$
- Q3. (a) $b = -8$ (b) $c = -2$
- Q4. (a) $d = \frac{2(T - an)}{n(n-1)}$ (b) $x = \frac{y}{zy-1}$ (c) $b = 3a - 4c$ (d) $y = X^2z - x$
 (e) $b = \frac{a^2}{c-a+2}$ (f) $x = \frac{ya}{y-1}$
- Q5. (a) $x = 16$, $y = 6$ \therefore Area = 96 m^2 (b) $x = 7$, \$95 788
- Q6. (a) $A = 2x^2 + \frac{y}{4}(2x + y)$ (b) $A = \frac{\pi}{2}(x^2 - y^2)$

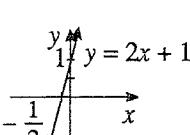
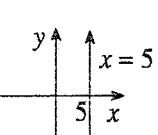
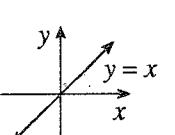
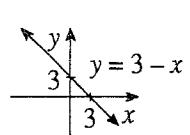
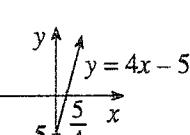
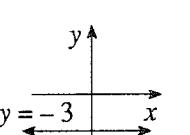
Level 1 — Surds

- Q1. (a) $\sqrt{18}$ (b) $\sqrt{5}$ (c) $2\sqrt{56}$ (d) 6 (e) $12\sqrt{6}$ (f) 4
- Q2. (a) $5\sqrt{2}$ (b) $3\sqrt{2}$ (c) $3\sqrt{5}$ (d) $6\sqrt{2}$ (e) $2\sqrt{3}$ (f) $2\sqrt{5}$ (g) $8\sqrt{6}$ (h) $9\sqrt{3}$
- Q3. (a) $2\sqrt{2}$ (b) $\sqrt{5} + 3\sqrt{3}$ (c) $3\sqrt{10} - 4\sqrt{5}$ (d) $8\sqrt{3}$ (e) $8\sqrt{3}$ (f) $45\sqrt{5}$
- Q4. (a) $5\sqrt{6} + 15$ (b) $\sqrt{6} - \sqrt{2}$ (c) $4\sqrt{10} - 10\sqrt{2}$ (d) $2\sqrt{10} + 10\sqrt{2}$ (e) $14 + 3\sqrt{7}$ (f) $14\sqrt{6} - 36$
- Q5. (a) $6 - 2\sqrt{5} + 3\sqrt{7} - \sqrt{35}$ (b) -1 (c) $2\sqrt{6} - 2\sqrt{2} + 3\sqrt{3} - 3$
 (d) $22 - 8\sqrt{6}$ (e) $8 + 4\sqrt{3} - 4\sqrt{5} - 2\sqrt{15}$ (f) 14
- Q6. (a) $\frac{\sqrt{2}}{2}$ (b) $\sqrt{5}$ (c) $\frac{5\sqrt{3}}{3}$ (d) $\frac{\sqrt{3}}{3}$ (e) $\frac{\sqrt{7}}{2}$ (f) $\frac{\sqrt{30}}{15}$ (g) $\frac{3\sqrt{2} - 2}{2}$ (h) $\frac{\sqrt{15} + 4\sqrt{3}}{6}$
- Q7. (a) $\sqrt{2} - 1$ (b) $\frac{30 + 5\sqrt{3}}{33}$ (c) $\frac{3\sqrt{5} - \sqrt{15}}{6}$ (d) $\frac{21\sqrt{6} - 14}{52}$
 (e) $\frac{-9 - 5\sqrt{3}}{2}$ (f) $\sqrt{5} + \sqrt{3}$ (g) $5\sqrt{3} + 5\sqrt{2}$ (h) $\frac{14 + 5\sqrt{3}}{11}$

