INDICES

NUMBER INDICES

(Non Calculator)

Question 1

Simplify the following without the use of a calculator, showing clearly all the steps in your calculations.

a) $4^{-1}+2^{-3}$

b) $5^{-2}+25^{-1}$

c) $2^{-4}+8^{-1}$

d) $2^{-5}-8^{-2}$

e) $3^{-3}+9^{-2}+27^{-1}$

Question 2

Simplify the following without the use of a calculator, showing clearly all the steps in your calculations.

a) $4^{\frac{1}{2}}+9^{\frac{1}{2}}$

b) $64^{\frac{1}{2}}+64^{\frac{1}{3}}$

c) $16^{\frac{1}{2}}+16^{\frac{1}{4}}$

d) $9^{\frac{1}{2}}+9^{\frac{3}{2}}$

e) $4^{\frac{1}{2}}+4^{\frac{5}{2}}$

Question 3

Simplify the following without the use of a calculator, showing clearly all the steps in your calculations.

a) $9^{\frac{1}{2}}+9^{-\frac{1}{2}}$

b) $4^{\frac{1}{2}}+4^{-\frac{1}{2}}$

c) $8^{\frac{1}{3}}+8^{-\frac{1}{3}}$

d) $25^{\frac{1}{2}}-25^{-\frac{3}{2}}$

e) $36^{\frac{1}{2}}-36^{-\frac{3}{2}}$

Question 4

Simplify the following without the use of a calculator, showing clearly all the steps in your calculations.

a) $16^{\frac{3}{2}}+8^{\frac{2}{3}}$

b) $27^{\frac{2}{3}}+25^{\frac{3}{2}}$

c) $8^{\frac{4}{3}}+16^{\frac{1}{4}}$

d) $8^{\frac{5}{3}}-16^{\frac{3}{4}}$

e) $27^{\frac{4}{3}}-81^{\frac{3}{4}}$

Question 5

Simplify the following without the use of a calculator, showing clearly all the steps in your calculations.

a) $9^{\frac{3}{2}}$

b) $8^{-\frac{2}{3}}$

c) $16^{-\frac{3}{2}}$

d) $27^{\frac{4}{3}}$

e) $81^{-\frac{3}{4}}$

Question 6

Simplify the following without the use of a calculator, showing clearly all the steps in your calculations.

a) $\left(\frac{2}{3}\right)^{-2}$

b) $\left(\frac{4}{9}\right)^{\frac{3}{2}}$

c) $\left(\frac{25}{16}\right)^{-\frac{1}{2}}$

d) $\left(\frac{81}{16}\right)^{\frac{3}{4}}$

e) $(2.25)^{\frac{3}{2}}$

Question 7

Simplify the following without the use of a calculator, showing clearly all the steps in your calculations.

a) $\left(1\frac{7}{9}\right)^{\frac{3}{2}}$

b) $\left(5\frac{4}{9}\right)^{-\frac{1}{2}}$

c) $\left(2\frac{1}{4}\right)^{\frac{5}{2}}$

d) $\left(4\frac{17}{27}\right)^{\frac{2}{3}}$

e) $\left(6\frac{1}{4}\right)^{-\frac{3}{2}}$

Question 8

Simplify the following without the use of a calculator, showing clearly all the steps in your calculations.

a) $32^5\times 8^{-9}\times 2^8$

b) $8^{-4}\times 2^{11}$

c) $\dfrac{8^6}{16^3}$

d) $27^{-4}\times 3^{11}$

e) $\left(5^6\times 25^3\div 125^2\right)^{\frac{1}{2}}$

Question 9

Simplify the following without the use of a calculator, showing clearly all the steps in your calculations.

a) $\dfrac{16^{\frac{1}{2}}}{81^{\frac{3}{4}}}$

b) $\dfrac{2^6}{8^{\frac{5}{2}}\times 2^{-\frac{1}{2}}}$

c) $2^{16}\times 4^{-8}\times 8^4\times 16^{-2}$

d) $\left(36^{\frac{1}{2}}+16^{\frac{1}{4}}\right)^{\frac{1}{3}}$

e) $\left(125^{\frac{1}{3}}\times 25^{\frac{1}{2}}+16^{\frac{3}{4}}\times 64^{\frac{1}{3}}+\dfrac{1}{49^{-\frac{1}{2}}}\right)^{-\frac{2}{3}}$

ALGEBRAIC INDICES

(Non Calculator)

Question 1

Simplify **fully** each of the following expressions.

a) $4a^2b^3 \times 3ab^4$

b) $\left(2a^3b^2\right)^4$

c) $\dfrac{3a^3b^2c \times 6ab^2c^3}{2a^2bc^3}$

d) $\dfrac{\left(4xy^2\right)^2}{\left(2x\right)^3}$

e) $\dfrac{\sqrt{9x^6y^4}}{\left(3x^2y^3\right)^2}$

Question 2

Simplify **fully** each of the following expressions.

