

## EF1.1 – Surds, Indices and Scientific Notation

### Section A - Revision

This section will help you revise previous learning which is required in this topic.

**R1 I can write whole numbers as products of two factors with one of the factors a perfect square (where possible).**

1. Write each number as a product of factors where one of the factors is a perfect square.

(a) 27

(b) 12

(c) 32

(d) 75

(e) 48

(f) 8

(g) 50

(h) 125

(i) 20

**R2 I have revised how to use the four operations in applications involving negative numbers.**

1. Evaluate

(a)  $-3 + 5$

(b)  $7 - 9$

(c)  $2 \times (-7)$

(d)  $-1 - (-6)$

(e)  $-3 \times (-2)$

(f)  $-10 \div 5$

(g)  $-4 \times 2$

(h)  $-24 \div (-6)$

(i)  $-8 + (-2)$

(j)  $-2 - 7$

(k)  $4 + (-2)$

(l)  $8 - 15$

2. Evaluate

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

(b)  $-\frac{3}{2} - 1$

(c)  $\frac{3}{8} \times 5$

(d)  $\frac{3}{4} \div -2$

(e)  $\frac{3}{2} + \left(-\frac{5}{4}\right)$

(f)  $\frac{3}{8} - \left(-\frac{5}{4}\right)$

(g)  $-\frac{3}{2} + \frac{5}{4}$

(h)  $-\frac{3}{8} \times \frac{5}{2}$

(i)  $\frac{3}{4} \div \left(-\frac{5}{2}\right)$

# Surds and Indices

## Section B - Assessment Standard Section

This section will help you practise for your Assessment Standard Test for Surds and indices (Expressions and Formulae 1.1)

### Practice Assessment Standard Questions

#### 1. Simplify

(a)  $\sqrt{27}$

(b)  $\sqrt{12}$

(c)  $\sqrt{32}$

(d)  $\sqrt{75}$

(e)  $\sqrt{48}$

(f)  $\sqrt{8}$

(g)  $\sqrt{50}$

(h)  $\sqrt{125}$

(i)  $\sqrt{20}$

#### 2. Simplify

(a)  $\frac{x^4 \times x^3}{x^5}$

(b)  $\frac{y^3 \times y^6}{y^2}$

(c)  $\frac{a^4 \times a^3}{a^6}$

(d)  $\frac{t^5 \times t}{t^3}$

(e)  $\frac{b^3 \times b^3}{b}$

(f)  $\frac{r^3 \times r^2}{r^{-1}}$

(g)  $\frac{f^5 \times f^3}{f^{-3}}$

(h)  $\frac{s^5 \times s^{-1}}{s^3}$

(i)  $\frac{d^{-2} \times d^7}{d^3}$

#### 3. Simplify

(a)  $4x^2 \times 2x^3$

(b)  $3x^3 \times 5x^5$

(c)  $2x^3 \times 6x^{-1}$

(d)  $5x^2 \times 3x^{\frac{1}{2}}$

(e)  $3x^2 \times 7x^{\frac{1}{3}}$

(f)  $8x^3 \times 2x^{\frac{1}{2}}$

(g)  $4x^2 \times 3x^{-\frac{1}{2}}$

(h)  $3x^3 \times 10x^{-\frac{1}{3}}$

(i)  $9x^2 \times 3x^{-\frac{1}{2}}$

4. A satellite travels  $3 \cdot 6 \times 10^5$  miles in a day.  
A higher orbit satellite travel 12 times this distance each day.

Calculate the distance the higher orbit satellite travels each day.  
**Give your answer in scientific notation.**

# Surds and Indices

## Section C - Operational Skills Section

This section provides problems with the operational skills associated with Surds and Indices

**01** *I understand the difference between rational and irrational numbers and I know what a surd is.*

1. For each of the numbers below, which are rational, write as a fraction with whole numbers in both the numerator and denominator.

