National 5 Portfolio

N5

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) -4×2 (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

O1 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) π (c) $\sqrt{9}$

(d) $\sqrt{\frac{1}{4}}$ (e) $\sqrt{16}$ (f) $\frac{\pi}{4}$

(g) $\sqrt{5}$ (h) $\sqrt{\frac{3}{16}}$ (i) $\sqrt{\frac{9}{25}}$

O2 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

O3 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) $\frac{10\sqrt{3}}{\sqrt{2}}$

O4 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) $-\sqrt{7}(\sqrt{7}+2)$

O5 I can use the rules of indices $\boldsymbol{mx^a \times nx^b = mnx^{(a+b)}}$, $\boldsymbol{mx^a \div nx^b = \frac{m}{n}x^{(a-b)}}$ ***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 $x = 32$.

O7 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) $5x^{\frac{1}{2}}\left(2\sqrt{x} + 3x^{\frac{3}{2}}\right)$ (e) $4a^2(2a^{-1} + 3a^{-2})$ (f) $a^{\frac{1}{2}}\left(\sqrt{a} + a^{-\frac{1}{2}}\right)$

(g) $t^{-2}(3t^{-2} - t^2)$ (h) $3m^2(2m^2 + 7m^{-4})$ (i) $p^{\frac{1}{3}}\left(p^{\frac{2}{3}} + p^{-\frac{1}{3}}\right)$

O8 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) 8×10^5 (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) $0 \cdot 04$ (b) $0 \cdot 000\,062$ (c) $0 \cdot 357$

(d) $0 \cdot 000\,000\,002\,4$ (e) $0 \cdot 000\,095$ (f) $0 \cdot 6$

(g) $0 \cdot 000\,012\,53$ (h) $0 \cdot 000\,000\,000\,236$ (i) $0 \cdot 001\,65$

4. Change each of the following back into normal form

(a) 3×10^{-4} (b) $7 \cdot 5 \times 10^{-2}$ (c) $6 \cdot 8 \times 10^{-6}$

(d) $5 \cdot 07 \times 10^{-3}$ (e) $4 \cdot 8 \times 10^{-5}$ (f) $5 \cdot 3 \times 10^{-7}$

(g) $4 \cdot 344 \times 10^{-5}$ (h) $9 \cdot 94 \times 10^{-6}$ (i) $5 \cdot 34 \times 10^{-1}$

5. Write each of the following in scientific notation

(a) $0 \cdot 000\,6$ (b) 65 (c) $3\,910$

(d) $0 \cdot 000\,002\,3$ (e) $858\,000$ (f) $0 \cdot 000\,000\,55$

6. Change each of the following back into normal form

(a) $8 \cdot 3 \times 10^{-3}$ (b) $3 \cdot 5 \times 10^{5}$ (c) $7 \cdot 13 \times 10^{-6}$

(d) $4 \cdot 873 \times 10^{8}$ (e) $2 \cdot 4 \times 10^{-5}$ (f) $6 \cdot 55 \times 10^{7}$

O9 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) $5 \times (4 \cdot 3 \times 10^{6})$ (b) $6 \times (2 \cdot 93 \times 10^{-3})$

(c) $9 \cdot 3 \times (7 \times 10^{5})$ (d) $(4 \cdot 8 \times 10^{7}) \div 4$

(e) $(6 \cdot 2 \times 10^{5}) \div 2$ (f) $(7.2 \times 10^{-3}) \div 8$

(g) $(5 \times 10^{2}) \times (3 \times 10^{6})$ (h) $(2 \cdot 5 \times 10^{-2}) \times (5 \times 10^{-4})$

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 £$9 \cdot 3 \times 10^6$ 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 3×10^8 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 $3 \cdot 27 \times 10^{-22}$ 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?

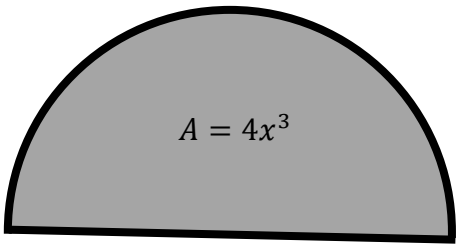
Give your answer in scientific notation correct to 2 significant figures.

Surds and Indices

Section D - Reasoning Skills Section

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

1.

