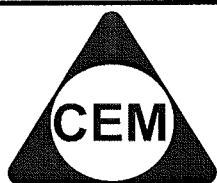


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YEAR 9 – ADVANCED MATHS EXERCISES & QUIZ

TOPIC 2: INDEX LAWS & SURDS

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Tutor's Initials

Dated on

Topic 2.1: Index laws:

Rules: (1) $a^m \times a^n = a^{m+n}$ (2) $a^m \div a^n = a^{m-n}$ (3) $(a^m)^n = a^{mn}$ (4) $a^0 = 1$

Simplify the following, giving the answers in index form:

1. $x^2 \times x \times x^3 =$

2. $6n \times 3n^2 =$

3. $36b^8 \div 9b^6 =$

4. $p^7q^6 \div p^4q^3 =$

5. $(z^7)^2 \div z^6 =$

6. $(2x^3)^4 =$

7. $9a^2b \times 3ab =$

8. $(8z^2)^2 =$

Simplify the following:

9. $(a^2)^0 =$

10. $9k^5 \div 9k^5 =$

Ans: 1. x^6 2. $18n^3$ 3. $4b^2$ 4. p^3q^3 5. z^8 6. $16x^{12}$ 7. $27a^3b^2$ 8. $64z^4$ 9. 1 10. 1

Topic 2.2: Negative indices

Rule: (1) $a^{-m} = \frac{1}{a^m}$

Evaluate the following:

1. $8^{-2} =$

2. $3^{-3} \times 2^{-2} =$

3. $\frac{5}{3^{-2}} =$

4. $3^{-7} \times 3^5 =$

Simplify, giving your answer without negative indices:

5. $a^3 \times a^{-5} =$

6. $(mn)^{-2} =$

7. $(4z^{-2})^{-2} =$

8. $20k^{-6} \div 10k^{-4} =$

9. $(5p^{-1})^2 =$

10. $(2x^{-6})^{-2} =$

Ans: 1. $\frac{1}{64}$ 2. $\frac{1}{108}$ 3. 45 4. $\frac{1}{9}$ 5. $\frac{1}{a^2}$ 6. $\frac{1}{m^2n^2}$ 7. $\frac{z^4}{16}$ 8. $\frac{2}{k^2}$ 9. $\frac{25}{p^2}$ 10. $\frac{x^{12}}{4}$

Topic 2.3: Fractional indices

Rules: (1) $a^{\frac{1}{n}} = \sqrt[n]{a}$ (2) $a^{\frac{m}{n}} = \sqrt[n]{(a^m)} = (\sqrt[n]{a})^m$

Evaluate the following:

1. $(125)^{\frac{1}{3}} =$

2. $(81)^{\frac{1}{4}} =$

3. $64^{-\frac{1}{3}} =$

4. $49^{\frac{1}{2}} =$

Simplify the following:

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

6. $\left(a^{\frac{2}{3}} \times b^{\frac{2}{3}}\right)^3 =$

7. $(z^2)^{\frac{1}{4}} =$

8. $y^{\frac{1}{2}} \times y^{\frac{1}{4}} \times y^{\frac{1}{4}} =$

Evaluate the following without using a calculator:

9. $(125)^{\frac{4}{3}} =$

10. $81^{-\frac{1}{4}} =$

Ans: 1. 5 2. 3 3. $\frac{1}{4}$ 4. $\frac{1}{7}$ 5. $36x$ 6. a^2b^2 7. $z^{\frac{1}{2}}$ 8. y 9. 625 10. $\frac{1}{3}$

Topic 2.4: Scientific Notation or Standard Notation

Rule: Number between 1 & 10 × Power of 10

Express the following in scientific notation:

1. 3687 =

2. 53 630 =

3. 83 000 =

4. 0.6 =

5. 0.001 =

6. 0.000835 =

Write the basic numeral for the following:

7. $4.6 \times 10^3 =$

8. $2.39 \times 10^{-2} =$

Use your calculator to answer the following correct to 3 significant figures:

9. $8.1 \times 10^{-2} \times 6.3 \times 10^4 =$

10. $(5.6 \times 10^4) \div (2.8 \times 10^2) =$

Ans: 1. 3.687×10^3 2. 5.363×10^4 3. 8.3×10^4 4. 6×10^{-1} 5. 1×10^{-3} 6. 8.35×10^{-4}
7. 4600 8. 0.0239 9. 5.10×10^3 10. 2×10^2