(a)  $\sqrt{3}$

(b)  $\pi$

(c)  $\sqrt{9}$

(d)  $\sqrt{\frac{1}{4}}$

(e)  $\sqrt{16}$

(f)  $\frac{\pi}{4}$

(g)  $\sqrt{5}$

(h)  $\sqrt{\frac{3}{16}}$

(i)  $\sqrt{\frac{9}{25}}$

**02** *I can simplify, add, subtract, multiply and divide surds.*

1. Simplify (without a calculator and showing all working)

(a)  $\sqrt{24}$

(b)  $\sqrt{18}$

(c)  $\sqrt{45}$

(d)  $\sqrt{80}$

(e)  $\sqrt{72}$

(f)  $\sqrt{108}$

(g)  $\sqrt{24} + \sqrt{6}$

(h)  $\sqrt{2} + \sqrt{18}$

(i)  $\sqrt{45} - \sqrt{5}$

(j)  $\sqrt{80} - 2\sqrt{5}$

(k)  $\sqrt{72} + 3\sqrt{2}$

(l)  $\sqrt{108} - 3\sqrt{3}$

(m)  $\sqrt{24} + \sqrt{54} - \sqrt{6}$

(n)  $\sqrt{125} + \sqrt{80} - \sqrt{20}$

(o)  $\sqrt{6} \times \sqrt{15}$

(p)  $\sqrt{14} \times \sqrt{7}$

(q)  $\sqrt{48} \div \sqrt{3}$

(r)  $\sqrt{15} \times \sqrt{10}$

(s)  $\frac{\sqrt{40}}{\sqrt{5}}$

(t)  $\frac{\sqrt{150}}{\sqrt{6}}$

(u)  $\sqrt{12} \times \sqrt{30}$

2. Solve the following for  $x$ .

(a)  $\sqrt{x} + \sqrt{18} = 4\sqrt{2}$

(b)  $\sqrt{x} + \sqrt{27} = \sqrt{48}$

(c)  $\sqrt{9x} - \sqrt{5} = \sqrt{20}$

# Surds and Indices

## 03 I can rationalise a surd denominator.

Rationalise the surd denominator and simplify where appropriate

(a)  $\frac{1}{\sqrt{5}}$

(b)  $\frac{2}{\sqrt{3}}$

(c)  $\frac{5}{\sqrt{7}}$

(d)  $\frac{4}{\sqrt{10}}$

(e)  $\frac{3}{\sqrt{6}}$

(f)  $\frac{14}{\sqrt{7}}$

(g)  $\frac{\sqrt{6}}{\sqrt{15}}$

(h)  $\frac{\sqrt{8}}{\sqrt{5}}$

(i)  $\frac{10\sqrt{3}}{\sqrt{2}}$

## 04 I can multiply out brackets which involve surds

Multiply out the brackets and simplify where appropriate

(a)  $\sqrt{2}(\sqrt{3} + 1)$

(b)  $\sqrt{5}(\sqrt{2} - \sqrt{3})$

(c)  $\sqrt{2}(\sqrt{2} + \sqrt{7})$

(d)  $-\sqrt{11}(\sqrt{2} + 1)$

(e)  $\sqrt{2}(\sqrt{3} + \sqrt{2}) - \sqrt{6}$

(f)  $\sqrt{3}(\sqrt{3} - \sqrt{12})$

(g)  $-\sqrt{5}(\sqrt{3} + \sqrt{5}) + \sqrt{15}$

(h)  $\sqrt{12}(\sqrt{3} + 1) - 2\sqrt{3}$

(i)  $-\sqrt{7}(\sqrt{7} + 2)$

## 05 I can use the rules of indices $mx^a \times nx^b = mnx^{(a+b)}$ , $mx^a \div nx^b = \frac{m}{n}x^{(a-b)}$

and  $(kx^a)^b = k^b x^{ab}$ ,  $a^0 = 1$  and  $a^{-n} = \frac{1}{a^n}$  applying them to my previous learning.

1. Simplify

(a)  $x^2 \times x^5$

(b)  $y^3 \times y^{-2}$

(c)  $a^3 \times 5a^2$

(d)  $6p^3 \times 3p^5$

(e)  $5h^3 \times 2h^{-1}$

(f)  $x^6 \div x^2$

(g)  $\frac{a^7}{a^5}$

(h)  $x^2 \div x^3$

(i)  $10y^4 \div 5y^2$

# Surds and Indices

## 2. Simplify

- (a)  $(x^2)^3$                       (b)  $(y^{-2})^4$                       (c)  $(z^{-2})^{-5}$   
(d)  $(3a^3)^2$                       (e)  $(2b^{-1})^5$                       (f)  $(5y^{-2})^3$

