

1

$$\frac{(125x^6)^{\frac{1}{3}}}{64^{\frac{1}{3}}} = \frac{5x^2}{4}$$

M1 A1

(Total for question 1 is 2 marks)

2

$$\frac{8x^{\frac{3}{2}}}{4x^2} = 2x^{-\frac{1}{2}}$$

M1 A1

(Total for question 2 is 2 marks)

3

$$\left(\frac{6x^2}{3y}\right)^{-2} = \frac{36x^4}{9y^2} = \frac{9y^2}{36x^4} = \frac{y^2}{4x^4}$$

M1 A1

(Total for question 3 is 2 marks)

4

$$(3^2)^{3x+2} = 3^{2(3x+2)} = 3^{6x+4}$$

M1 A1

(Total for question 4 is 2 marks)

5

$$(2^3)^{2x-5} = 2^{3(2x-5)} = 2^{6x-15}$$

M1 A1

(Total for question 5 is 2 marks)

6

(a)

$$4^x = 2^{2x} = (2^x)^2 = y^2$$

(B2)(b) Let $2^x = y$

$$y^2 - 6y - 16 = 0$$

$$(y - 8)(y + 2) = 0$$

$$y = 8, y = -2$$

$$2^x = 8 \implies x = 3$$

$$2^x = -2 \implies \text{no solution}$$

$$x = 3$$

(M1 M1 A1)**(Total for question 6 is 5 marks)**

7

$$2^{2x+1} = 2 \cdot (2^x)^2$$

Let $y = 2^x$

$$2y^2 - 5y - 12 = 0$$

$$(2y + 3)(y - 4) = 0$$

$$y = -\frac{3}{2}, y = 4$$

$$2^x = -\frac{3}{2} \implies \text{no solution}$$

$$2^x = 4 \implies x = 2$$

(M1 M1 M1 A1 A1)**(Total for question 7 is 5 marks)**

8

$$(2^3)^{2x-5} = 2^{x+1}$$

$$2^{6x-15} = 2^{x+1}$$

$$6x - 15 = x + 1$$

$$5x = 16$$

$$x = \frac{16}{5}$$

(M1 M1 A1)**(Total for question 8 is 3 marks)**

9

(a)

$$(x - 8)(x - 1) = 0$$

$$x = 8, x = 1$$

M1 A1(b) Let $x = y^{\frac{3}{2}}$

$$y^{\frac{3}{2}} = 8, y^{\frac{3}{2}} = 1$$

$$y = 8^{\frac{2}{3}}, y = 1^{\frac{2}{3}}$$

$$y = 4, y = 1$$

M1 A1**(Total for question 9 is 4 marks)**

10

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

$$3x + 3 = 6x - 2$$

$$5 = 3x$$

$$x = \frac{5}{3}$$

M1 M1 A1**(Total for question 10 is 3 marks)**

11

$$x(1 - 16x^2)$$

$$x(1 + 4x)(1 - 4x)$$

M1 A1**(Total for question 11 is 2 marks)**

12

$$3x(25 - 4x^2)$$

$$3x(5 + 2x)(5 - 2x)$$

M1 A1**(Total for question 12 is 2 marks)**

13

$$\begin{aligned}
 &(2x^2 + 4x - x - 2)(x - 3) \\
 &(2x^2 + 3x - 2)(x - 3) \\
 &2x^3 - 6x^2 + 3x^2 - 9x - 2x + 6 \\
 &2x^3 - 3x^2 - 11x + 6
 \end{aligned}$$

M1 A1

(Total for question 13 is 2 marks)

14

$$\begin{aligned}
 &(3x - 2)(x^2 - 10x + 25) \\
 &3x^3 - 30x^2 + 75x - 2x^2 + 20x - 50 \\
 &3x^3 - 32x^2 + 95x - 50
 \end{aligned}$$

M1 A1

(Total for question 14 is 2 marks)

15

$$\begin{aligned}
 1 + x &= \sqrt{5}x \\
 1 &= x(\sqrt{5} - 1) \\
 x &= \frac{1}{\sqrt{5} - 1} \\
 x &= \frac{1(\sqrt{5} + 1)}{(\sqrt{5} - 1)(\sqrt{5} + 1)} \\
 x &= \frac{\sqrt{5} + 1}{4} = \frac{1}{4} + \frac{1}{4}\sqrt{5}
 \end{aligned}$$

M1 M1 M1 A1

(Total for question 15 is 4 marks)

16

$$\begin{aligned}
 &\frac{(5 + \sqrt{3})(2 + \sqrt{3})}{(2 - \sqrt{3})(2 + \sqrt{3})} \\
 &\frac{10 + 5\sqrt{3} + 2\sqrt{3} + 3}{4 - 3} \\
 &\frac{13 + 7\sqrt{3}}{1} = 13 + 7\sqrt{3}
 \end{aligned}$$

M1 M1 A1

(Total for question 16 is 3 marks)

17

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

$$\frac{10 - 5\sqrt{3} + 4\sqrt{3} - 6}{4 - 3}$$

$$\frac{4 - \sqrt{3}}{1} = 4 - \sqrt{3}$$

M1 M1 A1**(Total for question 17 is 3 marks)**

18

$$\frac{(1 - \sqrt{2})(3 - 2\sqrt{2})}{(3 + 2\sqrt{2})(3 - 2\sqrt{2})}$$

$$\frac{3 - 2\sqrt{2} - 3\sqrt{2} + 4}{9 - 8}$$

$$\frac{7 - 5\sqrt{2}}{1} = 7 - 5\sqrt{2}$$

M1 M1 A1**(Total for question 18 is 3 marks)**

19

$$a^3 \div a^{\frac{1}{2}} = a^{3-\frac{1}{2}} = a^{\frac{5}{2}}$$

(Total for question 19 is 1 mark)