Topic 2.5: Simplifying surds

Example: $\sqrt{12} = \sqrt{4 \times 3} = 2\sqrt{3}$

Simplify the following surds:

1. $\sqrt{75} =$

2. $\sqrt{32} =$

3. $\sqrt{242} =$

4. $\sqrt{125} =$

5. $\sqrt{192} =$

6. $\sqrt{243} =$

7. $2\sqrt{54} =$

8. $7\sqrt{56} =$

9. $\sqrt{7a^6} =$

10. $\sqrt{28z^4} =$

Ans: 1. $5\sqrt{3}$ 2. $4\sqrt{2}$ 3. $11\sqrt{2}$ 4. $5\sqrt{5}$ 5. $8\sqrt{3}$ 6. $9\sqrt{3}$ 7. $6\sqrt{6}$ 8. $14\sqrt{14}$ 9. $a^3\sqrt{7}$
10. $2z^2\sqrt{7}$

Topic 2.6: Addition and subtraction of surds

Example: $2\sqrt{3} - 3\sqrt{2} + \sqrt{3} - 2\sqrt{2} = 3\sqrt{3} - 5\sqrt{2}$

Simplify the following:

1. $5\sqrt{x} + 6\sqrt{x} - 3\sqrt{x} =$

2. $16\sqrt{3} - 7\sqrt{3} + 2\sqrt{3} =$

3. $3b\sqrt{y} + 2b\sqrt{y} =$

4. $4\sqrt{5} - 8\sqrt{5} + 7\sqrt{5} =$

5. $4\sqrt{7} + 6\sqrt{7} - 3\sqrt{7} =$

6. $8\sqrt{3} + 11\sqrt{3} - 3\sqrt{3} =$

7. $3\sqrt{24} - 2\sqrt{96} =$

8. $\sqrt{5} + \sqrt{125} - \sqrt{20} =$

9. $\sqrt{8} + \sqrt{32} - \sqrt{18} =$

10. $\sqrt{242} - \sqrt{162} + \sqrt{18} =$

Ans: 1. $8\sqrt{x}$ 2. $11\sqrt{3}$ 3. $5b\sqrt{y}$ 4. $3\sqrt{5}$ 5. $7\sqrt{7}$ 6. $19\sqrt{3} - 3\sqrt{5}$ 7. $-2\sqrt{6}$ 8. $4\sqrt{5}$
9. $3\sqrt{2}$ 10. $5\sqrt{2}$

Topic 2.7: Multiplication and division of surds

Rules: (1) $\sqrt{m} \times \sqrt{n} = \sqrt{mn}$ (2) $\sqrt{m} \div \sqrt{n} = \sqrt{\frac{m}{n}}$

Simplify:

1. $\sqrt{8} \times \sqrt{2} =$

2. $5\sqrt{2} \times 6\sqrt{3} =$

3. $5\sqrt{6} \times 2\sqrt{8} =$

4. $18\sqrt{8} \div 2\sqrt{8} =$

5. $\sqrt{27} \div \sqrt{9} =$

6. $28\sqrt{5} \div 7\sqrt{5} =$

Expand and simplify:

7. $\sqrt{3}(2\sqrt{5} - \sqrt{7}) =$

8. $\sqrt{5}(\sqrt{2} + \sqrt{3}) =$

9. $\sqrt{5}(5 - \sqrt{3}) =$

10. $5(3\sqrt{6} - 5) =$

Ans: 1. 4 2. $30\sqrt{6}$ 3. $40\sqrt{3}$ 4. 9 5. $\sqrt{3}$ 6. 4 7. $2\sqrt{15} - \sqrt{21}$ 8. $\sqrt{10} + \sqrt{15}$
9. $5\sqrt{5} - \sqrt{15}$ 10. $15\sqrt{6} - 25$

Topic 2.8: Binomial products and conjugate surds

Expand and simplify:

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

2. $(7\sqrt{2}+\sqrt{3})(5\sqrt{2}+2)=$

3. $(2\sqrt{2}+5)(\sqrt{2}-3)=$

4. $(\sqrt{2}+\sqrt{3})^2 =$

5. $(2\sqrt{5}+3\sqrt{2})^2 =$

6. $(2\sqrt{7}-1)^2 =$

7. $(5+\sqrt{5})(5-\sqrt{5})=$

8. $(2\sqrt{11}+5)(2\sqrt{11}-5)=$

9. $(5\sqrt{2}-1)(5\sqrt{2}+1)=$

10. $(8\sqrt{3}+5)(8\sqrt{3}-5)=$

Ans: 1. 20 2. $70+14\sqrt{2}+2\sqrt{3}+5\sqrt{6}$ 3. $-11-\sqrt{2}$ 4. $5+2\sqrt{6}$ 5. $38+12\sqrt{10}$
6. $29-4\sqrt{7}$ 7. 20 8. 19 9. 49 10. 167

