1. a) $(11+x)(3-x) = 33-11x+3x-x^2 = 33-8x-x^2$ **A1**

b) $(x+5)(x^2-8x+6) = x^3-8x^2+6x+5x^2-40x+30$ **M1**

$= x^3-3x^2-34x+30$ **A1**

c) $(x-2)(x+3)(x-5) = (x^2+x-6)(x-5)$ **M1**

$= x^3-5x^2+x^2-5x-6x+30$ **M1**

$= x^3-4x^2-11x+30$ **A1** **[6 Marks]**

Alternative Method: You could instead multiply the second pair of brackets first to get $(x-2)(x^2-2x-15)$

2. a) $36-9x-x^2 = -(x^2+9x-36) = -(x+12)(x-3)$ **M1**

$= (x+12)(3-x)$ **A1**

b) $2y^2-y-21 = (2y-7)(y+3)$ **A1A1**

c) $2x^3-4x^2+2x = 2x(x^2-2x+1)$ **M1**

$= 2x(x-1)^2$ **A1** **[6 Marks]**

3. a) $\dfrac{7y^{11}}{35y^6} = \dfrac{1}{5}\times\dfrac{y^{11}}{y^6} = \dfrac{1}{5}\times y^{11-6} = \dfrac{y^5}{5}$ **A1**

b) $5x^2 \div x^{-4} = 5x^{2-(-4)} = 5x^6$ **A1**

c) $(x^5)^{\frac{3}{5}} = x^{5\times\frac{3}{5}} = x^3$ **A1** **[3 Marks]**

4. a) $\sqrt{75}+\sqrt{27} = \sqrt{25\times3}+\sqrt{9\times3} = \sqrt{25}\times\sqrt{3}+\sqrt{9}\times\sqrt{3}$ **M1**

$= 5\sqrt{3}+3\sqrt{3} = 8\sqrt{3}$ **A1**

b) $\dfrac{\sqrt{60}}{\sqrt{3}} = \sqrt{\dfrac{60}{3}} = \sqrt{20}$ **M1**

$= \sqrt{4\times5} = \sqrt{4}\times\sqrt{5}$ **M1**

$= 2\sqrt{5}$ **A1**

c) $\sqrt{2}\times3\sqrt{8} = 3\sqrt{2\times8}$ **M1**

$= 3\sqrt{16} = 3\times4 = 12$ **A1** **[7 marks]**

5. a) $\sqrt{x^4}\times\sqrt{x^7} = (x^4)^{\frac{1}{2}}\times(x^7)^{\frac{1}{2}}$ **M1**

$= x^{4\times\frac{1}{2}}\times x^{7\times\frac{1}{2}} = x^2\times x^{\frac{7}{2}}$ **M1**

$= x^{2+\frac{7}{2}} = x^{\frac{11}{2}}$ **A1**

b) $(\sqrt[3]{x})^5 = \left(x^{\frac{1}{3}}\right)^5$ **M1**

$= x^{\frac{1}{3}\times5} = x^{\frac{5}{3}}$ **A1**

c) $(\sqrt{x})^{-\frac{3}{2}} = \left(x^{\frac{1}{2}}\right)^{-\frac{3}{2}}$ **M1**

$= x^{\frac{1}{2}\times-\frac{3}{2}} = x^{-\frac{3}{4}}$ **A1** **[7 Marks]**

6. a) $8^{\frac{1}{3}} = \sqrt[3]{8} = \sqrt[3]{2\times2\times2} = 2$ **A1**

b) $16^{-\frac{3}{2}} = (\sqrt{16})^{-3}$ **M1**

$= 4^{-3} = \dfrac{1}{4^3} = \dfrac{1}{64}$ **A1** **[3 Marks]**

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7. $\dfrac{1}{-1+2\sqrt{2}} = \dfrac{1}{-1+2\sqrt{2}} \times \dfrac{-1-2\sqrt{2}}{-1-2\sqrt{2}} = \dfrac{-1-2\sqrt{2}}{\left(-1+2\sqrt{2}\right)\left(-1-2\sqrt{2}\right)}$ **M1**