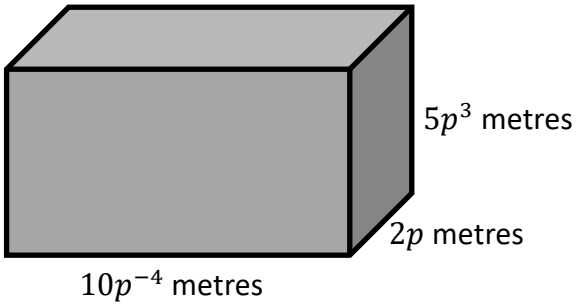


The area of the semi circle shown is $4x^3$.

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.

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

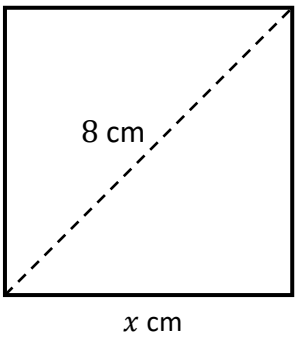
Is the statement true?

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.



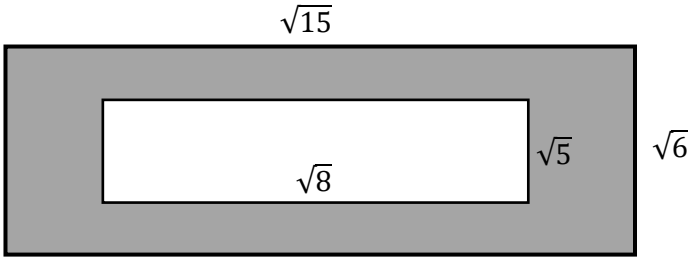
7. Sam's homework jotter has the following statement.

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

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) 9×3 (b) 4×3 (c) 16×2 (d) 25×3 (e) 16×3

(f) 4×2 (g) 25×2 (h) 25×5 (i) 4×5

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) $x = 5$

O3

(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) $5\sqrt{6}$

O4

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

O5

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) $\frac{1}{7d^2}$

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

O6

Q1 (a) $a^{\frac{1}{2}}$ (b) $b^{\frac{1}{3}}$ (c) $\frac{1}{c^{\frac{1}{4}}}$ or $c^{-\frac{1}{4}}$ (d) $x^{\frac{3}{5}}$

(e) $x^{\frac{7}{3}}$ (f) $\frac{1}{x^{\frac{3}{4}}}$ 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) $y = 8$

O7

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) $p + 1$

O8

Q1 (a) 7×10^3 (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) 3×10^6 (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) 4×10^{-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) 6×10^{-1} (g) $1 \cdot 253 \times 10^{-5}$ (h) $2 \cdot 36 \times 10^{-10}$

(i) $1 \cdot 65 \times 10^{-3}$

Q4 (a) $0 \cdot 0003$ (b) $0 \cdot 075$ (c) $0 \cdot 0000068$ (d) $0 \cdot 00507$

(e) $0 \cdot 000048$ (f) $0 \cdot 00000053$ (g) $0 \cdot 00004344$ (h) $0 \cdot 00000994$

(i) $0 \cdot 534$

Q5 (a) 6×10^{-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) $5 \cdot 5 \times 10^{-7}$

Q6 (a) $0 \cdot 0083$ (b) $350\,000$ (c) $0 \cdot 00000713$ (d) $487\,300\,000$

(e) $0 \cdot 000024$ (f) $65\,500\,000$

O9

Q1 (a) $2 \cdot 15 \times 10^{7}$ (b) $1 \cdot 758 \times 10^{-2}$ (c) $6 \cdot 51 \times 10^{6}$ (d) $1 \cdot 2 \times 10^{7}$

(e) $3 \cdot 1 \times 10^{5}$ (f) 9×10^{-4} (g) $1 \cdot 5 \times 10^{9}$ (h) $1 \cdot 25 \times 10^{-5}$

Q2 (a) $6 \cdot 25 \times 10^{9}$ (b) $1 \cdot 628 \times 10^{-2}$ (c) $5 \cdot 58 \times 10^{6}$ (d) $1 \cdot 512 \times 10^{14}$

(e) $2 \cdot 38328 \times 10^{17}$

Q3 (a) $3 \cdot 7872 \times 10^{8}$ (b) $3 \cdot 1 \times 10^{6}$ (c) $1 \cdot 015 \times 10^{-20}$

(d) $3 \cdot 1 \times 10^{8}$ (e) $8 \cdot 64 \times 10^{12}$ (f) $3 \cdot 1 \times 10^{24}$ (g) $2 \cdot 2 \times 10^{-3}$

Section D - Reasoning Skills Section

Q1 Proof Q2 Proof Q3 $\frac{b^2}{4ac}$ Q4 $n = -2$

Q5 – 9 Proof.