Topic 2.9: Rationalising the denominator

Simplify the following by rationalising the denominator:

1. $\frac{2\sqrt{3}}{\sqrt{7}} =$

2. $\frac{7\sqrt{2}}{\sqrt{5}} =$

3. $\frac{3\sqrt{5}}{3\sqrt{7}} =$

4. $\frac{9}{5\sqrt{5}} =$

5. $\frac{\sqrt{2}+1}{\sqrt{5}} =$

6. $\frac{3\sqrt{2}+\sqrt{7}}{\sqrt{5}} =$

7. $\frac{2}{\sqrt{7}-\sqrt{5}} =$

8. $\frac{8}{\sqrt{7}-\sqrt{3}} =$

9. $\frac{2}{5-\sqrt{3}} =$

10. $\frac{2}{\sqrt{3}+\sqrt{5}} =$

Ans: 1. $\frac{2\sqrt{21}}{7}$ 2. $\frac{7\sqrt{10}}{5}$ 3. $\frac{\sqrt{35}}{7}$ 4. $\frac{9\sqrt{5}}{25}$ 5. $\frac{\sqrt{10}+\sqrt{5}}{5}$ 6. $\frac{3\sqrt{10}+\sqrt{35}}{5}$ 7. $\sqrt{7}+\sqrt{5}$

8. $2\sqrt{7}+2\sqrt{3}$ 9. $\frac{5+\sqrt{3}}{11}$ 10. $\sqrt{5}-\sqrt{3}$

Topic 2 Revision: Indices

Simplify these expressions:

1. $\frac{(3x^2)^2 \times 2x^6}{4x^3 \times 5x^4} =$

2. $(8a^3b^5)^2 \div 4a^3b^5 =$

Express the following terms in their simplest form without negative indices:

3. $\frac{p^{-2}}{p^{-4}} =$

4. $2^{3x+5} \div 2^{x-2} =$

5. $\frac{8x^{-4}y^3}{(-3x^2y)^2} \div \frac{24x^{-2}y^3}{9x^{-1}y} =$

6. $\sqrt{\frac{a^{3p} \times a^{5q}}{a^{3p+5q}}} =$

Evaluate:

7. $\left(\frac{36}{16}\right)^{\frac{3}{2}} =$

8. $\left(-\frac{27}{8}\right)^{\frac{4}{3}} =$

9. Find the value of a^3b^{-1} given $a = 4$ and $b = \frac{4}{5}$.

10. Evaluate $x^{-3} \div yz^{-1}$ when $x = -3$, $y = -1$, and $z = \frac{1}{3}$.

Ans: 1. $\frac{9x^3}{10}$ 2. $16a^3b^5$ 3. p^2 4. 2^{2x+7} 5. $\frac{1}{3x^7y}$ 6. 1 7. $\frac{8}{27}$ 8. $\frac{16}{81}$ 9. 80 10. $\frac{1}{81}$

Topic 2 Revision: Surds

Simplify each of the following surds:

1. $\sqrt{28} =$

2. $\sqrt{180} =$

3. $\sqrt{117} =$

4. $2\sqrt{3} - 3\sqrt{5} + 2\sqrt{5} =$

5. $5\sqrt{12} + 6\sqrt{2} - 2\sqrt{3} =$

6. $7\sqrt{3} \times 4\sqrt{5} =$

7. $12\sqrt{6} \div 4\sqrt{2} =$

8. $(\sqrt{5} + 3)(\sqrt{3} - 1) =$

Express with a rational denominator in simplest form:

9. $\frac{\sqrt{2}}{5\sqrt{3}} =$

10. $\frac{8}{2\sqrt{3} - 4} =$

Ans: 1. $2\sqrt{7}$ 2. $6\sqrt{5}$ 3. $3\sqrt{13}$ 4. $2\sqrt{3} - \sqrt{5}$ 5. $8\sqrt{3} + 6\sqrt{2}$ 6. $28\sqrt{15}$ 7. $3\sqrt{3}$

8. $\sqrt{15} - \sqrt{5} + 3\sqrt{3} - 3$ 9. $\frac{\sqrt{6}}{15}$ 10. $-4\sqrt{3} - 8$