## 3. Write with positive indices

- (a)  $y^{-5}$                       (b)  $a^{-1}$                       (c)  $3x^{-4}$   
(d)  $\frac{1}{t^{-3}}$                       (e)  $\frac{5}{p^{-7}}$                       (f)  $\frac{2}{5p^{-7}}$   
(g)  $\frac{b^{-3}}{4}$                       (h)  $\frac{5c^{-1}}{2}$                       (i)  $\frac{d^{-2}}{7}$

## 4. Simplify

- (a)  $\frac{y^2 \times y^5}{y^3}$                       (b)  $\frac{y^3 \times y^{-2}}{y^{-6}}$                       (c)  $\frac{a^8}{a^2 \times a^4}$   
(d)  $\frac{p}{p^{-1} \times p^3}$                       (e)  $\frac{q^{-2} \times q^{-3}}{q^{-6}}$                       (f)  $\frac{5r^{-3} \times 4r^3}{2}$   
(g)  $\frac{f^2 \times f^{-5}}{f^{-3} \times f^4}$                       (h)  $\frac{s^5 \times 4s^{-5}}{2s^{-3}}$                       (i)  $\frac{8a^3 \times 4a^{-6}}{6a^2 \times a^{-2}}$

**O6** I know that  $a^{\frac{m}{n}} = (\sqrt[n]{a})^m$  and can apply this knowledge in problems.

## 1. Simplify, leaving the final answer with fractional indices.

- (a)  $\sqrt{a}$                       (b)  $\sqrt[3]{b}$                       (c)  $\frac{1}{\sqrt[4]{c}}$   
(d)  $\sqrt[5]{x^3}$                       (e)  $\sqrt[3]{x^7}$                       (f)  $\frac{1}{\sqrt[4]{x^3}}$   
(g)  $\sqrt{x} \times \sqrt[3]{x^2}$                       (h)  $3m \times \sqrt[3]{m}$                       (i)  $\frac{\sqrt{b}}{\sqrt[3]{b}}$   
(j)  $\frac{4\sqrt{a^3}}{3a}$                       (k)  $4p \times \sqrt[3]{p^2}$                       (l)  $\sqrt[4]{p^3} \times \sqrt[3]{p^5}$

# Surds and Indices

2. (a) Given that  $y = x^{\frac{1}{2}}$ , find  $y$  when  $x = 16$ .  
(b) Given that  $y = x^{\frac{2}{3}}$ , find  $y$  when  $x = 64$ .  
(c) Given that  $y = x^{\frac{1}{4}}$ , find  $y$  when  $x = 81$ .  
(d) Given that  $y = x^{\frac{1}{3}}$ , find  $y$  when  $x = 125$ .  
(e) Given that  $y = x^{\frac{3}{5}}$ , find  $y$  when  $x = 32$ .

## 07 I can multiply out brackets which involve fractional or negative indices

1. Multiply out the brackets and simplify where appropriate

(a) $x(x^2 - x^{-2})$	(b) $p^3(p^{-2} + p^3)$	(c) $a^{-3}(a + a^{-1})$
(d) $5x^{\frac{1}{2}}(2\sqrt{x} + 3x^{\frac{3}{2}})$	(e) $4a^2(2a^{-1} + 3a^{-2})$	(f) $a^{\frac{1}{2}}(\sqrt{a} + a^{-\frac{1}{2}})$
(g) $t^{-2}(3t^{-2} - t^2)$	(h) $3m^2(2m^2 + 7m^{-4})$	(i) $p^{\frac{1}{3}}(p^{\frac{2}{3}} + p^{-\frac{1}{3}})$

## 08 I can convert large and small numbers to and from scientific notation.

1. Write the following numbers in scientific notation

(a) 7 000	(b) 650 000	(c) 4 120 000
(d) 820	(e) 37 100 000 000	(f) 1 345 000
(g) 3 million	(h) $9\frac{1}{2}$ million	(i) $16 \cdot 2$ million

2. Change each of the following back into normal form

(a) $8 \times 10^5$	(b) $3 \cdot 25 \times 10^4$	(c) $7 \cdot 153 \times 10^8$
(d) $4 \cdot 03 \times 10^7$	(e) $2 \cdot 8 \times 10^6$	(f) $5 \cdot 55 \times 10^{10}$
(g) $1 \cdot 34 \times 10^2$	(h) $8 \cdot 714 \times 10^5$	(i) $2 \cdot 304 \times 10^9$