a) $\dfrac{x^6}{x^{-2}}$

b) $\dfrac{12y^{-5}}{3y^{-2}}$

c) $\left(3t^3q^4\right)^3$

d) $\dfrac{3z^4 \times \left(10z\right)^3}{125z^5}$

Question 3

Simplify **fully** each of the following expressions.

a) $x^{\frac{5}{2}} \times \sqrt{x}$

b) $2y^3 \times 2y^{-1}$

c) $2w^{\frac{1}{2}} \times 3w^2$

d) $2t^{\frac{4}{3}} \times 4\sqrt[3]{t^2}$

e) $k^{\frac{3}{2}} \times 4k^{-3}$

Question 4

Simplify **fully** each of the following expressions.

a) $\left(2k^{\frac{1}{2}}h^3\right)^4$

b) $\left(9a^6b^2\right)^{-\frac{1}{2}}$

c) $\left(2pq^2\right)^4 \times 5p\sqrt{q^6}$

d) $\dfrac{12\left(x^3y^2z\right)^4}{\left(4x^2z^6\right)^2}$

Question 5

Simplify **fully** each of the following expressions.

a) $\left(2ab^2c^3\right)^3$

b) $\left(\frac{1}{2}x^3y^2\right)^3$

c) $\left(9a^6b^4\right)^{\frac{1}{2}}$

d) $\left(16p^8q^{-2}\right)^{\frac{1}{2}}$

Question 6

Simplify **fully** each of the following expressions.

a) $2a^3\left(2a^{-1}+a^{\frac{1}{2}}\right)$

b) $4b^{\frac{1}{2}}\left(2b+b^{\frac{1}{2}}\right)$

c) $c^{\frac{3}{2}}\left(3c^{-1}+c\right)$

d) $3d^{\frac{3}{2}}\left(4d^{-2}-2d^{-\frac{1}{2}}\right)$

Question 7

Simplify **fully** each of the following expressions.

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

b) $3b^{2}\left(b^{-2}+2b^{-\frac{1}{2}}\right)$

c) $3c^{\frac{7}{2}}\left(2c^{-\frac{1}{2}}-c\right)$

d) $2d^{\frac{7}{2}}\left(2d^{-1}+d^{\frac{1}{2}}\right)$

Question 8

Write each of the following expressions as the sum of terms of the form kx^{n}, where k is a constant.

a) $\dfrac{1}{2\sqrt{x}}+\dfrac{4}{x^{2}}$

b) $x\sqrt{x}-\dfrac{1}{x^{2}}$

c) $\sqrt{x^{3}}-\dfrac{1}{2x^{2}}$

d) $\sqrt[3]{x^{2}}-\dfrac{3}{2x^{3}}$

e) $4\sqrt{x}+\dfrac{1}{4\sqrt{x}}$

Question 9

Write each of the following expressions as the sum of terms of the form kx^n, where k is a constant.

a) $\left(5-x^{-2}\right)\left(2x^3-x\right)$

b) $\left(1-x^{\frac{1}{2}}\right)\left(2-x^{\frac{1}{2}}\right)$

c) $\left(1+x^{\frac{1}{2}}\right)\left(x^{\frac{3}{2}}+2\right)$

Question 10

Write each of the following expressions as the sum of terms of the form kx^n, where k is a constant.

a) $\left(x^{\frac{3}{2}}+2x^{-\frac{3}{2}}\right)^2$

b) $\left(x^{\frac{1}{2}}-2x^{-\frac{1}{2}}\right)^2$

c) $\left(3x^{-\frac{3}{2}}+2x^{\frac{1}{2}}\right)^2$

d) $\left(x^{\frac{5}{2}}+x^{\frac{1}{2}}\right)^2$

e) $\left(3\sqrt{x}-2\right)^2$

Question 11

Write each of the following expressions as the sum of terms of the form kx^n, where k is a constant.

a) $\left(2x^{\frac{1}{2}}+3\right)^2$

b) $\left(2x^{\frac{1}{2}}-x^{-\frac{1}{2}}\right)^2$

c) $\left(2x^{\frac{3}{2}}-3x^{-\frac{3}{2}}\right)^2$

d) $\left(x^{\frac{1}{2}}-2x^{-\frac{3}{2}}\right)^2$

e) $\left(x^{\frac{1}{2}}-4\right)\left(x^{-\frac{1}{2}}-1\right)$

Question 12

Write each of the following expressions as the sum of terms of the form kx^n, where k is a constant.

a) $\dfrac{4+x}{2x^3}$

b) $\dfrac{9\sqrt{x}+6x}{3x^3}$

c) $\dfrac{(x+2)(2x-3)}{4x^5}$

d) $\dfrac{x^2+3x}{2\sqrt{x}}$

e) $\dfrac{\sqrt{x}(2x-4)}{3x^2}$

Question 13

Write each of the following expressions as the sum of terms of the form kx^n, where k is a constant.