$= \dfrac{-1-2\sqrt{2}}{(-1)^2-\left(2\sqrt{2}\right)^2}$ **M1**

$= \dfrac{-1-2\sqrt{2}}{1-8}$ **M1**

$= \dfrac{-1-2\sqrt{2}}{-7} = \dfrac{1+2\sqrt{2}}{7}$ **A1** **[4 Marks]**

Technique: Use the difference of two squares technique to eliminate surds from the denominator by multiplying by a fraction equivalent to 1

8. a) $7y^3 \times 4y^5 \times \dfrac{1}{2}y^2 = \left(7 \times 4 \times \dfrac{1}{2}\right) \times \left(y^3 \times y^5 \times y^2\right)$ **M1**

$= 14 \times y^{3+5+2} = 14y^{10}$ **A1**

b) $\left(8x^6\right)^{-\frac{2}{3}} = 8^{-\frac{2}{3}} \times \left(x^6\right)^{-\frac{2}{3}}$ **M1**

$= \left(\sqrt[3]{8}\right)^{-2} \times x^{6\times-\frac{2}{3}} = 2^{-2} \times x^{-4}$ **M1**

$= \dfrac{1}{2^2} \times \dfrac{1}{x^4} = \dfrac{1}{4x^4} \left(\text{or } \dfrac{1}{4}x^{-4}\right)$ **A1**

c) $\sqrt{45}-\sqrt{44}-\sqrt{20} = \sqrt{9\times5}-\sqrt{4\times11}-\sqrt{4\times5} = \sqrt{9}\times\sqrt{5}-\sqrt{4}\times\sqrt{11}-\sqrt{4}\times\sqrt{5}$ **M1**

$= 3\sqrt{5}-2\sqrt{11}-2\sqrt{5}$ **M1**

$= \sqrt{5}-2\sqrt{11}$ **A1** **[8 Marks]**

9. $x^2-4y^2 = x^2-(2y)^2$ **M1**

$= (x+2y)(x-2y)$ **A1** **[2 Marks]**

Technique: Use the difference of two squares:
$a^2 - b^2 = (a + b)(a - b)$

10. a) $\left(2+\sqrt{5}\right)\left(4-\sqrt{5}\right) = 8-2\sqrt{5}+4\sqrt{5}-\left(\sqrt{5}\right)^2$ **M1**

$= 8-2\sqrt{5}+4\sqrt{5}-5 = 3+2\sqrt{5}$ **A1**

b) $\dfrac{3}{\left(2+\sqrt{5}\right)\left(4-\sqrt{5}\right)} = \dfrac{3}{3+2\sqrt{5}} = \dfrac{3}{3+2\sqrt{5}} \times \dfrac{3-2\sqrt{5}}{3-2\sqrt{5}}$ **M1**

$= \dfrac{3\left(3-2\sqrt{5}\right)}{3^2-\left(2\sqrt{5}\right)^2}$ **M1**

$= \dfrac{9-6\sqrt{5}}{9-20} = \dfrac{9-6\sqrt{5}}{-11}$ **M1**

$= -\dfrac{9}{11}+\dfrac{6}{11}\sqrt{5}$ **A1** **[6 Marks]**

11. a) $\left(9x^2\right)^{\frac{3}{2}} = 9^{\frac{3}{2}} \times \left(x^2\right)^{\frac{3}{2}} = \left(\sqrt{9}\right)^3 \times x^{2\times\frac{3}{2}}$ **M1**

$= 3^3 \times x^3 = 27x^3$ **A1**

b) $\sqrt{x^7} \times \sqrt{25x^4} = \left(x^7\right)^{\frac{1}{2}} \times \sqrt{25} \times \sqrt{x^4} = \left(x^7\right)^{\frac{1}{2}} \times 5 \times \left(x^4\right)^{\frac{1}{2}}$ **M1**

$= 5 \times x^{7\times\frac{1}{2}} \times x^{4\times\frac{1}{2}}$ **M1**

$= 5 \times x^{\frac{7}{2}+2} = 5x^{\frac{11}{2}}$ **A1** **[5 Marks]**

12. $27^x = 9 \therefore \left(3^3\right)^x = 3^2$ **M1**

$\therefore 3^{3x} = 3^2 \therefore 3x = 2$ **M1**

$\therefore x = \dfrac{2}{3}$ **A1** **[3 Marks]**

Technique: Write 27 and 9 as powers of 3

TOTAL 60 MARKS

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