Level 2 — Surds

- Q1. (a) $12\sqrt{3}$ (b) $6\sqrt{6}$ (c) $16\sqrt{6}$ (d) $12\sqrt{3}$ (e) $27\sqrt{2}$ (f) $\frac{\sqrt{3}}{2}$ (g) $\frac{2\sqrt{6}}{5}$ (h) $x\sqrt{x}$
- Q2. (a) $7\sqrt{5} - 6\sqrt{2}$ (b) $11\sqrt{2} - 3\sqrt{7}$ (c) $9\sqrt{3} - 2\sqrt{6}$ (d) $12\sqrt{5}$ (e) $18\sqrt{x}$ (f) $12x\sqrt{y}$
- Q3. (a) $47 + 12\sqrt{15}$ (b) $6\sqrt{6} + 6\sqrt{3} - 3\sqrt{2} - 6$ (c) 20
(d) $36 - 27\sqrt{2} - 4\sqrt{42} + 6\sqrt{21}$ (e) $6x\sqrt{xy} - 2xy$ (f) $x^3 - y^3$
- Q4. (a) $\frac{5\sqrt{15} - 21}{33}$ (b) $\frac{-1 - \sqrt{3}}{2}$ (c) $\frac{12\sqrt{15} - 47}{7}$
(d) $\frac{6\sqrt{x} + 9\sqrt{y}}{4x - 9y}$ (e) $\frac{6\sqrt{x} - 8\sqrt{y} - 3\sqrt{5x} + 4\sqrt{5y}}{9x - 16y}$ (f) $\frac{2x + 3\sqrt{xy} + y}{8x - 2y}$
- Q5. (a) $\frac{\sqrt{2} + \sqrt{5}}{10}$ (b) $\frac{\sqrt{6}}{6}$ (c) $\frac{\sqrt{1470} + 5\sqrt{315}}{84}$ (d) 4
(e) $\frac{12 + \sqrt{6}}{2}$ (f) $\frac{249 - 169\sqrt{2}}{41}$
- Q6. $\frac{70 + 16\sqrt{10}}{9}$ Q7. $\frac{x^2\sqrt{2}}{4}$
- Q8. $12\sqrt{6}$ Q9. $\frac{2}{3}$

Level 1 — Coordinate geometry

- Q1. A(6, 3) B(-3, 5) C(-7, 0) D(-3, -6) E(2, -2) F(0, 0) G(7, -6) H(5, 0) I(-5, -2) J(0, -3)
- Q2. (a) (4, 6) (b) (3, 3) (c) $\left(3\frac{1}{2}, 2\right)$ (d) (2, -1) (e) $\left(-\frac{1}{2}, 1\right)$ (f) $\left(-1\frac{1}{2}, -5\frac{1}{2}\right)$
- Q3. (a) $2\sqrt{10}$ units (b) $\sqrt{97}$ units (c) $\sqrt{153}$ units (d) $\sqrt{10}$ units (e) $2\sqrt{61}$ units (f) $\sqrt{73}$ units
- Q4. (a) $\frac{1}{2}$ (b) $-1\frac{2}{3}$ (c) $\frac{1}{9}$ (d) $-2\frac{1}{2}$ (e) $-\frac{9}{7}$ (f) $-\frac{4}{13}$
- Q5. (a) 
(b) 
(c) 
(d) 
(e) 
(f) 
- Q6. (a) $m = 5, b = -2$ (b) $m = -2, b = 3$ (c) $m = \frac{3}{2}, b = -4$ (d) $m = -\frac{1}{2}, b = 1$
(e) $m = -1, b = 0$ (f) $m = -1, b = \frac{1}{2}$
- Q7. (a) $m = 2, b = 3$ (b) $m = -2, b = 3$ (c) $m = -1, b = -\frac{2}{3}$ (d) $m = -\frac{1}{5}, b = 0$
(e) $m = \frac{2}{3}, b = \frac{1}{3}$ (f) $m = \frac{1}{4}, b = -1$