# Surds and Indices

3. Write the following numbers in scientific notation

- |                     |                       |              |
|---------------------|-----------------------|--------------|
| (a) 0.04            | (b) 0.000 062         | (c) 0.357    |
| (d) 0.000 000 002 4 | (e) 0.000 095         | (f) 0.6      |
| (g) 0.000 012 53    | (h) 0.000 000 000 236 | (i) 0.001 65 |

4. Change each of the following back into normal form

- |                            |                           |                           |
|----------------------------|---------------------------|---------------------------|
| (a) $3 \times 10^{-4}$     | (b) $7.5 \times 10^{-2}$  | (c) $6.8 \times 10^{-6}$  |
| (d) $5.07 \times 10^{-3}$  | (e) $4.8 \times 10^{-5}$  | (f) $5.3 \times 10^{-7}$  |
| (g) $4.344 \times 10^{-5}$ | (h) $9.94 \times 10^{-6}$ | (i) $5.34 \times 10^{-1}$ |

5. Write each of the following in scientific notation

- |                 |             |                  |
|-----------------|-------------|------------------|
| (a) 0.000 6     | (b) 65      | (c) 3 910        |
| (d) 0.000 002 3 | (e) 858 000 | (f) 0.000 000 55 |

6. Change each of the following back into normal form

- |                          |                          |                           |
|--------------------------|--------------------------|---------------------------|
| (a) $8.3 \times 10^{-3}$ | (b) $3.5 \times 10^5$    | (c) $7.13 \times 10^{-6}$ |
| (d) $4.873 \times 10^8$  | (e) $2.4 \times 10^{-5}$ | (f) $6.55 \times 10^7$    |

**09** *I can solve problems involving multiplication and division of numbers expressed in scientific notation with and without a calculator.*

1. Do the following calculations without using a calculator and give your answer in normal form

- |  |  |
|--|--|
| (a) $5 \times (4.3 \times 10^6)$             | (b) $6 \times (2.93 \times 10^{-3})$                 |
| (c) $9.3 \times (7 \times 10^5)$             | (d) $(4.8 \times 10^7) \div 4$                       |
| (e) $(6.2 \times 10^5) \div 2$               | (f) $(7.2 \times 10^{-3}) \div 8$                    |
| (g) $(5 \times 10^2) \times (3 \times 10^6)$ | (h) $(2.5 \times 10^{-2}) \times (5 \times 10^{-4})$ |

# Surds and Indices

2. Use your calculator to work out the following and give your answer in scientific notation

(a)  $(5 \times 10^6) \div (8 \times 10^{-4})$

(b)  $4 \cdot 4 \times (3 \cdot 7 \times 10^{-3})$

(c)  $9 \cdot 3 \times (6 \times 10^5)$

(d)  $(2 \cdot 8 \times 10^{10}) \times (5 \cdot 4 \times 10^3)$

(e)  $(6 \cdot 2 \times 10^5)^3$

3. Complete the following calculations. Give your answers in scientific notation.

(a) There are  $3 \cdot 156 \times 10^7$  seconds in a solar year.

How many seconds are there in 12 solar years?

(b) The Lotto jackpot of  $\text{£}9 \cdot 3 \times 10^6$  was shared equally among 3 winners.

How much did each receive?

(c) A carbon atom weighs  $2 \cdot 03 \times 10^{-23}$  grams.

What do 500 carbon atoms weigh?

(d) The orbit of a planet around a star is circular.

The radius of the orbit is  $4 \cdot 96 \times 10^7$  kilometres.

Calculate the circumference of the orbit.

(e) Radio signals travel at a speed of  $3 \times 10^8$  metres per second.

A radio signal from Earth to a space probe takes 8 hours.

What is the distance from Earth to the probe?



# Surds and Indices

- (f) One atom of gold weighs  $3.27 \times 10^{-22}$  grams.

How many atoms will there be in one kilogram of gold?

***Give your answer in scientific notation correct to 2 significant figures.***

- (g) A snail crawls 3 kilometres in 16 days.

What is the average speed of the snail in metres per second?

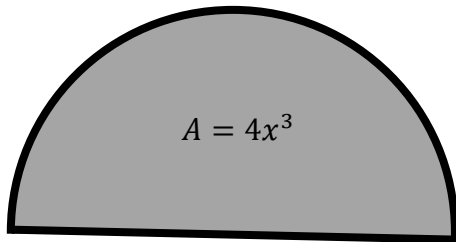
***Give your answer in scientific notation correct to 2 significant figures.***

# Surds and Indices

## Section D - Reasoning Skills Section

This section provides problems with Reasoning Skills in the context of Surds and Indices

1.



