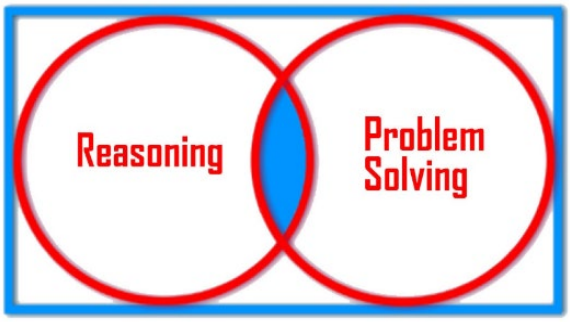

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Year 1 – (AS)

Indices and Surds – Set 2 (Solutions)

The marks shown are for guidance purposes only

The questions are repeated here for your convenience

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1 Given that $81^{x+1} = \frac{1}{27^{2k}}$

Express k in terms of x

Give your expression in its simplest form

Solution

$3^{4(x+1)} = 3^{-3\times 2k}$ **[1mark]**

Therefore, $4x + 4 = -6k$ **[1mark]**

$k = -\frac{4x+4}{6} = -\frac{2(x+1)}{3}$

$k = \frac{-2x-2}{3}$ **[1mark]**

2 Solve the equation below

$$5^{(x+0.5)} = \sqrt{5^{-x}}$$

Solution

$5^{\left(x+\frac{1}{2}\right)} = \left(5^{\frac{1}{x}}\right)^{\frac{1}{2}}$ **[1mark]**

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

Therefore, $x + \frac{1}{2} = \frac{1}{2x}$ **[1mark]**

$2x + 1 = \frac{1}{x}$ **[1mark]**

$2x^2 + x - 1 = 0$

$(2x - 1)(x + 1) = 0$ **[1mark]**

$x = \frac{1}{2}$ or $x = -1$ **[1mark]**

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3 Solve the equation below

$$\frac{2^{2x+3}}{8^{x-5}} = 6^0$$

Solution

Note that $6^0 = 1$

Therefore, $\frac{2^{2x+3}}{2^{3(x-5)}} = 1$ **[1mark]**

$2^{2x+3} = 2^{3x-15}$ **[1mark]**

Therefore, $2x + 3 = 3x - 15$ **[1mark]**

$-x = -18$

$x = 18$ **[1mark]**

4 Given that $\frac{\sqrt{28}+\sqrt{175}}{4\sqrt{63}} + \frac{5}{3} = \frac{m}{n}$

What is the value of the expression of $m + n$?

Solution

$\frac{2\sqrt{7}+5\sqrt{7}}{12\sqrt{7}} + \frac{5}{3} = \frac{7\sqrt{7}}{12\sqrt{7}} + \frac{5}{3}$ **[1mark]**

$= \frac{7}{12} + \frac{5}{3} = \frac{7}{12} + \frac{20}{12} = \frac{27}{12} = \frac{9}{4}$ **[1mark]**

Therefore, $m = 9$ and $n = 4$ **[1mark]**

Hence, $m + n = 9 + 4 = 13$ **[1mark]**

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5 Given that $(6+4\sqrt{3})(5-x\sqrt{3}) = k\sqrt{3}+30$
What is the value of x in terms of k?

Solution

$(6+4\sqrt{3})(5-x\sqrt{3})$

$= 30-6x\sqrt{3}-4x\sqrt{3}+20\sqrt{3}$ **[1mark]**

$30-6x\sqrt{3}-4x\sqrt{3}+20\sqrt{3}$

$= 30+(-6x-4x+20)\sqrt{3}$ **[1mark]**

Therefore, $k = -6x-4x+20$ **[1mark]**

$k-20 = -10x$

$x = \frac{20-k}{10}$ **[1mark]**

6 Solve the equation below

$$2x\sqrt{5}+\sqrt{50} = x\sqrt{125}-\sqrt{8}$$

Give your answer as a surd in its simplest form

Solution

$2x\sqrt{5}-5x\sqrt{5} = -2\sqrt{2}-5\sqrt{2}$ **[1mark]**

$-3x\sqrt{5} = -7\sqrt{2}$ **[1mark]**

$x = \frac{7\sqrt{2}}{3\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}}$ **[1mark]**

$x = \frac{7\sqrt{10}}{15}$ **[1mark]**

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7 Given that $x = a\sqrt{b}$ and $2\left(x + \sqrt{3}\right) = x\left(2 + \sqrt{32}\right)$
Find the values of a and b

Solution

Find the value of x

$2x + 2\sqrt{3} = 2x + 4x\sqrt{2}$ **[1mark]**

$4x\sqrt{2} = 2\sqrt{3}$ **[1mark]**

$x = \frac{2\sqrt{3}}{4\sqrt{2}}$ **[1mark]**

$x = \frac{2\sqrt{3}}{4\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{2\sqrt{6}}{8}$ **[1mark]**

$x = \frac{1}{4}\sqrt{6}$

Hence, $a = \frac{1}{4}$ and $b = 6$ **[1mark]**

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8 Solve the equation $3^{2x+2} - 3^{x+1} - 4 = 0$
Give your answer to 3 significant figures

Solution

$3^{2x} \times 3^2 - 3^x \times 3^1 - 4 = 0$ **[1mark]**

Note that $3^{2x+2} = 3^{2x} \times 3^2$

Therefore, $9(3^{2x}) - 3(3^x) - 4 = 0$ **[1mark]**

Let, $y = 3^x$

Then, we have $9y^2 - 3y - 4 = 0$ **[1mark]**

Use the quadratic formula

$y = 0.854(3\text{sf})$ or $y = -0.521(3\text{sf})$

Hence, $3^x = 0.854$

$x \ln 3 = \ln 0.854$ **[1mark]**

$x = \frac{\ln 0.854}{\ln 3} = -0.144$

Hence, $x = -0.144(3\text{sf})$ **[1mark]**

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