20

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

(Total for question 20 is 1 mark)

21

$$\frac{1}{\sqrt{x}} = \frac{3}{5}$$

$$\sqrt{x} = \frac{5}{3}$$

$$x = \left(\frac{5}{3}\right)^2 = \frac{25}{9}$$

M1 M1 A1**(Total for question 21 is 3 marks)**

22

$$2\sqrt{5} = \sqrt{4} \times \sqrt{5} = \sqrt{20}$$

$$3\sqrt{2} = \sqrt{9} \times \sqrt{2} = \sqrt{18}$$

$$\sqrt{20} > \sqrt{18} \implies 2\sqrt{5} > 3\sqrt{2}$$

M1 M1 A1**(Total for question 22 is 3 marks)**

23

$$\frac{2^{2(3x-1)}}{2^{3(y+2)}} = 2^4$$

$$2(3x - 1) - 3(y + 2) = 4$$

$$6x - 2 - 3y - 6 = 4$$

$$6x - 12 = 3y$$

$$y = 2x - 4$$

M1 M1 A1**(Total for question 23 is 3 marks)**

24

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

$$\frac{\sqrt{15} - \sqrt{10}}{3 - 2} = \sqrt{15} - \sqrt{10}$$

M1 M1 M1 A1**(Total for question 24 is 4 marks)**

25

$$\frac{14(3 + \sqrt{2})}{(3 - \sqrt{2})(3 + \sqrt{2})}$$

$$\frac{42 + 14\sqrt{2}}{9 - 2} = \frac{42 + 14\sqrt{2}}{7} = 6 + 2\sqrt{2}$$

M1 A1**(Total for question 25 is 2 marks)**

26

(i)

$$2^{\frac{9}{2}} = 2^4 \times 2^{\frac{1}{2}} = 16\sqrt{2}$$

M1 A1

(ii)

$$\frac{\sqrt{3}(2 + 2\sqrt{3})}{(2 - 2\sqrt{3})(2 + 2\sqrt{3})}$$

$$\frac{2\sqrt{3} + 6}{4 - 12} = \frac{2\sqrt{3} + 6}{-8} = -\frac{3}{4} - \frac{1}{4}\sqrt{3}$$

M1 M1 A1

(Total for question 26 is 5 marks)

27

$$x = \frac{18}{3 - \sqrt{3}}$$

$$x = \frac{18(3 + \sqrt{3})}{(3 - \sqrt{3})(3 + \sqrt{3})}$$

$$x = \frac{54 + 18\sqrt{3}}{9 - 3} = \frac{54 + 18\sqrt{3}}{6} = 9 + 3\sqrt{3}$$

M1 M1 A1

(Total for question 27 is 3 marks)

28

(i)

$$\frac{a^2}{\sqrt{a}} = 8 \implies a^{\frac{3}{2}} = 8$$

$$a = 8^{\frac{2}{3}} = 4$$

M1 M1 A1

(ii)

$$(b^2 - 7)(b^2 + 2) = 0$$

$$b^2 = 7, b^2 = -2$$

$$b = \pm\sqrt{7}$$

(reject $b^2 = -2$ for real solutions) **M1 M1 A1 A1**

(Total for question 28 is 7 marks)

29 Let $y = x^{\frac{3}{2}}$

$$y^2 + 3y - 10 = 0$$

$$(y + 5)(y - 2) = 0$$

$$y = -5, y = 2$$

$$x^{\frac{3}{2}} = 2 \implies x = 2^{\frac{2}{3}}$$

$$x^{\frac{3}{2}} = -5 \implies \text{no real solution}$$

M1 M1 A1 A1

(Total for question 29 is 4 marks)

30

(i)

$$\sqrt{12} = x\sqrt{3} - x$$

$$\sqrt{12} = x(\sqrt{3} - 1)$$

$$x = \frac{\sqrt{12}}{\sqrt{3} - 1} = \frac{2\sqrt{3}(\sqrt{3} + 1)}{(\sqrt{3} - 1)(\sqrt{3} + 1)}$$

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

M1 M1 A1

(ii)

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

$$3^{6x-2} = 3^{\frac{3}{2}}$$

$$6x - 2 = 1.5$$

$$6x = 3.5$$

$$x = \frac{7}{12}$$

M1 M1 A1

(Total for question 30 is 6 marks)

31

$$\begin{aligned}
 & \frac{3\sqrt{2} - k}{4 - 2\sqrt{2}} \\
 & \frac{(3\sqrt{2} - k)(4 + 2\sqrt{2})}{(4 - 2\sqrt{2})(4 + 2\sqrt{2})} \\
 & \frac{12\sqrt{2} + 12 - 4k - 2k\sqrt{2}}{16 - 8} \\
 & \frac{(12 - 4k) + (12 - 2k)\sqrt{2}}{8} \\
 & \left(\frac{3}{2} - \frac{1}{2}k\right) + \left(\frac{3}{2} - \frac{1}{4}k\right)\sqrt{2}
 \end{aligned}$$

M1 M1 M1 A1

(Total for question 31 is 4 marks)