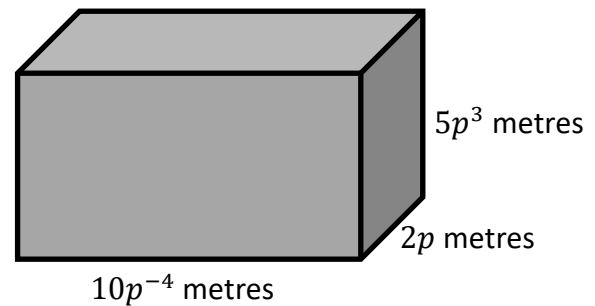
The area of the semi circle shown is  $4x^3$ .

**Show that** the radius of the semi circle is given by  $r = \frac{x^{\frac{3}{2}}}{\pi}$

2.

A cuboid has dimensions as shown .

**Show that** the volume of the cuboid is 100 cubic metres.



3.

A particle travels  $3ab^2$  metres in  $12a^2c$  seconds.

Calculate the particles average speed in metres per second.

4.

(a) Evaluate  $(2^4)^2$  .

(b) Hence find  $n$ , when  $(2^4)^n = \frac{1}{256}$

5.

Lauren writes down the following statement.

$$p^{\frac{1}{3}} \left( p^{\frac{2}{3}} - p^{-\frac{1}{3}} \right) = p - 1$$

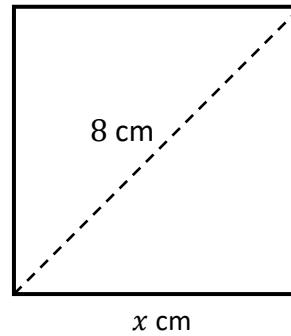
Is the statement true?

**Justify your answer with working.**

# Surds and Indices

6. A square of side  $x$  centimetres has a diagonal which is 8 centimetres long.

*Show that*  $x = 4\sqrt{2}$  cm.



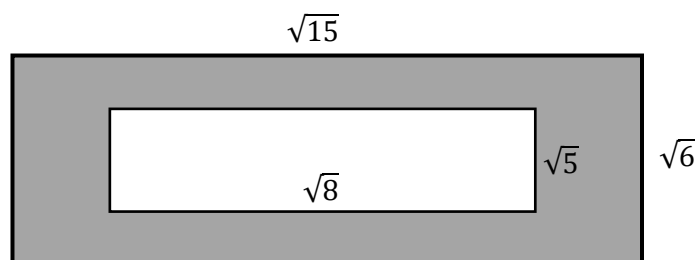
7. Sam's homework jotter has the following statement.

$$\frac{6}{\sqrt{3}} = 2\sqrt{3}$$

Is the statement true?

*Justify your answer with working.*

8. A small rectangle is drawn completely enclosed in a larger rectangle as show.



With the dimensions given, *show that* the shaded area is  $\sqrt{10}$  square units.

9. Show that  $\frac{\sqrt{3} \times \sqrt{12}}{\sqrt{3} + \sqrt{12}} = \frac{2\sqrt{3}}{3}$ .

# Surds and Indices

## Answers

### Section A

#### R1

- Q1 (a)  $9 \times 3$  (b)  $4 \times 3$  (c)  $16 \times 2$  (d)  $25 \times 3$  (e)  $16 \times 3$   
(f)  $4 \times 2$  (g)  $25 \times 2$  (h)  $25 \times 5$  (i)  $4 \times 5$

#### R2

- Q1 (a) 2 (b)  $-2$  (c)  $-14$  (d) 5 (e) 6  
(f)  $-2$  (g)  $-8$  (h) 4 (i)  $-10$  (j)  $-9$   
(k) 2 (l)  $-7$

- Q2 (a)  $\frac{5}{4}$  (b)  $-\frac{5}{2}$  (c)  $\frac{15}{8}$  (d)  $-\frac{3}{8}$  (e)  $\frac{1}{4}$   
(f)  $\frac{13}{8}$  (g)  $-\frac{1}{4}$  (h)  $-\frac{15}{16}$  (i)  $-\frac{3}{10}$