a) $\dfrac{(3x-2)(2x-1)}{2x^{\frac{3}{2}}}$

b) $\dfrac{(2\sqrt{x}+3)^2}{4x}$

c) $\dfrac{x^2(\sqrt{x}+4x)}{4\sqrt{x}}$

d) $\dfrac{\sqrt{x}\left(5x^2-8\right)}{4x}$

e) $\dfrac{(x^2-3)(\sqrt{x}+4x)}{3\sqrt{x}}$

INDICIAL EQUATIONS

(Non Calculator)

Question 1

Solve each of the following equations without using a calculator.

a) $x^{\frac{1}{3}} = 2$

b) $y^{-\frac{1}{3}} = 8$

c) $z^{\frac{3}{2}} = 27$

d) $w^{\frac{2}{3}} = 64$

e) $t^{-\frac{1}{2}} = \frac{1}{4}$

Question 2

Solve each of the following equations without using a calculator.

a) $x^{-\frac{3}{4}} = 8$

b) $y^{-\frac{1}{3}} = \frac{1}{2}$

c) $(3-z)^{\frac{3}{2}} = 8$

d) $\left(25w^2\right)^{-\frac{1}{2}} = 2$

Question 3

Solve each of the following equations without using a calculator.

a) $x^{-1} = \frac{x}{16}$

b) $3y^{-\frac{1}{2}} - 4 = 0$

c) $8w^{\frac{1}{2}} - w^{-1} = 0$

d) $32t^{\frac{3}{2}} - \frac{1}{t} = 0$

Question 4

Solve each of the following equations without using a calculator.

a) $2^{3-x} = 4^{x}$

b) $2^{y+2} = 4\sqrt{2}$

c) $4^{z} = 8^{2-z}$

d) $2^{w} = \frac{4}{\sqrt{2}}$

e) $2^{t} = 8\sqrt{2}$

Question 5

Solve each of the following equations without using a calculator.

a) $3^{x+2} = 9^{x}$

b) $2^{y+1} = 8^{2y-1}$

c) $27^{3z+1} = 9$

d) $9^{2w-3} = 27^{w+2}$

e) $8 \times 2^{2t} = \dfrac{2^{5t+1}}{4^{-t}}$

Question 6

Solve each of the following equations without using a calculator.

a) $2^{x+2} = 4^{x}$

b) $9^{y} = 27^{1-y}$

c) $4^{z} = 8^{3-z}$

d) $\dfrac{4^{w} \times 2^{5w}}{16^{w}} = 2^{w}$

e) $\dfrac{27^{t}}{3^{t-1}} = 3\sqrt{3}$

Question 7

Solve each of the following equations without using a calculator.

a) $\dfrac{81^{3-x}}{27^{2x+1}}=3$

b) $\dfrac{5^{y}}{25^{y-1}}=\sqrt{5}$

c) $\dfrac{16^{z}}{\sqrt{2}}=2^{z-1}$

d) $\dfrac{25^{t-1}}{5}=\sqrt{5}$

Question 8

Solve each of the following equations without using a calculator.

a) $2^{3x+4}=4\sqrt{2}$

b) $3^{x}=\dfrac{\sqrt{3}}{9}$

c) $2^{z}=\dfrac{\sqrt{2}}{2^{z+1}}$

d) $9^{w}=\dfrac{3^{w-1}}{27}$

e) $3^{t+1}=\dfrac{27^{t}}{9}$

Question 9

Solve each of the following equations without using a calculator.

a) $3x^{\frac{1}{3}} = x^{-\frac{2}{3}}$

b) $2x^{-\frac{1}{2}} - \frac{3}{2}x^{\frac{1}{2}} = 0$

c) $w^{\frac{3}{2}} - 8x^{-\frac{1}{2}} = 0$

d) $z\left(z^{\frac{1}{2}} - 2z^{-\frac{1}{2}}\right)^2 = 0$

e) $27t^{-\frac{1}{2}} = 125t$

Question 10

Solve each of the following equations without using a calculator.

a) $4^x - 2^{x+2} - 32 = 0$

b) $2^{y+2} + 2^{3-y} = 33$

c) $3^{2-z} - 3^{z+1} = 26$

d) $2^{2w+2} + 3 \times 2^w - 1 = 0$

Question 11

Solve each of the following equations without using a calculator.

a) $3^{2x} - 3^{x+1} = 54$

b) $100^{t} - 10001(10)^{t-1} + 100 = 0$

c) $3\left(3^{2k}\right) - 28\left(3^{k}\right) + 9 = 0$

d) $2^{2p-2} - 2^{p-2} - 3 = 0$

Question 12

Solve each of the following equations without using a calculator.

a) $2x^{\frac{2}{3}} + 5x^{\frac{1}{3}} - 12 = 0$

b) $y^{\frac{1}{4}} - y^{-\frac{1}{4}} = 2$

c) $6z^{-\frac{1}{3}} - z^{\frac{1}{3}} = 5$

d) $3w + w^{\frac{1}{2}} - 2 = 0$

e) $t^{\frac{1}{3}} = 2 + 15t^{-\frac{1}{3}}$