### Section B

#### Practice Assessment Standard Questions

- Q1 (a)  $3\sqrt{3}$  (b)  $2\sqrt{3}$  (c)  $4\sqrt{2}$  (d)  $5\sqrt{3}$  (e)  $4\sqrt{3}$   
(f)  $2\sqrt{2}$  (g)  $5\sqrt{2}$  (h)  $5\sqrt{5}$  (i)  $2\sqrt{5}$

- Q2 (a)  $x^2$  (b)  $y^7$  (c)  $a$  (d)  $t^3$  (e)  $b^5$   
(f)  $r^6$  (g)  $f^{11}$  (h)  $s$  (i)  $d^2$

- Q3 (a)  $8x^5$  (b)  $15x^8$  (c)  $12x^2$  (d)  $15x^{\frac{5}{2}}$  (e)  $21x^{\frac{7}{3}}$   
(f)  $16x^{\frac{7}{2}}$  (g)  $12x^{\frac{3}{2}}$  (h)  $30x^{\frac{8}{3}}$  (i)  $27x^{\frac{3}{2}}$

- Q4  $4 \cdot 32 \times 10^6$

### Section C

#### O1

- Q1 (c), (d), (e) and (i) are rational

#### O2

- Q1 (a)  $2\sqrt{6}$  (b)  $3\sqrt{2}$  (c)  $3\sqrt{5}$  (d)  $4\sqrt{5}$  (e)  $6\sqrt{2}$

# Surds and Indices

- (f)  $6\sqrt{3}$       (g)  $3\sqrt{6}$       (h)  $4\sqrt{2}$       (i)  $2\sqrt{5}$       (j)  $2\sqrt{5}$   
(k)  $9\sqrt{2}$       (l)  $3\sqrt{3}$       (m)  $4\sqrt{6}$       (n)  $7\sqrt{5}$       (o)  $3\sqrt{10}$   
(p)  $7\sqrt{2}$       (q) 4      (r)  $5\sqrt{6}$       (s)  $2\sqrt{2}$       (t) 5  
(u)  $6\sqrt{10}$

Q2 (a)  $x = 2$       (b)  $x = 3$       (c)  $x = 5$

**03**

- (a)  $\frac{\sqrt{5}}{5}$       (b)  $\frac{2\sqrt{3}}{3}$       (c)  $\frac{5\sqrt{7}}{7}$       (d)  $\frac{2\sqrt{10}}{5}$       (e)  $\frac{\sqrt{6}}{2}$   
(f)  $2\sqrt{7}$       (g)  $\frac{\sqrt{10}}{5}$       (h)  $\frac{2\sqrt{10}}{5}$       (i)  $5\sqrt{6}$

**04**

- (a)  $\sqrt{6} + \sqrt{2}$       (b)  $\sqrt{10} - \sqrt{15}$       (c)  $2 + \sqrt{14}$       (d)  $-\sqrt{22} - \sqrt{11}$   
(e) 2      (f) -3      (g) -5      (h) 6      (i)  $-7 - 2\sqrt{7}$

**05**

Q1 (a)  $x^7$       (b)  $y$       (c)  $5a^5$       (d)  $18p^8$   
(e)  $10h^2$       (f)  $x^4$       (g)  $a^2$       (h)  $x^{-1}$       (i)  $2y^2$

Q2 (a)  $x^6$       (b)  $\frac{1}{y^8}$       (c)  $z^{10}$       (d)  $9a^6$   
(e)  $\frac{32}{b^5}$       (f)  $\frac{125}{y^6}$

Q3 (a)  $\frac{1}{y^5}$       (b)  $\frac{1}{a}$       (c)  $\frac{3}{x^4}$       (d)  $t^3$   
(e)  $5p^7$       (f)  $\frac{2p^7}{5}$       (g)  $\frac{1}{4b^3}$       (h)  $\frac{5}{2c}$       (i)  $\frac{1}{7a^2}$

Q4 (a)  $y^4$       (b)  $y^7$       (c)  $a^2$       (d)  $\frac{1}{p}$   
(e)  $q$       (f) 10      (g)  $\frac{1}{f^4}$       (h)  $2s^3$       (i)  $\frac{16}{3a^3}$

# Surds and Indices

06

- Q1 (a)  $a^{\frac{1}{2}}$  (b)  $b^{\frac{1}{3}}$  (c)  $\frac{1}{\frac{1}{c^4}}$  or  $c^{-\frac{1}{4}}$  (d)  $x^{\frac{3}{5}}$   
(e)  $x^{\frac{7}{3}}$  (f)  $\frac{1}{\frac{3}{x^4}}$  or  $x^{-\frac{3}{4}}$  (g)  $x^{\frac{7}{6}}$  (h)  $3m^{\frac{4}{3}}$  (i)  $b^{\frac{1}{6}}$   
(j)  $\frac{4a^{\frac{1}{2}}}{3}$  (k)  $4p^{\frac{5}{3}}$  (l)  $p^{\frac{29}{12}}$
- Q2 (a)  $y = 4$  (b)  $y = 16$  (c)  $y = 3$  (d)  $y = 5$  (e)  $y = 8$

07

- Q1 (a)  $x^3 - \frac{1}{x}$  (b)  $p + p^6$  (c)  $\frac{1}{a^2} + \frac{1}{a^4}$  (d)  $10x + 15x^2$   
(e)  $8a + 12$  (f)  $a + 1$  (g)  $\frac{3}{t^4} - 1$  (h)  $6m^4 + \frac{21}{m^2}$  (i)  $p + 1$

08

- Q1 (a)  $7 \times 10^3$  (b)  $6 \cdot 5 \times 10^5$  (c)  $4 \cdot 12 \times 10^6$  (d)  $8 \cdot 2 \times 10^2$   
(e)  $3 \cdot 71 \times 10^{10}$  (f)  $1 \cdot 345 \times 10^6$  (g)  $3 \times 10^6$  (h)  $9 \cdot 5 \times 10^6$   
(i)  $1 \cdot 62 \times 10^7$
- Q2 (a) 800 000 (b) 32 500 (c) 715 300 000 (d) 40 300 000  
(e) 2 800 000 (f) 55 500 000 000 (g) 134  
(h) 871 400 (i) 2 304 000 000
- Q3 (a)  $4 \times 10^{-2}$  (b)  $6 \cdot 2 \times 10^{-5}$  (c)  $3 \cdot 57 \times 10^{-1}$  (d)  $2 \cdot 4 \times 10^{-9}$   
(e)  $9 \cdot 5 \times 10^{-5}$  (f)  $6 \times 10^{-1}$  (g)  $1 \cdot 253 \times 10^{-5}$  (h)  $2 \cdot 36 \times 10^{-10}$   
(i)  $1 \cdot 65 \times 10^{-3}$
- Q4 (a) 0·0003 (b) 0·075 (c) 0·0000068 (d) 0·00507  
(e) 0·000048 (f) 0·00000053 (g) 0·00004344 (h) 0·00000994  
(i) 0·534
- Q5 (a)  $6 \times 10^{-4}$  (b)  $6 \cdot 5 \times 10^1$  (c)  $3 \cdot 91 \times 10^3$  (d)  $2 \cdot 3 \times 10^{-6}$   
(e)  $8 \cdot 58 \times 10^5$  (f)  $5 \cdot 5 \times 10^{-7}$

# Surds and Indices

- Q6 (a)  $0.0083$  (b)  $350\,000$  (c)  $0.00000713$  (d)  $487\,300\,000$   
(e)  $0.000024$  (f)  $65\,500\,000$

## 09

- Q1 (a)  $2.15 \times 10^7$  (b)  $1.758 \times 10^{-2}$  (c)  $6.51 \times 10^6$  (d)  $1.2 \times 10^7$   
(e)  $3.1 \times 10^5$  (f)  $9 \times 10^{-4}$  (g)  $1.5 \times 10^9$  (h)  $1.25 \times 10^{-5}$
- Q2 (a)  $6.25 \times 10^9$  (b)  $1.628 \times 10^{-2}$  (c)  $5.58 \times 10^6$  (d)  $1.512 \times 10^{14}$   
(e)  $2.38328 \times 10^{17}$
- Q3 (a)  $3.7872 \times 10^8$  (b)  $3.1 \times 10^6$  (c)  $1.015 \times 10^{-20}$   
(d)  $3.1 \times 10^8$  (e)  $8.64 \times 10^{12}$  (f)  $3.1 \times 10^{24}$  (g)  $2.2 \times 10^{-3}$

## Section D - Reasoning Skills Section

Q1 Proof

Q2 Proof

Q3  $\frac{b^2}{4ac}$

Q4  $n = -2$

Q5 - 9 Proof.